ObjectScript Reference

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InterSystems IRIS Data Platform Version 2019.4 2020-01-28

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About This Book

This book provides reference material for various elements of the ObjectScript language for InterSystems IRIS® data platform: commands, functions, and special variables, and tables of abbreviations of their names, and symbols used in the language.

This book contains the following sections:

- Symbols and Abbreviations
- Commands
- Functions
- Special Variables
- Structured System Variables

There is also a detailed Table of Contents.

Other related topics in the documentation set are:

- *Using ObjectScript*
- *Defining and Using Classes*, particularly the chapter "Working with Registered Objects" and the appendix "Object-Specific ObjectScript Features."
- *I/O Device Guide*

Symbols and Abbreviations

Symbols Used in ObjectScript

A table of characters used in ObjectScript as operators, prefixes, and so on.

Table of Symbols

The following are the literal symbols used in ObjectScript for InterSystems IRIS® data platform. (This list does not include symbols indicating format conventions, which are not part of the language.) There is a separate table for symbols used in InterSystems SQL.

The name of each symbol is followed by its ASCII numeric value.

Symbol	Name and Usage
[space] or [tab]	*White space (Tab (9) or Space (32)):* Leading white space (space or tab) is required before every line of code, with the exceptions of labels, and some comment lines. Within commands, one (and only one) space is required between the command name and the first argument. Trailing white space (space or tab) is required between the last command argument and any following command or comment on the same line. Trailing whitespace is also required between a label and a following command or comment on the same line.
[two spaces, two tabs, or a space and a tab]	*Double white space:* Trailing double white space required between an argumentless command and the next command on the same line.
!	*Exclamation mark (33):* OR logical operator (full evaluation). In READ and WRITE commands, specifies a new line. As first character at terminal prompt, load interactive subshell.
"	*Quotes (34):* Used to enclose string literals. In Dynamic SQL used to enclose the SQL code as a string argument of the **%Prepare()** method. For differences between straight quotes (") and directional quotes (“ ”). see Pattern Matching in *Using ObjectScript*.
""	*Double quotes:* Used to specify the null string (""), which is a zero-length string. Used to specify a literal quote character within a quoted string.

Symbol	Name and Usage
#	*Pound sign (35):* Modulo division operator. Can be used to determine a bit value. For example, `$ZA#2` returns the 1's bit value (0 or 1); with the integer divide (\) operator `$ZJOB\1024#2` returns the 1024's bit value (0 or 1). In READ and WRITE commands, form feed. In fixed-length READ, number of characters to read. Prefix for referencing the value of a class parameter from within the class: *#ParameterName*. Prefix for many macro preprocessor directives such as: #Define, #Include, and #If. See also ##. In class syntax, parameter prefix used to return the parameter value. For example, `##class(%Library.Boolean).#XSDTYPE` or `myinstance.#EXTENTQUERYSPEC`. In ZBREAK debugging, an iteration counter for disabling a specified breakpoint or watchpoint. For example, the following disables the breakpoint at label^rou for 100 iterations: `ZBREAK -label^rou#100`. In the callout routine ZFENTRY, an argtype prefix indicating a DOUBLE data type: #D or #F. Regular expression end-of line comment indicator (in (?x) mode only).
##	*Double pound sign:* Object class invocation prefix: `##class(classname).methodname()` or `##class(classname).#parametername`. ##super() syntax is used to invoke an overridden superclass method. Prefix for certain macro preprocessor directives, including ##Continue, ##Expression, ##Function, ##Lit, ##SQL, and ##Unique. ##SQL is invoked to execute a line of SQL code from within ObjectScript: ##SQL(SQL command).
##;	*Double pound sign semicolon:* Single-line comment indicator; can be used in column 1 in either ObjectScript or Embedded SQL.
#;	*Pound sign semicolon:* Single-line comment indicator; can be used in column 1.
$	*Dollar sign (36):* system function prefix: $name(parameters). Special variable prefix: $name. $Znnn (a name beginning with $Z) can be a user-defined function or special variable defined using %ZLANG language extension library. It can also be an InterSystems-supplied system function or special variable. Regular expression end of string anchor; for example, (USA)$. In ZBREAK debugging, a single-step breakpoint. As first character at terminal prompt, load interactive subshell.
$$	*Double dollar sign:* user-supplied function call prefix: $$myname(parameters). $$ is returned by $STACK when context was established by a reference to a user-supplied function. Prefix to a routine name to directly invoke that routine.

Symbol	Name and Usage
$$$	*Triple dollar sign:* Macro invocation prefix.
%	*Percent sign (37):* Permitted as first character of names: (1) local variable names, indicating a "% variable" with special scoping rules, used for locking. (2) routine names, often indicates a system utility. (3) Package class names, such as %SYSTEM.*class* and %Library.*class* as well as class names within the %Library package, including data types such as %String. (4) %Persistent object property names and method names, such as %Dialect, **%New()**, and **%OpenId()**. A **%On...** method name is a callback method. (5) Labels. Required as first character of a macro argument. Prefix for some embedded SQL variables: %msg, %ROWCOUNT, and for some SQL keywords: %STARTSWITH. See i% (instance variable).
%%	*Double percent sign:* Prefix for the pseudo-field reference variable keywords %%CLASSNAME, %%CLASSNAMEQ, %%ID, and %%TABLENAME, used in ObjectScript computed field code and trigger code.
&	*Ampersand (38):* AND logical operator (full evaluation). $BITLOGIC bitstring AND operator. In a formal parameter list, an optional, non-functional variable name prefix that marks a parameter as one that should be passed by reference. The & is a marker and is not part of the variable name. For example `Calc(x,&y)`. Shell invocation prefix for embedded code. For example &sql (*SQL commands*). UNIX® batch command.
&&	*Double ampersand:* AND logical operator (partial evaluation). Regular expression AND logical operator.

Symbol	Name and Usage
'	*Apostrophe (39):* Unary Not operator. Can be combined with: logical operators '& (Not And), '| (Not Or); relational operators '= (not equal to), '< (not less than), '> (not greater than); or pattern match '(operand?pattern). European numeric group separator.

Symbol	Name and Usage
( )	*Parentheses (40,41):* Used to enclose a procedure or function parameter list. Parentheses are mandatory, even when empty. Used to nest expressions; nesting overrides the InterSystems IRIS default of strict left-to-right evaluation of operators, and allows you to give precedence to expressions. Used to specify array subscripts for a local variable: `a(1,1)`, a global variable: `^a(1,1)`, or a process-private global: `^||a(1,1)`. Used to enclose an alternating pattern match (following a ?). With NEW and KILL commands, exclusive (everything but) indicator. For postconditionals, required if postconditional contains a space. Used to enclose embedded SQL code, following an &sql shell invocation command: &sql(*SQL commands*). Regular expression match string (Boston) or string list (Boston|New York|Paris). Regular expression grouping construct. When setting a JSON object or array value, used to enclose an ObjectScript literal or expression.
*	*Asterisk (42):* Multiplication operator. In $ZSEARCH, wild card for zero, one, or more than one characters. In $EXTRACT, $LIST, and $PIECE specifies the final item at the end of the string; can be used with a signed integer to specify offset from the end, for example *-2, *+1. In WRITE command, specifies an integer code for a character. For example, `WRITE *65` writes the letter “A”. As prefix to $ZTRAP string value, specifies that call stack level should be left unchanged. In ZBREAK a name prefix denoting a local variable. In certain error codes returned to $ZERROR, a name prefix denoting an undefined local variable, class, method, or property. Regular expression 0 or more character quantifier.
**	*Double asterisk:* Exponentiation operator. For example, 4**3=64.
*+	*Asterisk plus:* In SET $EXTRACT, SET $LIST, and SET $PIECE specifies offset beyond the last item of the string; used to append values. For example, `*+1` appends an item to the end of string.
*-	*Asterisk minus:* In WRITE command, specifies a device control integer code. For example, `WRITE *-10` clears the terminal input buffer. In $EXTRACT, $LIST, $LISTGET, and $PIECE specifies offset backwards from the last item of the string; for example, `*-1` is the next-to-last item.
*/	*Asterisk slash:* Multi-line comment ending indicator. Comment begins with /*.

Symbol	Name and Usage
+	*Plus sign (43):* Unary arithmetic positive operator. When appended to a string or a function that returns a string forces numeric evaluation; for example, `WRITE +"007.0"` or `WRITE +$PIECE(str,",",2)`. Addition operator. Integer line count offset from a label: `label+offset`. In $ZTRAP, integer line count offset from top of a procedure: `+offset^procname`. With LOCK and ZBREAK commands, a prefix that enables or applies/increments the item that follows. Regular expression 1 or more character quantifier.
+=	*Plus sign, Equal sign* In commands and functions that output to a file, means that output data is appended to the existing file contents. Just an equal sign means that output data overwrites the contents of an existing file. See $ZF(-100).
,	*Comma (44):* In functions and procedures, multiple parameters separator. In commands, multiple arguments delimiter. In array variables, subscript levels separator. American numeric group separator or European decimal point character (configurable). In $ECODE, surround error code: ,M7,
,,	*Two commas:* In functions, a placeholder for an unspecified positional parameter (which takes a default value).
–	*Minus sign (45):* Unary arithmetic negative operator. Subtraction operator. With LOCK and ZBREAK commands, a prefix that disables or decrements/removes the item that follows. Regular expression character range operator; for example [A-Z].
––	*Double minus sign:* With ZBREAK command, a prefix that removes the item that follows. Regular expression subtract (except for) logical operator.
.	*Period (46):* American decimal point character, or European numeric group separator (configurable). Object dot syntax used to refer to a method or property of an object instance: `myinstance.Name`. Windows and UNIX®: As a pathname or part of a pathname, specifies the current directory. Used by $ZSEARCH. May be included within a global name or a routine name. Prefix to a variable or array name in an actual parameter list that specifies passing by reference: `SET x=$$Calc(num,.result)`. Pattern match repeat indicator. Regular expression single-character wildcard.

Symbol	Name and Usage
..	*Double period:* relative dot syntax: a prefix that specifies a method or property of the current object. For example, `WRITE ..foo()` Windows and UNIX®: As a pathname or part of a pathname, specifies the parent directory of the current directory. Used by $ZSEARCH.
..#	*Double period, pound sign:* A prefix for references to a class parameter from within a method of the same class. For example, `WRITE ..#MyParam`
...	*Triple period (ellipsis):* A suffix appended to the last (or only) parameter in a formal parameter list or actual parameter list that is used to specify a variable number of parameters. For example, `Calc(x,y,params...)`. This syntax is commonly used with a dynamic dispatch method, such as `Method %DispatchMethod(Method As %String,Params...)` In ZWRITE output, trailing ellipsis indicates string truncation. In a Terminal prompt, leading characters that indicate that a long implied namespace has been truncated to its final 24 characters. (This literal use of ellipsis in code should not be confused with format convention usage in our documentation, where ellipsis indicates that an argument can be repeated multiple times, or that a section of code is intentionally omitted.)
/	*Slash (47):* Division operator (keep remainder). In OPEN, CLOSE, and USE commands, I/O keyword parameter prefix. In READ and WRITE, device control mnemonic prefix. With ZBREAK command, a subcommand prefix.
//	*Double slash:* Single-line comment indicator.
///	*Triple slash:* Single-line comment indicator. Can be used in column 1 for macro comments.
/*	*Slash asterisk:* Multi-line comment begins indicator. Comment ends with */.
:	*Colon (58):* In commands, postconditional indicator, for example, WRITE:x=0 “nothing”. In commands such as OPEN, USE, CLOSE, JOB, LOCK, READ, and ZBREAK a placeholder separator of arguments and/or separator of parameters within an argument. For example, LOCK var1:10,+var2:15, or OPEN "|TCP|4":(:4200:"PSTE"::32767:32767) In $CASE and $SELECT functions, used to specify test:value paired items. In a JSON object, used to specify a key:value pair. For example, `SET JSONobj={"name":"Sam"}`. In $JOB special variable value, separates process ID (PID) and nodename. For example, `11368:MYCOMPUTER`. Prefix indicating an ObjectScript label within embedded ObjectScript code, such as SQL trigger code, where the label cannot be coded in column 1.
;	*Semicolon (59):* Single-line comment indicator.
;;	*Double semicolon:* Retained single-line comment indicator.

Symbol	Name and Usage
<	*Less than (60):* Less than operator.
<=	*Less than, Equal sign:* Less than or equal to operator.
'<	*Not operator, Less than:* Greater than or equal to operator.
=	*Equal sign (61):* Equal to comparison operator. In SET command, assignment operator.
'=	*Not operator, Equal sign:* Not equal to comparison operator
>	*Greater than (62):* Greater than operator.
>=	*Greater than, Equal sign:* Greater than or equal to operator.
'>	*Not operator, Greater than:* Less than or equal to operator.
?	*Question mark (63):* Pattern match operator. Regular expression 0 or 1 character quantifier suffix. Regular expression mode prefix. For example, (?i) case mode on; (?-i) case mode off. In $ZCONVERT translation table results, represents an untranslatable character. In $ZSEARCH, wild card for a single character. In READ and WRITE commands, column position indicator. In ZBREAK command, display help text. In Dynamic SQL, an input parameter variable supplied by the **%Execute()** method.
?#	*Question mark and pound sign:* Regular expression embedded comment prefix. For example, (?# this is a comment).
@	*At sign (64):* Indirection operator. For subscript indirection, appears as: @array@(subscript).
A, a	*The letter "A" (65,97):* Pattern match code (following a ?).
C, c	*The letter "C" (67,99):* Pattern match code (following a ?).
E, e	*The letter "E" (69,101):* Scientific notation operator. for example, 4E3=4000. The uppercase "E" is the standard exponent operator; the lowercase "e" is a configurable exponent operator, using the **ScientificNotation()** method of the %SYSTEM.Process class. Pattern match code (following a ?).
I, i	*The letter "I" (73,105):* Integer indicator in $NUMBER function.
i%	*The letter "i" percent:* instance variable syntax: i%propertyname.
L, l	*The letter "L" (76,108):* Pattern match code (following a ?).
N, n	*The letter "N" (78,110):* Pattern match code (following a ?).
P, p	*The letter "P" (80,112):* Pattern match code (following a ?).
U, u	*The letter "U" (85,117):* Pattern match code (following a ?).

Symbol	Name and Usage
[	*Open square bracket (91):* Contains operator.
[ ]	*Square brackets (91,93):* Used to enclose a namespace name, directory name, or the null string in an extended global reference `^["namespace"]global`. Used to specify a process-private global with the following syntax: `^["^"]ppgname` or `^["^",""]ppgname`. In a structured system variable (SSVN) used to enclose a namespace name `^$["namespace"]GLOBAL()` to specify an extended SSVN reference. In XECUTE command or a procedure definition, encloses a public variables list: `[a,b,c]` In ZWRITE or argumentless **WRITE** command display, encloses an object reference (oref). Regular expression match any character in a list [ABCD] or a range [A-D]. JSON dynamic array expression, which returns an instance of %DynamicArray. For example, `SET JSONarray=[1,2,3]`.
[: :]	*Square brackets and colons:* Regular expression character type keyword. For example, [:alpha:].
\	*Backslash (92):* Integer division operator (drop remainder). Can be used with modulo (#) operator to determine a bit value; for example, `$ZA\16#2` returns the value (0 or 1) of the $ZA 16 bit. Regular expression escape prefix. JSON string escape prefix, for example`\"`.
]	*Close square bracket (93):* Follows operator.
]]	*Double close square brackets:* Sorts After operator.
^	*Caret (94):* Global variable name prefix, for example, ^myglobal(i). Routine invocation prefix, for example, DO ^routine or DO label^routine. Implied namespace prefix with the format ^system^dir. $BITLOGIC bitstring XOR (exclusive or) operator. Regular expression beginning of string anchor; for example, ^A. Regular expression character type keyword inverse. For example, [:^alpha:].
^^	*Double caret:* Implied namespace prefix for the current system, with the format ^^. or ^^dirpath.
^$	*Caret dollar:* Structured system variable prefix. For example, ^$GLOBAL() or ^$|"namespace"|GLOBAL().
^$[	*Caret dollar bracket:* In a structured system variable (SSVN) used to enclose a namespace name `^$["namespace"]GLOBAL()` to specify an extended SSVN reference.
^$|	*Caret dollar bar:* In a structured system variable (SSVN) used to enclose a namespace name `^$|"namespace"|GLOBAL()` to specify an extended SSVN reference.
^%	*Caret percent:* System global prefix, for example, ^%utility or ^%qStream.
^(	*Caret parenthesis:* A naked global reference, where the most recently named subscripted global name is implied. For example: ^(1,2)

<table>
<tr><th>Symbol</th><th>Name and Usage</th></tr>
<tr><td>^[</td><td>Caret open square bracket: see Square brackets.</td></tr>
<tr><td>^|</td><td>Caret bar: depending on the character(s) that follow, this may be:

An extended global reference, a global reference where a pair of bars encloses a quoted namespace name, a directory name, or a null string. The bars and their contents are not part of the global name. For example: `^|""|globname`, or `^|"namespace"|globname`.

A process-private global prefix with the prefix ^||. The bars are part of the process-private global name. For example, `^||ppgname`. Also valid as syntax for this process-private global: `^|"^"|ppgname`.

An extended routine reference, where a pair of bars encloses a quoted namespace name, a variable that resolves to a namespace name, or a null string. For example, `DO ^|"namespace"|routine`.</td></tr>
<tr><td>_</td><td>Underscore (95): Concatenate operator.

As first character of a name.</td></tr>
<tr><td>{ }</td><td>Curly braces (123,125): Code block delimiters used in procedures, for TRY and CATCH blocks, or with the IF, FOR, DO WHILE, and WHILE commands.

In SQL compute code, encloses a field name. For example, `SET {Age}=18`, or `SET {f1} = {f2}`.

In XECUTE command, encloses code in which variables are treated as private.

Regular expression quantifier; for example, {5} = 5 times; {3,6} = at least 3 times but not more than 6 times. Regular expression character type letter code or keyword with \p prefix; for example, \p{LL}, \p{lower}. Regular expression single character keyword with \N prefix; for example, \N{comma}.

JSON dynamic object expression, which returns an instance of %DynamicObject. For example, `SET JSONobj={"name":"Sam"}`.</td></tr>
<tr><td>{*}</td><td>Asterisk within curly braces: In SQL compute code, specifies the current SQL field name.</td></tr>
<tr><td>|</td><td>Vertical bar (124): $BITLOGIC bitstring OR operator.

Regular expression OR operator.

For other uses, see ^| and ^$.</td></tr>
<tr><td>||</td><td>Double vertical bar (bar bar): OR logical operator (short circuit evaluation).

Compound ID indicator. Used by InterSystems IRIS to display a generated compound object ID (a concatenated ID). This can be either an IDKey defined on multiple properties (`prop1||prop2`), or an ID for a parent/child relationship (`parent||child`).</td></tr>
</table>

Symbol	Name and Usage
~	*Tilde (126):* $BITLOGIC bitstring NOT (one's complement) operator. In Windows pathnames, indicates 8.3 compression of long names. For example: c:\PROGRA~1\. To convert compressed directory names, use the **NormalizeDirectory()** method of the %Library.File class. In UNIX pathnames, indicates the current user's home directory. For example: ~myfile or ~/myfile.

Abbreviations Used in ObjectScript

A table of abbreviations for commands, functions, and special variables available in ObjectScript.

Table of Abbreviations

The following are the name abbreviations used in ObjectScript for InterSystems IRIS® data platform. Most, but not all, ObjectScript commands, functions, and special variables have name abbreviations. Other uses of letters as code characters are found in the table of symbols used in ObjectScript.

Abbreviation	Full Name
$A	$ASCII function
B	BREAK command
C	CLOSE command
$C	$CHAR function
D	DO command *or* DO keyword of DO WHILE command
$D	$DATA function (with arguments) *or* $DEVICE special variable (no arguments).
$E	$EXTRACT function
$EC	$ECODE special variable
$ES	$ESTACK special variable
F	FOR command
$F	$FIND function
$FN	$FNUMBER function
G	GOTO command
$G	$GET function
^$G	^$GLOBAL structured system variable
H	HALT command (no arguments) *or* HANG command (with argument)
$H	$HOROLOG special variable
I	IF command
$I	$INCREMENT function (with arguments) *or* $IO special variable (no arguments).
$IN	$INUMBER function
J	JOB command
$J	$JUSTIFY function (with arguments) *or* $JOB special variable (no arguments).
^$J	^$JOB structured system variable
K	KILL command
$K	$KEY special variable
L	LOCK command
$L	$LENGTH function

Abbreviation	Full Name
^$L	^$LOCK structured system variable
$LB	$LISTBUILD function
$LD	$LISTDATA function
$LF	$LISTFIND function
$LFS	$LISTFROMSTRING function
$LG	$LISTGET function
$LI	$LIST function
$LL	$LISTLENGTH function
$LS	$LISTSAME function
$LTS	$LISTTOSTRING function
$LU	$LISTUPDATE function
$LV	$LISTVALID function
M	MERGE command
N	NEW command
$NA	$NAME function
$NC	$NCONVERT function
$NUM	$NUMBER function
O	OPEN command
$O	$ORDER function
P	PRINT command
$P	$PIECE function (with arguments) *or* $PRINCIPAL special variable (no arguments).
Q	QUIT command
$Q	$QUERY function (with arguments) *or* $QUIT special variable (no arguments).
$QL	$QLENGTH function
$QS	$QSUBSCRIPT function
R	READ command
$R	$RANDOM function
^$R	^$ROUTINE structured system variable
$RE	$REVERSE function
RET	RETURN command
S	SET command
$S	$SELECT function (with arguments) *or* $STORAGE special variable (no arguments).
$SC	$SCONVERT function
$SEQ	$SEQUENCE function

Abbreviation	Full Name
$ST	$STACK function (with arguments) *or* $STACK special variable (no arguments).
$SY	$SYSTEM special variable
$T	$TEXT function (with arguments) *or* $TEST special variable (no arguments).
TC	TCOMMIT command
$TL	$TLEVEL special variable
$TR	$TRANSLATE function
TRO	TROLLBACK command
TS	TSTART command
U	USE command
V	VIEW command
$V	$VIEW function
W	WRITE command
$WA	$WASCII function
$WC	$WCHAR function
$WE	$WEXTRACT function
$WF	$WFIND function
$WL	$WLENGTH function
$WRE	$WREVERSE function
X	XECUTE command
$X	$X special variable (no abbreviation).
$Y	$Y special variable (no abbreviation).
$ZA	$ZA special variable (no abbreviation).
ZB	ZBREAK command
$ZB	$ZBOOLEAN function (with arguments) *or* $ZB special variable (no arguments, no abbreviation).
$ZC	$ZCYC function (with argument) *or* $ZCHILD special variable (no arguments).
$ZCVT	$ZCONVERT function
$ZD	$ZDATE function
$ZDA	$ZDASCII function
$ZDC	$ZDCHAR function
$ZDH	$ZDATEH function
$ZDT	$ZDATETIME function
$ZDTH	$ZDATETIMEH function
$ZE	$ZERROR special variable

Abbreviation	Full Name
$ZF	$ZF functions (no abbreviation). See also $ZF(-100), $ZF(-3), $ZF(-4), $ZF(-5), and $ZF(-6) functions.
$ZH	$ZHEX function (with arguments) *or* $ZHOROLOG special variable (no arguments).
ZI	ZINSERT command
$ZI	$ZIO special variable
$ZJ	$ZJOB special variable
ZK	ZKILL command
ZL	ZLOAD command
$ZLA	$ZLASCII function
$ZLC	$ZLCHAR function
$ZM	$ZMODE special variable
ZN	ZNSPACE command
$ZN	$ZNAME special variable
$ZO	$ZORDER special variable
ZP	ZPRINT command
$ZP	$ZPARENT special variable
$ZQA	$ZQASCII function
$ZQC	$ZQCHAR function
ZR	ZREMOVE command
$ZR	$ZREFERENCE special variable
ZS	ZSAVE command
$ZS	$ZSTORAGE special variable
$ZSE	$ZSEARCH function
$ZT	$ZTIME function (with arguments) *or* $ZTRAP special variable (no arguments).
$ZTH	$ZTIMEH function
$ZTS	$ZTIMESTAMP special variable
$ZTZ	$ZTIMEZONE special variable
$ZV	$ZVERSION special variable
ZW	ZWRITE command
$ZWA	$ZWASCII function
$ZWC	$ZWCHAR function

ObjectScript Commands

This document provides detailed descriptions of the commands supported by ObjectScript. In this manual, ObjectScript commands are divided into two groups:

- General Commands.
- Routine and Debugging Commands.

Within each group, the commands are presented in alphabetical order.

For more information on ObjectScript commands generally, see the Commands chapter of *Using ObjectScript*.

You can abbreviate most commands to the first letter of the command name, or, in the case of commands that begin with the letter Z, to the first two letters of the command name. In the Synopsis for each command, the full name syntax is first presented, and below it is shown the abbreviated name (if one exists).

The Synopsis for each command contains only literal syntactical punctuation. The Synopsis does not include punctuation for format conventions, such as what elements of the syntax are optional. This information is provided in the table of arguments immediately following the Synopsis.

The one exception is the ellipsis (...). An ellipsis following a comma indicates that the argument (or argument group) preceding the comma can be repeated multiple times as a comma-separated list. An ellipsis within curly braces { . . . } indicates that a block of code containing one or more commands can be specified within the curly braces. The curly braces are literal characters that must be specified in the code.

Most commands take one or more *arguments*. Arguments are expressions (for example, a function and its parameters, a variable, an operator and its operands, an object property, or an object method) that define or control the action of the command. Multiple arguments used with a command are generally referred to as an *argument list*. Some commands have arguments that themselves take argument parameters. For example, each argument of the **DO** command can take a parameter list. This is indicated in the syntax.

Some commands are *argumentless*, and can be invoked without any arguments. Some commands never take arguments; other commands take arguments only in certain circumstances. Such commands change their meaning depending on whether they are argumentless, or specify an argument list.

Most commands can take an optional postconditional expression, which specifies a condition that dictates whether or not the command should be executed. A postconditional expression is appended to the command name by a colon (:). No spaces or line breaks are permitted between a command name and its postconditional expression. While a postconditional expression is not, strictly speaking, a command argument, they are here presented with the arguments. An argumentless command can take a postconditional expression.

Most ObjectScript commands are the same on all hardware platforms. Any platform-specific features of a command are marked with the type of platform that supports it; for example, Windows or UNIX®. Any command not marked with a platform limitation is supported by all platforms.

BREAK

Interrupts execution at a breakpoint. Enables or disables user interrupts.

```
BREAK:pc extend
B:pc extend

BREAK:pc flag
B:pc flag
```

Arguments

pc	*Optional* — A postconditional expression.
extend	*Optional* — A letter code indicating the kind of breakpoints to enable or disable, specified as a quoted string. Valid values are listed in BREAK Extended Arguments. Cannot be used with the *flag* argument.
flag	*Optional* — An integer flag that specifies interrupt behavior. The *flag* value can be quoted or unquoted. Valid values are: 0 and 4 which disable **CTRL-C** interrupts, and 1 and 5 which enable **CTRL-C** interrupts. The default is determined by context (see BREAK flag for details). Cannot be used with the *extend* argument.

Description

The **BREAK** command has three syntax forms:

- BREAK without an argument breaks code execution at the current location.
- BREAK extend breaks code execution at regular breakpoint intervals.
- BREAK flag enables or disables **CTRL-C** interrupts.

Required Permission

To use **BREAK** statements when running code, the user must be assigned to a role (such as %Developer or %Manager) that provides the %Development resource with U (use) permission. A user is assigned to a role either through the SQL GRANT statement, or by using the Management Portal **System Administration**, **Security**, **Users** option. Select a user name to edit its definition, then select the **Roles** tab to assign that user to a role.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the **BREAK** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

extend

BREAK *extend* supports letter string codes to specify breakpoint behavior. Quotes are required. See BREAK Extended Arguments for a table of these *extend* codes.

flag

BREAK *flag* supports four different ways to handle **CTRL-C** interrupts:

- `BREAK 0`: dismisses any pending, but not yet signaled, **CTRL-C** trap. Disables future signaling of **CTRL-C**.
- `BREAK 1`: dismisses any pending **CTRL-C** trap. Enables future signaling of **CTRL-C**.

  This means that typing **CTRL-C** following execution of the BREAK 1 causes a **CTRL-C** signal.
- `BREAK 4`: does not dismiss any pending **CTRL-C** trap. Disables future signaling of **CTRL-C**.

  This means that a pending **CTRL-C** trap is signaled when a future BREAK 1 or BREAK 5 command enables **CTRL-C**.
- `BREAK 5`: does not dismiss any pending **CTRL-C** trap. Enables future signaling of **CTRL-C**.

  This means that a pending **CTRL-C** trap should be signaled by an ObjectScript command shortly following BREAK 5. Most, but not all ObjectScript commands poll for **CTRL-C**.

See BREAK flag to Enable or Disable Interrupts for further details and examples.

Argumentless BREAK

Argumentless **BREAK** interrupts code execution when encountered. You can use argumentless **BREAK** in program source code, with or without a postconditional, to interrupt program execution at that point and return control to the Terminal prompt. Argumentless **BREAK** is used for debugging purposes.

If you include an argumentless **BREAK** within a routine, it sets a breakpoint, which interrupts routine execution and returns the process to the Terminal prompt. By imbedding breakpoints in your code, you can establish specific contexts for debugging. Each time execution reaches a **BREAK**, InterSystems IRIS suspends the routine and returns you to the Terminal. You can then use other ObjectScript commands to perform debugging activities. For example, you might use the **WRITE** command to examine the values of variables at the current stopping point and the **SET** command to supply new values for these or other variables. You can also invoke the Routine Line Editor (XECUTE ^%), which provides basic editing capabilities for modifying the routine After you suspend routine execution with a **BREAK**, you can resume normal execution by using an argumentless **GOTO**. Alternatively, you can resume execution at a different location by specifying this location as the **GOTO** command argument.

Note: InterSystems recommends that you use the **ZBREAK** command to invoke the ObjectScript Debugger, rather than using the **BREAK** command in code. The Debugger provides much more extensive debugging capabilities.

You can configure argumentless **BREAK** behavior for the current process using the **BreakMode()** method of the %SYSTEM.Process class. You can configure argumentless **BREAK** behavior system-wide by setting the *BreakMode* property in the Config.Miscellaneous class.

Like all argumentless commands, you must insert at least two blank spaces between an argumentless **BREAK** and a command following it on the same line.

Using Argumentless BREAK with a Condition

You may find it useful to specify a condition on an argumentless **BREAK** command in code so that you can rerun the same code simply by setting a variable rather than having to change the routine. For example, you may have the following line in a routine:

```
BREAK:$DATA(debug)
```

You can then set the variable *debug* to suspend the routine and return the job to the Terminal prompt or clear the variable *debug* to continue running the routine.

BREAK Extended Arguments to Set Regular Breakpoints

You do not have to place argumentless **BREAK** commands at every location where you want to suspend your routine. **BREAK** has a series of "extended" arguments (*extend*) that can periodically suspend a routine as if you scattered argumentless **BREAK**s throughout the code. **BREAK** command extended arguments are listed in the following table.

Argument	Description
"S"	Use **BREAK "S"** (Single Step) to step through your code a single command (generated token) at a time. Not all ObjectScript commands generate a token; some generate multiple tokens and thus are parsed as multiple steps (see below). InterSystems IRIS stops breaking on commands invoked by a **DO** command or an **XECUTE** command, or within a **FOR** loop or a user-defined function, and resumes with the next token when the command or loop is done.
"S+"	**BREAK "S+"** acts like **BREAK "S"**, except that InterSystems IRIS includes breaking on commands invoked by a **DO** command or an **XECUTE** command, or within a **FOR** loop or a user-defined function.
"S-"	Use **BREAK "S-"** to disable break stepping ("S" or "L") at the current level and enable single stepping at the previous level. Acts like `BREAK "C"` at the current level and `BREAK "S"` at the previous level.
"L"	Use **BREAK "L"** (Line Stepping) to step through your code a single routine line at a time, breaking at the beginning of every line. Lines that do not generate tokens are ignored (see below). InterSystems IRIS stops breaking on commands invoked by a **DO** command or an **XECUTE** command, or within a **FOR** loop or a user-defined function, and resumes with the next line when the command or loop is done.
"L+"	**BREAK "L+"** acts like **BREAK "L"**, except that InterSystems IRIS also continues to break at the beginning of every routine line on commands invoked by a **DO** command or an **XECUTE** command, or within a **FOR** loop or a user-defined function.
"L-"	Use **BREAK "L-"** to disable break stepping ("S" or "L") at the current level and enable line stepping at the previous level. Acts like `BREAK "C"` at the current level and `BREAK "L"` at the previous level.
"C"	Use **BREAK "C"** (Clear Break) to stop all break stepping ("L" and "S") at the current level. Breaking resumes at a previous routine level after the job executes a **QUIT** if a **BREAK** state is in effect at that previous level.
"C-"	Use **BREAK "C-"** to stop all break stepping ("L" and "S") at the current level and all previous levels. This allows stepping to be removed at all levels without affecting other debugging features.
"OFF"	**BREAK "OFF"** removes all debugging that has been established for the process. It removes all breakpoints and watchpoints, and turns off stepping at all program stack levels. It also removes the association with the debug and trace devices, but does not close them.

BREAK "S" and **BREAK "L"** break on statements that generate tokens. Not all ObjectScript commands or lines generate a token. For example, **BREAK "S"** and **BREAK "L"** both ignore label lines, comments, and **TRY** statements. **BREAK "S"** breaks at a **CATCH** statement (if the **CATCH** block is entered); **BREAK "L"** does not.

One difference between **BREAK "S"** and **BREAK "L"** is that many command lines generate more than one token and thus consist of more than one step. This is not always obvious. For example, the following are all one line (and one ObjectScript command), but **BREAK "S"** parses each as two steps:

```
KILL x,y
SET x=1,y=2
IF x=1,y=2 {
   WRITE "hello",! }
```

BREAK "S" parses command postconditionals. If the postconditional is true (execute the command), it repositions the cursor to point to after the postconditional.

To resume code execution after a breakpoint, issue a GOTO command (abbreviated as **G**) at the Terminal prompt. See Debugging in *Using ObjectScript* for more information.

Issuing a **BREAK "OFF"** command is equivalent to issuing the following series of commands:

```
  ZBREAK /CLEAR
  ZBREAK /TRACE:OFF
  ZBREAK /DEBUG:""
  ZBREAK /ERRORTRAP:ON
  BREAK "C-"
```

BREAK flag to Enable or Disable Interrupts

Use **BREAK** *flag* to control whether user interrupts, such as **CTRL-C**, are enabled or disabled. The practical difference between these disable/enable options is as follows:

BREAK 0 and **BREAK 1** can be used to create a code block where a **CTRL-C** signal cannot interrupt a critical sequence of commands. However, a loop on such a block may be difficult for an interactive user to interrupt using **CTRL-C**. This is because there is a slight delay between detecting a **CTRL-C** trap and polling a **CTRL-C** signal. This delay may permit the next **BREAK** command loop to dismiss the **CTRL-C** user interrupt.

A program block containing **BREAK 4** and **BREAK 5** can be used to create code where a **CTRL-C** signal cannot interrupt a critical sequence of commands without affecting the ability of an interactive user to interrupt a loop operation on this block using **CTRL-C**.

The default *flag* behavior of **BREAK** is dependent upon the login mode, as follows:

- If you log in at the Terminal prompt, the default is **BREAK 1**. Interrupts, such as **CTRL-C**, are always enabled. The B (/break) protocol specified in an **OPEN** or **USE** command has no effect.
- If you execute code from a routine, the default is **BREAK 0**. Interrupts, such as **CTRL-C**, are enabled or disabled by the B (/break) protocol specified in an **OPEN** or **USE** command.

For further details on **OPEN** and **USE** mode protocols, refer to Terminal I/O in the *I/O Device Guide*.

BREAK flag Examples

The following example uses $ZJOB to determine if interrupts are enabled or disabled:

```
  BREAK 0
    DO InterruptStatus
  BREAK 1
    DO InterruptStatus
    WRITE "all done"
InterruptStatus()
  IF $ZJOB\4#2=1 {WRITE "Interrupts enabled",!}
  ELSE {WRITE "Interrupts disabled",!}
```

The following example uses a **READ** in a **FOR** loop for user input of a series of numbers. It sets **BREAK 0** to disable user interrupts during the **READ** operation. However, if the user inputs a value that is not a number, **BREAK 1** enables user interrupts so that the user can either reject or accept the value they just input:

```
  SET y="^"
InputLoop
  TRY {
      FOR {
           BREAK 0
           READ "input a number ",x
           IF x="" { WRITE !,"all done"  QUIT }
           ELSEIF 0=$ISVALIDNUM(x) {
             BREAK 1
             WRITE !,x," is not a number",!
             WRITE "you have four seconds to press CTRL-C",!
             WRITE "or accept this input value",!
             HANG 4 }
           ELSE {  }
           SET y=y_x_"^"
           WRITE !,"the number list is ",y,!
      }
```

```
}
CATCH { WRITE "Rejecting bad input",!
        DO InputLoop
}
```

See Also

- ZBREAK command
- GOTO command
- OPEN command
- USE command
- Debugging in *Using ObjectScript*
- Terminal I/O in *I/O Device Guide*

CATCH

Identifies a block of code to execute when an exception occurs.

```
CATCH exceptionvar
{
   . . .
}
```

Argument

exceptionvar	*Optional* — An exception variable. Specified as a local variable, with or without subscripts, that receives a reference to an InterSystems IRIS Object (an OREF). This argument can, optionally, be enclosed with parentheses.

Description

The **CATCH** command defines an exception handler, a block of code to execute when an exception occurs in a **TRY** block of code. The **CATCH** command is followed by a block of code statements, enclosed in curly braces.

If you specify a **TRY** block, a **CATCH** block is required; every **TRY** block must have a corresponding **CATCH** block. Only one **CATCH** block is permitted for each **TRY** block. The **CATCH** block must immediately follow its **TRY** block. No lines of executable code are permitted between a **TRY** block and its **CATCH** block. No label is permitted between a **TRY** block and its **CATCH** block, or on the same line as the **CATCH** command. You can, however, include comments between a **TRY** block and its **CATCH** block.

A **CATCH** block is entered when an exception occurs. If no exception occurs, the **CATCH** block should not be executed. You should *never* use a **GOTO** statement to enter a **CATCH** block.

You can exit a **CATCH** block using QUIT or RETURN. **QUIT** exits the current block structure and continues execution with the next command outside of that block structure. For example, if you are within a nested **CATCH** block, issuing a **QUIT** exits that **CATCH** block to the enclosing block structure. You cannot use an argumented **QUIT** to exit a **CATCH** block; attempted to do so results in a compile error. To exit a routine completely from within a **CATCH** block, issue a **RETURN** statement.

The **CATCH** command has two forms:

- Without an argument
- With an argument

The argumented form is preferred.

CATCH Exception Handling

CATCH *exceptionvar* receives an object instance reference (OREF) from the **TRY** block, either explicitly passed by the **THROW** command, or implicitly from the system runtime environment in the event of a system error. For information on OREFs, see "OREF Basics" in *Defining and Using Classes*.

This object instance reference provides properties that contain information about the exception.

An exception can pass four exception properties to **CATCH**. These are, in order: Name, Code, Location, and Data. A thrown exception cannot pass a Location parameter. You can use the **%IsA()** instance method to determine what type of exception passed in these properties.

In the following example, the **TRY** block can generate a system exception (undefined local variable), throw an SQL exception, throw a %Status exception, or throw a general exception. This general-purpose **CATCH** exception handler determines which type of exception occurred and displays the appropriate properties. It displays all four properties for a system exception (the Data property is the empty string for some types of system errors). It displays two properties for an SQL exception (Code and Data). It supplies two properties to **$SYSTEM.Status.Error()** to generate an error message string for a %Status exception. It displays three properties for a general ObjectScript exception (Name, Code, and Data). It uses the **$ZCVT** function to format a Name value containing angle brackets for browser display:

```
TRY {
  SET x=$RANDOM(4)
  IF x=0 { KILL undefvar
           WRITE undefvar }
  ELSEIF x=1 {
     SET oref=##class(%Exception.SQL).%New(,"-999",,"SQL error message")
     THROW oref }
  ELSEIF x=2 {
     SET oref=##class(%Exception.StatusException).%New(,"5002",,$LISTBUILD("My Status Error"))
     THROW oref }
  ELSE {
     SET oref=##class(%Exception.General).%New("<MY BAD>","999",,"General error message")
     THROW oref }
  WRITE "this should not display",!
}
CATCH exp { WRITE "In the CATCH block",!
              IF 1=exp.%IsA("%Exception.SystemException") {
                WRITE "System exception",!
                WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
                WRITE "Location: ",exp.Location,!
                WRITE "Code: "
              }
              ELSEIF 1=exp.%IsA("%Exception.SQL") {
                WRITE "SQL exception",!
                WRITE "SQLCODE: "
              }
              ELSEIF 1=exp.%IsA("%Exception.StatusException") {
                WRITE "%Status exception",!
                DO $SYSTEM.Status.DisplayError($SYSTEM.Status.Error(exp.Code,exp.Data))
                RETURN
              }
              ELSEIF 1=exp.%IsA("%Exception.General") {
                WRITE "General ObjectScript exception",!
                WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
                WRITE "Code: "
              }
              ELSE { WRITE "Some other type of exception",! RETURN }
            WRITE exp.Code,!
            WRITE "Data: ",exp.Data,!
            RETURN
}
```

Nested TRY/CATCH Blocks

Only one **CATCH** block is permitted for each **TRY** block. However, it is possible to nest paired **TRY**/**CATCH** blocks.

You can nest an inner **TRY**/**CATCH** pair within an outer **CATCH** block, such as the following:

```
TRY {
     /* TRY code */
}
CATCH exvar1 {
    /* CATCH code */
     TRY {
         /* nested TRY code */
     }
     CATCH exvar2 {
        /* nested CATCH code */
     }
}
```

You can nest an inner **TRY**/**CATCH** pair within an outer **TRY** block, such as the following:

```
TRY {
     /* TRY code */
     TRY {
         /* nested TRY code */
     }
     CATCH exvar2 {
        /* nested CATCH code */
     }
}
CATCH exvar1 {
    /* CATCH code */
}
```

Execution Stack

The %Exception object contains the execution stack at the time the object was created. You can access this execution stack using the **StackAsArray()** method. The following example shows this execution stack:

```
TRY {
    WRITE "In the TRY block",!
    WRITE 7/0
}
CATCH exobj {
     WRITE "In the CATCH block",!
     WRITE $ZCVT($ZERROR,"O","HTML"),!
     TRY {
          WRITE "In the nested TRY block",!
          KILL fred
          WRITE fred
     }
     CATCH exobj2 {
        WRITE "In the nested CATCH block",!
        WRITE $ZCVT($ZERROR,"O","HTML"),!!
        WRITE "The Execution Stack",!
        DO exobj2.StackAsArray(.stk)
        ZWRITE stk
     }
}
```

CATCH and $ZTRAP

You cannot set **$ZTRAP** within a **TRY** block. However, you can set **$ZTRAP** within a **CATCH** block. You can also set **$ZTRAP** before entering the **TRY** block.

If an exception occurs within the **CATCH** block, the specified **$ZTRAP** exception handler is taken.

TRY / CATCH Loop

A loop where a **TRY** block invokes a **CATCH** block that loops back to the **TRY** block does not loop infinitely. It eventually issues a <FRAMESTACK> error.

Disabling CATCH

Issuing a `ZBREAK /ERRORTRAP:OFF` command disables **CATCH** exception handling.

Argument

exceptionvar

A local variable, used to receive the exception object reference from the **THROW** command or from the system runtime environment in the event of a system error. When a system error occurs, *exceptionvar* receives a reference to an object of type %Exception.SystemException. When a user-specified error occurs, *exceptionvar* receives a reference to an object of type %Exception.General, %Exception.StatusException, or %Exception.SQL. For further details, refer to the %Exception.AbstractException abstract class in the *InterSystems Class Reference*.

The *exceptionvar* argument can optionally be enclosed with parentheses, thus: `CATCH(var) { code block }`. This parentheses syntax is provided for compatibility, and has no effect on functionality.

Examples: System Exceptions

The following example shows an argumentless **CATCH** invoked by a divide-by-zero runtime error. It displays the **$ZERROR** and **$ECODE** error values. Argumentless **CATCH** is not recommended because it is less reliable than passing an *exceptionvar*. If an error occurs in the **CATCH** block, **$ZERROR** will contain this most recent error, not the error that invoked the **CATCH**. In this example the **QUIT** command exits the **CATCH** block, but does not prevent “fall-through” to the next line outside the block structure:

```
TRY {
  WRITE !,"TRY block about to divide by zero",!!
  SET a=7/0
  WRITE !,"this should not display"
}
CATCH {
    WRITE "CATCH block exception handler",!!
    WRITE "$ZERROR is: ",$ZERROR,!
    WRITE "$ECODE is :",$ECODE,!
    QUIT
    WRITE !,"this should not display"
}
WRITE !,"this is where the code falls through"
```

The following example shows a **CATCH** invoked by a divide-by-zero runtime error and receiving an argument. This is the preferred coding practice. The *myexp* OREF argument receives a system-generated exception object. It displays the Name, Code, and Location properties of this exception instance. In this example the **RETURN** command exits the program, so no “fall-through” occurs:

```
TRY {
  WRITE !,"TRY block about to divide by zero",!!
  SET a=7/0
  WRITE !,"this should not display"
}
CATCH myexp {
    WRITE "CATCH block exception handler",!!
    WRITE "Name: ",$ZCVT(myexp.Name,"O","HTML"),!
    WRITE "Code: ",myexp.Code,!
    WRITE "Location: ",myexp.Location,!
    RETURN
}
WRITE !,"this is where the code falls through"
```

The following example shows a **CATCH** receiving a system exception object. The **CATCH** block code displays the system exception as a **$ZERROR**-formatted string using the **AsSystemError()** method of the %Exception.SystemException class. (**$ZERROR** is also displayed, for comparison purposes.) This **CATCH** block then displays the error name, error code, error data, and error location as separate properties:

```
TRY {
  WRITE !,"this global is not defined",!
  SET a=^badglobal(1)
  WRITE !,"this should not display"
}
CATCH myvar {
    WRITE !,"this is the exception handler",!
    WRITE "AsSystemError is: ",myvar.AsSystemError(),!
    WRITE "$ZERROR is:       ",$ZERROR,!!
    WRITE "Error name=",$ZCVT(myvar.Name,"O","HTML"),!
    WRITE "Error code=",myvar.Code,!
    WRITE "Error data=",myvar.Data,!
    WRITE "Error location=",myvar.Location,!
    RETURN
}
```

Examples: Thrown Exceptions

The following example shows a **CATCH** invoked by the **THROW** command. The *myvar* argument receives a user-defined exception object with four properties. Note that in this example the **THROW** does not supply a value for the omitted Location property of the %Exception.General class:

```
TRY {
  SET total=1234
  WRITE !,"Throw an exception!"
  THROW ##class(%Exception.General).%New("Example Error",999,,"MyThrow")
  WRITE !,"this should not display"
}
CATCH myvar {
    WRITE !!,"this is the exception handler"
    WRITE !,"Error data=",myvar.Data
    WRITE !,"Error code=",myvar.Code
    WRITE !,"Error name=",myvar.Name
    WRITE !,"Error location=",myvar.Location,!
    RETURN
}
```

The following two examples generate birth dates in the **TRY** block. If they generate a birth date that is in the future, they use **THROW** to issue a general exception, passing the user-defined exception to the **CATCH** block. (You may have to run these examples more than once to generate a date that throws an exception.)

The first of these examples does not specify a **CATCH** *exceptionvar*. It uses the OREF name defined in the **TRY** block to specify the exception properties:

```
TRY {
    WRITE "In the TRY block",!
    SET badDOB=##class(%Exception.General).%New("BadDOB","999",,"Birth date is in the future")
    FOR x=1:1:20 { SET rndDOB = $RANDOM(7)_$RANDOM(10000)
      IF rndDOB > $HOROLOG { THROW badDOB }
      ELSE { WRITE "Birthdate ",$ZDATE(rndDOB,1,,4)," is valid",! }
   }
}
CATCH {
      WRITE !,"In the CATCH block"
      WRITE !,"Birthdate ",$ZDATE(rndDOB,1,,4)," is invalid"
      WRITE !,"Error code=",badDOB.Code
      WRITE !,"Error name=",badDOB.Name
      WRITE !,"Error data=",badDOB.Data
      RETURN
}
```

The second of these examples specifies a **CATCH** *exceptionvar*. It uses this renamed OREF to specify the exception properties. This is the preferred usage:

```
TRY {
    WRITE "In the TRY block",!
    SET badDOB=##class(%Exception.General).%New("BadDOB","999",,"Birth date is in the future")
    FOR x=1:1:20 { SET rndDOB = $RANDOM(7)_$RANDOM(10000)
      IF rndDOB > $HOROLOG { THROW badDOB }
      ELSE { WRITE "Birthdate ",$ZDATE(rndDOB,1,,4)," is valid",! }
   }
}
CATCH err {
      WRITE !,"In the CATCH block"
      WRITE !,"Birthdate ",$ZDATE(rndDOB,1,,4)," is invalid"
      WRITE !,"Error code=",err.Code
      WRITE !,"Error name=",err.Name
      WRITE !,"Error data=",err.Data
      RETURN
}
```

Example: Nested TRY/CATCH

The following example shows a **CATCH** invoked by a divide-by-zero runtime error. The **CATCH** block contains an inner **TRY** block paired with an inner **CATCH** block. This inner **CATCH** block is invoked by a thrown exception. For the purposes of demonstration, this **THROW** is invoked randomly in this program. In a real-world program, the inner **CATCH** block would be invoked by an exception test, such as a mismatch between **AsSystemError()** (the caught error) and **$ZERROR** (the most-recent error):

```
TRY {
  WRITE !,"Outer TRY block",!!
  SET a=7/0
  WRITE !,"this should not display"
}
CATCH myexp {
    WRITE "Outer CATCH block",!
    WRITE "Name: ",$ZCVT(myexp.Name,"O","HTML"),!
```

```
      WRITE "Code: ",myexp.Code,!
      WRITE "Location: ",myexp.Location,!
      SET rndm=$RANDOM(2)
      IF rndm=1 {RETURN }
    TRY {
      WRITE !,"Inner TRY block",!
      SET oref=##class(%Exception.General).%New("<MY BAD>","999",,"General error message")
         THROW oref
      RETURN
    }
    CATCH myexp2 {
                  WRITE !,"Inner CATCH block",!
                  IF 1=myexp2.%IsA("%Exception.General") {
                    WRITE "General ObjectScript exception",!
                    WRITE "Name: ",$ZCVT(myexp2.Name,"O","HTML"),!
                    WRITE "Code: ",myexp2.Code,!
                  }
                  ELSE { WRITE "Some other type of exception",! }
                  QUIT
     }
     WRITE !,"back to Outer CATCH block",!
     RETURN
  }
```

See Also

- THROW command
- TRY command
- ZBREAK command
- Error Processing in *Using ObjectScript*

CLOSE

Closes a file or a device.

```
CLOSE:pc closearg,...
C:pc closearg,...
```

where *closearg* is:

```
device:parameters
```

Arguments

pc	*Optional* — A postconditional expression.
device	The device to be closed.
parameters	*Optional* — One or more parameters used to set characteristics of the device. A single parameter may be specified as a quoted string: `CLOSE device:"D"`. Multiple parameters must be specified enclosed by parentheses and separated by colons.

Description

CLOSE *device* releases ownership of the specified device, optionally sets a *parameter*, and returns it to the pool of available devices.

If the process does not own the specified device, or if the specified device is not open or does not exist, InterSystems IRIS ignores **CLOSE** and returns without issuing an error.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the **CLOSE** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

device

The device to be closed. A *device* can be a physical device, a TCP connection, or the pathname of a sequential file. Specify the same device ID (mnemonic or number) as specified on the corresponding **OPEN** command. For more information on specifying device IDs, refer to the OPEN command.

You can specify a single device ID or as a comma-separated list of device IDs. **CLOSE** closes all of the listed devices that the process currently has open. It ignores any listed devices that do not exist or are not currently open by this process.

The device ID of the current device is contained in the $IO special variable.

parameters

A parameter or a colon-separated list of parameters used when closing the specified device. Parameter codes are not case-sensitive. Multiple parameters must be enclosed with parentheses and separated by colons.

The available parameter values are as follows:

"D"	Closes and deletes a sequential file. Can also be specified as /DEL, /DEL=1, /DELETE, or /DELETE=1.
"R":newname	Closes and renames a sequential file. Can also be specified as /REN=newname or /RENAME=newname.
“K”	Closes at the InterSystems IRIS level but not at the operating system level. Used only on non-Windows systems.

If the specified *parameter* is not valid, **CLOSE** still closes the device.

Refer to Sequential File I/O in the *I/O Device Guide* for further information.

Examples

In the following UNIX® example, the **CLOSE** command closes device C (/dev/tty02), but only if it is not the current device. The postconditional uses the $IO special variable to check for the current device.

```
CloseDevC
  SET C="/dev/tty02"
  OPEN C
    ; ...
  CLOSE:$IO'=C C
```

Notes

Acquiring Ownership of a Device

A process acquires ownership of a device with the **OPEN** command and makes it active with the **USE** command. If the closed device is the active (that is, current) device, the default I/O device becomes the current device. (The default I/O device is established at login.) When a process is terminated (for example, after a **HALT**), all its opened devices are automatically closed and returned to the system.

If the process’s default device is closed, any subsequent output (such as error messages) to that device causes the process to hang. In this case, you must explicitly reopen the default device.

See Also

- OPEN command
- I/O Devices and Commands in *I/O Device Guide*

CONTINUE

Jumps to FOR, WHILE, or DO WHILE command and re-executes test and loop.

```
CONTINUE:pc
```

Argument

pc	*Optional* — A postconditional expression.

Description

The **CONTINUE** command is used within the code block following a FOR, WHILE, or DO WHILE command. CONTINUE causes execution to jump back to the FOR, WHILE, or DO WHILE command. The FOR, WHILE, or DO WHILE command evaluates its test condition, and, based on that evaluation, re-executes the code block loop. Thus, the CONTINUE command has exactly the same effect on execution as reaching the closing curly brace (}) of the code block.

CONTINUE takes no arguments (other than the postconditional). At least two blank spaces must separate it from a command following it on the same line.

A **CONTINUE** can cause execution to jump out of a **TRY** or **CATCH** block to return to its control flow statement.

Arguments

pc

An optional postconditional expression that can make the command conditional. InterSystems IRIS executes the **CONTINUE** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

Examples

The following example uses a **CONTINUE** with a postconditional expression. It loops through and prints out all the numbers from 1 to 10, except 3:

```
Loop
  FOR i=1:1:10 {
    IF i # 2 {
      CONTINUE:i=3
      WRITE !,i," is odd" }
    ELSE { WRITE !,i," is even" }
    }
  WRITE !,"done with the loop"
  QUIT
```

The following example shows two nested **FOR** loops. The **CONTINUE** jumps back to the **FOR** in the inner loop:

```
Loop
  FOR i=1:1:3 {
    WRITE !,"outer loop: i=",i
    FOR j=2:2:10 {
      WRITE !,"inner loop: j=",j
      IF j '= 8 {CONTINUE  }
      ELSE { WRITE " crazy eight"}
      }
    WRITE !,"back to outer loop"
  }
  QUIT
```

The following example shows a **CONTINUE** that exits a **TRY** block. The **CONTINUE** jumps back to the **FOR** statement outside the **TRY** block.

```
TryLoop
  FOR i=1:1:10 {
  WRITE !,"Top of FOR loop"
    TRY {
    WRITE !,"In TRY block: i=",i
    IF i=7 {
      WRITE " lucky seven" }
      ELSE { CONTINUE }
    }
    CATCH exp {
       WRITE !,"CATCH block exception handler",!
       WRITE "Error code=",exp.Code
       RETURN
    }
    WRITE !,"Bottom of the FOR loop"
  }
  QUIT
```

See Also

- DO WHILE command
- FOR command
- WHILE command

DO

Calls a routine.

```
DO:pc doargument,...
D:pc doargument,...
```

where *doargument* is:

```
entryref(param,...):pc
```

Arguments

pc	*Optional* — A postconditional expression.
entryref	The name of the routine to be called, preceded by a caret (`DO ^myroutine`), optionally with a label name (`DO Label2^myroutine`), or label and line offset (`DO Label2+3^myroutine`). To invoke the current routine you can omit the routine name and just specify a label or label and line offset. You can also invoke an object method as `DO oref.Method()` or using another syntax form, as listed below.
param	*Optional* — Parameter values to be passed to the called routine.

Description

Note: The **DO** command and the **DO WHILE** command are separate and unrelated commands. This page documents the **DO** command. In the DO WHILE command, the DO keyword and the WHILE keyword may be separated by several lines of code; however, you can immediately identify a **DO WHILE** command because the DO keyword is followed by an open curly brace.

The **DO** command calls a specified object method, subroutine, function, or procedure. InterSystems IRIS executes the called routine, then executes the next command after the **DO** command. You can call the routine with or without parameter passing. For example `DO ^myrou1` or `DO ^myrou(a,b,c)`.

DO cannot accept a return value from the called routine. If the called routine concludes with an argumented **QUIT**, the **DO** command completes successfully, but ignores the **QUIT** argument value.

DO can specify multiple arguments as a comma-separated list. For example, `DO ^myrou1,^myrou2,^myrou3`. The system executes the arguments in the order specified. Execution halts if it encounters an invalid argument.

DO is commonly invoked at the Terminal prompt to execute an existing compiled routine. The **DO** command can, of course, also be invoked from within a routine.

Each invocation of **DO** places a new context frame on the call stack for your process. The **$STACK** special variable contains the current number of context frames on the call stack. This context frame establishes a new execution level, incrementing **$STACK** and **$ESTACK**, and providing scope for **NEW** and **SET $ZTRAP** operations issued during the **DO** operation. Upon successful completion, **DO** decrements **$STACK** and **$ESTACK** and reverts **NEW** and **SET $ZTRAP** operations.

Current Routine

When invoking **DO** from the Terminal, **DO** first searches for the currently loaded routine. If the current process has a current routine, **DO** executes this routine, not the corresponding routine on disk.

For example, you load the routine *myroutine* from disk using the ZLOAD command. This makes it the current routine (as shown by the $ZNAME special variable). You then modify the current routine using **ZINSERT**, then invoke **DO ^myroutine**. The **DO** command executes the modified *myroutine*, not the unmodified *myroutine* on disk. The argumentless ZREMOVE command unloads the currently loaded routine. Following an argumentless **ZREMOVE**, **DO ^myroutine** executes the unmodified version of *myroutine* from disk.

You can invoke the current routine in either of two ways:

- With explicit routine name: **DO ^myroutine**, **DO Label2^myroutine**, or **DO Label2+3^myroutine**.
- With implied routine name, specifying just label and (optionally) offset: **DO Main**, **DO Label2**, or **DO Label2+3**.

Arguments

pc

An optional postconditional expression. If the postconditional expression is appended to the **DO** command keyword, InterSystems IRIS executes the **DO** command if the postconditional expression is TRUE (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the **DO** command if the postconditional expression is FALSE (evaluates to zero).

If the postconditional expression is appended to an argument, InterSystems IRIS executes the argument if the postconditional expression is TRUE (evaluates to a nonzero numeric value). If the postconditional expression is FALSE (evaluates to zero), InterSystems IRIS skips that argument and proceeds to evaluate the next argument (if there is one) or the next command. For example:

```
DO:0 $INCREMENT(myvar($INCREMENT(subvar))):1  /* myvar and subvar not incremented */
DO:1 $INCREMENT(myvar($INCREMENT(subvar))):0  /* myvar not incremented, subvar incremented */
```

Note that because InterSystems IRIS processes expressions from left to right, any part of the argument containing expressions (such as a parameter value or an object reference) is evaluated and can cause an error before the postconditional expression is evaluated. If **DO** invokes an object method with an appended postconditional, the maximum number of object method parameters is 253.

For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

entryref

The name of the routine (Object Method, Subroutine, Procedure, or User-supplied Function) to be called. You can specify multiple routines as a comma-separated list.

entryref can take any of the following forms.

label+offset	Specifies a line label within the current routine. The optional *+offset* can only be used when calling a subroutine to which no parameters are passed; it cannot be used when calling a procedure or when passing parameters to a subroutine. *offset* is a nonnegative integer that specifies the number of lines after the label at which execution of the subroutine is to start.
label+offset^routine	Specifies a line label within the named routine that resides on disk. InterSystems IRIS loads the routine from disk and begins execution at the indicated label. The *+offset* is optional.
^routine	The name of a routine that resides on disk. The system loads the routine from disk and begins execution at the first executable line of the routine. Must be a literal value; a variable cannot be used to specify *routine*. (Note that the ^ character is a separator character, not part of the routine name.) If the routine has been modified, InterSystems IRIS loads the updated version of the routine when **DO** invokes the routine. If the routine is not in the current namespace, you can specify the namespace that contains the routine using an extended routine reference, as follows: `^|"namespace"|routine`.
oref.Method()	Specifies an object method. The system accesses the object and executes the specified method, passing the arguments (if any) specified in *param*, the method's argument list. Object calls use dot syntax: *oref* (the object reference) and *Method*() are separated by a dot; blank spaces are not permitted. A method must specify its open and close parentheses, even if there are no *param* arguments. The following syntactic forms are supported: `DO oref.Method()`, `DO (oref).Method()`, `DO ..Method()`, `DO ##class(cname).Method()`, `DO i%prop(subs).Method()`.

You cannot specify an *offset* when calling a IRISSYS % routine. If you attempt to do so, InterSystems IRIS issues a <NOLINE> error.

If you specify a nonexistent label, InterSystems IRIS issues a <NOLINE> error. If you specify a nonexistent routine, InterSystems IRIS issues a <NOROUTINE> error. If you specify a nonexistent method, InterSystems IRIS issues a <METHOD DOES NOT EXIST> error. If you specify an existing property as a method (with parentheses), InterSystems IRIS issues an <OBJECT DISPATCH> error. If you use extended reference (for example, `DO ^|"%SYS"|MyProg`) and specify a nonexistent namespace, InterSystems IRIS issues a <NAMESPACE> error. If you use extended reference and specify a namespace for which you do not have privileges, InterSystems IRIS issues a <PROTECT> error, followed by the database path, such as the following: `<PROTECT> *^|^^c:\intersystems\iris\mgr\|MyRoutine`. For further details on these errors, refer to the $ZERROR special variable.

If you specify an *offset* that points to the middle of a multi-line statement, the system starts execution at the beginning of the next statement.

param

Parameter values to be passed to the subroutine, procedure, user-supplied function or object method. You can specify a single *param* value, or a comma-separated list of *param* values. A *param* list is enclosed in parentheses. When no *param* is specified, the enclosing parentheses are required when calling a procedure or user-supplied function, optional when calling a subroutine. Parameters can be passed by value or passed by reference. The same call can mix parameters passed by value and parameters passed by reference. When passing by value, you can specify a parameter as a value constant, expression, or unsubscripted local variable name. (See Passing By Value.) When passing by reference, the parameters must reference the name of a local variable or unsubscripted array in the form .*name* (See Passing By Reference.)

The maximum total *param* values for a **DO** entrypoint is 382; the maximum total *param* values for a **DO** method or **DO** with indirection is 380. This total can include up to 254 actual parameters and 128 postconditional parameters.

you can specify a variable number of parameters using ... syntax.

DO Command entryref Arguments

The **DO** command with *entryref* arguments invokes the execution of one or more blocks of code that are defined elsewhere. Each block of code to execute is specified by its *entryref*. The **DO** command can specify multiple blocks of code to execute as a comma-separated list. The execution of the **DO** command, and the execution of each *entryref* in a comma-separated list can be governed by optional postconditional expressions.

DO can invoke the execution of a subroutine (with or without parameter passing), a procedure, or a user-supplied function. Upon completion of the execution of the block of code, execution resumes at the next command after the **DO** command. A block of code invoked by the **DO** command cannot return a value to the **DO** command; any value returned is ignored. Thus **DO** can execute a user-supplied function, but cannot receive the return value of that function.

DO cannot invoke most ObjectScript system functions. Attempting to do so results in a <SYNTAX> error. A few system functions can be invoked as a **DO** command argument: $CASE, $CLASSMETHOD, $METHOD, $INCREMENT, and $ZF(-100). **DO** cannot receive the return value of a function. Like all **DO** command arguments, these functions can take a postconditional parameter. For example, `DO $CASE(exp,0:NoMul(),2:Square(num),3:Cube(num),:Exponent(num,exp)):0`. For an example program, refer to the $CASE function.

The DO Command without Parameter Passing

The **DO** command without parameter passing is only used with subroutines. Use of **DO** *entryref* without parameter passing (that is, without specifying the *param* option) takes advantage of the fact that a calling routine and its called subroutine share the same variable environment. Any variable updates made by the subroutine are automatically available to the code following the **DO** command.

When using **DO** without parameter passing, you must make sure that both the calling routine and the called subroutine reference the same variables.

Note: Procedures handle variables entirely differently. Refer to Procedures in *Using ObjectScript*.

In the following example, Start (the calling routine) and Exponent (the called subroutine) share access to three variables: *num*, *powr*, and *result*. Start sets *num* and *powr* to the user-supplied values. These values are automatically available to Exponent when it is called by the **DO** command. Exponent references *num* and *powr*, and places the calculated value in *result*. When Exponent executes the **RETURN** command, control returns to the **WRITE** command immediately after the **DO**. The **WRITE** command outputs the calculated value by referencing *result*:

```
Start  ; Raise an integer to a specified power.
  READ !,"Integer= ",num QUIT:num=""
  READ !,"Power= ",powr QUIT:powr=""
  DO Exponent()
  WRITE !,"Result= ",result,!
  RETURN
Exponent()
  SET result=num
  FOR i=1:1:powr-1 { SET result=result*num }
  RETURN
```

In the following example, **DO** invokes the Admit() method on the object referred to by pat. The method does not receive parameters or return a value.

```
DO pat.Admit()
```

In the following example, **DO** calls, in succession, the subroutines Init and Read1 in the current routine and the subroutine Convert in routine Test.

```
 DO Init,Read1,Convert^Test
```

In the following example, **DO** uses an extended reference to call the routine fibonacci in a different namespace (the SAMPLES namespace):

```
  NEW $NAMESPACE
  SET $NAMESPACE="USER"
  DO ^|"SAMPLES"|fibonacci
```

DO and GOTO

The **DO** command can be used to invoke a subroutine (with or without parameter passing), a procedure, or a user-supplied function. At the completion of the call, InterSystems IRIS executes the next command following the **DO** command.

The **GOTO** command can only be used to invoke a subroutine without parameter passing. At the completion of the call, InterSystems IRIS issues a **QUIT**, ending execution.

DO with Parameter Passing

When used with parameter passing, **DO** *entryref* explicitly passes one or more values to the called subroutine, procedure, user-supplied function or object method. The passed values are specified as a comma-separated list with the *param* option. With parameter passing, you must make sure that the called subroutine is defined with a parameter list. The subroutine definition takes the form:

>*label*(*param*)

where *label* is the label name of the subroutine, procedure, user-supplied function or object method, and *param* is a comma separated list of one or more unsubscripted local variable names. For example,

```
Main
  SET x=1,y=2,z=3
  WRITE !,"In Main ",x,y,z
  DO Sub1(x,y,z)
  WRITE !,"Back in Main ",x,y,z
  QUIT
Sub1(a,b,c)
  WRITE !,"In Sub1 ",a,b,c
  QUIT
```

The list of parameters passed by the **DO** command is known as the *actual parameter list*. The list of parameter variables defined as part of the label of the coded routine is known as the *formal parameter list*. When **DO** calls the routine, the parameters in the actual parameter list are mapped, by position, to the corresponding variables in the formal parameter list. In the above example, the value of the first actual parameter (x) is placed in the first variable (a) of the subroutine's formal parameter list; the value of the second actual parameter (y) is placed in the second variable (b); and so on. The subroutine can then access the passed values by using the appropriate variables in its formal parameter list.

If there are more variables in the actual parameter list than there are parameters in the formal parameter list, InterSystems IRIS issues a <PARAMETER> error.

If there are more variables in the formal parameter list than there are parameters in the actual parameter list, the extra variables are left undefined. In the following example, the formal parameter c is left undefined:

```
Main
  SET x=1,y=2,z=3
  WRITE !,"In Main ",x,y,z
  DO Sub1(x,y)
  WRITE !,"Back in Main ",x,y,z
  QUIT
Sub1(a,b,c)
  WRITE !,"In Sub1 "
  IF $DATA(a) {WRITE !,"a=",a}
     ELSE {WRITE !,"a is undefined"}
  IF $DATA(b) {WRITE !,"b=",b}
     ELSE {WRITE !,"b is undefined"}
  IF $DATA(c) {WRITE !,"c=",c}
     ELSE {WRITE !,"c is undefined"}
  QUIT
```

You can specify a default value for a formal parameter, to be used when no actual parameter value is specified.

You can leave any variable undefined by omitting the corresponding parameter from the **DO** command's actual parameter list. However, you must include a comma as a place holder for each omitted actual parameter. In the following example, the formal parameter b is left undefined:

```
Main
  SET x=1,y=2,z=3
  WRITE !,"In Main ",x,y,z
  DO Sub1(x,,z)
  WRITE !,"Back in Main ",x,y,z
  QUIT
Sub1(a,b,c)
  WRITE !,"In Sub1 "
  IF $DATA(a) {WRITE !,"a=",a}
     ELSE {WRITE !,"a is undefined"}
  IF $DATA(b) {WRITE !,"b=",b}
     ELSE {WRITE !,"b is undefined"}
  IF $DATA(c) {WRITE !,"c=",c}
     ELSE {WRITE !,"c is undefined"}
  QUIT
```

You can specify a variable number of parameters using ... syntax:

```
Main
  SET x=3,x(1)=10,x(2)=20,x(3)=30
  DO Sub1(x...)
  QUIT
Sub1(a,b,c)
  WRITE a," ",b," ",c
  QUIT
```

The **DO** command can pass parameters either *by value* (for example, `DO Sub1(x,y,z)`) or *by reference* (for example, `DO Sub1(.x,.y,.z)`). You can mix passing by value and passing by reference within the same **DO** command. For further details, refer to Parameter Passing in *Using ObjectScript*.

The following examples show the difference between passing by value and passing by reference:

```
Main /* Passing by Value */
  SET x=1,y=2,z=3
  WRITE !,"In Main ",x,y,z
  DO Sub1(x,y,z)
  WRITE !,"Back in Main ",x,y,z
  QUIT
Sub1(a,b,c)
  SET a=a+1,b=b+1,c=c+1
  WRITE !,"In Sub1 ",a,b,c
  QUIT
```

```
Main /* Passing by Reference */
  SET x=1,y=2,z=3
  WRITE !,"In Main ",x,y,z
  DO Sub1(.x,.y,.z)
  WRITE !,"Back in Main ",x,y,z
  QUIT
Sub1(&a,&b,&c)   /* The & prefix is an optional by-reference marker */
  SET a=a+1,b=b+1,c=c+1
  WRITE !,"In Sub1 ",a,b,c
  QUIT
```

DO with Indirection

You can use indirection to supply a target subroutine location for **DO**. For example, you might implement a generalized menu program by storing the various menu functions at different locations in a separate routine. In your main program code, you could use name indirection to provide the **DO** command with the location of the function corresponding to each menu choice.

You cannot use indirection with InterSystems IRIS object dot syntax. This is because dot syntax is parsed at compile time, not at runtime.

In *name indirection*, the value of the expression to the right of the indirection operator (@) must be a name (that is, a line label or a routine name). In the following code segment, name indirection supplies the **DO** with the location of a target function in the routine Menu.

```
READ !,"Enter the number for your choice: ",num QUIT:num=""
DO @("Item"_num)^Menu
```

The **DO** command invokes the subroutine in Menu whose label is Item concatenated with the user-supplied *num* value (for example, Item1, Item2, and so on).

You can also use the *argument* form of indirection to substitute the value of an expression for a complete **DO** argument. For example, consider the following **DO** command:

```
DO @(eref_":fstr>0")
```

This command calls the subroutine specified by the value of *eref* if the value of *fstr* is greater than 0.

For more information, refer to Indirection in *Using ObjectScript*.

DO with Argument Postconditionals

You can use argument postconditional expressions to select a target subroutine for a **DO** command. If the postconditional expression evaluates to FALSE (0), InterSystems IRIS ignores the associated subroutine call. If the postconditional expression evaluates to TRUE (1), InterSystems IRIS executes the associated subroutine call, then returns to the **DO** command. You can use postconditionals on both the **DO** command and on its arguments.

For example, consider the command:

```
DO:F>0 A:F=1,B:F=2,C
```

The **DO** command has a postconditional expression; if *F* is not greater than 0, no part of the **DO** is executed. The **DO** command's arguments also have postconditional expressions. **DO** uses these argument postconditionals to select which subroutine(s) (A, B, or C) to execute. All subroutines that fulfill the truth condition are executed, in the order presented. Thus, in the above example, C, with no postconditional, is always executed: if F=1 both A and C are executed; if F=2, B and C are executed; if F=3 (or any other number) C is executed. To establish C as a true default, do the following:

```
DO:F>0 A:F=1,B:F=2,C:((F'=1)&&(F'=2))
```

In this example, one and only one subroutine is executed.

In the following example, the **DO** command takes a postconditional, and each of its arguments also takes a postconditional. In this case, the first argument is not executed, because its postconditional is 0. The second argument is executed because its postconditional is 1.

```
Main
  SET x=1,y=2,z=3
  WRITE !,"In Main ",x,y,z
  DO:1 Sub1(x,y,z):0,Sub2(x,y,z):1
  WRITE !,"Back in Main ",x,y,z
  QUIT
Sub1(a,b,c)
  WRITE !,"In Sub1 ",a,b,c
  QUIT
Sub2(d,e,f)
  WRITE !,"In Sub2 ",d,e,f
  QUIT
```

Most Object (oref) methods invoked by **DO** can take an argument postconditional. However, $SYSTEM object methods cannot take an argument postconditional. Attempted to do so generates a <SYNTAX> error.

Note that because InterSystems IRIS evaluates expressions in strict left-to-right order, an argument that contains expressions is evaluated (and can generate an error) before InterSystems IRIS evaluates the argument postconditional.

When using argument postconditionals, make sure there are no unwanted side effects. For example, consider the following command:

```
DO @^Control(i):z=1
```

In this case, ^Control(i) contains the name of the subroutine to be called if the postconditional z=1 tests TRUE. Whether or not z=1, InterSystems IRIS evaluates the value of ^Control(i) and resets the current global naked indicator accordingly. If z=1 is FALSE, InterSystems IRIS does not execute the **DO**. However, it does reset the global naked indicator just as if it had executed the **DO**. For more details on the naked indicator, see Naked Global Reference in *Using Globals*.

For more information on how postconditional expressions are evaluated, see Command Postconditional Expressions in *Using ObjectScript*.

$TEST Behavior with DO

When you use **DO** to call a procedure, InterSystems IRIS preserves the value of **$TEST** by restoring it to its state at the time of the call upon quitting the procedure. However, when you use **DO** to call a subroutine (either with or without parameter passing), InterSystems IRIS *does not* preserve the value of **$TEST** across the call.

To save the **$TEST** value across a **DO** call, you can explicitly assign it to a variable before the call. You can then reference the variable in code that follows the call.

See Also

- GOTO command
- XECUTE command
- NEW command
- QUIT command
- $CASE function
- $ESTACK special variable
- $STACK special variable
- Subroutines in *Using ObjectScript*
- Procedures in *Using ObjectScript*
- Parameter Passing in *Using ObjectScript*

DO WHILE

Executes code while a condition exists.

```
DO {code} WHILE expression,...
D {code} WHILE expression,...
```

Arguments

code	A block of ObjectScript commands enclosed in curly braces.
expression	A boolean test condition expression, or a comma-separated list of boolean test condition expressions. This expression can, optionally, be enclosed in parentheses.

Description

DO WHILE executes *code*, then evaluates *expression*. If *expression* evaluates to TRUE, **DO WHILE** loops and re-executes *code*. If *expression* is not TRUE, *code* is not re-executed, and the next command following **DO WHILE** is executed.

Note that **DO WHILE** is always written in block-oriented form. The code to be executed is placed between the DO and the WHILE keywords, and is enclosed by curly braces.

An opening or closing curly brace may appear on its own code line or on the same line as a command. An opening or closing curly brace may even appear in column 1 (though this is not recommended). It is a recommended programming practice to indent curly braces to indicate the beginning and end of a nested block of code. No whitespace is required before or after an opening curly brace. No whitespace is required before or after a closing curly brace. No whitespace is required between the WHILE keyword and an *expression* enclosed in parentheses. A comment may appear between the closing curly brace and the WHILE keyword.

The DO keyword may be abbreviated.

DO WHILE (unlike the unrelated **DO** command) does not create a new execution level. Commands that are sensitive to the execution level, such as **NEW** and **SET $ZTRAP**, that are invoked during the **DO WHILE** loop remain in effect after the loop concludes.

Arguments

code

A block of one or more ObjectScript commands. The code block may span several lines. The code block is enclosed by curly braces. The commands and comments within the code block and arguments within commands may be separated from one another by one or more blank spaces and/or line returns. However, as in all ObjectScript commands, each command keyword must be separated from its first argument by exactly one space.

expression

A test condition which can take the form of a single expression or a comma-separated list of expressions. For an expression list, InterSystems IRIS evaluates the individual expressions in left to right order. It stops evaluation if it encounters an expression that is FALSE. If all expressions evaluate to TRUE, InterSystems IRIS re-executes the *code* commands. **DO WHILE** executes repeatedly, testing *expression* for each loop. If any expression evaluates to FALSE, InterSystems IRIS ignores any remaining expressions, and does not loop. It executes the next command after **DO WHILE**.

ObjectScript evaluates expressions in strictly left-to-right order. The programmer must use parentheses to establish any precedence.

Note: InterSystems IRIS performs no validation of *expression* before executing *code*. Therefore, **DO WHILE** always executes its *code* loop once, regardless of whether *expression* can successfully execute.

Examples

The following examples show first a **DO WHILE** in which expression is TRUE, and then a **DO WHILE** in which expression is FALSE. When expression is FALSE, the code block is executed once.

```
DoWhileTrue
   SET x=1
   DO {
     WRITE !,"Looping",x
     SET x=x+1
   } WHILE x<10
   WRITE !,"DONE"
```

This program writes `Looping1` through `Looping9` and then `DONE`.

```
DoWhileFalse
   SET x=11
   DO {
      WRITE !,"Looping",x
      SET x=x+1
   } WHILE x<10
   WRITE " DONE"
```

This program writes `Looping11 DONE`.

Notes

DO WHILE and WHILE

The **DO WHILE** command executes the loop once and then tests *expression*. The **WHILE** command tests *expression* before executing the loop.

DO WHILE and CONTINUE

Within the *code* block of a **DO WHILE** command, encountering a CONTINUE command causes execution to immediately jump to the WHILE keyword. The **DO WHILE** command then evaluates the WHILE *expression* test condition, and, based on that evaluation, determines whether to re-execute the *code* block loop. Thus, the **CONTINUE** command has exactly the same effect on execution as reaching the closing curly brace of the *code* block.

The following example only displays the results of its odd-numbered loops:

```
   SET x=0
   DO {SET x=x+1 IF x#2=0 {CONTINUE} WRITE !,"Loop ",x} WHILE x<20
   WRITE !,"DONE"
```

DO WHILE, QUIT, and RETURN

The QUIT command within the *code* block ends the **DO WHILE** loop and transfers execution to the command following the **WHILE** keyword, as shown in the following example:

```
Testloop
   SET x=1
   DO {
      WRITE !,"Looping",x
      QUIT:x=5
      SET x=x+1
    } WHILE x<10
    WRITE !,"DONE"
```

This program writes `Looping1` through `Looping5` and then `DONE`.

DO WHILE code blocks may be nested. That is, a **DO WHILE** code block may contain another flow-of-control loop (another **DO WHILE**, or a **FOR** or **WHILE** code block). A **QUIT** in an inner nested loop breaks out of the inner loop, to the next enclosing outer loop. This is shown in the following example:

```
Nestedloops
  SET x=1,y=1
  DO {
     WRITE "outer loop ",!
     DO {
        WRITE "inner loop "
        WRITE " y=",y,!
        QUIT:y=7
        SET y=y+2
        } WHILE y<100
     WRITE "back to outer loop x=",x,!!
     SET x=x+1
     } WHILE x<6
  WRITE "Done"
```

You can use RETURN to terminate execution of a routine at any point, including from within a **DO WHILE** loop or nested loop structure. **RETURN** always exits the current routine, returning to the calling routine or terminating the program if there is no calling routine. **RETURN** always behaves the same, regardless of whether it is issued from within a code block.

DO WHILE and GOTO

A **GOTO** command within the *code* block may direct execution to a label outside the loop, terminating the loop. (A label is also sometimes referred to as a tag.) A **GOTO** command within the *code* block may direct execution to a label within the same *code* block. A **GOTO** can be used to exit a nested code block. Other uses of **GOTO**, though supported, are not recommended.

The following example uses **GOTO** to exit a **DO WHILE** loop:

```
mainloop
  DO {
      WRITE !,"In an infinite DO WHILE loop"
      GOTO label1
      WRITE !,"This should not display"
  } WHILE 1=1
  WRITE !,"This should not display"
label1
  WRITE !,"Went to label1 and quit"
  QUIT
```

The following example uses **GOTO** to transfer execution within a **DO WHILE** loop:

```
mainloop ; Example of a GOTO to within the code block
  SET x=1
  DO {
      WRITE !,"In the DO WHILE loop"
      GOTO label1
      WRITE !,"This should not display"
label1
      WRITE !,"Still in the DO WHILE loop after GOTO"
      SET x=x+1
      WRITE !,"x= ",x
      } WHILE x<3
  WRITE !,"DO WHILE loop done"
```

See Also

- WHILE command
- FOR command
- IF command
- CONTINUE command
- GOTO command
- QUIT command
- RETURN command

ELSE

Clause of block-oriented **IF** command.

```
ELSE { code }
```

Refer to IF command for complete syntax.

Description

ELSE is not a separate command, but a clause of the block-oriented **IF** command. You can specify a single **ELSE** clause as the final clause of an **IF** command, or you can omit the **ELSE** clause. Refer to the **IF** command for details and examples.

Note: An earlier version of the **ELSE** command may exist in legacy applications where it is used with a line-oriented **IF** command. These commands may be recognized because they do not use curly braces. The old and new forms of **IF** and **ELSE** are syntactically different and should not be combined; therefore, an **IF** of one type should not be paired with an **ELSE** of the other type.

The earlier line-oriented **ELSE** command could be abbreviated as E. The block-oriented **ELSE** keyword cannot be abbreviated.

The **ELSE** keyword must be followed by an opening and closing curly brace ({) and (}). Usually these curly braces enclose a block of code. However, an **ELSE** with no code block is permissible, as in the following:

```
   SET x=1
Loop
   IF x=1{
          WRITE "Once only"
          SET x=x+1
          GOTO Loop
          }
   ELSE{}
   WRITE !,"All done"
```

There are no whitespace restrictions on the **ELSE** keyword.

See Also

- IF command
- Flow of Control Commands in *Using ObjectScript*

ELSEIF

Clause of block-oriented **IF** command.

```
ELSEIF expression,... { code }
```

Refer to IF command for complete syntax.

Description

ELSEIF is not a separate command, but a clause of the block-oriented **IF** command. You can specify one or more **ELSEIF** clauses in an **IF** command, or you can omit the **ELSEIF** clause. Refer to the **IF** command for details and examples.

See Also

- IF command
- Flow of Control Commands in *Using ObjectScript*

FOR

Executes a block of code repeatedly, testing at the beginning of each loop.

```
FOR var=forparameter { code }
F var=forparameter { code }

FOR var=forparameter,forparameter2,... { code }
F var=forparameter,forparameter2,... { code }
```

where *forparameter* can be:

```
expr
start:increment
start:increment:end
```

Arguments

var	*Optional* — A local variable or instance variable initialized by the **FOR** command. Commonly, this a numeric counter that is incremented each time the *code* block is executed.
expr	*Optional* — The value assigned to *var* before executing the *code* block. Can be a single value or a comma-separated list of values.
start	*Optional* — The numeric value assigned to *var* before the first execution of the *code* block. Used with *increment* and (optionally) *end* to govern multiple iterations of the **FOR** loop.
increment	*Optional* — The numeric value used to increment (or decrement) *var* after each iteration of the **FOR** loop.
end	*Optional* — The numeric value used to terminate the **FOR** loop. Looping ends when *var* is incremented to a value equal to or greater than *end*.
code	A block of ObjectScript commands enclosed in curly braces.

Description

FOR is a block-oriented command. Commonly, it consists of a counter and an executable block of code enclosed in curly braces. The number of times this block of code is executed is determined by the counter, which is tested at the top of each loop. Less commonly, a **FOR** command does not specify an incrementing counter. It can be argumentless (looping infinitely until exited), or can specify an expression as its argument (looping once).

The **FOR** command has two basic forms:

- Without an argument
- With an argument

FOR Without an Argument

FOR without an argument executes the loop code block infinitely until exited by a command within the code block. InterSystems IRIS repeats the commands within the curly braces until it encounters a **QUIT**, **RETURN**, or **GOTO** command that breaks out of the loop. The following example exits the loop when *x*=3:

```
SET x=8
FOR { WRITE "Running loop x=",x,!
      SET x=x-1
      QUIT:x=3
    }
WRITE "Next command after FOR code block"
```

An error, of course, also breaks out of a **FOR** loop, as shown in the following example. This **FOR** loop is exited by a divide-by-zero error, caught by the **CATCH** block:

```
 TRY {
 SET x=8
 FOR { SET y=4/x
       WRITE "Running loop 4/",x,"=",y,!
       SET x=x-1
     }
 WRITE "Next command after FOR code block"
 }
CATCH exp {
     WRITE !,"this is the exception handler",!
     IF 1=exp.%IsA("%Exception.SystemException") {
        WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
        WRITE "Location: ",exp.Location,!
        WRITE "Code: ",exp.Code
     }
     ELSE {WRITE "Unexpected exception type",! }
     RETURN
 }
```

FOR With an Argument

The action **FOR** performs depends on the argument form you use:

FOR *var*=*expr* executes the *code* block once, setting *var* to the value of *expr*. **FOR** *var*=*expr1*,*expr2*...,*exprN* executes the *code* block *N* times, setting *var* for each loop to each successive value of *expr*.

FOR *var*=*start*:*increment* executes the *code* block infinitely, unless exited. On the first iteration, InterSystems IRIS sets *var* to the value of *start*. Each execution of the **FOR** command increments the *var* value by the specified *increment* value. Execution repeats until it encounters a **QUIT**, **RETURN**, or **GOTO** command in the *code* block.

FOR *var*=*start*:*increment*:*end* sets *var* to the value of *start*. InterSystems IRIS then executes the *code* block based on the conditions described in this table:

***increment* is positive**	***increment* is negative**
If *start* > *end*, do not execute the *code* block. Stop looping when *var* is equal to or greater than *end*, or if InterSystems IRIS encounters a **QUIT**, **RETURN**, or **GOTO** command.	If *start* < *end*, do not execute the *code* block. Stop looping when *var* is equal to or less than *end*, or if InterSystems IRIS encounters a **QUIT**, **RETURN**, or **GOTO** command.

InterSystems IRIS evaluates the *start*, *increment*, and *end* values when it begins execution of the loop. Any changes made to these values within the loop are ignored and have no effect on the number of loop executions.

When the loop terminates, *var* contains a value that reflects the increment resulting from the last execution of the loop. However, *var* is never incremented beyond the maximum value specified in *end*.

A **FOR** loop can include multiple comma-separated *forparameter* arguments, but only one *var* argument. Valid syntax is as follows:

```
FOR var=start1:increment1:end1,start2:increment2:end2
```

This *var*=*forparameter* syntax must be specified as a single line of code. Line breaks are not permitted in a *forparameter* argument or between comma-separated *forparameter* arguments. Line breaks are permitted before or after the curly brace *code* delimiters and within the *code* block.

Blank spaces are permitted, but not required, in *forparameter* arguments. Therefore **FOR i=1:1:10{code}** and **FOR i = 1 : 1 : 10 { code }** are equally valid syntax.

Arguments

var

The *var* argument can be a simple local variable, a subscripted local variable, or an instance variable (such as i%property). The **FOR** command initializes (or sets) this variable; *var* does not need to be defined prior to the **FOR** command.

- When using loop counter syntax, *var* is a local variable that holds the current counter value for the **FOR** loop. It initially contains the numeric value specified by *start*. It is then recalculated using *increment* for each repetition of the **FOR** loop.
- When using *var*=*expr* syntax, a local variable is initialized to the *expr* value.

expr

The value InterSystems IRIS assigns to *var* before executing the loop commands. The value of *expr* can be specified as a literal or any valid expression. An *expr* can be a single value or a comma-separated list of values. If a single value, InterSystems IRIS executes the **FOR** loop once, supplying this *var* value to the code block. If a comma-separated list of values, InterSystems IRIS executes the **FOR** loop as many times as there are values, each loop equating *var* to the value, and supplying this *var* value to the code block

start

The numeric value InterSystems IRIS assigns to *var* on the first iteration of the **FOR** loop. The value of *start* can be specified as a literal or any valid expression; InterSystems IRIS evaluates *start* for its numeric value. A non-numeric *start* value is evaluated as 0.

increment

The numeric value InterSystems IRIS uses to increment *var* after each iteration of the **FOR** loop. It is required if you specify *start*. The value of *increment* can be specified as a literal or any valid expression; InterSystems IRIS evaluates *increment* for its numeric value. *increment* can be an integer or a fractional number; it can be a positive number (to increment) or a negative number (to decrement).

A value of 0 or a non-numeric *increment* value causes the **FOR** loop to repeat infinitely, unless exited. This is true even if *end*=0. However, if *start* is greater than *end*, the loop does not execute and an *increment* of 0 is ignored.

end

The numeric value InterSystems IRIS uses to terminate a **FOR** loop. When *var* equals (or exceeds) this value, the **FOR** loop is executed one last time and then terminated. The value of *end* can be specified as a literal or any valid expression; InterSystems IRIS evaluates *end* for its numeric value.

If *start*=*end* the **FOR** loop executes once. If *start* is greater than *end* (and *increment* is a positive number) the **FOR** loop does not execute.

code

A block of one or more ObjectScript commands enclosed in curly braces. This executable block of code can contain multiple commands, labels, comments, line returns, indents, and blank spaces as needed. When the **FOR** command concludes, execution continues with next command after the closing curly brace.

An opening or closing curly brace may appear on its own code line or on the same line as a command. An opening or closing curly brace may even appear in column 1 (though this is not recommended). It is a recommended programming practice to indent curly braces to indicate the beginning and end of a nested block of code. No whitespace is required before or after an opening curly brace. No whitespace is required before a closing curly brace, including a curly brace that follows an argumentless command. There is only one whitespace requirement for curly braces: a closing curly brace must be separated from the command that follows it by a space, tab, or line return.

Exiting a FOR Loop

You can exit a **FOR** loop by issuing a **QUIT**, **RETURN**, **CONTINUE**, or **GOTO**:

- QUIT exits the current **FOR** block structure. Therefore, a **QUIT** in a **FOR** block causes InterSystems IRIS to begin execution at the next line after the **FOR** block. A **QUIT** only exits the current **FOR** block; if a **FOR** block is nested in another **FOR** block (or in any other block structure), issuing a **QUIT** exits the inner **FOR** block to the outer block structure.

  QUIT behavior within a **FOR** block (and some other block structures) differs from **QUIT** behavior when not in a block structure. A **QUIT** outside of one of these block structures exits the current routine, not just the current code block. For further details, refer to the QUIT command reference page.

  A **QUIT** exits a **FOR** block only if the **QUIT** appears within the **FOR** block. If the **FOR** loop invokes a subroutine, issuing a **QUIT** in the subroutine terminates the subroutine, not the **FOR** loop that invoked it.

- RETURN exits the current routine, whether or not it is issued from within a **FOR** block structure.

- CONTINUE exits the current **FOR** loop. It causes execution to immediately jump back to the **FOR** command. The **FOR** command then increments and evaluates its arguments, and, based on that evaluation, determines whether to re-execute the code block loop. Thus, the **CONTINUE** command has exactly the same effect on execution as reaching the closing curly brace of the code block.

- GOTO can exit the current **FOR** block structure by transferring control outside of the **FOR** code block. A **FOR** loop is not terminated by a **GOTO** that transfers control within the **FOR** code block.

FOR Loop or WHILE Loop

You can use either a **FOR** or a WHILE to perform the same operation: loop until an event causes execution to break out of the loop. However, which loop construct you use has consequences for performing single-step (**BREAK "S+"** or **BREAK "L+"**) debugging on the code module.

A **FOR** loop pushes a new level onto the stack. A **WHILE** loop does not change the stack level. When debugging a **FOR** loop, popping the stack from within the **FOR** loop (using `BREAK "C" GOTO` or `QUIT 1`) allows you to continue single-step debugging with the command immediately following the end of the **FOR** command construct. When debugging a **WHILE** loop, issuing a using `BREAK "C" GOTO` or `QUIT 1` does not pop the stack, and therefore single-step debugging does not continue following the end of the **WHILE** command. The remaining code executes without breaking.

For further details, refer to the BREAK command and Debugging with BREAK in the “Command-line Routine Debugging” chapter of *Using ObjectScript*.

Examples

Argumentless FOR

In the following example, demonstrating argumentless **FOR**, the user is prompted repeatedly for a number that is then passed to the Calc subroutine by the **DO** command. The **FOR** loop terminates when the user enters a null string (presses ENTER without inputting a number), which causes the **QUIT** command to execute.

```
Mainloop
  FOR {
    READ !,"Number: ",num
    QUIT:num=""
    DO Calc(num)
  }
Calc(a)
   WRITE !,"The number squared is ",a*a
   QUIT
```

Using FOR var=expr

When you specify *var*=*expr*, InterSystems IRIS executes the **FOR** loop as many times as there are comma-separated values in *expr*. The value(s) in *expr* can be a literal or any valid expression. If you specify an expression, it must evaluate to a single value.

In the following example, the **FOR** command executes the code block once, with *num* having the value 4. It writes the number 12:

```
Loop
  SET val=4
  FOR num=val {
    WRITE num*3,!
  }
  WRITE "Next command after FOR code block"
```

In the following example, the **FOR** command executes the code block once, with *alpha(7)* having the value “abcdefg”:

```
Loop
  SET val="abc"
  FOR alpha(7)=val_"defg" {
    WRITE alpha(7),!
  }
  WRITE "Next command after FOR code block"
```

In the following example, the **FOR** command executes the code block eight times, supplying each successive perfect number to the code block:

```
  FOR pnum=6,28,496,8128,33550336,8589869056,137438691328,2305843008139952128 {
    WRITE "Perfect number ",pnum
    SET rp=$REVERSE(pnum)
    IF 54=$ASCII(rp,1) {
       WRITE " ends in 6",! }
    ELSEIF 56=$ASCII(rp,1),50=$ASCII(rp,2) {
       WRITE " ends in 28",! }
    ELSE {WRITE " is something unknown to mathematics",! }
  }
```

Using FOR var=start:increment:end

The arguments *start*, *increment*, and *end* specify a start, increment, and end value, respectively. All three are evaluated as numbers. They can be integer or real, positive or negative. If you supply string values, they are converted to their numeric equivalents at the start of the loop.

When InterSystems IRIS first enters the loop, it assigns the *start* value to *var* and compares the *var* value to the *end* value. If the *var* value is less than the *end* value (or greater than it, in the case of a negative *increment* value), InterSystems IRIS executes the loop commands. It then updates the *var* value using the *increment* value. (The *var* value is decremented if a negative *increment* is used.)

Execution of the loop continues until the incrementing of the *var* value would exceed the *end* value (or until InterSystems IRIS encounters a **QUIT**, **RETURN**, or **GOTO**). At that point, to prevent *var* from exceeding *end*, InterSystems IRIS suppresses variable assignment and loop execution ends. If the increment causes the *var* value to equal the *end* value, InterSystems IRIS executes the **FOR** loop one last time and then terminates the loop.

The following code executes the **WRITE** command repetitively to output, in sequence, all of the characters in *string1*, except for the last character. Because the end value is specified as *len*-1, the last character is not output. This is because the test is performed at the top of the loop, and the loop is terminated when the variable value (*index*) exceeds (not just matches) the end value (*len*-1).

```
Stringwriteloop
  SET string1="123 Primrose Path"
  SET len=$LENGTH(string1)
  FOR index=1:1:len-1 {
    WRITE $EXTRACT(string1,index)
  }
```

Using FOR var=start:increment

In this form of the **FOR** command there is no *end* value; the loop must contain a **QUIT**, **RETURN**, or **GOTO** command to terminate the loop.

The *start* and *increment* values are evaluated as numbers. They can be integer or real, positive or negative. If string values are supplied, they are converted to their numeric equivalents at the start of the loop. InterSystems IRIS evaluates the *start* and *increment* values when it begins execution of the loop. Any changes made to these values within the loop are ignored.

When InterSystems IRIS first enters the loop, it assigns the *start* value to *var* and executes the loop commands. It then updates the *var* value using the *increment* value. (The *var* value is decremented if a negative *increment* is used.) Execution of the loop continues until InterSystems IRIS encounters a **QUIT**, **RETURN**, or **GOTO** within the loop.

The following example uses *start*:*increment* syntax to return all of the multiples of 7 that are less than three digits in length:

```
  FOR i(1)=0:7 {
      QUIT:$LENGTH(i(1))=3
      WRITE "multiple of 7 = ",i(1),! }
```

The following example uses *start*:*increment* syntax to compute an average for a series of user supplied numbers. The postconditional **QUIT** is included to terminate execution of the loop when the user enters a null string (that is, presses **ENTER** without inputting a value). When the postconditional expression (*num*="") tests **TRUE**, InterSystems IRIS executes the **QUIT** and terminates the loop.

The loop counter (the *i* variable) is used to keep track of how many numbers have been entered. *i* is initialized to 0 because the counter increment occurs after the user inputs a number. InterSystems IRIS terminates the loop when the user enters a null. After the loop is terminated, the **SET** command references *i* (as a local variable) to calculate the average.

```
Averageloop
  SET sum=0
  FOR i=0:1 {
    READ !,"Number: ",num
    QUIT:num=""
    SET sum=sum+num
  }
  SET average=sum/i
```

Using FOR with Multiple forparameters

A **FOR** command can contain only one *var*= argument, but can contain multiple *forparameter* arguments, specified as a comma-separated list. For example, the syntax *var=expr1,expr2,expr3* would cause the *code* block to be executed three times, with a different *var* value for each execution.

These *forparameter* arguments are evaluated and executed in strict left-to-right order. Therefore an error in one *forparameter* does not prevent the execution of the *forparameter*s that precede it.

A single **FOR** command can contain both types of parameter syntax: *expr* syntax and *start*:*increment*:*end* syntax.

The following example combines *expr* syntax with *start*:*increment*:*end* syntax. The two *forparameter*s are separated by a comma. The first time through the **FOR**, InterSystems IRIS uses the *expr* syntax, and invokes the Test subroutine with *x* equal to the value of *y*. In the second (and subsequent) iterations, InterSystems IRIS uses the *start*:*increment*:*end* syntax. It sets *x* to 1, then 2, etc. On the final iteration, *x*=10.

```
Mainloop
  SET y="beta"
  FOR x=y,1:1:10 {
    DO Test
  }
  QUIT
Test
  WRITE !,"Running test number ",x
  QUIT
```

The following example is a sampling program that includes three *forparameter* arguments with *start*:*increment*:*end* syntax. It sets *i* to 1, then increments single-digit numbers by 1 for 1 through 10; the second *forparameter* takes the *i* value of 10 and increments it by 10s through 100; the third *forparameter* takes the *i* value of 100 and increments it by 100s through 1000. Note that this example repeats the 10 and 100 values:

```
FOR i=1:1:10,i:10:100,i:100:1000 {WRITE i,!}
```

The following example performs the same operation as the previous example, without repeating the 10 and 100 values:

```
FOR i=1:1:9,i+1:10:99,i+10:100:1000 {WRITE i,!}
```

Incrementing with Argumentless FOR

The argumentless **FOR** operates the same as the **FOR** *var*=*start*:*increment* form. The only difference is that it does not provide a way to keep track of the number of loop executions.

The following example shows how the previous loop counter example might be rewritten using the argumentless **FOR**. The assignment *i*=*i*+1 replaces the loop counter.

```
Average2loop
  SET sum=0
  SET i=0
  FOR {
    READ !,"Number: ",num QUIT:num=""
    SET sum=sum+num,i=i+1
  }
  SET average=sum/i
  WRITE !!,"Average is: ",average
  QUIT
```

Notes

FOR and NEW

A NEW command can affect *var*. Issuing an argumentless **NEW** command or an exclusive **NEW** command (that does not specifically exclude *var*) in the body of the **FOR** loop can result in *var* being undefined in the new frame context.

A **NEW** command that does not include *var* has no effect on **FOR** loop execution, as shown in the following example:

```
SET a=1,b=1,c=8
FOR i=a:b:c {
  WRITE !,"count is ",i
  NEW a,c
  WRITE " loop"
  NEW (i)
  WRITE " again"
}
```

FOR and Watchpoints

You have limited use of watchpoints with **FOR**. If you establish a watchpoint for the control (index) variable of a **FOR** command, InterSystems IRIS triggers the specific watchpoint action only on the initial evaluation of each **FOR** command argument. This restriction is motivated by performance considerations.

The following example contains three kinds of **FOR** command arguments for the watched variable *x*: a range, with initial value, increment, and limit (final value); a single value; and a range with initial value, increment, and no limit. Breaks occur when *x* has the initial values 1, 20, and 50.

```
USER>ZBREAK *x
USER>FOR x=1:1:10,20,50:2 {SET t=x QUIT:x>69}
<BREAK>
USER 2f0>WRITE
x=1
USER 2f0>g
USER>FOR x=1:1:10,20,50:2 {SET t=x QUIT:x>69}
<BREAK>
USER 2f0>WRITE
t=10
x=20
USER> 2f0>g
USER>FOR x=1:1:10,20,50:2 {SET t=x QUIT:x>69}
```

```
<BREAK>
USER 2f0>WRITE
t=20
x=50
USER 2f0>g
USER>WRITE
t=70
x=70
```

See Also

- DO WHILE command
- WHILE command
- IF command
- CONTINUE command
- DO command
- QUIT command
- RETURN command

GOTO

Transfers control.

```
GOTO:pc
GOTO:pc goargument,...

G:pc
G:pc goargument,...
```

where *goargument* is:

```
location:pc
```

Arguments

pc	*Optional* — A postconditional expression.
location	*Optional* — The point to which control will be transferred.

Description

The **GOTO** command has two forms:

- Without an argument
- With an argument

GOTO Without an Argument

GOTO without an argument resumes normal program execution after InterSystems IRIS encounters an error or a BREAK command in the currently executing code. You can use the argumentless **GOTO** only at the Terminal prompt.

The following example shows the use of an argumentless **GOTO**. In this example, the second **WRITE** is not executed because of the <BREAK> error; issuing a **GOTO** resumes execution, executing the second **WRITE**:

```
USER>WRITE "before" BREAK  WRITE "after"
before
WRITE "before" BREAK  WRITE "after"
               ^
<BREAK>
USER 1S0>GOTO
after
USER>
```

Note that there must be two spaces after the **BREAK** command.

If a **NEW** command is in effect when you issue an argumentless **GOTO**, InterSystems IRIS issues a <COMMAND> error, and the new context is maintained. Use the **QUIT 1** command, then argumentless **GOTO** to resume after a **NEW**.

Argumentless **GOTO** can also be used at the Terminal prompt to continue execution after an error. See Processing Errors at the Terminal Prompt in the "Error Processing" chapter of *Using ObjectScript*.

GOTO With an Argument

GOTO with the argument *location* transfers control to the specified location. If you specify a postconditional expression on either the command or the argument, InterSystems IRIS transfers control only if the postconditional expression evaluates to TRUE (nonzero).

You can use **GOTO** *location* from the Terminal prompt to resume an interrupted program at a different location.

You can specify a **$CASE** function as a **GOTO** command argument.

Arguments

pc

An optional postconditional expression that can make the command conditional. If the postconditional expression is appended to the **GOTO** command keyword, InterSystems IRIS executes the **GOTO** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the **GOTO** command if the postconditional expression is false (evaluates to zero). If the postconditional expression is appended to an argument, InterSystems IRIS executes the argument if the postconditional expression is true (evaluates to a nonzero numeric value). If the postconditional expression is false (evaluates to zero), InterSystems IRIS skips that argument and evaluates the next argument (if there is one) or the next command. For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

location

The point to which control will be transferred. It is *required* in routine code. It is *optional* from the Terminal prompt. You can specify *location* as a single value or as a comma-separated list of values (with postconditionals) and can take any of the following forms:

label+offset specifies a line label within the current routine. The optional *+offset* is a nonnegative integer that specifies the number of lines *after* the label at which execution is to start. The *offset* counts lines of code (including label lines), and counts comment lines; *offset* does not count blank lines and blank lines within comments. However, *offset* does count all Embedded SQL lines, including all blank lines.

label+offset^routine specifies a line label within the named routine, which resides on disk. InterSystems IRIS loads the routine from disk and continues execution at the indicated label. The optional *+offset* is a nonnegative integer that specifies the number of lines *after* the label at which execution is to start.

^routine specifies a routine that resides on disk. InterSystems IRIS loads the routine from disk and continues execution at the first line of executable code within the routine. If the routine has been modified, InterSystems IRIS loads the updated version of the routine when **GOTO** invokes the routine. Unlike the DO command, **GOTO** does not return to the invoking program following routine execution. If you specify a nonexistent routine, InterSystems IRIS issues a <NOROUTINE> error message. For more information, refer to the $ZERROR special variable.

Note: **GOTO** does not support extended routine reference. To execute a routine in another namespace, use the DO command.

You can also reference *location* as a variable containing any of the above forms. In this case, though, you must use name indirection. *location* cannot specify a subroutine label that is defined with a formal parameter list or the name of a user-defined function or procedure. If you specify a nonexistent *label*, InterSystems IRIS issues a <NOLINE> error message. For more information, refer to Indirection in *Using ObjectScript*.

You cannot specify an *offset* when calling a IRISSYS % routine. If you attempt to do so, InterSystems IRIS issues a <NOLINE> error.

Examples

In the following example, **GOTO** directs execution to one of three locations depending on the user-supplied age value. The location is a subroutine label that is stored in variable *loc* and then referenced by means of name indirection (@loc).

```
mainloop
  SET age=""
  READ !,"What is your age? ",age QUIT:age=""
  IF age<30 {
    SET loc="Young" }
  ELSEIF (age>29)&(age<60) {
    SET loc="Midage" }
  ELSEIF age>59 {
    SET loc="Elder" }
  ELSE {
    WRITE "data input error"
    QUIT }
  GOTO @loc
```

```
  QUIT
Young
  WRITE !,"You're still young"
  QUIT
Midage
  WRITE !,"You're in your prime"
  QUIT
Elder
  WRITE !,"You have a lifetime of wisdom to impart"
  QUIT
```

Note that this type of **GOTO** using name indirection is not permitted from within a procedure block.

As an alternative, you could omit the **IF** command and code the **GOTO** with a comma-separated list using postconditionals on the arguments, as follows:

```
   GOTO Young:age<30,Midage:(age>29)&(age<60),Elder:age>59
```

You might also code this example using a **DO** command to call the appropriate subroutine location. In this case, though, when InterSystems IRIS encounters a **QUIT**, it returns control to the command following the **DO**.

The following example shows how *offset* counts lines of code. It counts the intervening label line and the comment line; it does not count the blank line:

```
Main
  GOTO Branch+7
  QUIT
Branch
  WRITE "Line 1",!
SubBranch
  WRITE "Line 3",!
  /* comment line */
  WRITE "Line 5",!

  WRITE "Line 6",!
  WRITE "Line 7",!
  WRITE "Line 8",!
  QUIT
```

Notes

How Control is Transferred When QUIT is Encountered

Unlike the **DO** command, **GOTO** transfers control unconditionally. When InterSystems IRIS encounters a **QUIT** in a subroutine called by **DO**, it passes control to the command following the most recent **DO**.

When InterSystems IRIS encounters a **QUIT** after a **GOTO** transfer, it does not return control to the command following the **GOTO**. If there was a preceding **DO**, it returns control to the command following the most recent **DO**. If there was no preceding **DO**, then it returns to the Terminal.

In the following code sequence, the **QUIT** in C returns control to the **WRITE** command following the **DO** in A:

```
testgoto
A
  WRITE !,"running A"
  DO B
  WRITE !,"back to A, all done"
  QUIT
B
  WRITE !,"running B"
  GOTO C
  WRITE !,"this line in B should never execute"
  QUIT
C
  WRITE !,"running C"
  QUIT
```

Using GOTO with Code Blocks

GOTO can be used to exit a code block, but not to enter a code block.

If you use **GOTO** inside a **FOR**, **IF**, **DO WHILE**, or **WHILE** loop, you can go to a *location* outside of all code blocks, a *location* within the current code block, or go from a nested code block to a *location* in the code block that encloses it. You cannot go from a code block to a *location* within another code block, either an independent code block, or a code block nested within the current code block. For code examples, refer to the individual commands.

A **GOTO** to a *location* outside a code block terminates the loop. A **GOTO** to a *location* within a code block does not terminate the loop. A **GOTO** from a nested code block to an enclosing code block terminates the inner (nested) loop, but not the outer loop.

A **GOTO** can be used to exit a **TRY** or **CATCH** code block, but not to enter one of these code blocks. You also cannot specify a **GOTO** to a label on the same line as the **TRY** or **CATCH** keyword. Attempting to do so results in a <NOLINE> error.

GOTO Restrictions

The following **GOTO** operations are not permitted:

- **GOTO** should not be used to enter or exit a procedure.
- **GOTO** cannot be used with name indirection (`GOTO @name`) within a procedure block.

See Also

- DO command
- FOR command
- IF command
- DO WHILE command
- WHILE command
- BREAK command
- QUIT command
- $CASE function
- Processing Errors at the Terminal Prompt in the “Error Processing” chapter of *Using ObjectScript*
- Debugging With BREAK in the “Command-line Routine Debugging” chapter of *Using ObjectScript*

HALT

Terminates execution of the current process.

```
HALT:pc
H:pc
```

Argument

pc	*Optional* — A postconditional expression.

Description

The **HALT** command terminates execution of the current process. If a **$HALT** special variable is defined in the current context (or a prior context), issuing a **HALT** command invokes the halt trap routine specified in **$HALT**, rather than terminating the current process. Typically, a halt trap routine performs some cleanup or reporting operations, then issues a second **HALT** command to terminate execution.

HALT behaves the same whether it is encountered by running routine code or is entered from the Terminal prompt. In either case, it terminates the current process.

HALT has the same minimum abbreviation as the **HANG** command. **HANG** is distinguished by its required *hangtime* argument.

Effects of HALT

When **HALT** terminates a process, the system automatically relinquishes all locks and closes all devices owned by the process. This ensures that the halted process does not leave behind locked variables or unreleased devices.

If there is a transaction in progress when **HALT** terminates a process, the resolution of the transaction depends on the type of process. A **HALT** in a background job (non-interactive process) always rolls back the transaction in progress. A **HALT** in an interactive process (such as using Terminal to run a routine) prompts you to resolve the transaction in progress. The prompt is as follows:

```
You have an open transaction.
Do you want to perform a (C)ommit or (R)ollback? R =>
```

Specify "C" to commit the current transaction. Specify "R" (or just press the Enter key) to roll back the current transaction.

Halt Traps

Execution of a **HALT** command is interrupted by a halt trap. Halt traps are established using the **$HALT** special variable.

If a halt trap has been established for the current context frame, issuing a **HALT** command invokes the halt trap routine specified by **$HALT**. The **HALT** command itself is not executed.

If a halt trap has been established for a lower context frame, a **HALT** command removes context frames from the frame stack until the context frame with the halt trap is reached. **HALT** then invokes the halt trap routine specified by **$HALT** and ceases execution.

Arguments

pc

An optional postconditional expression that can make the command conditional. InterSystems IRIS executes the **HALT** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

Examples

In the following example, **HALT** allows the user to end the current application and return to the operating system. The system performs all necessary cleanup for the user. Note the use of the postconditional on the command.

```
Main
  READ !,"Do you really want to stop (Y or N)? ",ans QUIT:ans=""
  HALT:(ans["Y")!(ans="y")
  DO Start
Start()
  WRITE !,"This is the Start routine"
  QUIT
```

In the following example, **HALT** invokes the halt trap routine specified in **$HALT**. In this case, it is the second **HALT** command that actually halts execution. (For demonstration purposes, this example uses **HANG** statements so that you have time to view the displayed output.)

```
Main
   NEW $ESTACK
   SET $HALT="OnHalt"
   WRITE !,"Main $ESTACK= ",$ESTACK   // 0
   HANG 2
   DO SubA
   WRITE !,"this should never display"
SubA()
   WRITE !,"SubA $ESTACK= ",$ESTACK   // 1
   HANG 2
   HALT    // invoke the OnHalt routine
   WRITE !,"this should never display"
OnHalt()
   WRITE !,"OnHalt $ESTACK= ",$ESTACK   // 0
   HANG 2
   // clean-up and reporting operations
   HALT   // actually halt the current process
```

$SYSTEM.Process.Terminate()

You can use the **$SYSTEM.Process.Terminate()** method to halt the current process or to halt other running processes.

The following example halts the current process:

```
  DO $SYSTEM.Process.Terminate()
```

The following example halts the process with the PID 7732:

```
  DO $SYSTEM.Process.Terminate(7732)
```

The effects of the **Terminate()** method are the same as the **HALT** command for the current process, or the **^RESJOB** utility for other processes.

^RESJOB and ^JOBEXAM

The **HALT** command is used to halt the current process.

The **^RESJOB** or **^JOBEXAM** utility can be used to halt other running processes. These utilities cannot be used to halt the current process. They can be used to display information about all running processes, including the current process.

These utilities must be invoked from the %SYS namespace. You must have appropriate privileges to invoke these utilities. Utility names are case-sensitive.

- **^RESJOB** allows you to directly halt a process if you know the process ID (PID). You can use the ? option to display a listing of all of the running processes.
- **^JOBEXAM** first displays a listing of all of the running processes, then allows you to specify which process to halt (terminate), suspend, or resume. **View^JOBEXAM** allows you to display a listing of all of the running processes; it does not provide options to halt, suspend, or resume a process.

The following is an example invocation of **^RESJOB** from Terminal:

```
%SYS>DO ^RESJOB

Force a process to quit InterSystems IRIS

Process ID (? for status report): 7732

Process ID (? for status report):

%SYS>
```

At the prompt, you type the process ID (PID) for the process you wish to halt. **^RESJOB** halts the process, then prompts you for the next process ID. Press the Enter key at the prompt when you are finished entering process IDs. You can specify ? at the prompt to display a list of currently running processes.

- Current process: attempting to use **^RESJOB** to halt the current process fails with the message `This is your current process, not proceeding with kill.` **^RESJOB** then prompts you for another process ID.
- Non-running process: specifying the process ID of a non-running process fails with the message `[no such InterSystems IRIS process]`. **^RESJOB** then prompts you for another process ID.
- System processes: you cannot use **^RESJOB** to halt certain system processes. Attempting to do so fails with the message `Can NOT kill the` *`name`* `process.` **^RESJOB** then prompts you for another process ID.
- Transaction-in-progress: using **^RESJOB** to halt a process with a transaction-in-progress is the same as issuing a **HALT** command in that process. A non-interactive process rolls back the incomplete transaction; an interactive process prompts you at its Terminal prompt to either commit or roll back the incomplete transaction.

See Also

- $HALT special variable
- Debugging in *Using ObjectScript*

HANG

Suspends execution for a specified number of seconds.

```
HANG:pc hangarg
H:pc hangarg
```

where *hangarg* can be:

```
hangtime,...
```

Arguments

pc	*Optional* — A postconditional expression.
hangtime	The amount of time to wait, in seconds. An expression that resolves to a positive numeric value, or a comma-separated list of numeric expressions.

Description

HANG suspends the executing routine for the specified time period. If there are multiple arguments, InterSystems IRIS suspends execution for the duration of each argument in the order presented. The **HANG** time is calculated using the system clock, which determines its precision.

HANG has the same minimum abbreviation (H) as the **HALT** command. **HANG** is distinguished by its required *hangtime* argument.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the **HANG** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

hangtime

The amount of time to wait, in seconds. This time can be expressed as any numeric expression. You can specify *hangtime* as an integer to specify whole seconds, or as fractional number to specify fractional seconds. You can use exponentiation (**), arithmetic expressions, and other numeric operators.

You can set *hangtime* to 0 (zero), in which case no hang is performed. Setting *hangtime* to a negative number or a nonnumeric value is the same as setting it to 0.

You can specify multiple *hangtime* arguments as a comma-separated list, as described below.

Examples

The following example suspends the process for 10 seconds:

```
  WRITE !,$ZTIME($PIECE($HOROLOG,",",2))
  HANG 10
  WRITE !,$ZTIME($PIECE($HOROLOG,",",2))
```

The following example suspends the process for 1/2 second. **$ZTIMESTAMP**, unlike **$HOROLOG**, can return fractional seconds if the *precision* parameter of the **$ZTIME** function is specified.

```
WRITE !,$ZTIME($PIECE($ZTIMESTAMP,",",2),1,2)
HANG .5
WRITE !,$ZTIME($PIECE($ZTIMESTAMP,",",2),1,2)
```

Returns values such as the following:

```
14:34:19.75
14:34:20.25
```

Notes

Multiple HANG Arguments

You can specify *hangtime* as a comma-separated list of numeric expressions. InterSystems IRIS suspends execution for the duration of each argument in the order presented. Negative numbers are treated as zero. Therefore, a *hangtime* of 16,-15 would hang for 16 seconds.

That each *hangtime* argument is separately executed can affect operations that use the current time in hang calculations, as shown in the following example:

```
SET start=$ZHOROLOG
SET a=$ZHOROLOG+5
HANG 4,a-$ZHOROLOG
SET end=$ZHOROLOG
WRITE !,"elapsed hang=",end-start
```

In this example, HANG first suspends execution for 4 seconds, then suspends execution for the current time before the hang plus 5 seconds, minus the current time when the second hang argument is parsed. Because **HANG** executes each argument in turn, the total hang time in this example is (roughly) 5 seconds, rather than the (roughly) 9 seconds one might otherwise expect.

HANG Compared with Timed READ

You can use **HANG** to pause the routine while the user reads an output message. However, you can handle this type of pause more effectively with a timed **READ** command. A timed **READ** allows the user to continue when ready, but a **HANG** does not because it is set to a fixed duration.

HANG and ^JOBEXAM

The **HANG** command is used to pause execution of the current process.

The **^JOBEXAM** utility can be used to suspend and resume execution of other running processes; it cannot be used to suspend execution of the current process. You cannot use **^JOBEXAM** to resume process execution that has been paused by a **HANG** command. If you use **^JOBEXAM** to suspend a process that has been paused by a **HANG** command, the **^JOBEXAM** resume activates the process, which must complete whatever portion of the **HANG** time that remained when it was suspended.

^JOBEXAM displays State information about all running processes. A process that is paused by a **HANG** command is listed as State HANGW. A process that is suspended by **^JOBEXAM** is listed as State SUSPW.

The **^JOBEXAM** utility must be invoked by the Terminal from the %SYS namespace. You must have appropriate privileges to invoke this utility. Utility names are case-sensitive. You can execute **^JOBEXAM** as follows:

- **DO ^JOBEXAM**: displays a listing of all running processes. It provides letter code options to terminate, suspend, or resume a running process.
- **DO View^JOBEXAM** displays a listing of all running processes. It does not provide options to terminate, suspend, or resume a process.

See Also

- READ command

- $ZTIME function
- $HOROLOG special variable
- $ZTIMESTAMP special variable

IF

Evaluates an expression, then selects which block of code to execute based on the truth value of the expression.

```
IF expression1,... {
  code
}
ELSEIF expression2,... {
    code
}
ELSE {
    code
}
```

or

```
I expression1,... {
  code
}
ELSEIF expression2,... {
    code
}
ELSE {
    code
}
```

Arguments

expression1	A boolean test condition for the **IF** clause. A single condition or a comma-separated list of conditions.
expression2	A boolean test condition for an **ELSEIF** clause. A single condition or a comma-separated list of conditions.
code	A block of ObjectScript commands enclosed in curly braces.

Description

This page describes the **IF**, **ELSEIF**, and **ELSE** command keywords, all of which are considered to be component clauses of the **IF** command. The **IF** keyword can be abbreviated as **I**; the other two keywords cannot be abbreviated.

An **IF** command consist of one **IF** clause, followed by any number of **ELSEIF** clauses, followed by one **ELSE** clause. The **ELSEIF** and **ELSE** clauses are optional, but it is a good programming practice to always specify an **ELSE** clause.

The **IF** command first evaluates the **IF** clause *expression1* and, if *expression1* is TRUE, it executes the code block within the curly braces that follow it and the **IF** command completes.

If *expression1* is FALSE, execution jumps to the next clause of the **IF** statement. It evaluates the first **ELSEIF** clause (if present). If *expression2* in the **ELSEIF** clause is TRUE, it executes the **ELSEIF** code block within the curly braces that follow it and the **IF** command completes. If *expression2* is FALSE, the next **ELSEIF** clause (if present) is evaluated in the same way. Each successive **ELSEIF** clause is tested in the order listed until one of them evaluates TRUE, or all of them evaluate FALSE.

If the **IF** clause and all **ELSEIF** clauses evaluate to FALSE, execution continues with the **ELSE** clause. It executes the **ELSE** code block within the curly braces that follow it and the **IF** command completes. If the **ELSE** clause is omitted, the **IF** command completes.

IF is a block-oriented command. Each command keyword is followed by a block of code enclosed in curly braces. **IF**, **ELSEIF**, and **ELSE** clauses may use white space (line returns, indents, and blank spaces) freely. However, each **IF** and

ELSEIF keyword and the first character of its boolean test expression must be on the same line, separated by one blank space. A boolean test expression can span multiple lines and contain multiple blank spaces.

An opening or closing curly brace may appear on its own code line or on the same line as a command. An opening or closing curly brace may even appear in column 1 (though this is not recommended). It is a recommended programming practice to indent curly braces to indicate the beginning and end of a nested block of code. No whitespace is required before or after an opening curly brace. No whitespace is required before or after a closing curly brace, including a curly brace that follows an argumentless command. There is only one whitespace requirement for curly braces: the final closing curly brace of the last clause of the **IF** command must be separated from the command that follows it by a space, tab, or line return.

The **IF** command does not read or set the value of the **$TEST** special variable. If a boolean test expression evaluates to TRUE, it executes the block of code within the curly braces, regardless of the value of **$TEST**.

Arguments

expression1

A test condition for the **IF** clause. It can take the form of a single expression or a comma-separated list of expressions. For an expression list, InterSystems IRIS evaluates the individual expressions in left to right order. It stops evaluation if it encounters an expression in the comma-separated list that evaluates to FALSE. If all expressions in the comma-separated list evaluate to TRUE, InterSystems IRIS executes the block of code associated with the **IF** clause. If any expression in the list evaluates to FALSE, InterSystems IRIS ignores any remaining expressions, and does not execute the block of code associated with the **IF** clause.

Commonly, *expression1* is a boolean expression that evaluates to TRUE or FALSE (for example, x=7). Refer to the Operators and Expressions chapter of *Using ObjectScript*. **IF** interprets a literal value as a boolean TRUE and FALSE as follows:

- TRUE: any non-zero numeric value, or a numeric string that evaluates to a non-zero numeric value. For example, 1, 7, -.007, "7-7", and "7dwarves".
- FALSE: a zero numeric value, or a string that evaluates to a zero numeric value. A non-numeric string evaluates to a zero numeric value. For example, 0, -0.00, 7-7, "0", "TRUE", "FALSE", "strike3", and the empty string ("").

For further details, refer to Strings as Numbers in the “Data Types and Values” chapter of *Using ObjectScript*.

expression2

A test condition for an **ELSEIF** clause. It can take the form of a single expression or a comma-separated list of expressions. It is evaluated the same way as *expression1*.

IF with QUIT

If a **QUIT** command is encountered within an **IF** code block (or an **ELSEIF** code block or an **ELSE** code block) the **QUIT** behaves as a regular **QUIT** command, as if the code block did not exist. This behavior differs from a **QUIT** within any other type of curly brace code block (FOR, WHILE, DO...WHILE, TRY, or CATCH).

- If the **IF** code block is nested within a loop structure (such as a **FOR** code block), the **QUIT** exits the loop structure block and continues execution with the command that follows the loop structure code block.
- If the **IF** code block is within a **TRY** block or a **CATCH** block, the **QUIT** exits the **TRY** or **CATCH** block and continues execution with the command that follows the **TRY** or **CATCH** block.
- If the **IF** code block is *not* nested within a loop structure, or within a **TRY** or **CATCH** block, the **QUIT** exits the current routine.

Issuing a RETURN exits the current routine, whether or not it is issued from within a block structure.

The following example demonstrates the behavior of **QUIT** when the **IF** is *not* in a loop structure. The **QUIT** exits the routine:

```
SET y=$RANDOM(10)
IF y#2=0 {
  WRITE y," is even",!
  QUIT
  WRITE "never written"
  }
ELSE {
  WRITE y," is odd",!
  QUIT
  WRITE "never written"
  }
WRITE "QUIT out of the IF (never written)"
```

The following example demonstrates the behavior of **QUIT** when the **IF** is in a loop structure. The **QUIT** exits the **FOR** loop, then execution of the routine continues:

```
FOR x=1:1:8 {
  IF x#2=0 {
    WRITE x," is even",!
    QUIT:x=4
  }
  ELSE {
    WRITE x," is odd",!
  }
}
WRITE "QUIT out of the FOR loop (written)"
```

The following example demonstrates the behavior of **QUIT** when the **IF** is in a **TRY** block. The **QUIT** exits the **TRY** block, then execution of the routine continues with the next code after the **CATCH** block:

```
TRY {
SET y=$RANDOM(10)
  IF y#2=0 {
    WRITE y," is even",!
    QUIT
    WRITE "never written"
  }
  ELSE {
    WRITE y," is odd",!
    QUIT
    WRITE "never written"
  }
WRITE "QUIT out of the IF (never written)"
}
CATCH exp1 {
  WRITE "only written if an error occurred",!
  WRITE "Error Name: ",$ZCVT(exp1.Name,"O","HTML"),!
}
TRY {
  WRITE "on to the next TRY block"
}
CATCH exp2 {
  WRITE "only written if an error occurred",!
  WRITE "Error Name: ",$ZCVT(exp2.Name,"O","HTML"),!
}
```

IF with GOTO

If a **GOTO** is encountered within an **IF** code block, program execution obeys that statement, with certain restrictions:

A **GOTO** statement can jump to a location outside of the **IF** command, or within the code block of the current clause. A **GOTO** statement cannot jump into another code block: neither a code block that belongs to another clause of the current **IF** command, nor a code block that belongs to another **IF**, **FOR**, **DO WHILE**, or **WHILE** command.

Example

In the following example, the **IF** command is used to categorize responders into one of three groups and invokes the appropriate subroutine. The three groups are females aged 44 or less, males aged 44 or less, and either females or males from age 45 through 120. In this example, the sex test expressions use the Contains operator ([ ). (See Operators in *Using ObjectScript*.)

```
Mainloop
  NEW sex,age
  READ !,"What is your sex? (M or F): ",!,sex QUIT:sex=""
```

```
  READ !,"What is your age? ",!,age QUIT:age=""
  IF "Ff"[sex,age<45 {
    DO SubA(age)
  }
  ELSEIF "Mm"[sex,age<45 {
    DO SubB(age)
  }
  ELSEIF "FfMm"[sex,age>44,age<125 {
    DO SubC(age)
  }
  ELSE {
    WRITE !,"Invalid data value input"
  }
SubA(y)
  WRITE !,"Young woman ",y," years old"
SubB(y)
  WRITE !,"Young man ",y," years old"
SubC(y)
  WRITE !,"Older person ",y," years old"
```

See Also

- DO WHILE command
- FOR command
- WHILE command
- GOTO command
- QUIT command
- $CASE function

JOB

Runs a process in background.

```
JOB:pc jobargument,...
J:pc jobargument,...
```

where *jobargument* is one of the following:

Local Jobs:

```
routine(routine-params):(process-params):timeout
routine(routine-params)[joblocation]:(process-params):timeout
routine(routine-params)|joblocation|:(process-params):timeout
##class(className).methodName(args):(process-params):timeout
..methodName(args):(process-params):timeout
$CLASSMETHOD(className,methodName,args):(process-params):timeout
```

Remote Jobs:

```
routine[joblocation]
routine|joblocation|
```

Arguments

pc	*Optional* — A postconditional expression.
routine	The routine to be executed by the process created by **JOB**.
routine-params	*Optional* — A comma-separated list of parameters to pass to the routine. These parameters can be values, expressions, or existing local variable names. If specified, the enclosing parentheses are required. Routine parameters can only be passed to local jobs.
className.methodName(*args*) ..*methodName*(*args*)	The class method to be executed by the process created by **JOB**. The *className* cannot be $SYSTEM; it can be %SYSTEM. If you specify .. in place of *className*, JOB uses the current class context (the $THIS class). A comma-separated list of *args* arguments is optional; the enclosing parentheses are required. Omitted arguments are not permitted. For further details on using $CLASSMETHOD, refer to the section Dynamically Accessing Objects in the "Object-specific ObjectScript Features" chapter of *Defining and Using Classes*.
process-params	*Optional* — A colon-separated list of positional parameters used to set various elements in the job's environment. The *process-params* list is enclosed in parentheses and the parenthesized list preceded by a colon. All *process-params* are optional; the parentheses are required. To indicate a positional parameter is missing, its colon must be present, though trailing colons may be omitted. The *process-params* argument can only be specified for local jobs.
timeout	*Optional* — The number of seconds to wait for the jobbed process to start. Fractional seconds are truncated to the integer portion. The preceding colon is required. The *timeout* argument can only be specified for local jobs. If omitted, InterSystems IRIS waits indefinitely.

joblocation	*Optional* — An explicit or implied namespace used to specify the system and directory on which to run a local or remote job. An implied namespace is a directory path preceded by two caret characters: "^^*dir*". Enclose *joblocation* in either square brackets or vertical bars. You cannot specify a *joblocation* when jobbing a class method. If *joblocation* specifies a remote system, you cannot specify *routine-params*, *process-params*, or *timeout*. If *joblocation* specifies a local job, you cannot specify the first process parameter (*nspace*) because this would conflict with the *joblocation* parameter. Therefore, only the second, third, and fourth process parameters can be specified, and the missing *nspace* parameter must be indicated by a colon.

Description

JOB creates a separate process known as a *job*, *jobbed process*, or *background job*. The created process runs in the background, independently of the current process, usually without user interaction. A jobbed process inherits its configuration environment from the invoking process, except what is explicitly specified in the **JOB** command. For example, a jobbed process inherits the locale settings of the parent process, not the system default locale.

By contrast, a routine invoked with the **DO** command runs in the foreground as part of the current process.

JOB can create a local process on your local system, or it can invoke the creation of a remote process on another system. For more on remote jobs, see Remote Jobs.

When a job begins, InterSystems IRIS can call a user-written JOB^%ZSTART routine. When a job ends, InterSystems IRIS can call a user-written JOB^%ZSTOP routine. These entry points can be used for maintaining a log of job activity and troubleshooting problems encountered. For further details, see the section on "Using the InterSystems IRIS ^%ZSTART and ^%ZSTOP Routines" in *Specialized System Tools and Utilities*.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes **JOB** if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

routine

The process to be started. It can take any of the following forms:

Process Specification	Description
label	Specifies a line label within the current routine.
^routine	Specifies a routine that resides on disk. InterSystems IRIS loads the routine from disk and starts execution at the first line of executable code within the routine.
label^routine	Specifies a line label within the named routine, which resides on disk. InterSystems IRIS loads the routine from disk and starts execution at the indicated label.

Process Specification	Description
label+offset *label+offset^routine*	Specifies an offset of a specified number of lines from the line label. Use of offsets can cause problems with program maintenance, and is discouraged. You cannot specify an *offset* when calling a IRISSYS % routine. If you attempt to do so, InterSystems IRIS issues a <NOLINE> error.

If you are within a procedure block, calling the **JOB** command starts a child process that is outside the scope of the procedure block. It therefore cannot resolve a *label* reference within the procedure block. Therefore, for the **JOB** to reference a label within a procedure, the procedure cannot use a procedure block.

If you specify a nonexistent label, InterSystems IRIS issues a <NOLINE> error. If you specify a nonexistent routine, InterSystems IRIS issues a <NOROUTINE> error. For further details on these errors, refer to the $ZERROR special variable.

routine-params

A comma-separated list of values, expressions, or existing local variable names. The enclosing parentheses are required. This list is known as the *actual parameter list*. The routine must have a *formal parameter list* with the same or a greater number of parameters. If you specify extra actual parameters, InterSystems IRIS issues a <PARAMETER> error. Note that if the invoked routine contains a formal parameter list, you must specify the enclosing parentheses, even if you do not pass any parameters. You cannot omit items from the list of *routine-params*.

You can pass routine parameters only by value, which means that you cannot pass arrays. This is different from the **DO** command where you can pass parameters by value and by reference. A special consequence of this restriction is you cannot pass arrays with the **JOB** command, since they are passed only by reference.

You cannot pass an object reference (oref) to a jobbed process. This is because a reference to an object existing in the invoking process context cannot be referenced in the new jobbed process context. Attempting to pass an oref results in passing an empty string ("") to the jobbed process.

When the routine starts, InterSystems IRIS evaluates any expressions and maps the value of each parameter in the actual list, by position, to the corresponding variable in the formal list. If there are more variables in the formal list than there are parameters in the actual list, InterSystems IRIS leaves the extra variables undefined.

Routine parameters can only be passed to local processes. You cannot specify routine parameters when creating a remote job. See Remote Jobs.

process-params

A colon-separated list of positional parameters used to set various elements in the job's environment. The preceding colon and enclosing parentheses are required. All of the positional parameters are optional. You can specify up to six positional parameters for *process-params*. These six parameters are:

```
(nspace:switch:principal-input:principal-output:priority:os-directory)
```

Since the parameters are positional, you must specify them in the order shown. If you omit a parameter that precedes a specified parameter, you must include a colon as a placeholder for it.

Process parameters cannot be specified for a remote job.

The following table describes the process parameters:

Process Parameter	Description
nspace	The default namespace of the process. The specified *routine* is drawn from this namespace. If you omit *nspace*, your current default namespace is the default namespace of the jobbing process. An invalid namespace may prevent the job from starting. A local job cannot specify both the *joblocation* argument and namespace as a process parameter; you must omit the *nspace* process parameter, retaining the placeholder colon.
switch	An integer consisting of the sum of one or more of the following values: An integer bit mask that can represent zero or more of the following flags: 1 — Pass the symbol table to the spawned job. 2 — Do not use a JOB Server. 4 — Pass an open TCP/IP socket to the spawned job using the principal I/O device ($PRINCIPAL). (Deprecated, use 16 instead. See below.) 8 — Establish the process-specific window for two-digit years of the spawned job to be the system-wide default sliding window definition. Otherwise, the spawned job inherits the sliding window definition of the process issuing the **JOB** command. 16 — Pass an open TCP/IP socket to the spawned job using current I/O device ($IO). 128 through 16384 (in multiples of 32) — An additional integer value that specifies a partition size (in kilobytes) for the JOBbed child process. See "Specifying Child Process Partition Size" for more information. The *switch* value can be the sum of any combination of these integers. For example, a *switch* value of 13 (1+4+8) passes the symbol table (1), passes the open TCP/IP socket (4), and establishes a process-specific window for two-digit years that is the system-wide default (8). Blocking switches can be determined using the **CheckSwitch()** method of the %SYSTEM.Util class.
principal-input	Principal input device for the process. *UNIX®*: See *principal-output* for default.
principal-output	Principal output device for the process. The default is the device you specify for *principal-input*. *UNIX®*: If you do not specify either device, the process uses the default principal device for processes started with the **JOB** command, which is `/dev/null`.
priority	*UNIX®* — An integer that specifies the priority for the child process (subject to operating system constraints). If not specified, the child process takes the parent process' base priority plus the system-defined job priority modifier. You can use the $VIEW function to determine the current priority of a job. Windows has a Normal priority of 7. UNIX® priority ranges between -20 and 20, with 0 as Normal priority. In UNIX®, a process cannot give itself an increased priority unless running as root.

Process Parameter	Description
os-directory	An operating system working directory for file I/O. The default is to use the working directory inherited from the parent process. This parameter may be ignored on some systems.

Switch 4 and Switch 16

The use of *switch*=4 is discouraged, because this establishes the passed TCP device as the principal device of the child job. In this case, the child job could halt when it detected the TCP remote connection dropped and would not perform error trapping. Instead, users should use *switch*=16, and then in the child job use the **%SYSTEM.INetInfo.TCPName()** method to get the passed TCP device name. In this case, the child job could continue to run when it detected the TCP remote connection dropped, because the principal device of the child job is not the passed TCP device.

timeout

The number of seconds to wait for the jobbed process to start before timing out and aborting the job. The preceding colon is required. You must specify *timeout* as an integer value or expression. If a jobbed process times out, InterSystems IRIS aborts the process and sets the **$TEST** special variable to 0 (FALSE). Execution then proceeds to the next command in the calling routine; no error message is issued. If a jobbed process succeeds, InterSystems IRIS sets **$TEST** to 1 (TRUE). Note that **$TEST** can also be set by the user, or by a **LOCK**, **OPEN**, or **READ** timeout.

Timeout can only be specified for a local process.

Examples

The following example starts the monitor routine in the background. If the process does not start in 20 seconds, InterSystems IRIS sets **$TEST** to FALSE (0).

```
JOB ^monitor::20
WRITE $TEST
```

The following example starts execution of the monitor routine at the line label named Disp.

```
JOB Disp^monitor
```

The following example starts the Add routine, passing it the value in variable *num1*, the value 8, and the value resulting from the expression a+2. The Add routine must contain a formal parameter list that includes at least three parameters.

```
JOB ^Add(num1,8,a+2)
```

The following example starts the Add routine, which has a formal parameter list, but passes no parameters. In this case, the Add routine must include code to assign default values to its formal parameters, since they receive no values from the calling routine.

```
JOB ^Add()
```

The following example creates a process running your current routine at label AA. The process parameters pass your current symbol table to the routine. It can use a JOB Server.

```
JOB AA:("":1)
```

This following example passes the routine parameters VAL1 and the string "DR." to the routine **^PROG**, starting at entry point ABC, in the current namespace. The routine expects two arguments. InterSystems IRIS does not pass the current symbol table to this job, it will use a JOB Server if possible, and use tta5: as principal input and output device.

```
JOB ABC^PROG(VAL1,"DR."):(:0:"tta5:")
```

The following examples show the jobbing of a class method, with a timeout of ten seconds. They use tta5: as principal input and output device.

The following example uses ##class syntax to invoke a class method:

```
JOB ##class(MyClass).Run():(:0:"tta5:"):10
```

The following example uses the **$CLASSMETHOD** function to invoke a class method:

```
JOB $CLASSMETHOD(MyClass,Run):(:0:"tta5:"):10
```

$CLASSMETHOD parameters must be passed by value, not by reference, when using **JOB $CLASSMETHOD**.

The following example uses relative dot syntax (..) to refer to a method of the current object:

```
JOB ..CleanUp():(:0:"tta5:"):10
```

or simply:

```
JOB ..CleanUp()::10
```

For further details, refer to "Object-specific ObjectScript Features" in *Defining and Using Classes*.

Notes

InterSystems IRIS Assigns Job Numbers and Memory Partitions

After you start a jobbed process, InterSystems IRIS allocates a separate memory partition for it and assigns it a unique job number (also referred to as a Process ID or PID). The job number is stored in the **$JOB** special variable. The status of the job (including whether or not it was started by a **JOB** command) is stored in the **$ZJOB** special variable.

Since jobbed processes have separate memory partitions, they do not share a common local variable environment with the process that created them or with each other. When you start a jobbed process, you can use parameter passing (*routine-params*) to pass values from the current process to the jobbed process.

If the **JOB** command fails, it is usually because:

- There are no free partitions.
- There is not enough memory to create a partition with the characteristics specified by *process-params*.

Jobbed Process Permissions are Platform-dependent

Processes created by the **JOB** command run as the InterSystems service account user. This means that you must insure that the InterSystems service account has explicit permissions to access all necessary resources.

A spawned job process may run under a different userid than that of the process that issued the JOB command. The userid of the spawned job process depends on the platform:

- On Windows platforms, the job process uses the userid established for the InterSystems IRIS instance.
- On UNIX® platforms, the job process uses the userid of the process that issued the JOB command.

Thus, when you spawn a job, you must make sure that the userid for the job process has the necessary permissions to use any files read or written during the job execution.

Communicating Between Jobs

Parameter passing by value can occur in only one direction and only at job start up. For processes to communicate with each other, they must use mutually agreed upon global variables. Such variables are commonly known as *scratch globals* because their sole purpose is to allow processes to exchange information among themselves.

- Processes can use the %SYSTEM.Event class methods to communicate between jobs.
- You can pass all local variables in the current process to the invoked process by specifying a special process parameter.

- Processes can communicate between jobs through the IPC (Interprocess Communication) devices (device numbers 224 through 255) or, on UNIX® operating systems, through UNIX® pipes.

Establishing Device Ownership

InterSystems IRIS assumes that the invoked routine includes code (that is, **OPEN** and **USE** commands) to handle device ownership for the new process. The default device is the null device.

InterSystems IRIS does not assign a default device to any process other than the process started at sign in.

Setting Job Priority

The **%PRIO** utility allows you to control the priority at which a UNIX® jobbed process runs. The available options are NORMAL (uses load balancing to adjust CPU usage), LOW, and HIGH. A jobbed process with a priority of HIGH competes on an equal basis with interactive processes for CPU resources.

InterSystems IRIS also allows you to establish default priorities for jobbed processes.

You can use the **BatchFlag()** method to establish a process as executing in batch mode. A batch mode process has a lower priority than a non-batch process.

Using the JOB Command in a Raw Partition (UNIX®)

You can use the **JOB** command in a raw partition in either of two ways:

- Issue the **JOB** command while in the raw partition.
- Issue the **JOB** command while in another namespace, and specify the raw partition as the *nspace* process parameter of the **JOB** command. Here *nspace* is an implied namespace. An implied namespace is a directory path preceded by two caret characters: `"^^`*dir*`"`. Implied namespace syntax is described in Global Structure in *Using Globals*.

Commands and jobbed processes running in a raw partition must always specify the full pathname when making references to filenames, and must not use any pathname that starts with "." or ".." , as these are special UNIX® files and are not present in a raw partition. Violating either of these rules causes a <DIRECTORY> error.

To obtain the full pathname of the current namespace, you can invoke the **NormalizeDirectory()** method, as shown in the following example:

```
WRITE ##class(%Library.File).NormalizeDirectory("")
```

Alternatively, you can use UNIX® job-control syntax (**&**) instead of the ObjectScript **JOB** command.

Remote Jobs

Before starting a remote job, you must establish an ECP connection and set the netjob parameter to true. This enables the server to handle job requests from remote ECP client systems.

You must configure the ability to receive remote job requests on any system that will receive them.

On the receiving system, go to the Management Portal, select **System Administration**, **Configuration**, **Additional Settings**, **Advanced Memory**. Locate **netjob** to view and edit. When “true”, incoming remote job requests via ECP will be honored on this server. The default is “true”.

The license on the remote system must support enough users to run remotely initiated jobs. You can determine the number of available InterSystems IRIS licenses using class methods of the %SYSTEM.License class, as described in the *InterSystems Class Reference*.

JOB Syntax for Remote Job Request

You can send a remote job from one InterSystems IRIS system to another using the following syntax:

```
JOB routine[joblocation]
JOB routine|joblocation|
```

The two forms are equivalent; you can use either square brackets or vertical bars to enclose the *joblocation* parameter. A remote job cannot pass routine parameters, process parameters, or a timeout.

joblocation	A specification of the location of the job. The enclosing square brackets or vertical bars are required.

The action InterSystems IRIS takes depends on the job location syntax you are using.

joblocation **Syntax**	**Result**
["namespace"]	InterSystems IRIS checks whether this explicit namespace has its default dataset on the local system or on a remote system. If the default dataset is on the local system, the system starts the job using the parameters you specify. If the default dataset is on a remote system, the system starts the remote job in the directory of the namespace’s default dataset.
["dir","sys"]	InterSystems IRIS converts this location to the implied namespace form ["^sys^dir"].
["^sys^dir"]	The job runs in the specified directory on the specified remote system. InterSystems IRIS does not allow any routine parameters, process parameters, or timeout specification.
["^^dir"]	The job runs in the specified directory (implied namespace) as a local job on the current system using the parameters you specify. An implied namespace is a directory path preceded by two caret characters: "^^*dir*".
["dir",""]	InterSystems IRIS issues a <COMMAND> error.

Global Mapping with Remote Jobs (Windows)

InterSystems IRIS does not provide global mapping for remote jobs, whether or not global mapping has been defined on the requesting system. To avoid the lack of global mapping, use extended references with your global specifications that point to the location of any globals not in that namespace. If the namespace you specify in an extended reference is not defined on the system you specify, you receive a <NAMESPACE> error. Namespaces and the syntax for extended global references are described in Global Structure in *Using Globals*.

Using the $ZCHILD and $ZPARENT Special Variables

$ZPARENT contains the PID (Process ID) of the process which jobbed the current process, or 0 if the current process was not created through the **JOB** command.

$ZCHILD contains the PID of the last process created by the **JOB** command, whether or not the attempt was successful.

By using **$ZCHILD** it is possible to determine the execution status of a remote job by comparing the **$ZCHILD** value before and after running the **JOB** command. If the before and after values are different, and the after value is nonzero, the after **$ZCHILD** value is the PID of the newly created remote job, indicating that the process was successfully created. If the after value is zero, or the after value is the same as the before value, the remote job was not created.

$ZCHILD can only tell you that a remote job was created; it does not tell you if the remote job ran successfully. The best way to determine if a remote process ran without error and ran to completion is to provide some sort of logging and error trapping in the code being run. The remote job mechanism does not inform the parent process in any way about remote process errors or remote process termination, successful or otherwise.

Using JOB Servers

JOB Servers are InterSystems IRIS processes that wait to process job requests. Jobbed processes that attach to JOB Servers avoid the added overhead of having to create a new process. Whenever a user issues a **JOB** command with the switch parameter set to use JOB Server if available, InterSystems IRIS checks to see if any JOB Servers are available to handle it. If not, it will create a process. If there is a free JOB Server, the job attaches to that JOB Server.

When a job halts while running in a JOB Server, the JOB Server hibernates until it receives another job request. A jobbed process not running in a JOB Server exits and the process is deleted.

There are some unavoidable differences between the JOB Server environment and the jobbed process environment, which may be a security concern with jobbed processes executing in JOB Servers. A jobbed process takes on the security attributes of the process that issued the **JOB** command at the InterSystems IRIS level.

Input and Output Devices

Only one process can own a device at a time. This means that a job executing in a JOB Server is unable to perform input or output to your principal I/O devices even though you may close device 0.

Therefore, if you expect a JOB Server to perform input, you must specify:

- An alternative input device for it
- The null device for an output device (if you do not want to see the output)

Failure to follow these guidelines may cause the job executing in the JOB Server to hang if it needs to do any input or output from/to your principal I/O devices. You may find that frequently job output does get through to your terminal (for example, if you have the SHARE privilege), but typically it will not.

Troubleshooting Jobs That Will Not Execute

If your job does not start, check your I/O specification. Your job will not start if InterSystems IRIS cannot open the devices you requested. Note that the null device (/dev/null on UNIX®) is always available.

If your job starts but then halts immediately, make sure you have sufficient swap space. Your job receives an error if you do not have enough swap space. If the new process created by a **JOB** command halted immediately or was terminated by the ^RESJOB utility before the process startup was complete, the **JOB** command generates a <HALTED> or <RESJOB> error. Refer to the HALT command for further details.

If your job does not start, make sure that you have used the correct namespace in the **JOB** command. You can test whether a namespace is defined by using the **Exists()** method:

```
WRITE ##class(%SYS.Namespace).Exists("USER"),!  ; an existing namespace
WRITE ##class(%SYS.Namespace).Exists("LOSER")   ; a nonexistent namespace
```

If the **JOB** command is still not working, try the following:

- Execute the routine with the **DO** command.
- Make sure you are not exceeding the number of processes for which you are licensed in InterSystems IRIS. You can determine the number of available InterSystems IRIS licenses using class methods of the %SYSTEM.License class, as described in the *InterSystems Class Reference*.
- If there is a timeout parameter in your **JOB** command, check whether the speed of your system is using up the timeout period.

When many jobs are executing concurrently, the **JOB** command may hang while waiting for a routine buffer or a license slot. You can interrupt a **JOB** command by using **Ctrl-C**.

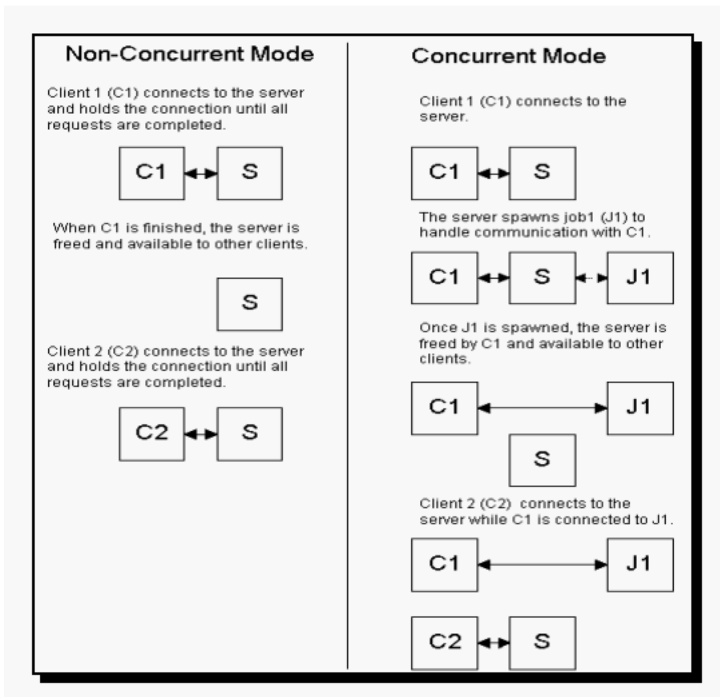
JOB Command Completion

A jobbed process continues to completion even if the process that created it logs off before that completion.

JOB Command with TCP Devices

You can use the **JOB** command to implement a *TCP concurrent server*. A TCP concurrent server allows multiple clients to be served simultaneously. In this mode a client does not have to wait for the server to finish serving other clients. Instead, each time a client requests the server, it spawns a separate subjob for that client which remains open as long as the client needs it. As soon as this subjob has been spawned (indicated by the return of the **JOB** command), another client may request service and the server will create a subjob for that client as well.

Figure B–1: Client/Server Connections in the Non-Concurrent and Concurrent Modes



A concurrent server uses the **JOB** command with the *switch* process parameter bit mask bit 4 or bit 16 turned on, and passes to the spawned process the input and output process parameters.

- If you specify *switch* bit 4, you must specify the TCP device in both *principal–input* and *principal–output* process parameters. You must use the same device for both *principal–input* and *principal–output*, as follows:

  ```
  JOB child:(:4:tcp:tcp)
  ```

  The spawned process then sets this single I/O device, as follows:

  ```
  SET tcp=$IO
  ```

- If you specify *switch* bit 16, you can specify different devices for the TCP device, the *principal–input*, and the *principal–output* process parameters, as follows:

  ```
  USE tcp
  JOB child:(:16:input:output)
  ```

  `USE tcp` preceding the **JOB** command specifies the current device (rather than the principal device), as the TCP device. The spawned process can then set these devices, as follows:

```
SET tcp=##class(%SYSTEM.INetInfo).TCPName()
SET input=$PRINCIPAL
SET output=$IO
WRITE tcp," ",input," ",output
```

It is important to note that the **JOB** command will pass the TCP socket to the jobbed process if the 4 or 16 bit is set. This capability may be combined with other features of the **JOB** command by adding the appropriate bit code for each additional feature. For example, when *switch* includes the bit with value 1, the symbol table is passed. To turn on concurrency and pass the symbol table, *switch* would have a value of 5 (4+1) or 17 (16+1).

Before you issue the **JOB** command, the TCP device must:

- Be open
- Be listening on a TCP port
- Have accepted an incoming connection

After the **JOB** command, the device in the spawning process is still listening on the TCP port, but no longer has an active connection. The application should check the **$ZA** special variable after issuing the **JOB** command to make sure that the CONNECTED bit in the state of the TCP device was reset.

The spawned process starts at the designated entry point using the specified device(s) as TCP device, *principal–input*, and *principal–output* device. The TCP device has the same name in the child process as in the parent process. The TCP device has one attached socket. The **USE** command is used to establish the TCP device in "M" mode, which is equivalent to "PSTE". The "P" (pad) option is needed to pad output with record terminator characters. When this mode is set, `WRITE !` sends LF (line feed) and `WRITE #` sends FF (form feed), in addition to flushing the write buffer.

The TCP device in the spawned process is in a connected state: the same state the device would receive after it is opened from a client. The spawned process can use the TCP device with an explicit **USE** statement. It can also use the TCP device implicitly.

The following example shows a very simple concurrent server that spawns off a child job whenever it detects a connection from a client. **JOB** uses a *switch* value of 17, consisting of the concurrent server bit 16 and the symbol table bit 1:

```
server ;
     SET io="|TCP|1"
     SET ^serverport=7001
     OPEN io:(:^serverport:"MA"):200
     IF $TEST=0 {
      WRITE !,"Cannot open server port"
      QUIT }
     ELSE { WRITE !,"Server port opened" }
loop  ;
     USE io READ x   ; Read for accept
     USE 0  WRITE !,"Accepted connection"
     USE io
     JOB child:(:17::)  ; Concurrent server bit is on
     GOTO loop
child ;
     SET io=##class(%SYSTEM.INetInfo).TCPName()
     SET input=$PRINCIPAL
     SET output=$IO
     USE io:(::"M")  ; Ensure that "M" mode is used
     WRITE $JOB,!  ; Send job id on TCP device to be read by client
     QUIT
client ;
     SET io="|TCP|2"
     SET host="127.0.0.1"
     OPEN io:(host:^serverport:"M"):200  ; Connect to server
     IF $TEST=0 {
      WRITE !,"Cannot open connection"
      QUIT }
     ELSE { WRITE !,"Client connection opened" }
     USE io READ x#3:200  ; Reads from subjob
     IF x="" {
        USE 0
        WRITE !,"No message from child"
        CLOSE io
        QUIT }
     ELSE {
        USE 0
```

```
WRITE !,"Child is on job ",x
CLOSE io
QUIT }
```

The child uses the inherited TCP connection to pass its job ID (in this case assumed to be 3 characters) back to the client, after which the child process exits. The client opens up a connection with the server and reads the child's job ID on the open connection. In this example, the IPv4 value `"127.0.0.1"` for the variable "host" indicates a loopback connection to the local host machine (the corresponding IPv6 loopback value is `"0:0:0:0:0:0:0:1"` or `"::1"`). You can set up a client on a different machine from the server if "host" is set to the server's IP address or name. Further details on IPv4 and IPv6 formats can be found in the section "Use of IPv6 Addressing" in the chapter "Server Configuration Options" in the *Orientation Guide for Server-Side Programming*.

In principle, the child and client can conduct extended communication, and multiple clients can be talking concurrently with their respective children of the server.

Specifying Child Process Partition Size

The partition size ($ZSTORAGE size) for a background job is determined as follows:

- If job servers are active, for any job server process the job partition size will always be 262144 (in kilobytes).
- If job servers are inactive, the job partition size defaults to the default partition size for non-background jobs (bbsiz). This is the system-wide default in effect when you execute **JOB**, regardless of the partition size of the parent process from which you issue **JOB**.

  If job servers are enabled, but all of them are active and you start a new job, that job process will not be a job server process, so its **$ZSTORAGE** value will default to bbsiz. This is also true when job servers are active, but due to loading the job is run in a non-job-server process.
- If job servers are inactive, you can specify the partition size of the jobbed child process in the **JOB** statement. You specify the partition size (in kilobytes) of the jobbed process in the second process parameter of the **JOB** command. For example, `JOB ^myroutine:(:8192)`. The value you specify must be a multiple of 32 and must range from 128 through 16384. It also cannot exceed the default partition size; it can only be used to specify a lower value than the default.

  You can optionally specify the partition-size process parameter value in combination with other process information that you would normally put in the second process parameter of **JOB**. Consider the following **JOB** command: `JOB ^myroutine:(:544+1)`. This command specifies that the symbol table of the jobbing process should be passed to the jobbed process and that the jobbed process should have a partition size of 544K. Although you can specify this second parameter, which passes two values (544 and 1) as 545, 544 +1 is clearer and has exactly the same effect.

Note that a job itself can programmatically set its own partition size using SET $ZSTORAGE.

See Also

- ^$JOB structured system variable
- $JOB special variable
- $TEST special variable
- $ZJOB special variable
- $ZCHILD special variable
- $ZPARENT special variable
- $ZF(-1) function
- $ZF(-2) function
- TCP Client/Server Communication in *I/O Device Guide*

- The Spool Device in *I/O Device Guide*
- Using the Management Portal to monitor and control processes in Managing InterSystems IRIS in *System Administration Guide*

KILL

Deletes variables.

```
KILL:pc killargument,...
K:pc killargument,...
```

where *killargument* can be:

```
variable,...
(variable,...)
```

Arguments

pc	*Optional* — A postconditional expression.
variable	*Optional* — A variable name or comma-separated list of variable names. Without parentheses: the variable(s) to be deleted. With parentheses: the variable(s) to be kept.

Description

There are three forms of the **KILL** command:

- **KILL** without an argument, known as an *argumentless* KILL.
- **KILL** with a variable list, known as an *inclusive* **KILL**.
- **KILL** with a variable list enclosed in parentheses, known as an *exclusive* **KILL**.

The **KILL** command without an argument deletes all local variables. It does not delete process-private globals, globals, or user-defined special variables.

KILL with a variable or comma-separated variable list as an argument:

```
KILL variable,...
```

is called an *inclusive* **KILL**. It deletes only the variable(s) you specify in the argument. Killing a variable kills all subscripts of that variable at all lower levels than the specified variable. The variables can be local variables, process-private globals, or globals. They do not have to be actual defined variables, but they must be valid variable names. You cannot kill a special variable, even if its value is user-specified. Attempting to do so generates a <SYNTAX> error.

KILL with a variable or comma-separated variable list enclosed in parentheses as an argument:

```
KILL (variable,...)
```

is called an *exclusive* **KILL**. It deletes all local variables except those you specify in the argument. The variables you specify can only be local variables. You cannot specify a subscripted variable; specifying a local variable preserves the variable and all of its subscripts. The local variables you specify do not have to be actual defined variables, but they must be valid local variable names.

Note: **KILL** can delete local variables created by InterSystems IRIS objects. Therefore, do not use either argumentless **KILL** or exclusive **KILL** in any context where they might affect system structures (such as %objTX currently used in %Save) or system objects (such as the stored procedure context object). In most programming contexts, these forms of **KILL** should be avoided.

You can use the $DATA function to determine whether a variable is defined or undefined, and whether a defined variable has subscripts. Killing a variable changes its **$DATA** status to undefined.

Using **KILL** to delete variables frees up local variable storage space. To determine or set the maximum storage space (in kilobytes) for the current process, use the $ZSTORAGE special variable. To determine the available storage space (in bytes) for the current process, use the $STORAGE special variable.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the **KILL** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

variable

If not enclosed in parentheses: the variable(s) to be deleted by the **KILL** command. *variable* can be a single variable or a comma-separated list of variables.

If enclosed in parentheses: the local variable(s) to be kept by the **KILL** command; the **KILL** command deletes all other local variables. *variable* can be a single variable or a comma-separated list of variables.

Examples

In the following example, an inclusive **KILL** deletes local variables *a*, *b*, and *d*, and the deletes the process-private global `^||ppglob` and all of its subscripts. No other variables are affected:

```
SET ^||ppglob(1)="fruit"
SET ^||ppglob(1,1)="apples"
SET ^||ppglob(1,2)="oranges"
SET a=1,b=2,c=3,d=4,e=5
KILL a,b,d,^||ppglob
WRITE "a=",$DATA(a)," b=",$DATA(b)," c=",$DATA(c)," d=",$DATA(d)," e=",$DATA(e),!
WRITE "^||ppglob(1)=",$DATA(^||ppglob(1)),
      " ^||ppglob(1,1)=",$DATA(^||ppglob(1,1)),
      " ^||ppglob(1,2)=",$DATA(^||ppglob(1,2))
```

In the following example, an inclusive **KILL** deletes the local variable *a(1)* and its subscripts *a(1,1)*, *a(1,2)* and *a(1,1,1)*; it does not delete the local variables *a*, *a(2)*, or *a(2,1)*:

```
SET a="food",a(1)="fruit",a(2)="vegetables"
SET a(1,1)="apple",a(1,1,1)="mackintosh",a(1,2)="banana"
SET a(2,1)="artichoke"
WRITE "before KILL:",!
WRITE $DATA(a)," ",$DATA(a(1))," ",$DATA(a(1,1))," ",$DATA(a(1,1,1))," ",
      $DATA(a(2))," ",$DATA(a(2,1)),!
KILL a(1)
WRITE "after KILL:",!
WRITE $DATA(a)," ",$DATA(a(1))," ",$DATA(a(1,1))," ",$DATA(a(1,1,1))," ",
      $DATA(a(2))," ",$DATA(a(2,1))
```

In the following example, an exclusive **KILL** deletes all local variables except for variables *d* and *e*:

```
SET a=1,b=2,c=3,d=4,e=5
KILL (d,e)
WRITE "a=",$DATA(a)," b=",$DATA(b)," c=",$DATA(c)," d=",$DATA(d)," e=",$DATA(e)
```

Note that because an exclusive **KILL** deletes object variables, the above program works from a terminal session, but does not work within an object method.

The following example, an inclusive **KILL** deletes two process-private globals and an exclusive **KILL** deletes all local variables except for variables *d* and *e*.

```
SET ^||a="one",^||b="two",^||c="three"
SET a=1,b=2,c=3,d=4,e=5
KILL ^||a,^||c,(d,e)
WRITE "a=",$DATA(a)," b=",$DATA(b)," c=",$DATA(c)," d=",$DATA(d)," e=",$DATA(e),!
WRITE "^||a=",$DATA(^||a)," ^||b=",$DATA(^||b)," ^||c=",$DATA(^||c)
```

Notes

KILL and Objects

Object instance references (OREFs) automatically maintain a reference count — the number of items currently referring to an object. Whenever you **SET** a variable or object property to refer to an object, InterSystems IRIS increments the object's reference count. When you **KILL** a variable, InterSystems IRIS decrements the corresponding object reference count. When this reference count goes to 0, the object is automatically destroyed; that is, InterSystems IRIS removes it from memory. The object reference count is also decremented when a variable is **SET** to a new value, or when the variable goes out of scope.

In the case of a persistent object, call the **%Save()** method before removing the object from memory if you wish to preserve changes to the object. The **%Delete()** method deletes the stored version of an InterSystems IRIS object; it does not remove the in-memory version of that object.

For information on OREFs, see "OREF Basics" in *Defining and Using Classes*.

KILL Using an Object Method

You can specify an object method on the left side of a **KILL** expression. The following example specifies the **%Get()** method:

```
SET obj=##class(test).%New()  // Where test is class with a multidimensional property md
SET myarray=[(obj)]
SET index=0,subscript=2
SET myarray.%Get(index).md(subscript)="value"
  WRITE $DATA(myarray.%Get(index).md(subscript)),!
KILL myarray.%Get(index).md(subscript)
  WRITE $DATA(myarray.%Get(index).md(subscript))
```

Inclusive KILL

An inclusive **KILL** deletes only those variables explicitly named. The list can include local variables, process-private globals, and globals—either subscripted or unsubscripted. The inclusive **KILL** is the only way to delete global variables.

You can delete a range of subscripted global variables by using the **KillRange()** method.

Exclusive KILL

An exclusive **KILL** deletes all local variables *except* those that you explicitly name. Listed names are separated by commas. The enclosing parentheses are required.

The local variables specified in the exception list do not have to be defined when exclusive **KILL** is invoked.

The exception list can contain only local unsubscripted variable names. For example, if you have a local variable array named fruitbasket, which has several subscript nodes, you can preserve the entire local variable array by specifying `KILL (fruitbasket)`; you cannot use exclusive **KILL** to selectively preserve individual subscript nodes.

The exception list can contain local variables representing object references (OREFs). The exception list cannot contain properties of an object reference.

An exclusive kill list cannot specify a process-private global, a global, or a special variable; attempting to do so results in a <SYNTAX> error. Local variables not named in the exception list are deleted; subsequent references to such variables generate an <UNDEFINED> error. The exclusive **KILL** has no effect on process-private globals, globals, and special variables. However, it does delete local variables created by system objects.

Using KILL with Arrays

You can use an inclusive **KILL** to delete an entire array or a selected node within an array. The specified array can be a local variable, a process-private global, or a global variable.

- To delete a local variable array, use any form of **KILL**.
- To delete a selected node within a local variable array, you must use an inclusive **KILL**.
- To delete a global variable array, you must use an inclusive **KILL**.
- To delete a selected node within a global variable array, you must use an inclusive **KILL**.

For further details on global variables with subscripted nodes, see Global Structure in *Using Globals*.

To delete an array, simply supply its name to an inclusive **KILL**. For example, the following command deletes global array ^fruitbasket and all of its subordinate nodes.

```
SET ^fruitbasket(1)="fruit"
SET ^fruitbasket(1,1)="apples"
SET ^fruitbasket(1,2)="oranges"
WRITE "Before KILL:",!
WRITE "^fruitbasket(1)=",$DATA(^fruitbasket(1)),
      " ^fruitbasket(1,1)=",$DATA(^fruitbasket(1,1)),
      " ^fruitbasket(1,2)=",$DATA(^fruitbasket(1,1)),!
KILL ^fruitbasket
WRITE "After KILL:",!
WRITE "^fruitbasket(1)=",$DATA(^fruitbasket(1)),
      " ^fruitbasket(1,1)=",$DATA(^fruitbasket(1,1)),
      " ^fruitbasket(1,2)=",$DATA(^fruitbasket(1,1))
```

To delete an array node, supply the appropriate subscript. For example, the following **KILL** command deletes the node at subscript 1,2.

```
SET ^fruitbasket(1)="fruit"
SET ^fruitbasket(1,1)="apples"
SET ^fruitbasket(1,2)="oranges"
SET ^fruitbasket(1,2,1)="navel"
SET ^fruitbasket(1,2,2)="mandarin"
WRITE ^fruitbasket(1)," contains ",^fruitbasket(1,1),
      " and ",^fruitbasket(1,2),!
WRITE ^fruitbasket(1,2)," contains ",^fruitbasket(1,2,1),
      " and ",^fruitbasket(1,2,2),!
KILL ^fruitbasket(1,2)
WRITE "1st level node: ",$DATA(^fruitbasket(1)),!
WRITE "2nd level node: ",$DATA(^fruitbasket(1,1)),!
WRITE "Deleted 2nd level node: ",$DATA(^fruitbasket(1,2)),!
WRITE "3rd level node under deleted 2nd: ",$DATA(^fruitbasket(1,2,1)),!
QUIT
```

When you delete an array node, you automatically delete all nodes subordinate to that node and any immediately preceding node that contains only a pointer to the deleted node. If a deleted node is the only node in its array, the array itself is deleted along with the node.

To delete multiple local variable arrays, you can use either the inclusive form or exclusive form of **KILL**, as described above. For example, the following command removes all local arrays except array1 and array2.

```
KILL (array1,array2)
```

To delete multiple array nodes, you can use only the inclusive form of **KILL**. For example, the following command removes the three specified nodes, deleting one node from each array.

```
KILL array1(2,4),array2(3,2),array3(1,7)
```

The nodes can be in the same or different arrays.

You may delete a specified local or global array node by using the **ZKILL** command. Unlike **KILL**, **ZKILL** does not delete all nodes subordinate to the specified node.

Effects of KILL with Parameter Passing

With parameter passing, values are passed to a user-defined function or to a subroutine called with the **DO** command. The values to be passed to the user-defined function or subroutine are supplied in a comma-separated list called the *actual parameter list*. Each value supplied is mapped, by position, into a corresponding variable in the *formal parameter list* defined for the user-defined function or subroutine.

Depending on how the actual parameter list is specified, parameter passing can occur in either of two ways: *by value* or *by reference*. For more information on these two types of parameter passing, see Parameter Passing in *Using ObjectScript*.

Killing a variable in the formal parameter list has different results depending on whether passing by value or passing by reference is in effect.

If you are passing a variable by value:

- Killing a variable in the formal list has no effect outside the context of the invoked function or subroutine. This is because InterSystems IRIS automatically saves the current value of the corresponding actual variable when the function or subroutine is invoked. It then automatically restores the saved value on exit from the function or subroutine.

In the following passing by value example, the **KILL** in Subrt1 deletes the formal variable *x* but does not affect the actual variable *a*:

```
Test
    SET a=17
    WRITE !,"Before Subrt1 a: ",$DATA(a)
    DO Subrt1(a)
    WRITE !,"After Subrt1 a: ",$DATA(a)
    QUIT
Subrt1(x)
    WRITE !,"pre-kill x: ",$DATA(x)
    KILL x
    WRITE !,"post-kill x: ",$DATA(x)
    QUIT
```

If you are passing a variable by reference:

- Performing KILL and including the variable in the formal list also kills the corresponding actual variable. When the function or subroutine terminates, the actual variable will no longer exist.
- Performing a KILL and excluding the variable in the formal list causes both the formal variable and the actual variable passed by reference to be preserved.

In the following passing by reference example, the **KILL** in Subrt1 deletes both the formal variable *x* and the actual variable *a*:

```
Test
    SET a=17
    WRITE !,"Before Subrt1 a: ",$DATA(a)
    DO Subrt1(.a)
    WRITE !,"After Subrt1 a: ",$DATA(a)
    QUIT
Subrt1(&x)
    WRITE !,"pre-kill x: ",$DATA(x)
    KILL x
    WRITE !,"post-kill x: ",$DATA(x)
    QUIT
```

As a general rule, you should not **KILL** variables specified in a formal parameter list. When InterSystems IRIS encounters a function or subroutine that uses parameter passing (whether by value or by reference), it implicitly executes a **NEW** command for each variable in the formal list. When it exits from the function or subroutine, it implicitly executes a **KILL** command for each variable in the formal list. In the case of a formal variable that uses passing by reference, it updates the corresponding actual variable (to reflect changes made to the formal variable) before executing the **KILL**.

Transaction Processing

A **KILL** of a global variable is journaled as part of the current transaction; this global variable deletion is rolled back during transaction rollback. A **KILL** of a local variable or a process-private global variable is *not* journaled, and thus this variable deletion is unaffected by a transaction rollback.

See Also

- ZKILL command
- $DATA function
- $STORAGE special variable

LOCK

Enables a process to apply and release locks to control access to data resources.

```
LOCK:pc
L:pc

LOCK:pc +lockname#locktype:timeout,...
L:pc +lockname#locktype:timeout,...

LOCK:pc +(lockname#locktype,...):timeout,...
L:pc +(lockname#locktype,...):timeout,...
```

Arguments

pc	*Optional* — A postconditional expression.
+ –	*Optional* — The lock operation indicator (a + character, – character, or no character) to apply or remove a lock. A + (plus sign) applies the specified lock(s) without unlocking any prior locks. This can be used to apply an incremental lock. A – (minus sign) unlocks (or decrements) a lock. If you omit the lock operation indicator (no character), InterSystems IRIS unlocks all prior locks and applies the specified lock(s).
lockname	A lock name associated with the resource(s) to be locked or unlocked. Must be a valid identifier, following the same naming conventions as local variables or globals.
#locktype	*Optional* — A letter code specifying the type of lock to lock or unlock, specified in quotation marks. Available values are "S" (shared lock), "E" (escalating lock), "I" (immediate unlock), and "D" (deferred unlock). When specifying, the preceding # symbol is mandatory. For example, `#"S"`. You can specify more than one letter code. For example, `#"SEI"`. "S" and "E" are specified for both locking and unlocking operations; "I" and "D" are only specified for unlocking operations. If omitted, the lock type defaults to an exclusive lock (non-S) that does not escalate (non-E) and that always defers releasing an unlocked lock to the end of the current transaction (non-I / non-D).
:timeout	*Optional* — The time to wait before the attempted lock operation times out. Specified as seconds with or without a fractional component up to 100ths of a second (`s.ff`). Can be specified with or without the optional *#locktype*. When specifying, the preceding : symbol is mandatory. For example, `LOCK ^a(1):10` or `LOCK ^a(1)#"E":10`. Specify timeout as an integer number of seconds. A value of 0 means to make one attempt, then time out. If omitted, InterSystems IRIS waits indefinitely.

Description

There are two basic forms of the **LOCK** command:

- Without arguments
- With arguments

LOCK without Arguments

The argumentless **LOCK** releases (unlocks) all locks currently held by the process in all namespaces. This includes exclusive and shared locks, both local and global. It also includes all accumulated incremental locks. For example, if there are three incremental locks on a given lock name, InterSystems IRIS releases all three locks and removes the lock name entry from the lock table.

If you issue an argumentless **LOCK** during a transaction, InterSystems IRIS places all locks currently held by the process in a Delock state until the end of the transaction. When the transaction ends, InterSystems IRIS releases the locks and removes the corresponding lock name entries from the lock table.

The following example applies various locks during a transaction, then issues an argumentless **LOCK** to release all of these locks. The locks are placed in a Delock state until the end of the transaction. The **HANG** commands give you time to check the lock's ModeCount in the Lock Table:

```
TSTART
LOCK +^a(1)      // ModeCount: Exclusive
HANG 2
LOCK +^a(1)#"E"  // ModeCount: Exclusive/1+1e
HANG 2
LOCK +^a(1)#"S"  // ModeCount: Exclusive/1+1e,Shared
HANG 2
LOCK             // ModeCount: Exclusive/1+1e->Delock,Shared->Delock
HANG 10
TCOMMIT          // ModeCount: locks removed from table
```

Argumentless **LOCK** releases all locks held by the process without applying any locks. Completion of a process also releases all locks held by that process.

LOCK with Arguments

LOCK with arguments specifies one or more lock names on which to perform locking and unlocking operations. What lock operation InterSystems IRIS performs depends on the lock operation indicator argument you use:

- **LOCK** *lockname* unlocks all locks previously held by the process in all namespaces, then applies a lock on the specified lock name(s).
- **LOCK** +*lockname* applies a lock on the specified lock name(s) without unlocking any previous locks. This allows you to accumulate different locks, and allows you to apply incremental locks to the same lock.
- **LOCK** -*lockname* performs an unlock operation on the specified lock name(s). Unlocking decrements the lock count for the specified lock name; when this lock count decrements to zero, the lock is released.

A lock operation may immediately apply the lock, or it may place the lock request on a wait queue pending the release of a conflicting lock by another process. A waiting lock request may time out (if you specify a timeout) or may wait indefinitely (until the end of the process).

LOCK with Multiple Lock Names

You can specify multiple locks with a single **LOCK** command in either of two ways:

- Without Parentheses: By specifying multiple lock arguments without parentheses as a comma-separated list, you can specify multiple independent lock operations, each of which can have its own timeout. (This is functionally identical to specifying a separate **LOCK** command for each lock argument.) Lock operations are performed in strict left-to-right order. For example:

  ```
  LOCK var1(1):10,+var2(1):15
  ```

  Multiple lock arguments without parentheses each can have their own lock operation indicator and their own timeout argument. However, if you use multiple lock arguments, be aware that a lock operation without a plus sign lock operation indicator unlocks all prior locks, including locks applied by an earlier part of the same **LOCK** command. For example, the command **LOCK ^b(1,1), ^c(1,2,3), ^d(1)** would be parsed as three separate lock commands: the first releasing the processes' previously held locks (if any) and locking ^b(1,1), the second immediately releasing ^b(1,1) and locking ^c(1,2,3), the third immediately releasing ^c(1,2,3) locking ^d(1). As a result, only ^d(1) would be locked.

- With Parentheses: By enclosing a comma-separated list of lock names in parentheses, you can perform these locking operations on multiple locks as a single atomic operation. For example:

  ```
  LOCK +(var1(1),var2(1)):10
  ```

All lock operations in a parentheses-enclosed list are governed by a single lock operation indicator and a single timeout argument; either all of the locks are applied or none of them are applied. A parentheses-enclosed list without a plus sign lock operation indicator unlocks all prior locks then locks all of the listed lock names.

Arguments

pc

An optional postconditional expression that can make the command conditional. InterSystems IRIS executes the **LOCK** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). You can specify a postconditional expression on an argumentless **LOCK** command or a **LOCK** command with arguments. For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

lock operation indicator

The lock operation indicator is used to apply (lock) or remove (unlock) a lock. It can be one of the following values:

No character	Unlock all prior locks belonging to the current process and attempt to apply the specified lock. For example, `LOCK ^a(1)` performs the following atomic operation: it releases all locks previously held by the process (whether local or global, exclusive or shared, escalating or non-escalating) and it attempts to lock `^a(1)`. This can result in one of two outcomes: (1) all prior locks unlocked and `^a(1)` locked; (2) all prior locks unlocked and `^a(1)` placed in a lock waiting state pending the release of a conflicting lock held by another process.
Plus sign (+)	Attempt to apply the specified lock without performing any unlocks. This allows you to add a lock to the locks held by the current process. One use of this option is to perform incremental locking of a lock name.
Minus sign (-)	Unlocks the specified lock. If the lock name has a lock count of 1, an unlock remove the lock from the lock table. If the lock name has a lock count of more than 1, an unlock removes one of its incremental locks (decrements the lock count). By default, this unlocks an exclusive, non-escalating lock. To remove a shared lock and/or an escalating lock, you must specify the corresponding #locktype.

If your **LOCK** command contains multiple comma-separated lock arguments, each lock argument can have its own lock operation indicator. InterSystems IRIS parses this as multiple independent **LOCK** commands.

lockname

A *lockname* is the name of a lock for a data resource; it is not the data resource itself. That is, your program can specify a lock named `^a(1)` and a variable named `^a(1)` without conflict. The relationship between the lock and the data resource is a programming convention; by convention, processes must acquire the lock before modifying the corresponding data resource.

Lock names are case-sensitive. Lock names follow the same naming conventions as the corresponding local variables and global variables. A lock name can be subscripted or unsubscripted. Lock subscripts have the same naming conventions and maximum length and number of levels as variable subscripts. In InterSystems IRIS, the following are all valid and unique lock names: a, a(1), A(1), ^a, ^a(1,2), ^A(1,1,1). For further details, see the Variables chapter of *Using ObjectScript*.

Note: For performance reasons, it is recommended you specify lock names with subscripts whenever possible. For example, `^a(1)` rather than `^a`. Subscripted lock names are used in documentation examples.

Lock names can be local or global. A lock name such as `A(1)` is a local lock name. It applies only to that process, but does apply across namespaces. A lock name that begins with a caret (^) character is a global lock name; the mapping for this lock follows the same mapping as the corresponding global, and thus can apply across processes, controlling their access to the same resource. (See Global Structure in *Using Globals*.)

Note: Process-private global names *can not* be used as lock names. Attempting to use a process-private global name as a lock name performs no operation and completes without issuing an error.

A lock name can represent a local or global variable, subscripted or unsubscripted. It can be an implicit global reference, or an extended reference to a global on another computer. (See Global Structure in *Using Globals*.)

The data resource corresponding to a lock name does not need to exist. For example, you may lock the lock name `^a(1,2,3)` whether or not a global variable with the same name exists. Because the relationship between locks and data resources is an agreed-upon convention, a lock may be used to protect a data resource with an entirely different name.

locktype

A letter code specifying the type of lock to apply or remove. *locktype* is an optional argument; if you omit *locktype*, the lock type defaults to an exclusive non-escalating lock. If you omit *locktype*, you must omit the pound sign (#) prefix. If you specify *locktype*, the syntax for lock type is a mandatory pound sign (#), followed by quotation marks enclosing one or more lock type letter codes. Lock type letter codes can be specified in any order and are not case-sensitive. The following are the lock type letter codes:

- S: Shared lock

  Allows multiple processes to simultaneously hold nonconflicting locks on the same resource. For example, two (or more) processes may simultaneously hold shared locks on the same resource, but an exclusive lock limits the resource to one process. An existing shared lock prevents all other processes from applying an exclusive lock, and an existing exclusive lock prevents all other processes from applying a shared lock on that resource. However, a process can first apply a shared lock on a resource and then the same process can apply an exclusive lock on the resource, upgrading the lock from shared to exclusive. Shared and Exclusive lock counts are independent. Therefore, to release such a resource it is necessary to release both the exclusive lock and the shared lock. All locking and unlocking operations that are not specified as shared (“S”) default to exclusive.

  A shared lock may be incremental; that is, a process may issue multiple shared locks on the same resource. You may specify a shared lock as escalating (“SE”) when locking and unlocking. When unlocking a shared lock, you may specify the unlock as immediate (“SI”) or deferred (“SD”). To view the current shared locks with their increment counts for escalating and non-escalating lock types, refer to the system-wide lock table, described in the “Lock Management” chapter of *Using ObjectScript*.

- E: Escalating lock

  Allows you to apply a large number of concurrent locks without overflowing the lock table. By default, locks are non-escalating. When applying a lock, you can use *locktype* “E” to designate that lock as escalating. When releasing an escalating lock, you must specify *locktype* “E” in the unlock statement. You can designate both exclusive locks and shared (“S”) locks as escalating.

  Commonly, you would use escalating locks when applying a large number of concurrent locks at the same subscript level. For example `LOCK +^mylock(1,1)#"E",+^mylock(1,2)#"E",+^mylock(1,3)#"E"....`

  The same lock can be concurrently applied as a non-escalating lock and as an escalating lock. For example, `^mylock(1,1)` and `^mylock(1,1)#"E"`. InterSystems IRIS counts locks issued with *locktype* “E” separately in the lock table. For information on how escalating and non-escalating locks are represented in the lock table, refer to the “Lock Management” chapter of *Using ObjectScript*.

  When the number of “E” locks at a subscript level reaches a threshold number, the next “E” lock requested for that subscript level automatically attempts to lock the parent node (the next higher subscript level). If it cannot, no escalation occurs. If it successfully locks the parent node, it establishes one parent node lock with a lock count corresponding to the number of locks at the lower subscript level, plus 1. The locks at the lower subscript level are released. Subsequent "E" lock requests to the lower subscript level further increment the lock count of this parent node lock. You must unlock all "E" locks that you have applied to decrement the parent node lock count to 0 and de-escalate to the lower subscript level. The default lock threshold is 1000 locks; lock escalation occurs when the 1001st lock is requested.

Note that once locking is escalated, lock operations preserve only the number of locks applied, not what specific resources were locked. Therefore, failing to unlock the same resources that you locked can cause "E" lock counts to get out of sync.

In the following example, lock escalation occurs when the program applies the lock threshold + 1 "E" lock. This example shows that lock escalation both applies a lock on the next-higher subscript level and releases the locks on the lower subscript level:

```
Main
  TSTART
  SET thold=$SYSTEM.SQL.GetLockThreshold()
  WRITE "lock escalation threshold is ",thold,!
  SET almost=thold-5
  FOR i=1:1:thold+5 { LOCK +dummy(1,i)#"E"
     IF i>almost {
       IF ^$LOCK("dummy(1,"_i_")","OWNER") '= "" {WRITE "lower level lock applied at ",i,"th lock
 ",! }
       ELSEIF ^$LOCK("dummy(1)","OWNER") '= ""   {WRITE "lock escalation",!
                                                  WRITE "higher level lock applied at ",i,"th lock
 ",!
                                                  QUIT }
       ELSE {WRITE "No locks applied",! }
     }
  }
  TCOMMIT
```

Note that only "E" locks are counted towards lock escalation. The following example applies both default (non-"E") locks and "E" locks on the same variable. Lock escalation only occurs when the total number of "E" locks on the variable reaches the lock threshold:

```
Main
  TSTART
  SET thold=$SYSTEM.SQL.GetLockThreshold()
  WRITE "lock escalation threshold is ",thold,!
  SET noE=17
  WRITE "setting ",noE," non-escalating locks",!
  FOR i=1:1:thold+noE { IF i < noE {LOCK +a(6,i)}
                  ELSE {LOCK +a(6,i)#"E"}
    IF ^$LOCK("a(6)","OWNER") '= "" {
       WRITE "lock escalation on lock a(6,",i,")",!
       QUIT }
  }
  TCOMMIT
```

Unlocking "E" locks is the reverse of the above. When locking is escalated, unlocks at the child level decrement the lock count of the parent node lock until it reaches zero (and is unlocked); these unlocks decrementing a count, they are not matched to specific locks. When the parent node lock count reaches 0, the parent node lock is removed and "E" locking de-escalates to the lower subscript level. Any subsequent locks at the lower subscript level create specific locks at that level.

The "E" *locktype* can be combined with any other *locktype*. For example, "SE", "ED", "EI", "SED", "SEI". When combined with the "I" *locktype* it permits unlocks of "E" locks to occur immediately when invoked, rather than at the end of the current transaction. This "EI" *locktype* can minimize situations where locking is escalated.

Commonly, "E" locks are automatically applied for SQL INSERT, UPDATE, and DELETE operations within a transaction. However, there are specific limitations on SQL data definition structures that support "E" locking. Refer to the specific SQL commands for details.

- I: Immediate unlock

  Immediately releases a lock, rather than waiting until the end of a transaction:

- Specifying “I” when unlocking a non-incremented (lock count 1) lock immediately releases the lock. By default, an unlock does not immediately release a non-incremented lock. Instead, when you unlock a non-incremented lock InterSystems IRIS maintains that lock in a delock state until the end of the transaction. Specifying “I” overrides this default behavior.
- Specifying “I” when unlocking an incremented lock (lock count > 1) immediately releases the incremental lock, decrementing the lock count by 1. This is the same behavior as a default unlock of an incremented lock.

The “I” *locktype* is used when performing an unlock during a transaction. It has the same effect on InterSystems IRIS unlock behavior whether the lock was applied within the transaction or outside of the transaction. The “I” *locktype* performs no operation if the unlock occurs outside of a transaction. Outside of a transaction, an unlock always immediately releases a specified lock.

“I” can only be specified for an unlock operation; it cannot be specified for a lock operation. “I” can be specified for an unlock of a shared lock (`#"SI"`) or an exclusive lock (`#"I"`). Locktypes “I” and “D” are mutually exclusive. “IE” can be used to immediately unlock an escalating lock.

This immediate unlock is shown in the following example:

```
TSTART
LOCK +^a(1)      // apply lock ^a(1)
LOCK -^a(1)      // remove (unlock) ^a(1)
                 // An unlock without a locktype defers the unlock
                 // of a non-incremented lock to the end of the transaction.
WRITE "Default unlock within a transaction.",!,"Go look at the Lock Table",!
HANG 10          // This HANG allows you to view the current Lock Table
LOCK +^a(1)      // reapply lock ^a(1)
LOCK -^a(1)#"I"  // remove (unlock) lock ^a(1) immediately
                 // this removes ^a(1) from the lock table immediately
                 // without waiting for the end of the transaction
WRITE "Immediate unlock within a transaction.",!,"Go look at the Lock Table",!
HANG 10          // This HANG allows you to view the current Lock Table
                 // while still in the transaction
TCOMMIT
```

- D: Deferred unlock

  Controls when an unlocked lock is released during a transaction. The unlock state is deferred to the state of the previous unlock of that lock. Therefore, specifying *locktype* “D” when unlocking a lock may result in either an immediate unlock or a lock placed in delock state until the end of the transaction, depending on the history of the lock during that transaction. The behavior of a lock that has been locked/unlocked more than once differs from the behavior of a lock that has only been locked once during the current transaction.

  The “D” unlock is only meaningful for an unlock that releases a lock (lock count 1), not an unlock that decrements a lock (lock count > 1). An unlock that decrements a lock is always immediately released.

  “D” can only be specified for an unlock operation. “D” can be specified for a shared lock (`#"SD"`) or an exclusive lock (`#"D"`). “D” can be specified for a escalating (“E”) lock, but, of course, the unlock must also be specified as escalating (“ED”). Lock types “D” and “I” are mutually exclusive.

  This use of “D” unlock within a transaction is shown in the following examples. The **HANG** commands give you time to check the lock’s ModeCount in the Lock Table.

  If the lock was only applied once during the current transaction, a “D” unlock immediately releases the lock. This is the same as “I” behavior. This is shown in the following example:

```
TSTART
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)#"D"  // Lock Table ModeCount: null (immediate unlock)
HANG 10
TCOMMIT
```

  If the lock was applied more than once during the current transaction, a “D” unlock reverts to the prior unlock state.

  - If the last unlock was a standard unlock, the “D” unlock reverts unlock behavior to that prior unlock’s behavior — to defer unlock until the end of the transaction. This is shown in the following examples:

```
TSTART
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)      // Lock Table ModeCount: Exclusive
   WRITE "1st unlock",! HANG 5
LOCK -^a(1)#"D"  // Lock Table ModeCount: Exclusive->Delock
   WRITE "2nd unlock",! HANG 5
TCOMMIT

TSTART
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)      // Lock Table ModeCount: Exclusive->Delock
   WRITE "1st unlock",! HANG 5
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)#"D"  // Lock Table ModeCount: Exclusive->Delock
   WRITE "2nd unlock",! HANG 5
TCOMMIT

TSTART
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)#"I"  // Lock Table ModeCount: Exclusive/2
   WRITE "1st unlock",! HANG 5
LOCK -^a(1)      // Lock Table ModeCount: Exclusive
   WRITE "2nd unlock",! HANG 5
LOCK -^a(1)#"D"  // Lock Table ModeCount: Exclusive->Delock
   WRITE "3rd unlock",! HANG 5
TCOMMIT
```

– If the last unlock was an “I” unlock, the “D” unlock reverts unlock behavior to that prior unlock’s behavior — to immediately unlock the lock. This is shown in the following examples:

```
TSTART
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)#"I"  // Lock Table ModeCount: null (immediate unlock)
   WRITE "1st unlock",! HANG 5
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)#"D"  // Lock Table ModeCount: null (immediate unlock)
   WRITE "2nd unlock",! HANG 5
TCOMMIT

TSTART
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)#"I"  // Lock Table ModeCount: Exclusive
   WRITE "1st unlock",! HANG 5
LOCK -^a(1)#"D"  // Lock Table ModeCount: null (immediate unlock)
   WRITE "2nd unlock",! HANG 5
TCOMMIT
```

– If the last unlock was a “D” unlock, the “D” unlock follows the behavior of the last prior non-“D” lock:

```
TSTART
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)#"D"  // Lock Table ModeCount: Exclusive
   WRITE "1st unlock",! HANG 5
LOCK -^a(1)#"D"  // Lock Table ModeCount: null (immediate unlock)
   WRITE "2nd unlock",! HANG 5
TCOMMIT

TSTART
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)      // Lock Table ModeCount: Exclusive/2
   WRITE "1st unlock",! HANG 5
LOCK -^a(1)#"D"  // Lock Table ModeCount: Exclusive
   WRITE "2nd unlock",! HANG 5
LOCK -^a(1)#"D"  // Lock Table ModeCount: Exclusive->Delock
   WRITE "3rd unlock",! HANG 5
TCOMMIT
```

```
TSTART
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK +^a(1)      // Lock Table ModeCount: Exclusive
LOCK -^a(1)#"I"  // Lock Table ModeCount: Exclusive/2
   WRITE "1st unlock",! HANG 5
LOCK -^a(1)#"D"  // Lock Table ModeCount: Exclusive
   WRITE "2nd unlock",! HANG 5
LOCK -^a(1)#"D"  // Lock Table ModeCount: null (immediate unlock)
   WRITE "3rd unlock",! HANG 5
TCOMMIT
```

timeout

The number of seconds or fractions of a second to wait for a lock request to succeed before timing out. *timeout* is an optional argument. If omitted, the **LOCK** command waits indefinitely for a resource to be lockable; if the lock cannot be applied, the process will hang. The syntax for *timeout* is a mandatory colon (:), followed by an numeric value or an expression that evaluates to an numeric value.

Valid values are seconds with or without fractional tenths or hundredths of a second. Thus the following are all valid *timeout* values: `:5`, `:5.5`, `:0.5`, `:.5`, `:0.05`, `:.05`. Any value smaller than `:0.01` is parsed as zero. A value of zero invokes one locking attempt before timing out. A negative number is equivalent to zero.

Commonly, a lock will wait if another process has a conflicting lock that prevents this lock request from acquiring (holding) the specified lock. The lock request waits until either a lock is released that resolves the conflict, or the lock request times out. Terminating the process also ends (deletes) pending lock requests. Lock conflict can result from many situations, not just one process requesting the same lock held by another process. A detailed explanation of lock conflict and lock request wait states is provided in the "Lock Management" chapter of *Using ObjectScript*.

If you use *timeout* and the lock is successful, InterSystems IRIS sets the **$TEST** special variable to 1 (TRUE). If the lock cannot be applied within the timeout period, InterSystems IRIS sets **$TEST** to 0 (FALSE). Issuing a lock request without a *timeout* has no effect on the current value of **$TEST**. Note that **$TEST** can also be set by the user, or by a **JOB**, **OPEN**, or **READ** timeout.

The following example applies a lock on lock name `^abc(1,1)`, and unlocks all prior locks held by the process:

```
LOCK ^abc(1,1)
```

This command requests an exclusive lock: no other process can simultaneously hold a lock on this resource. If another process already holds a lock on this resource (exclusive or shared), this example must wait for that lock to be released. It can wait indefinitely, hanging the process. To avoid this, specifying a timeout value is strongly recommended:

```
LOCK ^abc(1,1):10
```

If a **LOCK** specifies multiple *lockname* arguments in a comma-separated list, each *lockname* resource may have its own *timeout* (syntax without parentheses), or all of the specified *lockname* resources may share a single *timeout* (syntax with parentheses).

- Without Parentheses: each *lockname* argument can have its own *timeout*. InterSystems IRIS parses this as multiple independent **LOCK** commands, so the *timeout* of one lock argument does not affect the other lock arguments. Lock arguments are parsed in strict left-to-right order, with each lock request either completing or timing out before the next lock request is attempted.
- With Parentheses: all *lockname* arguments share a *timeout*. The **LOCK** must successfully apply all locks (or unlocks) within the timeout period. If the timeout period expires before all locks are successful, none of the lock operations specified in the **LOCK** command are performed, and control returns to the process.

InterSystems IRIS performs multiple operations in strict left-to-right order. Therefore, in **LOCK** syntax without parentheses, the **$TEST** value indicates the outcome of the last (rightmost) of multiple *lockname* lock requests.

In the following examples, the current process cannot lock ^a(1) because it is exclusively locked by another process. These examples use a timeout of 0, which means they make one attempt to apply the specified lock.

The first example locks ^x(1) and ^z(1). It sets $TEST=1 because ^z(1) succeeded before timing out:

```
LOCK +^x(1):0,+^a(1):0,+^z(1):0
```

The second example locks ^x(1) and ^z(1). It sets $TEST=0 because ^a(1) timed out. ^z(1) did not specify a timeout and therefore had no effect on **$TEST**:

```
LOCK +^x(1):0,+^a(1):0,+^z(1)
```

The third example applies no locks, because a list of locks in parentheses is an atomic (all-or-nothing) operation. It sets $TEST=0 because ^a(1) timed out:

```
LOCK +(^x(1),^a(1),^z(1)):0
```

Using the Lock Table to View and Delete Locks System-wide

InterSystems IRIS maintains a system-wide lock table that records all locks that are in effect and the processes that have applied them. The system manager can display the existing locks in the Lock Table or remove selected locks using the Management Portal interface or the ^LOCKTAB utility, as described in the "Lock Management" chapter of *Using ObjectScript*. You can also use the %SYS.LockQuery class to read lock table information. From the %SYS namespace you can use the SYS.Lock class to manage the lock table.

You can use the Management Portal to view held locks and pending lock requests system-wide. Go to the Management Portal, select **System Operation**, select **Locks**, then select **View Locks**. For further details on the View Locks table refer to the "Lock Management" chapter of *Using ObjectScript*.

You can use the Management Portal to remove (delete) locks currently held on the system. Go to the Management Portal, select **System Operation**, select **Locks**, then select **Manage Locks**. For the desired process (**Owner**) click either "Remove" or "Remove All Locks for Process".

Removing a lock releases all forms of that lock: all increment levels of the lock, all exclusive, exclusive escalating, and shared versions of the lock. Removing a lock immediately causes the next lock waiting in that lock queue to be applied.

You can also remove locks using the **SYS.Lock.DeleteOneLock()** and **SYS.Lock.DeleteAllLocks()** methods.

Removing a lock requires WRITE permission. Lock removal is logged in the audit database (if enabled); it is not logged in messages.log.

Incremental Locking and Unlocking

Incremental locking permits you to apply the same lock multiple times: to increment the lock. An incremented lock has a lock count of > 1. Your process can subsequently increment and decrement this lock count. The lock is released when the lock count decrements to 0. No other process can acquire the lock until the lock count decrements to 0. The lock table maintains separate lock counts for exclusive locks and shared locks, and for escalating and non-escalating locks of each type. The maximum incremental lock count is 32,766. Attempting to exceed this maximum lock count results in a <MAX LOCKS> error.

You can increment a lock as follows:

- Plus sign: Specify multiple lock operations on the same lock name with the plus sign lock operation indicator. For example: `LOCK +^a(1) LOCK +^a(1) LOCK +^a(1)` or `LOCK +^a(1),+^a(1),+^a(1)` or `LOCK +(^a(1),^a(1),^a(1))`. All of these would result in a lock table ModeCount of `Exclusive/3`. Using the plus sign is the recommended way to increment a lock.
- No sign: It is possible to increment a lock without using the plus sign lock operation indicator by specifying an atomic operation performing multiple locks. For example, `LOCK (^a(1),^a(1),^a(1))` unlocks all prior locks and

incrementally locks ^a(1) three times. This too would result in a lock table ModeCount of `Exclusive/3`. While this syntax works, it is not recommended.

Unlocking an incremented lock when not in a transaction simply decrements the lock count. Unlocking an incremented lock while in a transaction has the following default behavior:

- Decrementing Unlocks: each decrementing unlock immediately release the incremental unlock until the lock count is 1. By default, the final unlock puts the lock in delock state, deferring release of the lock to the end of the transaction. This is always the case when you delock with the minus sign lock operation indicator, whether or not the operation is atomic. For example: `LOCK -^a(1) LOCK -^a(1) LOCK -^a(1)` or `LOCK -^a(1),-^a(1),-^a(1)` or `LOCK -(^a(1),^a(1),^a(1))`. All of these begin with a lock table ModeCount of `Exclusive/3` and end with `Exclusive->Delock`.
- Unlocking Prior Resources: an operation that unlocks all prior resources immediately puts an incremented lock into a delock state until the end of the transaction. For example, either `LOCK x(3)` (lock with no lock operation indicator) or an argumentless **LOCK** would have the following effect: the incremented lock would begin with a lock table ModeCount of `Exclusive/3` and end with `Exclusive/3->Delock`.

Note that separate lock counts are maintained for the same lock as an Exclusive lock, a Shared lock, a Exclusive escalating lock and a Shared escalating lock. In the following example, the first unlock decrements four separate lock counts for lock ^a(1) by 1. The second unlock must specify all four of the ^a(1) locks to remove them. The **HANG** commands give you time to check the lock's ModeCount in the Lock Table.

```
LOCK +(^a(1),^a(1)#"E",^a(1)#"S",^a(1)#"SE")
LOCK +(^a(1),^a(1)#"E",^a(1)#"S",^a(1)#"SE")
HANG 10
LOCK -(^a(1),^a(1)#"E",^a(1)#"S",^a(1)#"SE")
HANG 10
LOCK -(^a(1),^a(1)#"E",^a(1)#"S",^a(1)#"SE")
```

If you attempt to unlock a lock name that has no current locks applied, no operation is performed and no error is returned.

Automatic Unlock

When a process terminates, InterSystems IRIS performs an implicit argumentless **LOCK** to clear all locks that were applied by the process. It removes both held locks and lock wait requests.

Locks on Global Variables

Locking is typically used with global variables to synchronize the activities of multiple processes that may access these variables simultaneously. Global variables differ from local variables in that they reside on disk and are available to all processes. The potential exists, then, for two processes to write to the same global at the same time. In fact, InterSystems IRIS processes one update before the other, so that one update overwrites and, in effect, discards the other.

Global lock names begin with a caret (^) character.

To illustrate locking with global variables, consider the case in which two data entry clerks are concurrently running the same student admissions application to add records for newly enrolled students. The records are stored in a global array named ^student. To ensure a unique record for each student, the application increments the global variable ^index for each student added. The application includes the **LOCK** command to ensure that each student record is added at a unique location in the array, and that one student record does not overwrite another.

The relevant code in the application is shown below. In this case, the **LOCK** controls not the global array ^student but the global variable ^index. ^index is a scratch global that is shared by the two processes. Before a process can write a record to the array, it must lock ^index and update its current value (SET ^index=^index+1). If the other process is already in this section of the code, ^index will be locked and the process will have to wait until the other process releases the lock (with the argumentless **LOCK** command).

```
READ !,"Last name: ",!,lname QUIT:lname=""  SET lname=lname_","
READ !,"First name: ",!,fname QUIT:fname=""  SET fname=fname_","
READ !,"Middle initial: ",!,minit QUIT:minit=""  SET minit=minit_":"
READ !,"Student ID Number: ",!,sid QUIT:sid=""
SET rec = lname_fname_minit_sid
LOCK ^index
SET ^index = ^index + 1
SET ^student(^index)=rec
LOCK
```

The following example recasts the previous example to use locking on the node to be added to the ^student array. Only the affected portion of the code is shown. In this case, the ^index variable is updated after the new student record is added. The next process to add a record will use the updated index value to write to the correct array node.

```
LOCK ^student(^index)
SET ^student(^index) = rec
SET ^index = ^index + 1
LOCK  /* release all locks */
```

Note that the lock location of an array node is where the top level global is mapped. InterSystems IRIS ignores subscripts when determining lock location. Therefore, ^student(name) is mapped to the namespace of ^student, regardless of where the data for ^student(name) is stored.

Locks in a Network

In a networked system, one or more servers may be responsible for resolving locks on global variables.

You can use the **LOCK** command with any number of servers, up to 255. A **LOCK** command can specify a maximum of 8 remote systems, and a maximum of 20 locks for each remote system.

You can use ^$LOCK to list remote locks, but it cannot list the lock state of a remote lock.

Remote locks held by a client job on a remote server system are released when you call the ^RESJOB utility to remove the client job.

Local Variable Locks

The behavior is as follows:

- Local (non-careted) locks acquired in the context of a specific namespace, either because the default namespace is an explicit namespace or through an explicit reference to a namespace, are taken out in the manager's dataset on the local machine. This occurs regardless of whether the default mapping for globals is a local or a remote dataset.
- Local (non-careted) locks acquired in the context of an implied namespace or through an explicit reference to an implied namespace on the local machine, are taken out using the manager's dataset of the local machine. An implied namespace is a directory path preceded by two caret characters: "^^*dir*".

Referencing explicit and implied namespaces is further described in Global Structure in *Using Globals*.

See Also

- $TEST special variable
- ^$LOCK structured system variable
- Lock Management in *Using ObjectScript*
- Using ObjectScript for Transaction Processing in *Using ObjectScript*
- The Monitoring Locks section of the “Monitoring InterSystems IRIS Using the Management Portal” chapter in *Monitoring Guide*
- The article *Locking and Concurrency Control*

MERGE

Merges global nodes or subtrees from source into destination.

```
MERGE:pc mergeargument,...
M:pc mergeargument,...
```

where *mergeargument* is:

```
destination=source
```

Arguments

pc	*Optional* — A postconditional expression.
destination and *source*	Local variables, process-private globals, or globals to be merged. If specified as a class property, the *source* variable must be a multidimensional (subscripted) variable.

Description

MERGE *destination=source* copies *source* into *destination* and all descendants of *source* into descendants of *destination*. It does not modify *source*, or kill any nodes in *destination*.

MERGE simplifies the copying of a subtree (multiple subscripts) of a variable to another variable. Either variable can be a subscripted local variable, process-private global, or global. A subtree is all variables that are descendants of a specified variable. **MERGE** offers a one-command alternative to the current technique for doing subtree copy: a series of **SET** commands with **$ORDER** references.

MERGE issues a <COMMAND> error if the *source* and *destination* have a parent-child relationship.

MERGE Execution

The **MERGE** command can take longer than most other ObjectScript commands to execute. As a result, it is more prone to interruption. The effect of interruption is implementation-specific. Under InterSystems IRIS, an interruption may cause an unpredictable subset of the source to have been copied to the destination subtree.

MERGE is a non-atomic operation. When executing **MERGE** while other processes are performing concurrent data modification operations, the contents of *destination* will be the state of the data at the time that **MERGE** was initiated, minus any variables that were **KILL**ed at the time the **MERGE** operation concluded. Other data modifications that occurred during **MERGE** processing may not be reflected in the contents of *destination*.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the **MERGE** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

destination and source

Variables to be merged. Either variable can be a local variable, a process-private global, or a global. If *destination* is undefined, **MERGE** defines it and sets it to *source*. If *source* is undefined, **MERGE** completes successfully, but does not change *destination*.

You can specify multiple, comma-separated *destination*=*source* pairs. They are evaluated in left-to-right order.

A *mergeargument* can reference a *destination*=*source* pair by indirection. For example, `MERGE @tMergeString`.

A *mergeargument* can be an array passed by reference that specifies a variable number of parameters, such in `myargs...`

The ^$GLOBAL SSVN can be the *source* variable. This copies the global directory to a *destination* variable. **MERGE** adds each global name as a *destination* subscript with a null value. This is shown in the following example:

```
MERGE gbls=^$GLOBAL("")
ZWRITE gbls
```

Examples

The following example copies a subtree from one global variable (^a) to another global variable (^b). In this case, the merge is being used to create a smaller global ^b, which contains only the ^a(1,1) subtree of the information in ^a.

```
SET ^a="cartoons"
SET ^a(1)="The Flintstones",^a(2)="The Simpsons"
SET ^a(1,1)="characters",^a(1,2)="place names"
SET ^a(1,1,1)="Flintstone family"
SET ^a(1,1,1,1)="Fred"
SET ^a(1,1,1,2)="Wilma"
SET ^a(1,1,2)="Rubble family"
SET ^a(1,1,2,1)="Barney"
SET ^a(1,1,2,2)="Betty"
MERGE ^b=^a(1,1)
WRITE ^b,!,^b(2),!,^b(2,1)," and ",^b(2,2)
```

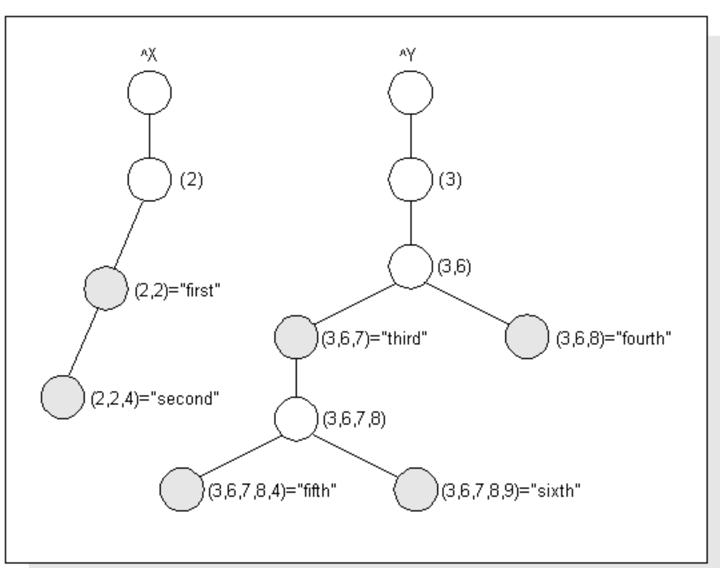
The following example shows how a destination global variable looks after it has been merged with a subtree of a source global variable.

Suppose you execute the following:

```
KILL ^X,^Y
SET ^X(2,2)="first"
SET ^X(2,2,4)="second"
SET ^Y(3,6,7)="third"
SET ^Y(3,6,8)="fourth"
SET ^Y(3,6,7,8,4)="fifth"
SET ^Y(3,6,7,8,9)="sixth"
WRITE ^X(2,2),!,^X(2,2,4),!
WRITE ^Y(3,6,7),!,^Y(3,6,8),!
WRITE ^Y(3,6,7,8,4),!,^Y(3,6,7,8,9)
```

The following figure shows the resulting logical structure of ^X and ^Y.

Figure B–2: Initial Structure of ^X and ^Y

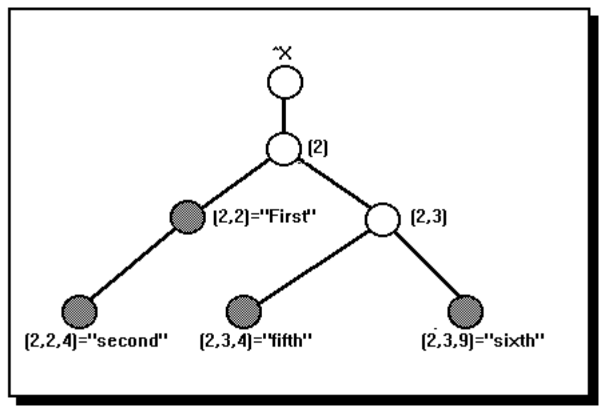


Consider the following **MERGE** command:

```
MERGE ^X(2,3)=^Y(3,6,7,8)
```

When you issue the previous statement, InterSystems IRIS copies part of ^Y into ^X(2,3). The global ^X now has the structure illustrated in the figure below.

Figure B–3: Result on ^X and ^Y of MERGE Command



Notes

Naked Indicator

When both *destination* and *source* are local variables, the naked indicator is not changed. If *source* is a global variable and *destination* is a local variable, then the naked indicator references *source*.

When both *source* and *destination* are global variables, the naked indicator is unchanged if *source* is undefined (**$DATA**(*source*)=0). In all other cases (including **$DATA**(*source*)=10), the naked indicator takes the same value that it would have if the **SET** command replaced the **MERGE** command and *source* had a value. For more details on the naked indicator, see Naked Global Reference in *Using Globals*.

Merge to Self

When the *destination* and *source* are the same variable, no merge occurs. Nothing is recorded in the journal file. However, the naked indicator may be changed, based on the rules described in the previous section.

Watchpoints

The **MERGE** command supports watchpoints. If a watchpoint is in effect, InterSystems IRIS triggers that watchpoint whenever that **MERGE** alters the value of a watched variable. To set watchpoints, use the **ZBREAK** command.

See Also

- ZBREAK command
- Debugging chapter in *Using ObjectScript*
- Global Structure chapter in *Using Globals*

NEW

Creates empty local variable environment.

```
NEW:pc newargument,...
N:pc newargument,...
```

where *newargument* can be:

```
variable,...
(variable,...)
```

Arguments

pc	*Optional* — A postconditional expression.
variable	*Optional* — Name of variable(s) to be added to the existing local variable environment. The effect of a **NEW** on existing local variables depends on whether *variable* is enclosed in parentheses (exclusive **NEW**) or is not enclosed in parentheses (inclusive **NEW**). A *variable* must be a valid local variable name, but does not have to be a defined variable; specifying an undefined variable neither issues an error nor defines the variable.

Description

The **NEW** command has two forms:

- Without an argument
- With an argument

NEW without an argument creates an empty local variable environment for a called subroutine or user-defined function. Existing local variable values are not available in this new local environment. They can be restored by returning to the previous local environment.

The action **NEW** with an argument performs depends on the argument form you use.

- **NEW** *variable* (*inclusive* **NEW**) retains the existing local variable environment and adds the specified variable(s) to it. If any of the specified local variables has the same name as an existing local variable, the old value for that named variable is no longer accessible in the current environment.
- **NEW** (*variable*) (*exclusive* **NEW**) replaces all existing variables in the local variable environment except the specified variable(s).

NEW Restrictions

The **NEW** command (inclusive or exclusive) cannot be used on the following:

- Globals
- Process-Private Globals
- Local variable subscripts
- Private variables
- Special variables, except $ESTACK, $NAMESPACE, and $ROLES

Attempting to use **NEW** in any of these contexts results in a <SYNTAX> error.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the **NEW** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

variable

Name of a single variable or a comma-separated list of variable names. You can specify only unsubscripted variable names, although you can **NEW** an entire array (that is, an array name without subscripts). You can specify undefined variable names or you can reuse the names of existing local variables. For an inclusive **NEW**, when you specify an existing local variable, InterSystems IRIS reinitializes that variable in the local environment, but saves its current value on the program stack and restores it after the subroutine or function terminates.

When a variable name or comma-separated list of variable names is enclosed in parentheses (exclusive **NEW**), InterSystems IRIS performs the opposite operation. That is, all local variables are reinitialized *except* the specified variable names, which retain their previous values. InterSystems IRIS saves the current values of all variables on the program stack and restores them after the subroutine or function terminates.

Examples

The following example illustrates an inclusive **NEW**, which keeps the existing local variables *a*, *b*, and *c*, and adds variables *d* and *e*, in this case, overlaying the prior value of *d*.

```
Main
  SET a=7,b=8,c=9,d=10
  WRITE !,"Before NEW:",!,"a=",a,!,"b=",b,!,"c=",c,!,"d=",d
  DO Sub1
  WRITE !,"Returned to prior context:"
  WRITE !,"a=",a,!,"b=",b,!,"c=",c,!,"d=",d
  QUIT
Sub1
  NEW d,e
  SET d="big number"
  WRITE !,"After NEW:",!,"a=",a,!,"b=",b,!,"c=",c,!,"d=",d
  QUIT
```

The following example illustrates an exclusive **NEW**, which removes all existing local variables except the specified variables *a* and *c*.

```
  SET a=7,b=8,c=9,d=10
  NEW (a,c)
  WRITE
```

Notes

Where to Use NEW

NEW allows you to insulate the current process's local variable environment from changes made by a subroutine, user-defined function, or **XECUTE** string. **NEW** is most frequently used within a subroutine called by the **DO** command.

The basic purpose of the **NEW** command is to redefine the local variable environment within a called subroutine or user-defined function. A subroutine or user-defined function called without parameter passing inherits its local variable environment from the calling routine. To redefine this environment for a subroutine or function, you can use **NEW** for all local variables (argumentless **NEW**), for named local variables (inclusive **NEW**) or for all local variables except the named variables (exclusive **NEW**).

Within a procedure, variables are either *private* or *public*:

- By default, local variables are *private* to that procedure. The procedure block uses private variables that do not interact with variables with the same names outside the procedure block. You cannot perform a **NEW** on a private variable; attempting an inclusive or exclusive **NEW** on a private variable within a procedure block results in a <SYNTAX> error.
- When declaring a procedure, you can explicitly list local variables as *public* variables. You can perform a **NEW** on a public variable within a procedure block. This **NEW** only affects the variable value within that procedure. You can repeatedly **NEW** a public variable within a procedure.

For further details, refer to "Procedure Variables" in *Using ObjectScript*.

Special considerations apply in the case of a subroutine called by the **DO** command with parameter passing. These considerations are described under "Subroutines with Parameter Passing".

NEW and KILL

Variables created by **NEW** do not require explicit and corresponding **KILL** commands. When a called subroutine or a user-defined function terminates, InterSystems IRIS executes an implicit **KILL** for each variable initialized by a **NEW** command within that subroutine or function.

Inclusive NEW

An inclusive **NEW** — **NEW** *variable* — retains the existing local variable environment and adds the specified variables to it. If an existing variable is named, the "new" variable replaces the existing variable, which is saved on the stack and then restored when the subroutine or function terminates.

Inclusive **NEW** does not restrict the number of variables you can specify as a comma-separated list. Inclusive **NEW** also does not limit the number of local variable environment levels (number of times **NEW** is issued).

In the following example, assume that the local variable environment of the calling routine (Main) consists of variables a, b, and c. When the **DO** calls Subr1, the **NEW** command redefines Subr1's local variable environment to new variable c and add variable d. After the **NEW**, the subroutine's environment consists of the existing variables a and b plus the new variables c and d. The variables a and b are inherited and retain their existing values. The new variables c and d are created undefined. Since c is the name of an existing local variable, the system saves the existing value on the stack and restores it when Subr1 **QUIT**s. Note that the first **SET** command in Subr1 references a and b to assign a value to d. Note that variable c in this context is undefined.

```
Main
    SET a=2,b=4,c=6
    WRITE !,"c in Main before DO: ",c
    DO Subr1(a,b,c)
    WRITE !,"c in Main after DO: ",c
    QUIT
Subr1(a,b,c)
    NEW c,d
    IF $DATA(c) {WRITE !,"c=",c}
     ELSE {WRITE !,"c in Subr1 is undefined"}
    SET d=a*b
    SET c=d*2
    WRITE !,"c in Subr1: ",c
    QUIT
```

When executed, this code produces the following results:

```
c before DO: 6
c in Subr1 is undefined
c in Subr1: 16
c after DO: 6
```

The results are the same whether passing parameters by value, as in the previous example, or passing parameters by reference:

```
Main
    SET a=2,b=4,c=6
    WRITE !,"c in Main before DO: ",c
    DO Subr1(.a,.b,.c)
    WRITE !,"c in Main after DO: ",c
    QUIT
Subr1(&a,&b,&c)
    NEW c,d
    IF $DATA(c) {WRITE !,"c=",c}
     ELSE {WRITE !,"c in Subr1 is undefined"}
    SET d=a*b
    SET c=d*2
    WRITE !,"c in Subr1: ",c
    QUIT
```

Note that variable *c* is passed to Subr1 and then immediately redefined using **NEW**. In this case, passing variable *c* was unnecessary; the program results are identical whether or not *c* is passed. If you **NEW** any of the variables named in the subroutine's formal parameter list, you render them undefined and make their passed values inaccessible.

Exclusive NEW

An exclusive **NEW** — `NEW (var1,var2)` — replaces the entire existing local variable environment except the specified variables. If an existing variable is named, it is retained and can be referenced in the new environment. However, any changes made to such a variable are reflected in the existing variable when the function or subroutine terminates.

An exclusive **NEW** can specify a maximum of 255 variables as a comma-separated list. Exceeding this number causes InterSystems IRIS to issue a <SYNTAX> error.

Exclusive **NEW** (`NEW (x,y,z)`) temporarily removes local variables from the current scope. This can affect local variables created by InterSystems IRIS objects. For example, InterSystems IRIS maintains %objcn which is the cursor pointer for InterSystems IRIS object queries. Removing this from the current scope can result in collisions with other internal structures. Therefore, do not use exclusive **NEW** in any context where it might affect system structures.

Attempting to issue more than 31 levels of exclusive **NEW** or argumentless **NEW** results in a <MAXSCOPE> error.

When using exclusive **NEW** in a **FOR** code block, you must specify the **FOR** count variable as an excluded variable. For further details, refer to the FOR command.

In the following example, assume that the local variable environment of the calling routine (Start) consists of variables *a*, *b*, and *c*. When the **DO** calls Subr1, the **NEW** command redefines Subr1's local variable environment to exclude all variables except *c* and *d*.

After the **NEW**, the subroutine's environment consists only of the new variables *c* and *d*. The new variable *c* is retained from the calling routine's environment and keeps its existing value. The new variable *d* is created undefined.

The first **SET** command in Subr1 references *c* to assign a value to *d*. The second **SET** command assigns a new value (24) to *c*. When the subroutine **QUIT**s, *c* will have this updated value (and not the original value of 6) in the calling routine's environment.

```
Start    SET a=2,b=4,c=6
    DO Subr1
    WRITE !,"c in Start: ",c
    QUIT
Subr1    NEW (c,d)
    SET d=c+c
    SET c=d*2
    WRITE !,"c in Subr1: ",c
    QUIT
```

When executed, this code produces the following results:

c in Subr1: 24

c in Start: 24

Argumentless NEW

The argumentless **NEW** provides an empty local variable environment for a called subroutine or user-defined function. The existing local variable environment (in the calling routine) is saved and then restored when the subroutine or function terminates. Any variables created after the **NEW** are deleted when the subroutine or function terminates.

If a command follows the **NEW** on the same line, be sure to separate the **NEW** command from the command following it by (at least) two spaces.

Argumentless **NEW** should not be used within the body of a **FOR** loop or in a context in which it can affect InterSystems IRIS objects.

Attempting to issue more than 31 levels of exclusive **NEW** or argumentless **NEW** results in a <MAXSCOPE> error.

Special Variables: $ESTACK, $NAMESPACE, and $ROLES

You cannot use **NEW** on most special variables; attempting to do so results in a <SYNTAX> error. There are three exceptions: **$ESTACK**, **$NAMESPACE**, and **$ROLES**. When you issue the command `NEW $NAMESPACE`, the system creates a new namespace context. Within this context you can change the namespace. When you exit this context (with **QUIT**, for example) InterSystems IRIS reverts to the prior namespace.

Subroutines with Parameter Passing

If you call a subroutine with parameter passing, InterSystems IRIS issues an implicit **NEW** command for each of the variables named in the subroutine's formal parameter list. It then assigns the values passed in the **DO** command's actual parameter list (by value or by reference) to these variables.

If the **DO** command uses parameter passing by value and if the formal list names any existing local variables, InterSystems IRIS places the existing variables and their values on the stack. When the subroutine terminates (with either an explicit or an implicit **QUIT**), InterSystems IRIS issues an implicit **KILL** command for each of the formal list variables to restore them from the stack.

See Also

- DO command
- QUIT command
- SET command
- $NAMESPACE special variable

OPEN

Acquires ownership of a device or file for input/output operations.

```
OPEN:pc device:(parameters):timeout:"mnespace",...
O:pc device:(parameters):timeout:"mnespace",...
```

Arguments

pc	*Optional* — A postconditional expression.
device	The device to be opened, specified by a device ID or a device alias. A device ID can be an integer (a device number), a device name, or the pathname of a sequential file. If a string, it must be enclosed with quotation marks. The maximum length of *device* is 256 characters.
parameters	*Optional* — The list of parameters used to set device characteristics. The parameter list is enclosed in parentheses, and the parameters in the list are separated by colons. Parameters can either be positional (specified in a fixed order in the parameter list) or keyword (specified in any order). A mix of positional and keyword parameters is permitted. The individual parameters and their positions and keywords are highly device-dependent.
timeout	*Optional* — The number of seconds to wait for the request to succeed, specified as an integer. Fractional seconds are truncated to the integer portion. If omitted, InterSystems IRIS waits indefinitely.
mnespace	*Optional* — The name of the mnemonic space that contains the control mnemonics to use with this device, specified as a quoted string.

Description

Use the **OPEN** command to acquire ownership of a specified device (or devices) for input/output operations. An **OPEN** retains ownership of the device until ownership is released with the **CLOSE** command.

An **OPEN** command can be used to open multiple devices by using a comma to separated the specifications for each device. Within the specification of a device, its arguments are separated by using colons (:). If an argument is omitted, the positional colon must be specified; however, trailing colons are not required.

The **OPEN** command can be used to open devices such as terminal devices, spool devices, TCP bindings, interprocess pipes, named pipes, and interjob communications.

The **OPEN** command can also be used to open a sequential file. The *device* argument specifies the file pathname as a quoted string. The *parameters* argument specifies the parameters governing the sequential file. These parameters can include the option of creating a new file if the specified file does not exist. Specifying the *timeout* argument, though optional, is strongly encouraged when opening a sequential file.

Sequential file open option defaults are set for the current process using the %SYSTEM.Process class **OpenMode()** and **FileMode()** methods, and system-wide by using the Config.Miscellaneous class *OpenMode* and *FileMode* properties. For much more details on opening sequential files, see Sequential File I/O in the *I/O Device Guide*.

The **OPEN** command is *not* used to access an InterSystems IRIS database file.

On Windows, ObjectScript allocates each process an open file quota between database files and files opened with **OPEN**. When **OPEN** causes too many files to be allocated to **OPEN** commands, you receive a <TOOMANYFILES> error. The InterSystems IRIS maximum number of open files for a process is 1,024. The actual maximum number of open files for each process is a platform-specific setting. For example, Windows defaults to a maximum of 998 open files per process. Consult the operating system documentation for your system.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the **OPEN** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the **OPEN** command if the postconditional expression is false (evaluates to zero). Only one postconditional is permitted, even if the **OPEN** command opens multiple devices or files. For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

device

The device to be opened. You can specify the device using any of the following:

- Physical device number, specified as a positive integer. For example, 2 is always the spooler device. This number is internal to InterSystems IRIS and is unrelated to device numbers assigned by the platform operating system.
- Device ID, specified as a quoted string. For example, `"|TRM|:|4294318809"`. This value for the current device is found in the **$IO** special variable.
- Device alias, specified as a positive integer. A device alias refers to a physical device number.
- File pathname, specified as a quoted string. This is used for opening sequential files. A pathname can be canonical (c:\myfiles\testfile) or relative to the current directory (\myfiles\testfile). In UNIX pathnames, you can use tilde (~) expansion to indicate the current user's home directory. For example: ~myfile or ~/myfile.

The maximum length of *device* is 256 characters for Windows and UNIX®. See "Specifying the Device" for more information.

parameters

The list of parameters used to set operating characteristics of the device to be opened. The enclosing parentheses are required if there is more than one parameter. (It's good programming practice to always use parentheses when you specify a parameter.) Note the required colon before the left parenthesis. Within the parentheses, colons are used to separate multiple parameters.

The parameters for a device can be specified using either positional parameters or keyword parameters. You can also mix positional parameters and keyword parameters within the same parameter list.

In most cases, specifying contradictory, duplicate, or invalid parameter values does not result in an error. Wherever possible, InterSystems IRIS ignores inappropriate parameter values and takes appropriate defaults.

If you do not specify a list of parameters, InterSystems IRIS uses the device's default parameters. The default parameters for a device are configurable. Go to the Management Portal, select **System Administration**, **Configuration**, **Device Settings**, **Devices** to display the current list of devices. For the desired device, click "edit" to display its **Open Parameters:** option. Specify this value in the same way you specify the **OPEN** command parameters, including the enclosing parentheses. For example, `("AVL":0:2048)`.

The available parameters are specific to the type of device that is being opened. For more information on device parameters, see I/O Devices and Commands in *I/O Device Guide*.

Positional Parameters

Positional parameters must be specified in a fixed sequence in the parameter list. You can omit a positional parameter (and receive the default value), but you must retain the colon to indicate the position of the omitted positional parameter. Trailing colons are not required; excess colons are ignored. The individual parameters and their positions are highly device-dependent. There are two types of positional parameters: values and letter code strings.

A value can be an integer (for example, record size), a string (for example, host name), or a variable or expression that evaluates to a value.

A letter code string uses individual letters to specify device characteristics for the open operation. For most devices, this letter code string is one of the positional parameters. You can specify any number of letters in the string, and specify the letters in any order. Letter codes are not case-sensitive. A letter code string is enclosed in quotation marks; no spaces or other punctuation is allowed within a letter code string (exception: K and Y may be followed by a name delimited by backslashes: thus: K\name\). For example, when opening a sequential file, you might specify a letter code string of “ANDFW” (append to existing file, create new file, delete file, fix-length records, write access.) The position of the letter code string parameter, and the meanings of individual letters is highly device-dependent.

Keyword Parameters

Keyword parameters can be specified in any sequence in the parameter list. A parameter list can consist entirely of keyword parameters, or it can contain a mix of positional and keyword parameters. (Commonly, the positional parameters are specified first (in their correct positions) followed by the keyword parameters.) You must separate all parameters (positional or keyword) with a colon (:). A parameter list of keyword parameters has the following general syntax:

```
OPEN device:(/KEYWORD1=value1:/KEYWORD2=value2:.../KEYWORDn=valuen):timeout
```

The individual parameters and their positions are highly device-dependent. As a general rule, you can specify the same parameters and values using either a positional parameter or a keyword parameter. You can specify a letter code string as a keyword parameter by using the /PARAMS keyword.

timeout

The number of seconds to wait for the **OPEN** request to succeed. The preceding colon is required. *timeout* must be specified as an integer value or expression. If *timeout* is set to zero (0), **OPEN** makes a single attempt to open the file. If the attempt fails, the **OPEN** immediately fails. If the attempt succeeds it successfully opens the file. If *timeout* is not set, InterSystems IRIS will continue trying to open the device until the **OPEN** is successful or the process is terminated manually. If you use the *timeout* option and the device is successfully opened, InterSystems IRIS sets the **$TEST** special variable to 1 (TRUE). If the device cannot be opened within the timeout period, InterSystems IRIS sets **$TEST** to 0 (FALSE). Note that **$TEST** can also be set by the user, or by a **JOB**, **LOCK**, or **READ** timeout.

mnespace

The name of the mnemonic space that contains the device control mnemonics used by this device. By default, InterSystems IRIS provides the mnemonic space ^%X364 (ANSI X3.64 compatible) for devices and sequential files. Default mnemonic spaces are assigned by device type.

Go to the Management Portal, select **System Administration**, **Configuration**, **Device Settings**, **IO Settings**. View and edit the File, Terminal, or Other mnemonic space setting.

A mnemonic space is a routine that contains entry points for the device control mnemonics used by **READ** and **WRITE** commands. The **READ** and **WRITE** commands invoke these device control mnemonics using the /*mnemonic*(*params*) syntax. These device control mnemonics perform operations such a moving the cursor to a specified screen location.

Use the *mnespace* argument to override the default mnemonic space assignment. Specify an ObjectScript routine that contains the control mnemonics entry points used with this device. The enclosing double quotes are required. Specify this option only if you plan to use device control mnemonics with the **READ** or **WRITE** command. If the mnemonic space does not exist, a <NOROUTINE> error is returned. For further details on mnemonic spaces, see I/O Devices and Commands in the *I/O Device Guide*.

Examples

In the following example, the **OPEN** command attempts to acquire ownership of device 2 (the spooler). The first positional parameter (3) specifies the file number within the ^SPOOL global and the second positional parameter (12) specifies the line number within the file. If you later use the **USE** command to make this the current device (that is, `USE 2`), ObjectScript sends subsequent output to the spooler.

```
OPEN 2:(3:12)
```

In the following example, the **OPEN** command attempts to acquire ownership of the sequential file CUSTOMER within the timeout period of 10 seconds.

```
OPEN "\myfiles\customer"::10
```

Note that because no parameters are specified, the parentheses are omitted, but the colon must be present.

The following example opens a sequential file named Seqtest; the letter code positional parameter is ”NRW”. The “N” letter code specifies that if the file does not exist, create a new sequential file with this name. The “R” and “W” letter codes specify that the file is being opened for reading and writing. The timeout is 5 seconds.

```
NEW $NAMESPACE
SET $NAMESPACE="%SYS"
SET dir=##class(%SYSTEM.Process).CurrentDirectory()  ; determine InterSystems IRIS directory
SET seqfilename=dir_"Samples\Seqtest"
OPEN seqfilename:("NRW"):5
  WRITE !,"Opened a sequential file named Seqtest"
  USE seqfilename
  WRITE "a line of data for the sequential file"
CLOSE seqfilename:"D"
WRITE !,"Closed and deleted Seqtest"
QUIT
```

This example requires that UnknownUser have assigned the %DB_IRISSYS role.

Notes

Device Ownership and the Current Device

OPEN establishes ownership of the specified device. The process retains ownership of the device until the process either terminates or releases the device with a subsequent **CLOSE** command. While a device is owned by a process, no other process can acquire or use the device.

A process can own multiple devices at the same time. However, only one device can be the current device. You establish an owned device as the current device with the **USE** command. The ID of the current device is found in the $IO special variable.

A process always owns at least one device (designated as device 0), which is its principal device. This device is assigned to the process when it is started and is typically the terminal used to sign onto InterSystems IRIS. The ID of the principal device is found in the $PRINCIPAL special variable.

When a process terminates, InterSystems IRIS issues an implicit **CLOSE** for each of the devices owned by the process and returns them to the pool of available devices.

Changing Parameters for an Owned Device

To change the parameters for a device that is already owned by the process, you can:

- Close and then reopen the device with new parameter values.
- If the device is a terminal or TCP device, you can issue an **OPEN** with new parameter values on an already open device.

If you specify the device on another **OPEN** command, any device parameters set by the initial **OPEN** command remain in effect unless explicitly changed. Depending on the type of device, subsequent I/O may be different than if you had closed and then reopened the device.

For some devices, you can omit the parameters option and later set the desired characteristics with the parameters option on the **USE** command.

Specifying the Device

When you open a device, you can identify the device by supplying a device number or an alias assigned to the device.

Using Physical Device Numbers

InterSystems IRIS allows you to identify certain devices by supplying their system-assigned physical device numbers. All implementations of InterSystems IRIS recognize the following physical device numbers:

- 0 = The process's principal device (usually the device at which you sign on).
- 2 = The spooler (to store output for later printing).
- 63 = The view buffer.

OPEN 63 accepts a namespace, as shown in the following example:

```
OPEN 63:"SAMPLES"
```

If you specify a nonexistent namespace, InterSystems IRIS issues a <NAMESPACE> error. If you specify a namespace for which you do not have privileges, InterSystems IRIS issues a <PROTECT> error.

Device 3 is an invalid device; attempting to open it returns a <NOTOPEN> error without waiting for *timeout* expiration.

See About I/O Devices in *I/O Device Guide* for more information about device numbers.

Using a Device Alias

An alias is an alternate numeric device ID. It must be a valid device number, it must be unique and cannot conflict with an assigned device number.

You can establish a numeric alias for a device. Go to the Management Portal, select **System Administration**, **Configuration**, **Device Settings**, **Devices** to display the current list of devices and their aliases. For the desired device, click "edit" to edit its **Alias:** option.

After you have assigned an alias to a device, you can use the **OPEN** command or the %IS utility to open the device using this alias.

Exceeding the Open File Quota

InterSystems IRIS allocates each process' open file quota between database files and files opened with **OPEN**. When **OPEN** causes too many files to be allocated to **OPEN** commands, you receive a <TOOMANYFILES> error. The InterSystems IRIS maximum number of open files for a process is 1,024. The actual maximum number of open files for each process is a platform-specific setting. For example, Windows defaults to a maximum of 998 open files per process.

Default Record Length

If the record size for sequential files is not specified in the **OPEN** command, InterSystems IRIS assumes a default record length of 32,767 characters.

See Also

- CLOSE command
- USE command
- $TEST special variable
- $IO special variable
- I/O Devices and Commands in *I/O Device Guide*
- Terminal I/O in *I/O Device Guide*

- TCP Client/Server Communication in *I/O Device Guide*
- Sequential File I/O in *I/O Device Guide*
- The Spool Device in *I/O Device Guide*
- ^%IS global and %IS utility in *I/O Device Guide*

QUIT

Terminates execution of a loop structure or a routine.

```
QUIT:pc expression
Q:pc expression

QUIT n
Q n
```

Arguments

pc	*Optional* — A postconditional expression.
expression	*Optional* — A value to return to the invoking routine; a valid expression.
n	*Optional* — *Terminal prompt only*: The number of program levels to clear; an expression that resolves to a positive integer.

Description

The **QUIT** command is used in two different contexts:

- QUIT in program code
- QUIT at the Terminal prompt

In Program Code

The **QUIT** command terminates execution of the current context, exiting to the enclosing context. When invoked in a routine, **QUIT** returns to the calling routine, or terminates the program if there is no calling routine. When invoked from within a **FOR**, **DO WHILE**, or **WHILE** flow-of-control structure, or a **TRY** or **CATCH** block, the **QUIT** breaks out of the structure and continues execution with the next command outside of that structure.

The similar RETURN command terminates execution of a routine at any point, including from within a **FOR**, **DO WHILE**, or **WHILE** loop or nested loop structure, or a **TRY** or **CATCH** block. **RETURN** always exits the current routine, returning to the calling routine or terminating the program if there is no calling routine.

The **QUIT** command has two forms:

- Without an argument
- With an argument

A postconditional is not considered an argument. The **$QUIT** special variable indicates whether or not an argumented **QUIT** command is required to exit from the current context. Two $ECODE error codes are provided for this purpose: M16 “Quit with an argument not allowed” and M17 “Quit with an argument required.”

QUIT Without an Argument

QUIT without an argument exits from the current context without returning a value. It is used to terminate the execution level of a process started with a **DO** or **XECUTE** command, or to exit from a **FOR**, **DO WHILE**, or **WHILE** flow-of-control loop.

If **DO**, **XECUTE**, or an (unnested) flow-of-control loop command was issued from the Terminal prompt, **QUIT** returns control to the Terminal. If the terminated operation contains any **NEW** commands before **QUIT**, **QUIT** automatically **KILL**s the affected variables and restores them to their original values.

QUIT With an Argument

QUIT *expression* terminates a user-defined function or an object method and returns the value resulting from the specified expression. **QUIT** with an argument cannot be used to exit a routine from within a **FOR**, **DO WHILE**, or **WHILE** command loop. **QUIT** with an argument also cannot be used to exit from within a **TRY** block or a **CATCH** block.

If an argumented **QUIT** is invoked inside a subroutine, one of the following occurs:

- If an argumented **QUIT** is invoked inside a subroutine (instead of a function), the **QUIT** argument is evaluated (which may produce side effects or throw an error) and the argument result is discarded. Execution returns to the caller of the subroutine.
- If the subroutine was called by a **DO** command and is in the scope of that **DO** argument, then the **QUIT** command evaluates its argument (and any side effects of that evaluation occur), but it does not return the argument. For example, a subroutine called by **DO** that concludes with `QUIT 4/0` generates a <DIVIDE> error.

At the Terminal Prompt

Issuing a **QUIT** at the Terminal prompt clears entities from the program stack.

- **QUIT *n*** clears the specified number of levels from the program stack. You can use the $STACK special variable to determine the current number of levels on the program stack.

  You can specify *n* as a literal, a variable, or an arithmetic expression. If *n* is larger than the current number of levels, all levels are cleared from the program stack and no error is issued. A fractional number for *n* is truncated to its integer value. If *n* resolves to a negative non-zero integer, **QUIT** clears all levels from the program stack. If *n* resolves to 0 (zero), the system generates a <COMMAND> error.
- **QUIT** clears all levels from the program stack.

The **$STACK** special variable contains the current number of context frames on the call stack. This number is also displayed as part of the Terminal prompt.

The following example use **QUIT** with an integer argument to clear the specified number of levels from the program stack, then uses argumentless **QUIT** to clear all remaining levels:

```
USER 5f0>QUIT 1

USER 4d0>QUIT 2

USER 2d0>QUIT

USER>
```

For further details see Processing Errors at the Terminal Prompt in the "Error Processing" chapter of *Using ObjectScript*.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*. If the **QUIT** command takes no other arguments, there must be two or more spaces between the postconditional and the next command following it on the same line.

expression

Any valid ObjectScript expression. It can be used only within a user-defined function to return the evaluated result to the calling routine.

Examples

The following two examples contrast **QUIT** and **RETURN** behavior when issued from within a flow-of-control structure. **QUIT** exits the **FOR** loop, continuing with the remainder of MySubroutine before returning to MyRoutine. **RETURN** exits MySubroutine, returning to MyRoutine.

```
MyMain
  WRITE "In the main routine",!
  DO MySubroutine
  WRITE "Returned to main routine",!
  QUIT
MySubroutine
  WRITE "In MySubroutine",!
  FOR i=1:1:5 {
    WRITE "FOR loop:",i,!
    IF i=3 QUIT
    WRITE "  loop again",!
  }
  WRITE "MySubroutine line displayed with QUIT",!
  QUIT
```

```
MyMain
  WRITE "In the main routine",!
  DO MySubroutine
  WRITE "Returned to main routine",!
  QUIT
MySubroutine
  WRITE "In MySubroutine",!
  FOR i=1:1:5 {
    WRITE "FOR loop:",i,!
    IF i=3 RETURN
    WRITE "  loop again",!
  }
  WRITE "MySubroutine line not displayed with RETURN",!
  QUIT
```

In the following example, execution of the first **QUIT** command is controlled by a postconditional (:x>46). If the randomly generated number is greater than 46 InterSystems IRIS does not perform the Cube procedure; the first **QUIT** takes the postconditional, returning a string to the calling routine as *num*. If the randomly generated number is less than or equal to 46 the second **QUIT** returns the results of the expression *x*x*x* as *num*.

```
Main
  SET x = $RANDOM(99)
  WRITE "Number is: ",x,!
  SET num=$$Cube(x)
  WRITE "Cube is: ",num
  QUIT
Cube(x) QUIT:x>46 "a six-digit number."
  WRITE "Calculating the cube",!
  QUIT x*x*x
```

The following two examples contrast **QUIT** and **RETURN** behavior with **TRY** and **CATCH**. The **TRY** block attempts a divide-by-zero operation, invoking the **CATCH** block; this **CATCH** block contains a nested **TRY** block which is exited by either a **QUIT** or a **RETURN**. (For the purpose of demonstration, these programs do not include the recommended code (**QUIT** or **RETURN**) to prevent “fall-through”.)

QUIT exits the nested **TRY** block to the enclosing block, continuing execution with the remainder of the **CATCH** block. When it completes the **CATCH** block it execute the fall-through line outside of the **TRY**/**CATCH** structures:

```
TRY {
  WRITE "In the TRY block",!
  SET x = 5/0
  WRITE "This line should never display"
}
CATCH exp1 {
  WRITE "In the CATCH block",!
  WRITE "Error Name: ",$ZCVT(exp1.Name,"O","HTML"),!
    TRY {
      WRITE "In the nested TRY block",!
      QUIT
    }
    CATCH exp2 {
      WRITE "In the nested CATCH block",!
      WRITE "Error Name: ",$ZCVT(exp1.Name,"O","HTML"),!
    }
  WRITE "QUIT displays this outer CATCH block line",!
}
WRITE "fall-through at the end of the program"
```

RETURN exits the routine. It therefore exits the nested **TRY** block and any enclosing blocks, and does not execute the fall-through line outside of the **TRY**/**CATCH** structures:

```
TRY {
  WRITE "In the TRY block",!
  SET x = 5/0
  WRITE "This line should never display"
}
CATCH exp1 {
  WRITE "In the CATCH block",!
  WRITE "Error Name: ",$ZCVT(exp1.Name,"O","HTML"),!
    TRY {
      WRITE "In the nested TRY block",!
      RETURN
    }
    CATCH exp2 {
      WRITE "In the nested CATCH block",!
      WRITE "Error Name: ",$ZCVT(exp1.Name,"O","HTML"),!
    }
  WRITE "RETURN does not display this outer CATCH block line",!
}
WRITE "fall-through at the end of the program"
```

In this example, the argument of the **QUIT** command is an object method. InterSystems IRIS terminates execution of the method and returns control to the calling routine.

```
 QUIT inv.TotalNum()
```

Notes

QUIT Restores Variables

If a terminated process contains any **NEW** commands before **QUIT**, **QUIT** automatically **KILL**s the affected variables and restores them to their original values.

QUIT and Flow-of-Control Structures

A **QUIT** can be used to break out of a **FOR** loop, a **DO WHILE** loop, or a **WHILE** loop. Execution continues with the command that follows the end of the loop structure. If these loop structures are nested, the **QUIT** breaks out of the inner loop from which it was called to the next enclosing outer loop.

If a **QUIT** command is encountered within an **IF** code block (or an **ELSEIF** code block or an **ELSE** code block) the **QUIT** behaves as a regular **QUIT** command, as if the code block did not exist:

- If the **IF** code block is nested within a loop structure (such as a **FOR** code block), the **QUIT** exits the loop structure block and continues execution with the command that follows the loop structure code block.
- If the **IF** code block is *not* nested within a loop structure, the **QUIT** terminates the current routine.

Use with Indefinite FOR Loop

An indefinite **FOR** loop is a **FOR** without an argument; unless broken out of, it will loop infinitely. To control an indefinite **FOR** loop, you must include within the loop structure either a **QUIT** with a postconditional, or an **IF** command that invokes a **QUIT**. The **QUIT** within the **IF** terminates the enclosing **FOR** loop. Without one of these **QUIT**s, the loop will be an infinite loop and will execute endlessly.

In the following example, the indefinite **FOR** loop is exited using a **QUIT** with a postconditional. The loop continues to execute as long as the user enters some value in response to the "`Text =`" prompt. Only when the user enters a null string (that is, just presses Return or Enter) is **QUIT** executed and the loop terminated.

```
Main
  FOR   {
    READ !,"Text =",var1
    QUIT:var1=""  DO Subr1
    }
Subr1
   WRITE "Thanks for the input", !
   QUIT
```

This command requires at least two spaces between the postconditional on the **QUIT** command and the following **DO** command on the same line. This is because InterSystems IRIS treats postconditionals as *command modifiers*, not as arguments.

Implicit QUIT

In the following cases, a **QUIT** command is not required, because InterSystems IRIS automatically issues an implicit **QUIT** to prevent execution "falling through" to a separate unit of code.

- InterSystems IRIS executes an implicit **QUIT** at the end of a routine.
- InterSystems IRIS executes an implicit **QUIT** when it encounters a label with parameters. A label with parameters is defined as one with parentheses, even if the parentheses contain zero parameters. All procedures begin with a label with parameters (even if no parameters are defined). Many subroutines and functions also have a label with parameters.

You can, of course, code an explicit **QUIT** in any of these circumstances.

Behavior with DO

When encountered in a subroutine called by the **DO** command, **QUIT** terminates the subroutine and returns control to the command following the **DO** command.

Behavior with XECUTE

When encountered in a line of code that is being executed, **QUIT** terminates execution of the line and returns control to the command following the **XECUTE** command. No argument is allowed.

Behavior with User-Defined Functions

When encountered in a user-defined function, **QUIT** terminates the function and returns the value that results from the specified expression. The expression argument is required.

In their use, user-defined functions are similar to **DO** commands with parameter passing. They differ from such **DO** commands, however, in that they return the value of an expression directly, rather than through a variable. To invoke a user-defined function, use the form:

$$*name*(*parameters*)

where *name* is the name of the function. It can be specified as *label*, *^routine*, or *label^routine*.

parameters is a comma-separated list of parameters to be passed to the function. The *label* associated with the function must also have a parameter list. The parameter list on the invoked function is known as the *actual parameter list*. The parameter list on the function label is known as the *formal parameter list*.

In the following example, the **FOR** loop uses a **READ** command to first acquire the number to be squared and store it in the *num* variable. (Note the two spaces after the argumentless **FOR** and the postconditional **QUIT**.) It then uses a **WRITE** command to invoke the Square standard function, with *num* specified as the function parameter.

The only code for the function is the **QUIT** command followed by an expression to calculate the square. When it encounters the **QUIT** command, InterSystems IRIS evaluates the expression, terminates the function, and returns the resulting value directly to the **WRITE** command. The value of *num* is not changed.

```
Test  WRITE "Calculate the square of a number",!
  FOR   {
    READ !,"Number:",num QUIT:num=""
    WRITE !,$$Square(num),!
    QUIT
  }
Square(val)
  QUIT val*val
```

Using QUIT for Program Readability

InterSystems IRIS executes an implicit **QUIT** at the end of each routine, but you can include it explicitly to improve program readability.

See Also

- DO command
- DO WHILE command
- FOR command
- NEW command
- RETURN command
- WHILE command
- XECUTE command
- $ECODE special variable
- $ESTACK special variable
- $QUIT special variable
- $STACK special variable

READ

Accepts input and stores it in a variable.

```
READ:pc readargument,...
R:pc readargument,...
```

where *readargument* can be:

```
fchar
prompt
variable:timeout
*variable:timeout
variable#length:timeout
```

Arguments

pc	*Optional* — A postconditional expression.
fchar	*Optional* — One or more format control characters. Permitted characters are !, #, ?, and /.
prompt	*Optional* — A string literal that provides a prompt or message for user input. Enclose in quotation marks.
variable	The variable to receive the input data. Can be a local variable, a process-private global, or a global. May be unsubscripted or subscripted.
length	*Optional* — The number of characters to accept, specified as an integer, or an expression or variable that evaluates to an integer. The preceding # symbol is mandatory.
timeout	*Optional* — The number of seconds to wait for the request to succeed, specified as an integer. Fractional seconds are truncated to the integer portion. The preceding colon (:) is mandatory. If omitted, InterSystems IRIS waits indefinitely.

You can specify more that one *fchar* or *prompt* argument by separating the arguments with commas.

Description

The **READ** command accepts input from the current device. The current device is established using the **OPEN** and **USE** commands. The **$IO** special variable contains the device ID of the current device. By default, the current device is the user terminal.

The **READ** command suspends program execution until it either receives input from the current device or times out. For this reason, the **READ** command should not be used in programs executed as background (non-interactive) jobs if the current device is the user terminal.

The *variable* argument receives the input characters. **READ** first defines *variable*, if it is undefined, or clears it if it has a previous value. Therefore, if no data is input for *variable* (for example, if the **READ** times out before any characters are entered) *variable* is defined and contains the null string. This is also true if the only character entered is a terminator character (for example, pressing the <Enter> key from the user terminal). For the effects of an interrupt (for example, <Ctrl-C>) see below.

Note that for fixed-length and variable-length reads, *variable* does not store the terminator character used to terminate the read operation. Single-character reads handle *variable* differently; for single-character read use of *variable*, see below.

If you specify the optional timeout value, a **READ** can time out before all characters are input. If a **READ** times out, those characters input before the timeout are stored in *variable*. Entering a terminator character is not necessary in this case; the characters entered before the timeout are transferred to *variable*, and the **READ** terminates, setting **$TEST** equal to 0.

There are three types of **READ** operations: variable-length read, fixed-length read, and single-character read. All of these can be specified with or without a timeout argument. A single **READ** command can include multiple **READ** operations in any combination of these three types. Each read operation is executed independently in left-to-right sequence. A **READ** command can also contain any number of comma-separated *prompt* and *fchar* arguments.

The three types of **READ** operations are as follows:

- A variable-length read has the following format:

  READ *variable*

  A variable-length read accepts any number of input characters and stores them in the specified *variable*. Input is concluded by a terminator character. For a terminal, this terminator is usually supplied by pressing the <Enter> key. The input characters, but not the terminator character, are stored in *variable*.

- A fixed-length read has the following format:

  READ *variable#length*

  A fixed-length read accepts a maximum of *length* input characters and stores them in the specified *variable*. Input concludes automatically when the specified number of characters is input, or when a terminator character is encountered. For example, entering two characters in a four-character fix-length read, and then pressing the <Enter> key. The input characters, but not the terminator character (if any), are stored in *variable*.

- A single-character read has the following format:

  READ **variable*

  A single-character read accepts a single input character and stores its ASCII numeric value equivalent in the specified *variable*. It stores the character itself in the **$ZB** and **$KEY** special variables. Input concludes automatically when a single character is input. A terminator character is considered a single-character input, and is stored as such. If the optional *timeout* argument is specified, and a timeout occurs, the timeout sets *variable* to –1.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

fchar

Any of the following format control codes. When used with user input from the keyboard, these controls determine where a specified *prompt* or the user input area will appear on the screen.

! starts a new line. You may specify multiple exclamation points

starts a new page. On a terminal, it clears the current screen and starts at the top of the new screen.

?n positions at the *n*th column location, where *n* is a positive integer.

/*keyword*(*parameters*) A device control mnemonic. Performs a device-specific operation, such as positioning the cursor on a video terminal. The slash character (/) is followed by a keyword, which is optionally followed by one or more parameters enclosed in parentheses. Multiple parameters are separated by commas. The keyword is an entry point label into the current device’s mnemonic space routine.

You can establish the default mnemonic space for a device type in either of the following ways:

- Go to the Management Portal, select **System Administration**, **Configuration**, **Device Settings**, **IO Settings**. View and edit the File, Other, or Terminal mnemonic space setting.
- Include the /mnemonic space parameter in the **OPEN** or **USE** command for the device.

You can specify multiple format controls. For example: `#!!!?20` means to start at the top of a new page (or screen), go down three lines, and then position to column 20. You can intersperse format control characters with other comma-separated **READ** arguments. For example:

```
READ #!!,"Please enter",!,"your name: ",x,"THANK YOU"
```

Displays something like the following:

```
>

Please enter
your name: FRED
THANK YOU
>
```

prompt

A string literal that provides a prompt or message for user input with the terminal keyboard. Generally, a *prompt* argument is followed by a *variable*, so that the user input area follows the displayed literal. You can specify a multi-line prompt or message by using a comma-separated series of *prompt* and *fchar* arguments.

variable

The local variable, process-private global, or global that is to receive the input data. It can be either unsubscripted or subscripted. If a specified variable does not already exist, InterSystems IRIS defines it at the beginning of the **READ** operation. If a specified variable is defined and has a value, InterSystems IRIS clears this value at the beginning of the **READ** operation.

When you input characters, they are stored in *variable* as they are input. If the optional *timeout* argument is specified, and the read operation is interrupted by a timeout, the characters typed up to that point are stored in *variable*. (However, note the behavior of *variable* upon a encountered a <Ctrl-C> interrupt, as described below.)

Nonprinting characters (such as <Tab>) are stored in *variable*. A terminator character can be used to conclude any type of read operation. For example, from a terminal, you press the <Enter> key to conclude a read operation. This terminator character is not stored in *variable* for a variable-length or fixed-length read. The terminator character *is* stored in *variable* for a single-character read.

length

A positive integer specifying the maximum number of characters to accept for a fixed-length read. The **READ** completes either when the specified number of characters is input, or when it encounters a terminator character. This argument is optional, but if specified the preceding # symbol is required.

Specifying zero or a negative number results in a <SYNTAX> error. However, leading zeros and the fractional portion of a number are ignored, and the integer portion used. You can specify *length* as a variable or an expression that resolve to an integer.

Note that `READ a#1` and `READ *a` can both be used to input a single character. However the value stored in *variable* is different: `a#1` stores the input character in variable a; `*a` stores the ASCII numeric value for the input character in variable *a*; both store the input character in the **$ZB** special variable. These two types of single-character input also differ in how they handle terminator characters and how they handle a timeout.

timeout

The number of seconds to wait for the request to succeed. This argument is optional, but if specified, the preceding colon is required. You must specify *timeout* as an integer or an expression that evaluates to an integer. The *timeout* argument sets the **$TEST** special variable as follows:

- **READ** with timeout argument completes successfully (does not time out): **$TEST** set to 1 (TRUE).
- **READ** with timeout argument times out: **$TEST** set to 0 (FALSE).
- **READ** with *no* timeout argument: **$TEST** remains set to its previous value.

Note that **$TEST** can also be set by the user, or by a **LOCK**, **OPEN**, or **JOB** timeout.

If the timeout period expires before the **READ** completes and some characters have been input (for a variable-length or fixed-length reads) the input characters are stored in *variable*. If no characters have been input (for a variable-length or fixed-length reads), InterSystems IRIS defines *variable* (if necessary) and sets it to the null string. If no character has been input for a single-character **READ**, InterSystems IRIS defines *variable* (if necessary) and sets it to –1.

Examples

The following example uses the variable-length form of **READ** to acquire any number of characters from the user. The format control ! starts the prompt on a new line.

```
   READ !,"Enter your last name: ",lname
```

The following example uses the single-character form of **READ** to acquire one character from the user and store it as its ASCII numeric value.

```
   READ !,"Enter option number (1,2,3,4): ",*opt
   WRITE !,"ASCII value input=",opt
   WRITE !,"Character input=",$KEY
```

The following example uses the fixed-length form of **READ** to acquire exactly three characters from the user.

```
   READ !,"Enter your 3-digit area code: ",area#3
```

The following example prompts for three parts of a name: a fixed-length given name (gname) of up to 12 characters, a fixed-length (one-character) middle initial (iname), and a family name (fname) of any length. The gname and iname variables are coded to time out after 10 seconds:

```
   READ "Given name:",gname#12:10,!,
        "Middle initial:",iname#1:10,!,
        "Family name:",fname
   WRITE $TEST
```

A timeout of a read operation causes the **READ** command to proceed to the next read operation. The first two read operations set **$TEST** whether or not they time out. The third read operation does not set **$TEST**, so the value of **$TEST** in this example reflects the result (success or timeout) of the second read operation.

The following example uses indirection to dynamically change the prompt associated with the **READ** command:

```
PromptChoice
   READ "Type 1 for numbers or 2 for names:",p,#!!!!
   IF p'=1,p'=2 {WRITE !,"Invalid input" RETURN }
   ELSE {DO DataInput(p) }
DataInput(dtype)
   SET MESS(1)="""ENTER A NUMBER:"""
   SET MESS(2)="""ENTER A NAME:"""
   SET x=1
   READ !,@MESS(dtype),val(x)
   IF val(x)="" {WRITE !,"Goodbye" RETURN
   }
   ELSE {
        IF dtype=1,1=$ISVALIDNUM(val(x)) { WRITE !,"You input number: ",val(x),! }
        ELSEIF dtype=2 { WRITE !,"You input string: ",val(x),! }
        ELSE { WRITE !,"That is not a number",! }
   SET x=x+1
   DO DataInput(dtype)
   }
```

The following example sets the length of a fixed-length read based on the number of digits of the first number input:

```
FirstNum
   READ "ENTER LARGEST INTEGER (and press Return): ",val(1)
   SET ibuf=$LENGTH(val(1))
   WRITE !,"Your largest number is: ",val(1),!
   DO OtherNums(ibuf)
OtherNums(digits)
   SET x=2
   READ !,"ENTER NEXT INTEGER: ",val(x)#digits
   IF val(x)="" { WRITE !,"Goodbye" RETURN }
   ELSEIF val(x)>val(1) { WRITE !,"Number is too big",!
                          DO OtherNums(digits) }
   ELSE { WRITE !,"You input: ",val(x),!
   SET x=x+1
   DO OtherNums(digits) }
```

Notes

READ Uses the Current Device

READ inputs character-oriented data from the current I/O device. You must open a device with the **OPEN** command, then establish it as the current device with the **USE** command. InterSystems IRIS maintains the current device ID in the **$IO** special variable.

While the most common use for **READ** is to acquire user input from the keyboard, you can also use it to input characters from any byte-oriented device, such as a sequential disk file or a communications buffer.

Read Line Recall

Read line recall mode permits a **READ** command on a terminal device to receive as its input a previously input line. This recalled input line can then be edited. The user must interactively conclude the input of a recalled line in the same way that user-specified input is concluded. InterSystems IRIS supports read line recall for both variable-length terminal reads (`READ variable`) and fixed-length terminal reads (`READ variable#length`). InterSystems IRIS does not support read line recall for single-character terminal reads (`READ *variable`). To activate read line recall for the current process, use the **LineRecall()** method of the %SYSTEM.Process class. To set the system-wide read line recall default, use the *LineRecall* property of the Config.Miscellaneous class. You can also set the **OPEN** and **USE** protocols for terminals, as described in the Terminal I/O chapter of the *I/O Device Guide*.

READ Terminators

InterSystems IRIS terminates a read operation when the input string reaches the specified length (for single-character **READ** and fixed-length **READ**). For a variable-length **READ**, InterSystems IRIS terminates reading if the input string reaches the maximum string length for the current process.

InterSystems IRIS also terminates reading when it encounters certain terminator characters. The terminators are determined by the device type. For example, with terminals, the default terminators are RETURN (also known as the <Enter> key) (ASCII 13), LINE FEED (ASCII 10), and ESCAPE (ASCII 27).

You can modify the terminator default when you issue an **OPEN** or **USE** command for a device. **OPEN** and **USE** allow you to specify a terminator parameter value. See the Terminal I/O chapter of the *I/O Device Guide* for **OPEN** and **USE** protocols for terminals. See the I/O Devices and Commands chapter of the *I/O Device Guide* for details about terminators based on device type.

InterSystems IRIS does not store the input terminator with the input value for variable-length and fixed-length reads; it records it in the **$KEY** and **$ZB** special variables. InterSystems IRIS *does* store the input terminator (if specified) as the input value for a single-character read.

Timeout and the $ZA, $ZB, and $TEST Special Variables

InterSystems IRIS records the completion status of a **READ** in the **$TEST**, **$ZA**, and **$ZB** special variables, as follows:

Type of READ	Variable data	$TEST value	$ZA value	$ZB value
Variable, ended with line return	input characters (or null string if none)	1	0	terminator character
Variable, some input, then timeout	input characters	0	2	null string
Variable, no input, timeout	null string	0	2	null string
Fixed, all chars entered	input characters	1	0	the last character entered
Fixed, line return	input characters (or null string if none)	1	0	terminator character
Fixed, timed out	input characters (or null string if none)	0	2	null string
Single character, data input	ASCII value of input character	1	0	the input character
Single character, terminator character input	ASCII value of terminator character	1	0 <Enter>, 256 <Esc>	terminator character
Single character, timed out	–1	0	2	null string

$ZB and $KEY

The **$ZB** and **$KEY** special variables return the exact same value for every type of read, except one. When you perform a fixed-length read and input the specified number of characters, the **READ** completes without a terminator. In this case, **$ZB** contains the last character input (the terminating character), and **$KEY** contains the null string (there being no terminator character).

Interrupts

If there is a pending **CTRL-C** interrupt when **READ** is invoked, **READ** dismisses this interrupt before reading from the terminal.

If a read in progress is interrupted by a **CTRL-C** interrupt, *variable* reverts to its previous state. For example, if you input several characters for a read operation, and then issue a **CTRL-C**, *variable* reverts to its state before the read operation. That is, if it was undefined, it remains undefined; if it had a previous value, it contains the previous value. This behavior is completely different than a read operation that times out. A read timeout retains the new state of *variable*, including any characters input before the timeout occurred. If a **READ** command contains multiple read operations, the interrupt affects only the read operation in progress. To commit or revert multiple read operations as a unit, use transaction processing.

For information on enabling and disabling **CTRL-C** interrupts, refer to the BREAK flag command and the $ZJOB special variable.

Reading from Non-Keyboard Devices

As described earlier, **READ** can be used to acquire input from any character-oriented device. This includes devices such as sequential disk files, as well terminal keyboards. However, you must first establish the device to read from as the current device with the **OPEN** and **USE** commands.

With non-keyboard devices, you can use any of the three available forms (variable-length, single-character, and fixed-length). The choice of which form to use in any given case depends on the type of terminator available. With fixed-length **READ**, InterSystems IRIS treats terminators encountered within the input string the same as any other character.

For example, if you are reading from a device that presents data in a line-oriented format with CARRIAGE RETURN/LINE FEED as the line terminator, you can use the variable-length form. In this case, InterSystems IRIS reads each line into *variable* in its entirety, terminating input only when it reaches the Return (ASCII code 13) at the end of the line. (Remember, from the user input examples shown previously, that <Return> is the input terminator.)

On the other hand, if you are reading from a device that presents records as a series of fixed-length fields, you would use the fixed-length (*variable#length*) form. For example, assume that you have a device that uses a record format consisting of four fields of up to 8, 12, 4, and 6 characters, respectively. You might use code similar to the following to read in the data:

```
READ field1#8,field2#12,field3#4,field4#6
```

In this case, the #n value sets the input terminator for each field.

Which terminator is used for a given device can be set by the device parameters that you specify for that device on the **OPEN** or **USE** command.

When reading block-oriented data, the **$ZB** special variable contains the number of bytes remaining in the I/O buffer. Its function is entirely different than its use when reading character-oriented data. **$ZB** does not contain the read terminator character or the last input character during block-oriented I/O. Refer to $ZB for further details.

Reading Nonprinting Characters

Nonprinting characters are characters outside the standard range of ASCII printable characters. In other words, they are characters whose ASCII codes are less than ASCII 32 or greater than ASCII 127. They are characters that have no single key equivalents on a standard keyboard.

The characters whose codes are less than ASCII 32 are usually used for control operations. They can be entered only in conjunction with the Ctrl key. For example, ETX (ASCII 3) is entered as <Ctrl-C> and is used to assert a BREAK when entered from the keyboard.

The characters whose codes are greater than ASCII 127 are usually used for graphics operations. As a rule, they cannot be entered from the keyboard, but they can be read from other types of devices. For example, ASCII 179 produces the vertical line character.

You can use the **READ** command to input nonprinting characters as well as the standard ASCII printable characters. However, you must include code to handle the escape sequence used for each such character. An escape sequence is a sequence of characters that starts with the Esc character (ASCII 27). For example, you can code a **READ** so that the user is allowed to press a function key as a valid input response. Pressing the function key produces an escape sequence that can be different for different types of terminals.

ObjectScript supports input of escape sequences by storing them in the **$ZB** and **$KEY** special variables, rather than in the specified *variable*. For example, for a function key press, InterSystems IRIS stores the Esc code (ASCII 27) in **$ZB** and **$KEY**. To handle an escape sequence, you must include code that tests the current value in **$ZB** or **$KEY** after each **READ** because subsequent reads update these special variables and overwrite any previous value. (**$ZB** and **$KEY** are very similar, but not identical; see **$KEY** for details.) To display a nonprinting character, such as an escape sequence, use the **ZZDUMP** command or the **$ASCII** function.

Sequential File End-of-File

The behavior of **READ** when encountering an end-of-file for a sequential file depends on the system-wide default. Go to the Management Portal, select **System Administration**, **Configuration**, **Additional Settings**, **Compatibility**. View and edit the current setting of **SetZEOF**. This option controls the behavior when InterSystems IRIS encounters an unexpected end-of-file when reading a sequential file. When set to "true", InterSystems IRIS sets the **$ZEOF** special variable to indicate that you have reached the end of the file. When set to "false", InterSystems IRIS issues an <ENDOFFILE> error. The default is "false".

To change this end-of-file behavior for the current process, use the **SetZEOF()** method of the %SYSTEM.Process class. To set the system-wide default for end-of-file behavior, use the *SetZEOF* property of the Config.Miscellaneous class.

Default Record Length

If the number of characters to read is not specified, InterSystems IRIS assumes a default length of 32,767 characters.

See Also

- OPEN command
- WRITE command
- ZZDUMP command
- USE command
- $KEY special variable
- $TEST special variable
- $ZA special variable
- $ZB special variable
- $ZEOF special variable
- Terminal I/O in *I/O Device Guide*
- Sequential File I/O in *I/O Device Guide*

RETURN

Terminates execution of a routine.

```
RETURN:pc expression
RET:pc expression
```

Arguments

pc	*Optional* — A postconditional expression.
expression	*Optional* — An ObjectScript expression.

Description

The **RETURN** command is used to terminate execution of a routine. In many contexts it is a synonym for the QUIT command. **RETURN** and **QUIT** differ when issued from within a **FOR**, **DO WHILE**, or **WHILE** flow-of-control structure, or a **TRY** or **CATCH** block.

- You can use **RETURN** to terminate execution of a routine at any point, including from within a **FOR**, **DO WHILE**, or **WHILE** loop or nested loop structure. **RETURN** always exits the current routine, returning to the calling routine or terminating the program if there is no calling routine. **RETURN** always behaves the same, regardless of whether it is issued from within a code block. This includes a **TRY** block or a **CATCH** block.
- In contrast, **QUIT** exits only the current structure when issued from within a **FOR** loop, a **DO WHILE** loop, a **WHILE** loop, or a **TRY** or **CATCH** block. **QUIT** exits the structure block and continues execution of the current routine with the next command outside of that structure block. **QUIT** exits the current routine when issued outside of a block structure or from within an **IF**, **ELSEIF**, or **ELSE** code block.

The **RETURN** command has two forms:

- Without an argument
- With an argument

A postconditional is not considered an argument. The **$QUIT** special variable indicates whether or not an argumented **RETURN** command is required to exit from the current context. Two $ECODE error codes are provided for this purpose: M16 “Quit with an argument not allowed” and M17 “Quit with an argument required.”

RETURN Without an Argument

RETURN without an argument exits from the current context without returning a value. It is used to terminate the execution level of a process started with a **DO** or **XECUTE** command.

If **DO** or **XECUTE** is invoked from the Terminal prompt, **RETURN** returns control to the Terminal prompt. If the terminated process contains any **NEW** commands before **RETURN**, **RETURN** automatically **KILL**s the affected variables and restores them to their original values.

RETURN With an Argument

RETURN *expression* terminates a user-defined function or an object method and returns the value resulting from the specified expression. **RETURN** with an argument can be used to exit a routine from within a **FOR**, **DO WHILE**, or **WHILE** command loop, or from within a **TRY** block or a **CATCH** block.

If an argumented **RETURN** is invoked inside a subroutine, one of the following occurs:

- If an argumented **RETURN** is invoked inside a subroutine (instead of a function), the **RETURN** argument is evaluated (which may produce side effects or throw an error) and the argument result is discarded. Execution returns to the caller of the subroutine.
- If the subroutine was called by a **DO** command and is in the scope of that **DO** argument, then the **RETURN** command evaluates its argument (and any side effects of that evaluation occur), but it does not return the argument. For example, a subroutine called by **DO** that concludes with `RETURN 4/0` generates a <DIVIDE> error.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*. If the **RETURN** command takes no other arguments, there must be two or more spaces between the postconditional and the next command following it on the same line.

expression

Any valid ObjectScript expression. It can be used only within a user-defined function to return the evaluated result to the calling routine.

Examples

The following two examples contrast **RETURN** and **QUIT** behavior when issued from within a flow-of-control structure. **RETURN** exits MySubroutine, returning to MyRoutine. **QUIT** exits the **FOR** loop, continuing with the remainder of MySubroutine before returning to MyRoutine:

```
MyMain
  WRITE "In the main routine",!
  DO MySubroutine
  WRITE "Returned to main routine",!
  QUIT
MySubroutine
  WRITE "In MySubroutine",!
  FOR i=1:1:5 {
    WRITE "FOR loop:",i,!
    IF i=3 RETURN
    WRITE "  loop again",!
  }
  WRITE "MySubroutine line not displayed with RETURN",!
  QUIT
```

```
MyMain
  WRITE "In the main routine",!
  DO MySubroutine
  WRITE "Returned to main routine",!
  QUIT
MySubroutine
  WRITE "In MySubroutine",!
  FOR i=1:1:5 {
    WRITE "FOR loop:",i,!
    IF i=3 QUIT
    WRITE "  loop again",!
  }
  WRITE "MySubroutine line displayed with QUIT",!
  QUIT
```

In the following example, execution of the first **RETURN** command is controlled by a postconditional (:x>46). If the randomly generated number is greater than 46 InterSystems IRIS does not perform the Cube procedure; the first **RETURN** takes the postconditional, returning a string to the calling routine as *num*. If the randomly generated number is less than or equal to 46 the second **RETURN** returns the results of the expression *x*x*x* as *num*.

```
Main
  SET x = $RANDOM(99)
  WRITE "Number is: ",x,!
  SET num=$$Cube(x)
  WRITE "Cube is: ",num
  QUIT
Cube(x) RETURN:x>46 "a six-digit number."
  WRITE "Calculating the cube",!
  RETURN x*x*x
```

The following two examples contrast **QUIT** and **RETURN** behavior with **TRY** and **CATCH**. The **TRY** block attempts a divide-by-zero operation, invoking the **CATCH** block; this **CATCH** block contains a nested **TRY** block which is exited by either a **QUIT** or a **RETURN**. (For the purpose of demonstration, these programs do not include the recommended code (**QUIT** or **RETURN**) to prevent “fall-through”.)

RETURN exits the routine. It therefore exits the nested **TRY** block and any enclosing blocks, and does not execute the fall-through line outside of the **TRY**/**CATCH** structures:

```
  TRY {
    WRITE "In the TRY block",!
    SET x = 5/0
    WRITE "This line should never display"
  }
  CATCH exp1 {
    WRITE "In the CATCH block",!
    WRITE "Error Name: ",$ZCVT(exp1.Name,"O","HTML"),!
      TRY {
        WRITE "In the nested TRY block",!
        RETURN
      }
      CATCH exp2 {
        WRITE "In the nested CATCH block",!
        WRITE "Error Name: ",$ZCVT(exp1.Name,"O","HTML"),!
      }
    WRITE "RETURN does not display this outer CATCH block line",!
  }
  WRITE "fall-through at the end of the program"
```

QUIT exits the nested **TRY** block to the enclosing block, continuing execution with the remainder of the **CATCH** block. When it completes the **CATCH** block it execute the fall-through line outside of the **TRY**/**CATCH** structures:

```
  TRY {
    WRITE "In the TRY block",!
    SET x = 5/0
    WRITE "This line should never display"
  }
  CATCH exp1 {
    WRITE "In the CATCH block",!
    WRITE "Error Name: ",$ZCVT(exp1.Name,"O","HTML"),!
      TRY {
        WRITE "In the nested TRY block",!
        QUIT
      }
      CATCH exp2 {
        WRITE "In the nested CATCH block",!
        WRITE "Error Name: ",$ZCVT(exp1.Name,"O","HTML"),!
      }
    WRITE "QUIT displays this outer CATCH block line",!
  }
  WRITE "fall-through at the end of the program"
```

In this example, the argument of the **RETURN** command is an object method. InterSystems IRIS terminates execution of the method and returns control to the calling routine.

```
   RETURN inv.TotalNum()
```

Notes

RETURN Restores Variables

If a terminated process contains any **NEW** commands before **RETURN**, **RETURN** automatically **KILL**s the affected variables and restores them to their original values.

Implicit RETURN

In the following cases, a **RETURN** command is not required, because InterSystems IRIS automatically issues an implicit **RETURN** to prevent execution "falling through" to a separate unit of code.

- InterSystems IRIS executes an implicit **RETURN** at the end of a routine.
- InterSystems IRIS executes an implicit **RETURN** when it encounters a label with parameters. A label with parameters is defined as one with parentheses, even if the parentheses contain zero parameters. All procedures begin with a label with parameters (even if no parameters are defined). Many subroutines and functions also have a label with parameters.

You can, of course, code an explicit **RETURN** in any of these circumstances.

Behavior with DO

When encountered in a subroutine called by the **DO** command, **RETURN** terminates the subroutine and returns control to the command following the **DO** command.

Behavior with XECUTE

When encountered in a line of code that is being executed, **RETURN** terminates execution of the line and returns control to the command following the **XECUTE** command. No argument is allowed.

Behavior with User-Defined Functions

When encountered in a user-defined function, **RETURN** terminates the function and returns the value that results from the specified expression. The expression argument is required.

In their use, user-defined functions are similar to **DO** commands with parameter passing. They differ from such **DO** commands, however, in that they return the value of an expression directly, rather than through a variable. To invoke a user-defined function, use the form:

$$*name*(*parameters*)

where *name* is the name of the function. It can be specified as *label*, *^routine*, or *label^routine*.

parameters is a comma-separated list of parameters to be passed to the function. The *label* associated with the function must also have a parameter list. The parameter list on the invoked function is known as the *actual parameter list*. The parameter list on the function label is known as the *formal parameter list*.

Clearing Levels from the Program Stack

Each invocation of **RETURN** removes a context frame from the call stack for your process. The **$STACK** special variable contains the current number of context frames on the call stack.

You can use **RETURN** from the Terminal to clear some or all levels from the program stack. The following example clears the top two levels from the stack:

```
RETURN 2
```

The argumentless **RETURN** clears all the levels from the stack.

Using RETURN for Program Readability

InterSystems IRIS executes an implicit **RETURN** at the end of each routine, but you can include it explicitly to improve program readability.

See Also

- DO command
- DO WHILE command

- FOR command
- NEW command
- QUIT command
- WHILE command
- XECUTE command
- $ECODE special variable
- $QUIT special variable
- $STACK special variable

SET

Assigns a value to a variable.

```
SET:pc setargument,...
S:pc setargument,...
```

where *setargument* can be:

```
variable=value
(variable-list)=value
```

Arguments

pc	*Optional* — A postconditional expression.
variable	The variable to set to the corresponding *value*. *variable* can be a local variable, a process-private global, a global, an object property, or a special variable. (Not all special variables can be set by an application; see documentation of individual special variables.)
variable-list	A comma-separated list, enclosed in parentheses, that consists of one or more *variable* arguments. All of the *variable* arguments in *variable-list* are assigned the same *value*.
value	A literal value, or any valid ObjectScript expression that evaluates to a value. Can be a JSON object or JSON array.

Description

The **SET** command assigns a value to a variable. It can set a single variable, or set multiple variables using any combination of two syntactic forms. It can assign values to variables by specifying a comma-separated list of `variable=value` pairs. For example:

```
SET a=1,b=2,c=3
WRITE a,b,c
```

There is no restriction in the number of assignments you can perform with a single invocation of **SET a=value,b=value,c=value,...**.

If a specified variable does not exist, **SET** creates it and assigns the value. If a specified variable exists, **SET** replaces the previous value with the specified value. Because **SET** executes in left-to-right order, you can assign a value to a variable, then assign that variable to another variable:

```
SET a=1,b=a
WRITE a,b
```

A value can be a string, a numeric, a JSON object, JSON array, or an expression that evaluates to one of these values. To define an “empty” variable, you can set the variable to the empty string ("") value.

Setting Multiple Variables to the Same Value

You can use **SET** to assign the same value to multiple variables by specifying a comma-separated list of variables enclosed in parentheses. For example:

```
SET (a,b,c)=1
WRITE a,b,c
```

You can combine the two **SET** syntactic forms in any combination. For example:

```
SET (a,b)=1,c=2,(d,e,f)=3
WRITE a,b,c,d,e,f
```

The maximum number of assignments you can perform with a single invocation of **SET (a,b,c,...)=value** is 128. Exceeding this number results in a <SYNTAX> error.

Restrictions on Setting Multiple Variables

- $LIST: You cannot use **SET (a,b,c,...)=value** syntax to assign a value to a **$LIST** function on the left side of the equal sign. Attempting to do so results in a <SYNTAX> error. You must use **SET a=value,$LIST(mylist,n)=value,c=value,...** syntax when using **$LIST** to set one of the items.
- $EXTRACT and $PIECE: You cannot use **SET (a,b,c,...)=value** syntax to assign a value to an **$EXTRACT** or **$PIECE** function on the left side of the equal sign if that function uses relative offset syntax. In relative offset syntax an asterisk represents the end of a string, and `*-n` and `*+n` represent a relative offset from the end of the string. For example, `SET (x,$PIECE(mylist,"^",3))=123` is valid, but `SET (x,$PIECE(mylist,"^",*))=123` results in an <UNIMPLEMENTED> error. You must use **SET a=value,b=value,c=value,...** syntax when setting one of these functions using relative offset.
- Object Property: You cannot use **SET (a,b,c,...)=value** syntax to assign a value to an object property on the left side of the equal sign. Attempting to do so results in an <OBJECT DISPATCH> error with a message such as the following: `Set property MyProp of class MyPackage.MyClass is not a direct reference and may not be multiple SET arg`. You must use **SET a=value,oref.MyProp=value,c=value,...** syntax when setting an object property.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

variable

The variable to receive the value resulting from the evaluation of *value*. It can be a local variable, a process-private global, a global variable, or a special variable. A local variable, process-private global, or global variable can be either subscripted or unsubscripted (see SET and Subscripts for further details). A global variable can be specified with extended global reference (see Global Structure in *Using Globals*).

Local variables, process-private globals, and special variables are specific to the current process; they are mapped to be accessible from all namespaces. A global variable persists after the process that created it terminates.

A global is specific to the namespace in which it was created. By default, a **SET** assigns a global in the current namespace. You can use **SET** to define a global (^myglobal) in another namespace by using syntax such as the following: `SET ^["Samples"]myglobal="Ansel Adams"`. If you specify a nonexistent namespace, InterSystems IRIS issues a <NAMESPACE> error. If you specify a namespace for which you do not have privileges, InterSystems IRIS issues a <PROTECT> error, followed by the global name and database path, such as the following: `<PROTECT> ^myglobal,c:\intersystems\iris\mgr\`.

A variable can be a piece or segment of a variable as specified in the argument of a **$PIECE** or **$EXTRACT** function.

A variable can be represented as an object property using obj.property or .. property syntax, or by using the $PROPERTY function. You can set an i%property instance variable reference using the following syntax:

```
SET i%propname = "abc"
```

SET accepts a variable name of any length, but it truncates a long variable name to 31 characters before assigning it a value. If a variable name is not unique within the first 31 characters this name truncation can cause unintended overwriting of variable values, as shown in the following example:

```
SET abcdefghijklmnopqrstuvwxyz2abc="30 characters"
SET abcdefghijklmnopqrstuvwxyz2abcd="31 characters"
SET abcdefghijklmnopqrstuvwxyz2abcde="32 characters"
SET abcdefghijklmnopqrstuvwxyz2abcdef="33 characters"
WRITE !,abcdefghijklmnopqrstuvwxyz2abc     // returns "30 characters"
WRITE !,abcdefghijklmnopqrstuvwxyz2abcd    // returns "33 characters"
WRITE !,abcdefghijklmnopqrstuvwxyz2abcde   // returns "33 characters"
WRITE !,abcdefghijklmnopqrstuvwxyz2abcdef  // returns "33 characters"
```

Special variables are, by definition, set by system events. You can use **SET** to assign a value to certain special variables. However, most special variables cannot be assigned a value using **SET**. See the reference pages for individual special variables for further details.

Refer to the "Variables" chapter of *Using ObjectScript* for further details on variable types and naming conventions.

value

A literal value or any valid ObjectScript expression. Usually a *value* is a numeric or string expression. A *value* can be a JSON object or JSON array.

- A numeric value is converted to canonical form before assignment: leading and trailing zeros, a plus sign or a trailing decimal point are removed. Conversion from scientific notation and evaluation of arithmetic operations are performed.
- A string value is enclosed in quotation marks. A string is assigned unchanged, except that doubled quotation marks within the string are converted to a single quotation mark. The null string ("") is a valid *value*.
- A numeric value enclosed in quotation marks is not converted to canonical form and no arithmetic operations are performed before assignment.
- If a relational or logical expression is used, InterSystems IRIS assigns the truth value (0 or 1) resulting from the expression.
- Object properties and object methods that return a value are valid expressions. Use the relative dot syntax (..) for assigning a property or method value to a variable.

JSON Values

You can use the **SET** command to set a variable to a JSON object or a JSON array. For a JSON object, the *value* is a JSON object delimited by curly braces. For a JSON array, the *value* is a JSON array delimited by square brackets.

Within these delimiters, the literal values are JSON literals, not ObjectScript literals. An invalid JSON literal generates a <SYNTAX> error.

- String literal: You must enclose a JSON string in double quotes. To specify certain characters as literals within a JSON string, you must specify the \ escape character, followed by the literal. If a JSON string contains a double-quote literal character this character is written as \". JSON string syntax provides escapes for double quote (\"), backslash (\\), and slash (\/). Line space characters can also be escaped: backspace (\b), formfeed (\f), newline (\n), carriage return (\r), and tab (\t). Any Unicode character can be represented by a six character sequence: a backslash, followed by lowercase letter u, followed by four hexadecimal digits. For example, `\u0022` specifies a literal double quote character; `\u03BC` specifies the Greek lowercase letter Mu.
- Numeric literal: JSON does not convert numbers to ObjectScript canonical form. JSON has its own conversion and validation rules: Only a single leading minus sign is permitted; a leading plus sign is not permitted, multiple leading signs are not permitted. The "E" scientific notation character is permitted, but not evaluated. Leading zeros are not permitted; trailing zeros are preserved. A decimal separator must have a digit character on both sides of it. Therefore, the JSON numerics `0`, `0.0`, `0.4`, and `0.400` are valid. A negative sign on a zero value is preserved.

  For IEEE floating-point numbers, additional rules apply. Refer to the $DOUBLE function for details.

JSON fractional numbers are stored in a different format than ObjectScript numbers. ObjectScript floating point fractional numbers are rounded when they reach their maximum precision, and trailing zeros are removed. JSON packed BCD fractional numbers allow for greater precision, and trailing zeros are retained. This is shown in the following example:

```
SET jarray=[1.23456789123456789876000,(1.23456789123456789876000)]
WRITE jarray.%ToJSON()
```

- Special values: JSON supports the following special values: `true`, `false`, and `null`. These are literal values that must be specified as an unquoted literal in lowercase letters. These JSON special values cannot be specified using a variable, or specified in an ObjectScript expression.
- ObjectScript: To include an ObjectScript literal or expression within a JSON array element or a JSON object value, you must enclose the entire string in parentheses. You cannot specify ObjectScript in a JSON object key. ObjectScript and JSON use different escape sequence conventions. To escape a double quote character in ObjectScript, you double it. In the following example, a JSON string literal and an ObjectScript string literal are specified in a JSON array:

```
SET jarray=["This is a \"good\" JSON string",("This is a ""good"" ObjectScript string")]
WRITE jarray.%ToJSON()
```

The following JSON array example specifies an ObjectScript local variable and performs ObjectScript numeric conversion to canonical form:

```
SET str="This is a string"
SET jarray=[(str),(--0007.000)]
WRITE jarray.%ToJSON()
```

The following example specifies an ObjectScript function in a JSON object value:

```
SET jobj={"firstname":"Fred","namelen":($LENGTH("Fred"))}
WRITE jobj.%ToJSON()
```

JSON Object

A *value* can be a JSON object delimited by curly braces. The *variable* is set to an OREF, such as the following: `3@%Library.DynamicObject`. You can use the ZWRITE command with a specified local variable name to display the JSON value:

```
SET jobj={"inventory123":"Fred's \"special\" bowling ball"}
ZWRITE jobj
```

You can use the **%Get()** method to retrieve the value of a specified key using the OREF. You can resolve the OREF to the full JSON object value using the **%ToJSON()** method. This is shown in the following example:

```
SET jobj={"inventory123":"Fred's \"special\" bowling ball"}
WRITE "JSON object reference = ",jobj,!
WRITE jobj.%Get("inventory123")," (data value in ObjectScript format)",!
WRITE jobj.%Get("inventory123",,"json")," (data value in JSON format)",!
WRITE jobj.%ToJSON()," (key and data value in JSON format)"
```

A valid JSON object has the following format:

- Begins with an open curly brace, ends with a close curly brace. The empty object `{}` is a valid JSON object.
- Within the curly braces, a key:value pair or a comma-separated list of key:value pairs. Both the key and the value components are JSON literals, not ObjectScript literals.
- The key component must be a JSON quoted string literal. It cannot be an ObjectScript literal or expression enclosed in parentheses.
- The value component can be a JSON string or a JSON numeric literal. These JSON literals follow JSON validation criteria. A value component can be an ObjectScript literal or expression enclosed in parentheses. The value component can be specified as a defined variable specifying a string, a numeric, a JSON object, or a JSON array. The value component can contain nested JSON objects or JSON arrays. A value component can also be one of the following three

JSON special values: true, false, null, specified as an unquoted literal in lowercase letters; these JSON special values cannot be specified using a variable.

The following are all valid JSON objects: `{"name":"Fred"}`, `{"name":"Fred","city":"Bedrock"}`, `{"bool":true}`, `{"1":true,"0":false,"Else":null}`, `{"name":{"fname":"Fred","lname":"Flintstone"},"city":"Bedrock"}`, `{"name":["Fred","Wilma","Barney"],"city":"Bedrock"}`.

A JSON object can specify a null property name and assign it a value, as shown in the following example:

```
SET jobj={}
SET jobj.""="This is the ""null"" property value"
WRITE jobj.%Get(""),!
WRITE "JSON null property object value = ",jobj.%ToJSON()
```

Note that the returned JSON string uses the JSON escape sequence (`\"`) for a literal double quote character.

You can use the **%Set()** method to add a key:value pair to a JSON object.

You can use the **%Get()** method to return the value of a specified key in various formats. The syntax is:

```
jobj.%Get(keyname,default,format)
```

The *default* argument is the value returned if *keyname* does not exist.

The *format* argument specifies the format for the returned value. If no *format* is specified, the value is returned in ObjectScript format; if *format*=`"json"`, the value is returned in JSON format; if *format*=`"string"`, all string and numeric values are returned in ObjectScript format, but the JSON `true` and `false` special values are returned as JSON alphabetic strings rather than boolean integers; the JSON `null` special value is returned in ObjectScript format as a zero-length null string. This is shown in the following example:

```
SET x={"yep":true,"nil":null}
WRITE "IRIS: ",x.%Get("yep")," JSON: ",x.%Get("yep",,"json")," STRING: ",x.%Get("yep",,"string"),!
   /*  IRIS: 1 JSON: true STRING: true */
WRITE "IRIS: ",x.%Get("nil")," JSON: ",x.%Get("nil",,"json")," STRING: ",x.%Get("nil",,"string")
  /*   IRIS:  JSON: null STRING:       */
```

For further details, see Using JSON.

JSON Array

A *value* can be a JSON array delimited by square brackets. The *variable* is set to an OREF, such as the following: `1@%Library.DynamicArray`. You can use the ZWRITE command with a specified local variable name to display the JSON value:

```
SET jary=["Fred","Wilma","Barney"]
ZWRITE jary
```

You can use the **%Get()** method to retrieve the value of a specified array element (counting from 0) using the OREF: **%Get(n)** returns the ObjectScript value; **%Get(n,,”json”)** returns the JSON value. **%Get(n,”no such element”,”json”)** specifies a default value to return if the specified array element does not exist. You can resolve the OREF to the full JSON array value using the **%ToJSON()** function. This is shown in the following example:

```
SET jary=["Fred","Wilma","Barney"]
WRITE "JSON array reference = ",jary,!
WRITE jary.%Get(1)," (array element value in ObjectScript format)",!
WRITE jary.%Get(1,,"json")," (array element value in JSON format)",!
WRITE jary.%ToJSON()," (array values in JSON format)"
```

A valid JSON array has the following format:

- Begins with an open square bracket, ends with a close square bracket. The empty array `[]` is a valid JSON array.

- Within the square brackets, an element or a comma-separated list of elements. Each array element can be a JSON string or JSON numeric literal. These JSON literals follow JSON validation criteria. An array element can be an ObjectScript literal or expression enclosed in parentheses. An array element can be specified as a defined variable specifying a string, a numeric, a JSON object, or a JSON array. An array element can contain one or more JSON objects or JSON arrays. An array element can also be one of the following three JSON special values: true, false, null, specified as an unquoted literal in lowercase letters; these JSON special values cannot be specified using a variable.

The following are all valid JSON arrays: `[1]`, `[5,7,11,13,17]`, `["Fred","Wilma","Barney"]`, `[true,false]`, `["Bedrock",["Fred","Wilma","Barney"]]`, `[{"name":"Fred"},{"name":"Wilma"}]`, `[{"name":"Fred","city":"Bedrock"},{"name":"Wilma","city":"Bedrock"}]`, `[{"names":["Fred","Wilma","Barney"]}]`.

You can use the **%Push()** method to add a new element to the end of the array. You can use the **%Set()** method to add a new array element or update an existing array element by position.

For further details, see Using JSON.

SET Command with Objects

The following example contains three SET commands: the first sets a variable to an OREF (object reference); the second sets a variable to the value of an object property; the third sets an object property to a value:

```
SET myobj=##class(%SQL.Statement).%New()
SET dmode=myobj.%SelectMode
WRITE "Default select mode=",dmode,!
SET myobj.%SelectMode=2
WRITE "Newly set select mode=",myobj.%SelectMode
```

Note that dot syntax is used in object expressions; a dot is placed between the object reference and the object property name or object method name.

To set a variable with an object property or object method value for the current object, use the double-dot syntax:

```
SET x=..LastName
```

If the specified object property does not exist, InterSystems IRIS issues a <PROPERTY DOES NOT EXIST> error. If you use double-dot syntax and the current object has not been defined, InterSystems IRIS issues a <NO CURRENT OBJECT> error.

For further details, refer to Object-Specific ObjectScript Features in *Defining and Using Classes*.

The following command sets *x* to the value returned by the **GetNodeName()** method:

```
SET x=##class(%SYS.System).GetNodeName()
WRITE "the current system node is: ",x
```

A **SET** command for objects can take an expression with cascading dot syntax, as shown in the following examples:

```
SET x=patient.Doctor.Hospital.Name
```

In this example, the patient.Doctor object property references the Hospital object, which contains the Name property. Thus, this command sets *x* to the name of the hospital affiliated with the doctor of the specified patient. The same cascading dot syntax can be used with object methods.

A **SET** command for objects can be used with system-level methods, such as the following data type property method:

```
SET x=patient.NameIsValid(Name)
```

In this example, the **NameIsValid()** method returns its result for the current patient object. **NameIsValid()** is a boolean method generated for data type validation of the Name property. Thus, this command sets *x* to 1 if the specified name is a valid name, and sets *x* to 0 if the specified name is not a valid name.

SET Using an Object Method

You can specify an object method on the left side of a **SET** expression. The following example specifies the **%Get()** method:

```
SET obj=##class(test).%New()  // Where test is class with a multidimensional property md
SET myarray=[(obj)]
SET index=0,subscript=2
SET myarray.%Get(index).md(subscript)="value"
IF obj.md(2)="value" {WRITE "success"}
ELSE {WRITE "failure"}
```

Setting a List of Variables to an Object

When using **SET** with objects, multiple assignments set all of the variables in a list to the same OREF, as shown in the following examples:

```
SET (a,b,c)=##class(Sample.Person).%New()
```

```
SET (dyna1,dyna2,dyn3) = ["default","default"]
```

To assign each variable a separate OREF, issue a separate **SET** command for each assignment, as shown in the following examples:

```
SET a=##class(Sample.Person).%New()
SET b=##class(Sample.Person).%New()
SET c=##class(Sample.Person).%New()
```

```
SET dyna1 = ["default","default"]
SET dyna2 = ["default","default"]
SET dyna3 = ["default","default"]
```

You can also use the #Dim preprocessor directive to assign all of the variables in a list to individual OREFs, as shown in the following examples:

```
#Dim a,b,c As %ClassDefinition
= ##class(Sample.Person).%New()
```

```
#Dim dyn1,dyn2,dyn3 As %DynamicArray = ["default","default"]
```

Examples

The following example specifies multiple arguments for the same **SET** command. Specifically, the command assigns values to three variables. Note that arguments are evaluated in left-to-right order.

```
SET var1=12,var2=var1*3,var3=var1+var2
WRITE "var1=",var1,!,"var2=",var2,!,"var3=",var3
```

The following example shows the `(variable-list)=value` form of the **SET** command. It shows how to assign the same value to multiple variables. Specifically, the command assigns the value 0 to three variables.

```
SET (sum,count,average)=0
WRITE "sum=",sum,!,"count=",count,!,"average=",average
```

The following example sets a subscripted global variable in a different namespace using extended global reference.

```
NEW $NAMESPACE
SET $NAMESPACE="%SYS"
SET ^["user"]nametest(1)="fred"
NEW $NAMESPACE
SET $NAMESPACE="USER"
WRITE ^nametest(1)
KILL ^nametest
```

Notes

Each variable assignment can be a local variable, a process-private global, or a global, the **$PIECE** function, the **$EXTRACT** function, and certain special variables, including **$ECODE**, **$DEVICE**, **$KEY**, **$TEST**, **$X**, and **$Y**.

If the target variable does not already exist, **SET** creates it and then assigns the value. If it does exist, **SET** replaces the existing value with the assigned value.

SET and Subscripts

You can set individual subscripted values (array nodes) for a local variable, process-private global, or a global. You can set subscripts in any order. If the variable subscript level does not already exist, **SET** creates it and then assigns the value. Each subscript level is treated as an independent variable; only those subscript levels set are defined. For example:

```
KILL myarray
SET myarray(1,1,1)="Cambridge"
WRITE !,myarray(1,1,1)
SET myarray(1)="address"
WRITE !,myarray(1)
```

In this example, the variables myarray(1,1,1) and myarray(1) are defined and contain values. However, the variables myarray and myarray(1,1) are not defined, and return an <UNDEFINED> error when invoked.

By default, you cannot set a null subscript. For example, `SET ^x("")=123` results in a <SUBSCRIPT> error. However you can set **%SYSTEM.Process.NullSubscripts()** method to allow null subscripts for global and process-private global variables. You cannot set a null subscript for a local variable.

The maximum length of a subscript is 511 characters. Exceeding this length results in a <SUBSCRIPT> error.

The maximum number of subscript levels for a local variable is 255. The maximum number of subscript levels for a global variable depends on the subscript level names, and may exceed 255 levels. Attempting to set a local variable to more than 255 subscript levels (either directly or by indirection) results in a <SYNTAX> error. For further information on subscripted variables, refer to Global Structure in *Using Globals*.

Order of Evaluation

InterSystems IRIS evaluates the arguments of the **SET** command in strict left-to-right order. For each argument, it performs the evaluation in the following sequence:

1. Evaluates occurrences of indirection or subscripts to the left of the equal sign in a left-to-right order to determine the variable name(s). For more information, refer to Indirection in *Using ObjectScript*.
2. Evaluates the expression to the right of the equal sign.
3. Assigns the expression to the right of the equal sign to the variable name or references to the left of the equal sign.

Transaction Processing

A **SET** of a global variable is journaled as part of the current transaction; this global variable assignment is rolled back during transaction rollback. A **SET** of a local variable or a process-private global variable is *not* journaled, and thus this assignment is unaffected by a transaction rollback.

Defined and Undefined Variables

Most ObjectScript commands and functions require that a variable be defined before it is referenced. By default, attempting to reference an undefined variable generates an <UNDEFINED> error. Attempting to reference an undefined object generates a <PROPERTY DOES NOT EXIST> or <METHOD DOES NOT EXIST> error. Refer to $ZERROR for further details on these error codes.

You can change InterSystems IRIS behavior when referencing an undefined variable by setting the **%SYSTEM.Process.Undefined()** method.

The READ command and the $INCREMENT function can reference an undefined variable and assign a value to it. The $DATA function can take an undefined or defined variable and return its status. The $GET function returns the value of a defined variable; optionally, it can also assign a value to an undefined variable.

SET with $PIECE and $EXTRACT

You can use the **$PIECE** and **$EXTRACT** functions with **SET** on either side of the equals sign. For detailed descriptions, refer to $PIECE and $EXTRACT.

When used on the right side of the equals sign, **$PIECE** and **$EXTRACT** extract a substring from a variable and assign its value to the specified variable(s) on the left side of the equals sign. **$PIECE** extracts a substring using a specified delimiter, and **$EXTRACT** extracts a substring using a character count.

For example, assume that variable *x* contains the string "HELLO WORLD". The following commands extract the substring "HELLO" and assign it to variables *y* and *z*, respectively:

```
SET x="HELLO WORLD"
SET y=$PIECE(x," ",1)
SET z=$EXTRACT(x,1,5)
WRITE "x=",x,!,"y=",y,!,"z=",z
```

When used on the left side of the equals sign, **$PIECE** and **$EXTRACT** insert the value from the expression on the right side of the equals sign into the specified portion of the target variable. Any existing value in the specified portion of the target variable is replaced by the inserted value.

For example, assume that variable *x* contains the string "HELLO WORLD" and that variable *y* contains the string "HI THERE". In the command:

```
SET x="HELLO WORLD"
SET y="HI THERE"
SET $PIECE(x," ",2)=$EXTRACT(y,4,9)
WRITE "x=",x
```

The **$EXTRACT** function extracts the string "THERE" from variable *y* and the **$PIECE** function inserts it into variable *x* at the second field position, replacing the existing string "WORLD". Variable *x* now contains the string "HELLO THERE".

If the target variable does not exist, the system creates it and pads it with delimiters (in the case of **$PIECE**) or with spaces (in the case of **$EXTRACT**) as needed.

In the following example, **SET $EXTRACT** is used to insert the value of *z* into strings *x* and *y*, overwriting the existing values:

```
SET x="HELLO WORLD"
SET y="OVER EASY"
SET z="THERE"
SET $EXTRACT(x,7,11)=z
SET $EXTRACT(y,*-3,*)=z
WRITE "edited x=",x,!
WRITE "edited y=",y
```

Variable *x* now contains the string "HELLO THERE" and *y* contains the string "OVER THERE". Note that because one of the **SET $EXTRACT** operations in this example uses a negative offset (*-3) these operations must be done as separate sets. You cannot set multiple variables with a single **SET** using enclosing parentheses if any of the variables uses negative offset.

In the following example, assume that the global array ^client is structured so that the root node contains the client’s name, with subordinate nodes containing the street address and city. For example, ^client(2,1,1) would contain the city address for the second client stored in the array.

Assume further that the city node (x,1,1) contains field values identifying the city, state abbreviation, and ZIP code (postal code), with the comma as the field separator. For example, a typical city node value might be "Cambridge,MA,02142". The three **SET** commands in the following code each use the **$PIECE** function to assign a specific portion of the array node value to the appropriate local variable. Note that in each case **$PIECE** references the comma (",") as the string separator.

```
ADDRESSPIECE
   SET ^client(2,1,1)="Cambridge,MA,02142"
   SET city=$PIECE(^client(2,1,1),",",1)
   SET state=$PIECE(^client(2,1,1),",",2)
   SET zip=$PIECE(^client(2,1,1),",",3)
   WRITE "City is ",city,!,
         "State or Province is ",state,!
        ,"Postal code is ",zip
   QUIT
```

The **$EXTRACT** function could be used to perform the same operation, but only if the fields were fixed length and the lengths were known. For example, if the city field was known to contain only up to 9 characters and the state and ZIP fields were known to contain only 2 and 5 characters, respectively, the **SET** commands could be coded with the **$EXTRACT** function as follows:

```
ADDRESSEXTRACT
   SET ^client(2,1,1)="Cambridge,MA,02142"
   SET city=$EXTRACT(^client(2,1,1),1,9)
   SET state=$EXTRACT(^client(2,1,1),11,12)
   SET zip=$EXTRACT(^client(2,1,1),14,18)
   WRITE "City is ",city,!,
         "State or Province is ",state,!,
         "Postal code is ",zip
   QUIT
```

Notice the gaps between 9 and 11 and 12 and 14 to accommodate the comma field separators.

The following example replaces the first substring in *A* (originally set to 1) with the string "abc".

```
StringPiece
   SET A="1^2^3^4^5^6^7^8^9"
   SET $PIECE(A,"^")="abc"
   WRITE !,"A=",A
   QUIT
```

```
A="abc^2^3^4^5^6^7^8^9"
```

The following example uses **$EXTRACT** to replace the first character in *A* (again, a 1) with the string "abc".

```
StringExtract
   SET A="123456789"
   SET $EXTRACT(A)="abc"
   WRITE !,"A=",A
   QUIT
```

```
A="abc23456789"
```

The following example replaces the third through sixth pieces of *A* with the string "abc" and replaces the first character in the variable *B* with the string "abc".

```
StringInsert
   SET A="1^2^3^4^5^6^7^8^9"
   SET B="123"
   SET ($PIECE(A,"^",3,6),$EXTRACT(B))="abc"
   WRITE !,"A=",A,!,"B=",B
   QUIT
```

```
A="1^2^abc^7^8^9"
```

```
B="abc23"
```

The following example sets **$X**, **$Y**, **$KEY**, and the fourth piece of a previously undefined local variable, *A*, to the value of 20. It also sets the local variable *K* to the current value of **$KEY**. *A* includes the previous three pieces and their caret delimiter (^).

```
SetVars
   SET ($X,$Y,$KEY,$PIECE(A,"^",4))=20,X=$X,Y=$Y,K=$KEY
   WRITE !,"A=",A,!,"K=",K,!,"X=",X,!,"Y=",Y
   QUIT
```

```
A="^^^20" K="20" X=20 Y=20
```

SET with $LIST and $LISTBUILD

The $LIST functions create and manipulate lists. They encode the length (and type) of each element within the list, rather than using an element delimiter. They then use the encoded length specifications to extract specified list elements during list manipulation. Because the $LIST functions do not use delimiter characters, the lists created using these functions should not be input to **$PIECE** or other character-delimiter functions.

When used on the *right side of the equal sign*, these functions return the following:

$LIST

$LIST returns the specified element of the specified list.

$LISTBUILD

$LISTBUILD returns a list containing one element for each argument given.

When used on the *left side of the equal sign*, in a **SET** argument, these functions perform the following tasks:

$LIST

Replaces the specified element(s) with the value given on the right side of the equal sign.

```
   SET A=$LISTBUILD("red","blue","green","white")
   WRITE "Created list A=",$LISTTOSTRING(A),!
   SET $LIST(A,2)="yellow"
   WRITE "Edited list A=",$LISTTOSTRING(A)
```

```
   SET A=$LISTBUILD("red","blue","green","white")
   WRITE "Created list A=",$LISTTOSTRING(A),!
   SET $LIST(A,*-1,*)=$LISTBUILD("yellow")
   WRITE "Edited list A=",$LISTTOSTRING(A)
```

You cannot use parentheses with **SET $LIST** to assign the same value to multiple variables.

$LISTBUILD

Extracts several elements of a list in a single operation. The arguments of **$LISTBUILD** are variables, each of which receives an element of the list corresponding to their position in the **$LISTBUILD** parameter list. Variable names may be omitted for positions that are not of interest.

In the following example, **$LISTBUILD** (on the right side of the equal sign) is first used to return a list. Then **$LISTBUILD** (on the left side of the equal sign) is used to extract two items from that list and set the appropriate variables.

```
SetListBuild
   SET J=$LISTBUILD("red","blue","green","white")
   SET $LISTBUILD(A,,B)=J
   WRITE "A=",A,!,"B=",B
```

In this example, A="red" and B="green".

See Also

- $LIST function
- $LISTBUILD function
- $EXTRACT function
- $PIECE function
- $X special variable
- $Y special variable

TCOMMIT

Marks the successful completion of a transaction.

```
TCOMMIT:pc
TC:pc
```

Argument

pc	*Optional* — A postconditional expression.

Description

TCOMMIT marks the successful end of a transaction initiated by the corresponding **TSTART**.

TCOMMIT decrements the value of the **$TLEVEL** special variable. InterSystems IRIS terminates the transaction only if **$TLEVEL** goes to 0. Usually this is when **TCOMMIT** has been called as many times as **TSTART**. Changes made during nested transactions are not committed until **$TLEVEL**=0.

Calling **TCOMMIT** when **$TLEVEL** is already 0 results in a <COMMAND> error. This can occur if you issue a **TCOMMIT** when no transaction is in progress, when the number of **TCOMMIT** commands is larger than the number of **TSTART** commands, or following a **TROLLBACK** command. The corresponding $ZERROR value consists of `<COMMAND>`, the location of the error (for example `+3^mytest`), and the data literal `*NoTransaction`.

Argument

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

Examples

You use **TCOMMIT** with the **TROLLBACK** and **TSTART** commands. See TROLLBACK and TSTART for examples of how to use these transaction processing commands together.

Notes

Nested TSTART / TCOMMIT

InterSystems IRIS supports the nesting of the **TSTART/TCOMMIT** commands, so that modules can issue their **TSTART/TCOMMIT** pairs correctly, independent of any other **TSTART/TCOMMIT** issued in the modules that called them or in the modules they call. The current nesting level of the transaction is tracked by the special variable **$TLEVEL**. The transaction is committed when the outermost matching **TCOMMIT** is issued; that is, when **$TLEVEL** goes back to 0.

You can roll back individual nested transactions by calling **TROLLBACK 1** or roll back all current transactions by calling **TROLLBACK**. **TROLLBACK** rolls back the whole transaction that is in effect — no matter how many levels of **TSTART** were issued — and sets **$TLEVEL** to 0.

Synchronous Commit

A **TCOMMIT** command requests a flush of the journal data involved in that transaction to disk. Whether to wait for this disk write operation to complete is a configurable option.

Go to the Management Portal, select **System Administration**, **Configuration**, **Additional Settings**, **Compatibility**. View and edit the current setting of **SynchCommit**. When set to "true", **TCOMMIT** does not complete until the journal data write operation completes. When set to "false", **TCOMMIT** does not wait for the write operation to complete. The default is "false". A restart is required for a change to the **SynchCommit** setting to take effect.

SQL and Transactions

ObjectScript and SQL transaction commands are fully compatible and interchangeable, with the following exception:

ObjectScript **TSTART** and SQL **START TRANSACTION** both start a transaction if no transaction is current. However, **START TRANSACTION** does not support nested transactions. Therefore, if you need (or may need) nested transactions, it is preferable to start the transaction with **TSTART**. If you need compatibility with the SQL standard, use **START TRANSACTION**.

ObjectScript transaction processing provides limited support for nested transactions. SQL transaction processing supplies support for savepoints within transactions.

See Also

- TROLLBACK command
- TSTART command
- $TLEVEL special variable
- Using ObjectScript for Transaction Processing in *Using ObjectScript*

THROW

Explicitly throws an exception to the next exception handler.

```
THROW oref
```

Argument

oref	*Optional* — An object reference (OREF) that is thrown to an exception handler. Optional, but highly recommended.

Description

The **THROW** command explicitly throws an exception. An exception can be a system error, a %Status exception, or a user-defined exception. It throws this exception as an object reference (OREF) that inherits from the %Exception.AbstractException object. The **THROW** command throws this exception to the next exception handler.

There are two ways to use **THROW** *oref*:

- TRY/CATCH: Use **THROW** *oref* to explicitly signal an exception from within a **TRY** block of code, transferring execution from the **TRY** block to its corresponding **CATCH** block exception handler.
- Other Exception Handlers: Use **THROW** *oref* to explicitly signal an exception when *not* in a **TRY** block. This triggers the current exception handler (for example, $ZTRAP), where the *oref* can be retrieved from the $THROWOBJ special variable.

Note: Use of **THROW** without an argument is deprecated and not recommended for new code.

System Errors

InterSystems IRIS issues a system error when a runtime error occurs, such a referencing an undefined variable. A system error generates a %Exception.SystemException object reference, sets the *oref* properties Code, Name, Location, and Data, and also sets the **$ZERROR** and **$ECODE** special variables, and transfers control to the next error handler. This error handler can be a **CATCH** exception handler, or a **$ZTRAP** error handler. A system error is an implicit error, which does not use a **THROW**.

You can use **THROW** within an error handler to throw a system error object to a further error handler. This is known as re-signalling a system error.

A **THROW** passes control up the execution stack to the next error handler. If the exception is an %Exception.SystemException object, the next error handler can be either type (**CATCH** or **$ZTRAP**). Otherwise, there must be a **CATCH** to handle the exception or InterSystems IRIS generates a <THROW> error.

Argument

oref

A reference to an exception object, which is an instance of any class that inherits from %Exception.AbstractException. A exception object for a system error is an instance of the class %Exception.SystemException. A user-specified exception object can be a %Status exception object (%Exception.StatusException), a general exception object (%Exception.General), or SQL exception object (%Exception.SQL). The creation and population of a user exception object is the responsibility of the programmer.

For information on OREFs, see "OREF Basics" in *Defining and Using Classes*.

THROW from a TRY Block

THROW *oref* can be issued from a **TRY** block to its corresponding **CATCH** block. This explicitly signals a user-defined exception. This transfers execution from a **TRY** block to its corresponding **CATCH** block. The thrown *oref* is set as the **CATCH** block's *exceptionvar* argument.

To issue an argumented **THROW** from a **CATCH** exception handler, you can either throw to a non-CATCH exception handler, or you can nest a **TRY** block (and associated nested **CATCH** block) within the **CATCH** exception handler, and issue the **THROW** from this nested **TRY** block.

%Status Exceptions and User-Defined Exceptions

To trap a %Status exception or a user-defined exception, specify an object based on the %Exception.AbstractException object as the *oref* argument. Define an exception class, then create an instance of the class using **%New()** and supply the exception information. These types of exceptions must be handled by a **CATCH** exception handler. If no **CATCH** exists, the system generates a <THROW> error.

A user-defined exception does not change the value of **$ZERROR** or **$ECODE**. In order to use either of these special variables, your program must explicitly set them using the **SET** command.

General Exception

InterSystems IRIS supplies a general exception that you can supply as the **THROW** argument. This is the %Exception.General subclass of the %Exception.AbstractException abstract class. Its use is shown in the following example:

```
  TRY {
       WRITE "In the TRY block",!!
       SET mygenex = ##class(%Exception.General).%New("My exception","999",,
                              "My own special exception")
       THROW mygenex
       WRITE "This shouldn't display",!
      }
  CATCH stuff {
       WRITE "In the CATCH block",!
       WRITE stuff.Name,!
       WRITE stuff.Code,!
       WRITE stuff.Data,!
       WRITE "End of the CATCH block",!
       RETURN
      }
```

THROW when not in a TRY Block

If you issue a **THROW** outside of a **TRY** block, InterSystems IRIS generates a <THROW> error, such as the following: `<THROW>+3^myprog *%Exception.General MyErr 999 My user-definied error`. This use of **THROW** is useful for re-signalling an error.

The object reference (*oref*) specified in the **THROW** is stored in the **$THROWOBJ** special variable. For example, `9@%Exception.General`. The **$THROWOBJ** value is cleared by the next successful **THROW** operation, or by `SET $THROWOBJ=""`.

In the following example, a **THROW** throws an exception to a $ZTRAP exception handler:

```
MainRou
       WRITE "In the Main Routine",!!
       SET $ZTRAP=^ErrRou
       SET mygenex = ##class(%Exception.General).%New("My exception","999",,
                              "My own special exception")
       THROW mygenex
       WRITE "This shouldn't display",!
       RETURN
```

```
ErrRou
       WRITE "In $ZTRAP",!
       SET oref=$THROWOBJ
       SET $THROWOBJ=""
       WRITE oref.Name,!
       WRITE oref.Code,!
       WRITE oref.Data,!
       WRITE "End of $ZTRAP",!
       RETURN
```

THROW without an Argument

Argumentless **THROW** re-signals the current system error, transferring control to the next exception handler. The current system error is the error referenced by the **$ZERROR** special variable. Thus, an argumentless **THROW** is equivalent to the command **ZTRAP $ZERROR**.

Use of argumentless **THROW** is not recommended, because which system error is the current system error may change. For instance, this would occur if the error handler changes the **$ZERROR** value, or if the error handler itself generates a system error. It is therefore preferable to explicitly specify the system error to be thrown to the next exception handler by using **THROW** *oref*.

Examples

Note that `$ZCVT(myerr.Name,"O","HTML")` is used in these examples because InterSystems IRIS error names are enclosed in angle brackets and these examples are run from a web browser. In most other contexts, `myerr.Name` will return the desired value.

The following example uses an instance of the %Exception.General class to throw a user-defined exception. It generates birth dates in the **TRY** block; if it generates a birth date that is in the future, it uses **THROW** to issue a general exception, passing the OREF of the user-defined exception to a general-purpose **CATCH** block. (You may have to run this example more than once to generate a date that throws an exception):

```
TRY {
    WRITE "In the TRY block",!
    SET badDOB=##class(%Exception.General).%New("<BAD DOB>","999",,"Birth date is in the future")
    FOR x=1:1:20 { SET rndDOB = $RANDOM(7)_$RANDOM(10000)
      IF rndDOB > $HOROLOG { WRITE !,"Birthdate ",$ZDATE(rndDOB,1,,4)," is invalid"
                              THROW badDOB }
      ELSE { WRITE "Birthdate ",$ZDATE(rndDOB,1,,4)," is valid",! }
   }
}
CATCH err {
      WRITE !,"In the CATCH block"
      WRITE !,"Error code=",err.Code
      WRITE !,"Error name=",$ZCVT(err.Name,"O","HTML")
      WRITE !,"Error data=",err.Data
      RETURN
}
```

The following example can issue either of two **THROW** commands with a user-defined argument. **$RANDOM** picks which **THROW** to issue (random values 0 or 1) or to not issue a **THROW** (random value 2). Note that code execution continues after the **TRY** / **CATCH** block pair, unless block execution ends with a **RETURN** command:

```
TRY {
   SET errdatazero="this is the zero error"
   SET errdataone="this is the one error"
   /* Error Randomizer */
      SET test=$RANDOM(3)
      WRITE "Error test is ",test,!
   IF test=0 {
     WRITE !,"Throwing exception 998",!
     THROW ##class(Sample.MyException).%New("TestZeroError",998,,errdatazero)
       THROW myvar
     }
   ELSEIF test=1 {
     WRITE !,"Throwing exception 999",!
     THROW ##class(Sample.MyException).%New("TestOneError",999,,errdataone)
     }
   ELSE { WRITE !,"No THROW error this time" }
}
CATCH exp {
    WRITE !,"This is the exception handler"
```

```
      WRITE !,"Error code=",exp.Code
      WRITE !,"Error name=",exp.Name
      WRITE !,"Error data=",exp.Data
      RETURN
  }
  WRITE !!,"Execution after TRY block continues here"
```

The following example shows the use of **THROW** with a system error. **THROW** is commonly used in a **CATCH** exception handler to forward the system error to another handler. This may occur when the system error received is an unexpected type of system error. Note that this requires nesting a TRY block (and corresponding CATCH block) within the CATCH block. It is used to **THROW** the system error to the nested **CATCH** block. This is shown in the following example, which calls Calculate to perform a division operation and return the answer. There are three possible outcomes: If *y* = any non-zero number, the division operation succeeds and no **CATCH** block code is executed. If *y*=0 (or any nonnumeric string), the division operation attempts to divide by zero, throwing a system error to its **CATCH** block; this is caught by the calcerr exception handler, which "corrects" this error and returns a value of 0. If, however, *y* is not defined (`NEW y`), calcerr catches an unexpected system error, and throws this error to the myerr exception handler. To demonstrate these three possible outcomes, this sample program uses **$RANDOM** to set the divisor (*y*):

```
Randomizer
  SET test=$RANDOM(3)
  IF test=0 { SET y=0 }
  ELSEIF test=1 { SET y=7 }
  ELSEIF test=2 { NEW y }
  /* Note: if test=2, y is undefined */
Main
  SET x=4
  TRY {
    SET result=$$Calculate(x,y)
    WRITE !,"Calculated value=",result
  }
  CATCH myerr {
    WRITE !,"this is the exception handler"
    WRITE !,"Error code=",myerr.Code
    WRITE !,"Error name=",$ZCVT(myerr.Name,"O","HTML")
    WRITE !,"Error data=",myerr.Data
  }
  QUIT

Calculate(arg1,arg2) PUBLIC {
  TRY {
  SET answer=arg1/arg2
  }
  CATCH calcerr {
      WRITE "In the CATCH Block",!
      TRY {
          IF calcerr.Name="<DIVIDE>" {
          WRITE !,"handling zero divide error"
          SET answer=0 }
          ELSE { THROW calcerr }
          RETURN
      }
      CATCH {
          WRITE "Unexpected error",!
          WRITE "Error name=",$ZCVT(myerr.Name,"O","HTML"),!
      }
  }
  QUIT answer
}
```

See Also

- CATCH command
- TRY command
- ZTRAP command
- $THROWOBJ special variable
- $ZERROR special variable
- $ZTRAP special variable
- Error Processing in *Using ObjectScript*

TROLLBACK

Rolls back an unsuccessful transaction.

```
TROLLBACK:pc
TRO:pc

TROLLBACK:pc 1
TRO:pc 1
```

Arguments

pc	*Optional* — A postconditional expression.
1	*Optional* — The integer 1. Rolls back one level of nesting. Must be specified as a literal.

Description

TROLLBACK terminates the current transaction and restores all journaled database values to the values they held at the start of the transaction. **TROLLBACK** has two forms:

- **TROLLBACK** rolls back all transactions in progress (no matter how many levels of **TSTART** were issued) and resets **$TLEVEL** to 0.
- **TROLLBACK 1** rolls back the current level of nested transactions (the one initiated by the most recent **TSTART**) and decrements **$TLEVEL** by 1. The 1 argument must be the literal number 1; it *cannot* be a variable or an expression that resolve to 1. Numbers other than 1 are not supported.

You can determine the level of nested transactions from the $TLEVEL special variable. Calling **TROLLBACK** when **$TLEVEL** is 0 has no effect.

You can use the **GetImageJournalInfo()** method of the %SYS.Journal.System class to search the journal file for **TSTART** commands, and thus identify open transactions. A **TSTART** increments **$TLEVEL** and writes a journal file record: either a "BT" (Begin Transaction) record if **$TLEVEL** was zero, or a "BTL" (Begin Transaction with Level) record if **$TLEVEL** was greater than 0. Use the **Sync()** method of the %SYS.Journal.System class to flush the journal buffer following a successful rollback operation.

TROLLBACK disables **Ctrl-C** interrupts for the duration of the rollback operation.

What Is and Isn't Rolled Back

TROLLBACK rolls back all journaled operations. These include the following:

- **TROLLBACK** rolls back most changes to global variables, including **SET** and **KILL** operations. Global variables underlie many InterSystems IRIS operations. Local variables are not reverted by a rollback operation.

  TROLLBACK rolls back changes to bit string values in global variables during a transaction. However, a rollback operation does not return the global variable bit string to its previous internal string representation.
- **TROLLBACK** rolls back insert, update, and delete changes to SQL data.

However, not all changes made by an application are journaled:

- **TROLLBACK** does not roll back changes to local variables or process-private globals.
- **TROLLBACK** does not roll back changes to special variables, such as $TEST.
- **TROLLBACK** does not roll back changes to the current namespace.
- **TROLLBACK** does not roll back LOCK command lock or unlock operations.

- **TROLLBACK** does not roll back $INCREMENT changes to global variables.
- **TROLLBACK** does not roll back $SEQUENCE changes to global variables.

InterSystems IRIS treats a **SET** or **KILL** of a global variable as a journaled transaction event; rolling back the transaction reverses these operations. InterSystems IRIS does not treat a **SET** or **KILL** of a local variable or a process-private global variable as a journaled transaction event; rolling back the transaction has no effect on these operations. By default, a **SET** or **KILL** of a global variable is immediately visible by other processes while the transaction is in progress. To prevent the **SET** or **KILL** of a global variable invoked within a transaction from being seen by other users before the transaction has been committed, you must coordinate access to the global variable via the **LOCK** command.

Transaction Rollback Logging

If an error occurs during a roll back operation, InterSystems IRIS issues a <ROLLFAIL> error message, and logs an error message in the messages.log operator messages log file. You can use the Management Portal **System Operation** option to view messages.log: **System Operation**, **System Logs**, **Messages Log**.

By default, the messages.log operator messages log file is in the InterSystems IRIS system management directory (`mgr`). This default location is configurable. Go to the Management Portal **System Administration** option, select **Configuration**, then **Additional Settings**, then **Advanced Memory**. View and edit the current setting of **ConsoleFile**. By default this setting is blank, routing console messages to messages.log in the `mgr` directory. You can specify a different directory location for the messages.log file.

<ROLLFAIL> Errors

If **TROLLBACK** cannot successfully roll back the transaction, a <ROLLFAIL> error occurs. The process behavior depends on the setting of the system-wide journal configuration setting flag **Freeze on error** (from Management Portal select **System Administration**, **Configuration**, **System Configuration**, **Journal Settings**):

- If **Freeze on error** is not set (the default), the process gets a <ROLLFAIL> error. The transaction is closed and any locks retained for the transaction are released. This option trades data integrity for system availability.
- If **Freeze on error** is set, the process halts and the clean job daemon (CLNDMN) retries rolling back the open transaction. During the CLNDMN retry period, locks retained for the transaction are intact and, as a result, the system might hang. This option trades system availability for data integrity.

For further details, refer to Journal IO Errors in the *Data Integrity Guide*.

When a <ROLLFAIL> occurs, the %msg records both the <ROLLFAIL> error itself, and the previous error that caused the roll back. For example, attempting to update a date with an out-of-range value and then failing roll back might return the following %msg: `SQLCODE = -105 %msg = Unexpected error occurred: <ROLLFAIL>%0Ac+1^dpv during TROLLBACK. Previous error: SQLCODE=-105, %msg='Field 'Sample.Person.DOB' (value '5888326') failed validation'`.

A <ROLLFAIL> occurs upon transaction rollback if within the transaction a global accessed a remote database, and then the program explicitly dismounted that remote database.

A <ROLLFAIL> occurs upon transaction rollback if the process disabled journaling before making database changes and an error occurred that invoked transaction rollback. A <ROLLFAIL> *does not* occur upon transaction rollback if the process disabled journaling after all database changes had been made but before issuing the **TROLLBACK** command. Instead, InterSystems IRIS temporarily enables journaling for the duration of the rollback operation. Upon completion of the rollback operation InterSystems IRIS again disables journaling.

Transactions Suspended

The **TransactionsSuspended()** method of the %SYSTEM.Process class can be used to suspend and resume all current transactions system-wide. Suspending transactions suspends journaling of changes. Therefore, if transaction suspension occurred during the current transaction, **TROLLBACK** cannot roll back any changes made while transactions were suspended; however, **TROLLBACK** rolls back any changes made during the current transaction that occurred before or after the tranaction suspension was in effect.

For further details, refer to Using ObjectScript for Transaction Processing in *Using ObjectScript*.

SQL and Transactions

ObjectScript and SQL transaction commands are fully compatible and interchangeable, with the following exception:

ObjectScript **TSTART** and SQL **START TRANSACTION** both start a transaction if no transaction is current. However, **START TRANSACTION** does not support nested transactions. Therefore, if you need (or may need) nested transactions, it is preferable to start the transaction with **TSTART**. If you need compatibility with the SQL standard, use **START TRANSACTION**.

ObjectScript transaction processing provides limited support for nested transactions. SQL transaction processing supplies support for savepoints within transactions.

Purging Cached Queries

If during a transaction you call the **Purge()** method of %SYSTEM.SQL class to purge cached queries, the cached queries are permanently deleted. A subsequent **TROLLBACK** will not restore purged cached queries.

Globals and TROLLBACK 1

TROLLBACK 1 rolls back and restores all globals changed within its nested transaction. However, if globals are changed that are mapped to a remote system that does not support nested transactions, these changes are treated as occurring at the outermost nested level. Such globals are only rolled back when a rollback resets **$TLEVEL** to 0, either by calling **TROLLBACK** or by calling **TROLLBACK 1** when **$TLEVEL**=1.

Locks and TROLLBACK 1

TROLLBACK 1 *does not* restore locks established during its nested transaction to their prior state. All locks established during a transaction remain in the lock table until the transaction is concluded by a **TROLLBACK** to level 0 or a **TCOMMIT**. At that point InterSystems IRIS releases all locks created during the nested transaction, and restores all pre-existing locks to their state before **TSTART**.

A **TCOMMIT** of a nested transaction does not release the corresponding locks, so a subsequent **TROLLBACK** can effect locks in a committed sub-transaction.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

Examples

The following example uses a single-level transaction to transfer a random amount of money from one account to another. If the transfer amount is more than the available balance, the program uses **TROLLBACK** to roll back the transaction:

```
SetupBankAccounts
   SET num=12345
   SET ^CHECKING(num,"balance")=500.99
   SET ^SAVINGS(num,"balance")=100.22
   IF $DATA(^NumberOfTransfers)=0 {SET ^NumberOfTransfers=0}
BankTransfer
  WRITE "Before transfer:",!,"Checking=$",^CHECKING(num,"balance")," Savings=$",^SAVINGS(num,"balance"),!

   // Transfer funds from one account to another
   SET transfer=$RANDOM(1000)
   WRITE "transfer amount $",transfer,!
   DO CkToSav(num,transfer)
```

```
   IF ok=1 {WRITE "sucessful transfer",!,"Number of transfers to date=",^NumberOfTransfers,!}
   ELSE {WRITE "*** INSUFFICIENT FUNDS ***",!}
  WRITE "After transfer:",!,"Checking=$",^CHECKING(num,"balance")," Savings=$",^SAVINGS(num,"balance"),!

   RETURN
CkToSav(acct,amt)
  TSTART
  SET ^CHECKING(acct,"balance") = ^CHECKING(acct,"balance") - amt
  SET ^SAVINGS(acct,"balance") = ^SAVINGS(acct,"balance") + amt
  SET ^NumberOfTransfers=^NumberOfTransfers + 1
  IF ^CHECKING(acct,"balance") > 0 {TCOMMIT  SET ok=1 QUIT:ok}
  ELSE {TROLLBACK  SET ok=0 QUIT:ok}
```

The following example shows the effects of **TROLLBACK** on nested transactions. Each **TSTART** increments **$TLEVEL** and sets a global. Issuing a **TCOMMIT** on the inner nested transaction decrements **$TLEVEL**, but the commitment of changes made in a nested transaction is deferred. In this case, the subsequent **TROLLBACK** on the outer transaction rolls back all changes made, including those in the inner “committed” nested transaction.

```
  SET ^a(1)="[- - -]",^b(1)="[- - -]"
  WRITE !,"level:",$TLEVEL," ",^a(1)," ",^b(1)
  TSTART
   LOCK +^a(1)
   SET ^a(1)="hello"
   WRITE !,"level:",$TLEVEL," ",^a(1)," ",^b(1)
     TSTART
     LOCK +^b(1)
     SET ^b(1)="world"
     WRITE !,"level:",$TLEVEL," ",^a(1)," ",^b(1)
     TCOMMIT
  WRITE !,"After TCOMMIT"
  WRITE !,"level:",$TLEVEL," ",^a(1)," ",^b(1)
  TROLLBACK
  WRITE !,"After TROLLBACK"
  WRITE !,"level:",$TLEVEL," ",^a(1)," ",^b(1)
  QUIT
```

The following example shows how **TROLLBACK** rolls back global variables, but not local variables:

```
  SET x="default",^y="default"
  WRITE !,"level:",$TLEVEL
  WRITE !,"local:",x," global:",^y
  TSTART
  SET x="first",^y="first"
  WRITE !,"TSTART level:",$TLEVEL
  WRITE !,"local:",x," global:",^y
    TSTART
    SET x=x_" second",^y=^y_" second"
    WRITE !,"TSTART level:",$TLEVEL
    WRITE !,"local:",x," global:",^y
     TSTART
     SET x=x_" third",^y=^y_" third"
    WRITE !,"TSTART level:",$TLEVEL
    WRITE !,"local:",x," global:",^y
  TROLLBACK
  WRITE !!,"After Rollback:"
  WRITE !,"TROLLBACK level:",$TLEVEL
  WRITE !,"local:",x," global:",^y
```

The following example shows how **$INCREMENT** changes to a global are not rolled back.

```
  SET ^x=-1,^y=0
  WRITE !,"level:",$TLEVEL
  WRITE !,"Increment:",$INCREMENT(^x)," Add:",^y
  TSTART
  SET ^y=^y+1
  WRITE !,"level:",$TLEVEL
  WRITE !,"Increment:",$INCREMENT(^x)," Add:",^y
    TSTART
    SET ^y=^y+1,^z=^z_" second"
    WRITE !,"level:",$TLEVEL
    WRITE !,"Increment:",$INCREMENT(^x)," Add:",^y
     TSTART
     SET ^y=^y+1,^z=^z_" third"
     WRITE !,"level:",$TLEVEL
     WRITE !,"Increment:",$INCREMENT(^x)," Add:",^y
  TROLLBACK
  WRITE !!,"After Rollback"
  WRITE !,"level:",$TLEVEL
  WRITE !,"Increment:",^x," Add:",^y
```

See Also

- TCOMMIT command
- TSTART command
- $TLEVEL special variable
- Using ObjectScript for Transaction Processing in *Using ObjectScript*

TRY

Identifies a block of code to monitor for errors during execution.

```
TRY {
   . . .
}
```

Description

The **TRY** command takes no arguments. It is used to identify a block of ObjectScript code statements enclosed in curly braces. This block of code is protected code for structured exception handling. If an exception occurs within this block of code, InterSystems IRIS sets **$ZERROR** and **$ECODE**, then transfers execution to an exception handler, identified by the CATCH command.

An exception may occur as a result of a runtime error, such as attempting to divide by 0, or it may be explicitly propagated by issuing a THROW command. If no error occurs, execution continues with the next ObjectScript statement after the **CATCH** block of code.

A **TRY** block must be immediately followed by a **CATCH** block. You cannot specify either executable code statements or a label between the closing curly brace of the **TRY** code block and the **CATCH** command. However, you can specify comments between the **TRY** and block and its **CATCH** block. Only one **CATCH** block is permitted for each **TRY** block. However, it is possible to nest paired **TRY**/**CATCH** blocks, such as the following:

```
TRY {
     /* TRY code */
     TRY {
         /* nested TRY code */
     }
     CATCH {
        /* nested CATCH code */
     }
}
CATCH {
    /* CATCH code */
}
```

Commonly, an ObjectScript program consists of multiple **TRY** blocks, each **TRY** block immediately followed by its associated **CATCH** block.

QUIT and RETURN

You exit a **TRY** block using QUIT or RETURN. **QUIT** exits the current block structure and continues execution with the next command outside of that block structure. For example, if you are within a nested **TRY** block, issuing a **QUIT** exits that **TRY** block to the enclosing block structure. Issuing a **QUIT** command within a **TRY** block transfers execution to the first code line after the corresponding **CATCH** block. You cannot use an argumented **QUIT** to exit a **TRY** block; attempted to do so results in a compile error. To exit a routine completely from within a **TRY** block, issue a **RETURN** statement.

In rare circumstances, a **TRY** block **QUIT** or **RETURN** command may generate an exception. This could happen if the **TRY** created a new context and then deleted some aspect of the old context; attempting to revert to the old context would cause an exception. A **TRY** block **QUIT** or **RETURN** exception does not invoke the **CATCH** block exception handler.

$ZTRAP

The **TRY** and **CATCH** commands perform error handling within an execution level. When an exception occurs within a **TRY** block, InterSystems IRIS normally executes the **CATCH** block of exception handler code that immediately follows the **TRY** block. This is the preferred error handling behavior.

You cannot set **$ZTRAP** within a **TRY** block.

If a **$ZTRAP** was set before entering the **TRY** block and an exception occurs within the **TRY** block, InterSystems IRIS takes the **CATCH** block rather than the **$ZTRAP**.

GOTO and DO

You can use a GOTO or DO command to enter a **TRY** block at a label within the **TRY** block. If an exception occurs later in the **TRY** block, the **CATCH** block exception handler is taken, just as if you had entered the **TRY** block at the **TRY** keyword. However, for clarity of coding, entering a **TRY** block using **GOTO** or **DO** should be avoided.

You can, of course, issue a **GOTO** from within a **TRY** block or a **CATCH** block.

Using a **GOTO** or **DO** to enter a **CATCH** block is strongly discouraged.

DO Within a TRY Block

When using a **TRY** statement, a **THROW** causes a search of the frame stack trying to find the appropriate **CATCH** block. When the frame stack indicates execution within a **TRY** block then execution will resume at the corresponding **CATCH** block. However, InterSystems IRIS must remove any "local" calls within the current **TRY** block before executing the **CATCH** block.

If a **TRY** block contains a **DO** statement that results in a reentry to that **TRY** block, one of two things may happen:

A “local” **DO** call (**DO** call that remains within the current **TRY** block): If the previous frame stack entry is a **DO** call located in the same **TRY** block, that **DO** is assumed to be a "local" subroutine call within the current **TRY** block. In this case, the **CATCH** is *not* immediately entered, but instead the frame stack is popped (possibly removing some recently allocated **NEW** variables) and the search resumes at the **DO** call in the current **TRY** block. If the new previous frame stack entry is not a **DO** from inside the current **TRY** block then the corresponding **CATCH** block is entered. However, if the previous frame stack entry is another **DO** in the same **TRY** then the frame stack is popped again (along with recently allocated **NEW** variables). This operation continues until the previous frame stack entry is not a **DO**, at which point the **CATCH** block is entered.

A “recursive” **DO** call (**DO** call inside a **TRY** block that leaves the **TRY** block but later execution reenters that **TRY** block): When searching for a **CATCH** block, if the previous frame stack entry is a **DO** inside the current **TRY** block, but the target label of that previous stack frame is not within the current **TRY** block (including any nested **TRY** blocks) then the frame stack is not popped (and no recently allocated local variables are popped) and the**CATCH** block is immediately entered. Note that if that **CATCH** block does another **THROW** then it is possible that the current **CATCH** block will be reentered because the recursive **DO** frame is still on the frame stack.

Examples

The examples in this section show runtime errors (%Exception.SystemException errors). For examples of user-specified exceptions invoked by issuing a **THROW**, refer to the THROW and CATCH commands.

In the following examples, the **TRY** code block is executed. It attempts to set the local variable *a*. In the first example, the code completes successfully, and the **CATCH** is skipped over. In the second example, the code fails with an <UNDEFINED> error, and execution is passed to the **CATCH** exception handler.

TRY succeeds. **CATCH** block is skipped. Execution continues with the 2nd **TRY** block:

```
TRY {
  WRITE "1st TRY block",!
  SET x="fred"
  WRITE "x is a defined variable",!
  SET a=x
}
CATCH exp
{
   WRITE !,"This is the CATCH exception handler",!
    IF 1=exp.%IsA("%Exception.SystemException") {
       WRITE "System exception",!
       WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
       WRITE "Location: ",exp.Location,!
       WRITE "Code: ",exp.Code,!
       WRITE "Data: ",exp.Data,!!
    }
    ELSE { WRITE "not a system exception",!!}
    WRITE "$ZERROR: ",$ZERROR,!
    WRITE "$ECODE: ",$ECODE
```

```
    RETURN
}
TRY {
  WRITE !,"2nd TRY block",!
  WRITE "This is where the code falls through",!
  WRITE "$ZERROR: ",$ZERROR,!
  WRITE "$ECODE: ",$ECODE
}
CATCH exp2 {
  WRITE !,"This is the 2nd CATCH exception handler",!
}
```

TRY fails. Execution continues with the **CATCH** block. **CATCH** block ends with **RETURN**, so 2nd **TRY** block is not executed:

```
TRY {
  WRITE "1st TRY block",!
  KILL x
  WRITE "x is an undefined variable",!
  SET a=x
}
CATCH exp {
    WRITE !,"This is the CATCH exception handler",!
    IF 1=exp.%IsA("%Exception.SystemException") {
       WRITE "System exception",!
       WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
       WRITE "Location: ",exp.Location,!
       WRITE "Code: ",exp.Code,!
       WRITE "Data: ",exp.Data,!!
    }
    ELSE { WRITE "not a system exception",!!}
    WRITE "$ZERROR: ",$ZERROR,!
    WRITE "$ECODE: ",$ECODE
    RETURN
}
TRY {
  WRITE !,"2nd TRY block",!
  WRITE "This is where the code falls through",!
  WRITE "$ZERROR: ",$ZERROR,!
  WRITE "$ECODE: ",$ECODE
}
CATCH exp2 {
  WRITE !,"This is the 2nd CATCH exception handler",!
}
```

TRY quits. In the following example, the **CATCH** block is not executed because execution of the **TRY** block is ended by either a **QUIT** or a **RETURN**, not an error. If **RETURN**, program execution stops. If **QUIT**, program execution continues with the 2nd **TRY** block:

```
TRY {
  WRITE "1st TRY block",!
  KILL x
  WRITE "x is an undefined variable",!
  SET decide=$RANDOM(2)
  IF decide=0 { WRITE "issued a QUIT",!
              QUIT }
  IF decide=1 { WRITE "issued a RETURN",!
              RETURN }
  WRITE "This should never display",!
  SET a=x
}
CATCH exp {
    WRITE !,"This is the CATCH exception handler",!
    IF 1=exp.%IsA("%Exception.SystemException") {
       WRITE "System exception",!
       WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
       WRITE "Location: ",exp.Location,!
       WRITE "Code: ",exp.Code,!
       WRITE "Data: ",exp.Data,!!
    }
    ELSE { WRITE "not a system exception",!!}
    WRITE "$ZERROR: ",$ZERROR,!
    WRITE "$ECODE: ",$ECODE
    RETURN
}
TRY {
  WRITE !,"2nd TRY block",!
  WRITE "This is where the code falls through",!
  WRITE "$ZERROR: ",$ZERROR,!
  WRITE "$ECODE: ",$ECODE
}
```

```
CATCH exp2 {
  WRITE !,"This is the 2nd CATCH exception handler",!
}
```

See Also

- CATCH command
- THROW command
- Error Processing in *Using ObjectScript*

TSTART

Marks the beginning of a transaction.

```
TSTART:pc
TS:pc
```

Argument

pc	*Optional* — A postconditional expression.

Description

TSTART marks the beginning of a transaction. Following **TSTART**, database operations are journaled to enable a subsequent **TCOMMIT** or **TROLLBACK** command.

TSTART increments the value of the **$TLEVEL** special variable. A **$TLEVEL** value of 0 indicates that no transaction is in effect. The first **TSTART** begins a transaction and increments **$TLEVEL** to 1. Subsequent **TSTART** commands can create nested transactions, further incrementing **$TLEVEL**.

Not all operations that occur within a transaction can be rolled back. For example, setting global variables within a transaction can be rolled back; setting local variables within a transaction cannot be rolled back. Refer to Using ObjectScript for Transaction Processing in *Using ObjectScript* for further details.

By default, a lock issued within a transaction will be held until the end of the transaction, even if the lock is released within the transaction. This default can be overridden when setting the lock. Refer to the LOCK command for more details.

Nested Transactions

If you issue a **TSTART** within a transaction it begins a nested transaction. Issuing a **TSTART** increments the **$TLEVEL** value, indicating the number of levels of transaction nesting. You end a nested transaction by issuing either a **TCOMMIT** to commit the nested transaction, or a **TROLLBACK 1** to roll back the nested transaction. Ending a nested transaction decrements the **$TLEVEL** value by 1.

- Issuing a **TROLLBACK 1** for a nested transaction rolls back changes made in that nested transaction and decrements **$TLEVEL**. You can issue a **TROLLBACK** to roll back the whole transaction, no matter how many levels of **TSTART** were issued.
- Issuing a **TCOMMIT** for a nested transaction decrements **$TLEVEL**, but the actual commitment of the nested transaction is deferred. Changes made during a nested transaction are only irreversibly committed when the outermost transaction is committed; that is, when a **TCOMMIT** decrements the **$TLEVEL** value to 0.

You can use the **GetImageJournalInfo()** method of the %SYS.Journal.System class to search the journal file for **TSTART** commands, and thus identify open transactions. A **TSTART** writes either a “BT” (Begin Transaction) journal file record if **$TLEVEL** was zero, or a “BTL” (Begin Transaction with Level) journal file record if **$TLEVEL** was greater than 0.

The maximum number of levels of nested transactions is 255. Attempting to exceed this nesting levels limit results in a <TRANSACTION LEVEL> error.

SQL and Transactions

ObjectScript and SQL transaction commands are fully compatible and interchangeable, with the following exception:

ObjectScript **TSTART** and SQL **START TRANSACTION** both start a transaction if no transaction is current. However, **START TRANSACTION** does not support nested transactions. Therefore, if you need (or may need) nested transactions, it is preferable to start the transaction with **TSTART**. If you need compatibility with the SQL standard, use **START TRANSACTION**.

ObjectScript transaction processing provides limited support for nested transactions. SQL transaction processing supplies support for savepoints within transactions.

Argument

pc

An optional postconditional expression. InterSystems IRIS executes the **TSTART** command if the postconditional expression is true and does not execute the **TSTART** command if the postconditional expression is false. For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

Examples

The following example uses a single-level transaction to transfer a random amount of money from one account to another. If the transfer amount is more than the available balance, the program rolls back the transaction:

```
SetupBankAccounts
   SET num=12345
   SET ^CHECKING(num,"balance")=500.99
   SET ^SAVINGS(num,"balance")=100.22
   IF $DATA(^NumberOfTransfers)=0 {SET ^NumberOfTransfers=0}
BankTransfer
  WRITE "Before transfer:",!,"Checking=$",^CHECKING(num,"balance")," Savings=$",^SAVINGS(num,"balance"),!

   // Transfer funds from one account to another
   SET transfer=$RANDOM(1000)
   WRITE "transfer amount $",transfer,!
   DO CkToSav(num,transfer)
   IF ok=1 {WRITE "sucessful transfer",!,"Number of transfers to date=",^NumberOfTransfers,!}
   ELSE {WRITE "*** INSUFFICIENT FUNDS ***",!}
  WRITE "After transfer:",!,"Checking=$",^CHECKING(num,"balance")," Savings=$",^SAVINGS(num,"balance"),!

   RETURN
CkToSav(acct,amt)
  TSTART
  SET ^CHECKING(acct,"balance") = ^CHECKING(acct,"balance") - amt
  SET ^SAVINGS(acct,"balance") = ^SAVINGS(acct,"balance") + amt
  SET ^NumberOfTransfers=^NumberOfTransfers + 1
  IF ^CHECKING(acct,"balance") > 0 {TCOMMIT  SET ok=1 QUIT:ok}
  ELSE {TROLLBACK  SET ok=0 QUIT:ok}
```

The following examples use **TSTART** to create nested transactions. They show three scenarios for rollback of nested transactions:

Roll back the innermost transaction, commit the middle transaction, commit the outermost transaction:

```
  KILL ^a,^b,^c
  TSTART  SET ^a=1 WRITE "tlevel=",$TLEVEL,!
    TSTART  SET ^b=2 WRITE "tlevel=",$TLEVEL,!
      TSTART  SET ^c=3 WRITE "tlevel=",$TLEVEL,!
      TROLLBACK 1 WRITE "tlevel=",$TLEVEL,!
    TCOMMIT  WRITE "tlevel=",$TLEVEL,!
  TCOMMIT  WRITE "tlevel=",$TLEVEL,!
  IF $DATA(^a) {WRITE "^a=",^a,!} ELSE {WRITE "^a is undefined",!}
  IF $DATA(^b) {WRITE "^b=",^b,!} ELSE {WRITE "^b is undefined",!}
  IF $DATA(^c) {WRITE "^c=",^c,!} ELSE {WRITE "^c is undefined",!}
```

Commit the innermost transaction, roll back the middle transaction, commit the outermost transaction:

```
  KILL ^a,^b,^c
  TSTART  SET ^a=1 WRITE "tlevel=",$TLEVEL,!
    TSTART  SET ^b=2 WRITE "tlevel=",$TLEVEL,!
      TSTART  SET ^c=3 WRITE "tlevel=",$TLEVEL,!
      TCOMMIT  WRITE "tlevel=",$TLEVEL,!
    TROLLBACK 1 WRITE "tlevel=",$TLEVEL,!
  TCOMMIT  WRITE "tlevel=",$TLEVEL,!
  IF $DATA(^a) {WRITE "^a=",^a,!} ELSE {WRITE "^a is undefined",!}
  IF $DATA(^b) {WRITE "^b=",^b,!} ELSE {WRITE "^b is undefined",!}
  IF $DATA(^c) {WRITE "^c=",^c,!} ELSE {WRITE "^c is undefined",!}
```

Commit the innermost transaction, commit the middle transaction, roll back the outermost transaction:

```
KILL ^a,^b,^c
TSTART  SET ^a=1  WRITE "tlevel=",$TLEVEL,!
  TSTART  SET ^b=2  WRITE "tlevel=",$TLEVEL,!
    TSTART  SET ^c=3  WRITE "tlevel=",$TLEVEL,!
    TCOMMIT  WRITE "tlevel=",$TLEVEL,!
  TCOMMIT  WRITE "tlevel=",$TLEVEL,!
TROLLBACK 1  WRITE "tlevel=",$TLEVEL,!
IF $DATA(^a) {WRITE "^a=",^a,!} ELSE {WRITE "^a is undefined",!}
IF $DATA(^b) {WRITE "^b=",^b,!} ELSE {WRITE "^b is undefined",!}
IF $DATA(^c) {WRITE "^c=",^c,!} ELSE {WRITE "^c is undefined",!}
```

Note that in this third case, **TROLLBACK 1** and **TROLLBACK** would have the same result, because both would decrement **$TLEVEL** to 0.

See Also

- TCOMMIT command
- TROLLBACK command
- $TLEVEL special variable
- Using ObjectScript for Transaction Processing in *Using ObjectScript*

USE

Establishes a device as the current device.

```
USE:pc useargument,...
U:pc useargument,...
```

where *useargument* is:

```
device:(parameters):"mnespace"
```

Arguments

pc	*Optional* — A postconditional expression.
device	The device to be selected as the current device, specified by a device ID or a device alias. A device ID can be an integer (a device number), a device name, or the pathname of a sequential file. If a string, it must be enclosed with quotation marks.
parameters	*Optional* — The list of parameters used to set device characteristics. The parameter list is enclosed in parentheses, and the parameters in the list are separated by colons. Parameters can either be positional (specified in a fixed order in the parameter list) or keyword (specified in any order). A mix of positional and keyword parameters is permitted. The individual parameters and their positions and keywords are highly device-dependent.
mnespace	*Optional* — The name of the mnemonic space that contains the control mnemonics to use with this device, specified as a quoted string.

Description

USE *device* establishes the specified device as the current device. The process must have already established ownership of the device with the **OPEN** command.

The current device remains current until you issue another **USE** command to select another owned device as the current device or until the process terminates.

The **USE** command can establish as the current device such devices as terminal devices, spool devices, TCP bindings, interprocess pipes, named pipes, and inter-job communications. The **USE** command can also be used to open a sequential file. The *device* argument specifies the file pathname as a quoted string.

The *parameters* available with the **USE** command are highly device-dependent. In many cases the available *parameters* are the same as those available with the **OPEN** command; however, some device parameters can only be set using the **OPEN** command, and other can only be set using the **USE** command.

The **USE** command can specify more than one *useargument*, separated by commas. However, you can only have one current device at a time. If you specify more than one *useargument*, the device specified in the last *useargument* becomes the current device. This form of **USE** may be used to set *parameters* for several devices, and then establish the last-named device as the current device.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

device

The device to be selected as the current device. Specify the same device ID (or other device identifier) as you specified in the corresponding **OPEN** command. For more information on specifying devices, refer to the OPEN command.

parameters

The list of parameters used to set operating characteristics of the device to be used as the current device. The enclosing parentheses are required if there is more than one parameter. (It is good programming practice to always use parentheses when you specify a parameter.) Note the required colon before the left parenthesis. Within the parentheses, colons are used to separate multiple parameters.

The parameters for a device can be specified using either positional parameters or keyword parameters. You can also mix positional parameters and keyword parameters within the same parameter list.

In most cases, specifying contradictory, duplicate, or invalid parameter values does not result in an error. Wherever possible, InterSystems IRIS ignores inappropriate parameter values and takes appropriate defaults.

The available parameters are, in many cases, the same as those supported for the **OPEN** command. For sequential files, TCP devices, and interprocess communication pipes some parameters can only be set with the **OPEN** command; for sequential files some parameters can only be set with the **USE** command. **USE** parameters are specific to the type of device that is being selected and to the particular implementation. The **USE** command keyword parameters are listed by device type in I/O Devices and Commands in the *I/O Device Guide*.

If you do not specify a list of **USE** parameters, InterSystems IRIS uses the device's default **OPEN** parameters. The default parameters for a device are configurable. Go to the Management Portal, select **System Administration**, **Configuration**, **Device Settings**, **Devices** to display the current list of devices. For the desired device, click "edit" to display its **Open Parameters:** option. Specify this value in the same way you specify the **OPEN** command parameters, including the enclosing parentheses. For example, `("AVL":0:2048)`.

Positional Parameters

Positional parameters must be specified in a fixed sequence in the parameter list. You can omit a positional parameter (and receive the default value), but you must retain the colon to indicate the position of the omitted positional parameter. Trailing colons are not required; excess colons are ignored. The individual parameters and their positions are highly device-dependent. There are two types of positional parameters: values and letter code strings.

A value can be an integer (for example, record size), a string (for example, host name), or a variable or expression that evaluates to a value.

A letter code string uses individual letters to specify device characteristics for the open operation. For most devices, this letter code string is one of the positional parameters. You can specify any number of letters in the string, and specify the letters in any order. Letter codes are not case-sensitive. A letter code string is enclosed in quotation marks; no spaces or other punctuation is allowed within a letter code string (exception: K and Y may be followed by a name delimited by backslashes: thus: K\name\). For example, when opening a sequential file, you might specify a letter code string of "ANDFW" (append to existing file, create new file, delete file, fix-length records, write access.) The position of the letter code string parameter, and the meanings of individual letters is highly device-dependent.

Keyword Parameters

Keyword parameters can be specified in any sequence in the parameter list. A parameter list can consist entirely of keyword parameters, or it can contain a mix of positional and keyword parameters. (Commonly, the positional parameters are specified first (in their correct positions) followed by the keyword parameters.) You must separate all parameters (positional or keyword) with a colon (:). A parameter list of keyword parameters has the following general syntax:

```
USE device:(/KEYWORD1=value1:/KEYWORD2=value2:.../KEYWORDn=valuen):"mnespace"
```

The individual parameters and their positions are highly device-dependent. As a general rule, you can specify the same parameters and values using either a positional parameter or a keyword parameter. You can specify a letter code string as a keyword parameter by using the /PARAMS keyword.

mnespace

The name of the mnemonic space that contains the device control mnemonics used by this device. By default, InterSystems IRIS provides the mnemonic space ^%X364 (ANSI X3.64 compatible) for all devices and sequential files. Default mnemonic spaces are assigned by device type.

Go to the Management Portal, select **System Administration**, **Configuration**, **Device Settings**, **IO Settings**. View and edit the File, Other, or Terminal mnemonic space setting.

A mnemonic space is a routine that contains entry points for the device control mnemonics used by **READ** and **WRITE** commands. The **READ** and **WRITE** commands invoke these device control mnemonics using the /*mnemonic*(*params*) syntax. These device control mnemonics perform operations such as moving the cursor to a specified screen location.

Use the *mnespace* argument to override the default mnemonic space assignment. Specify an ObjectScript routine that contains the control mnemonics entry points used with this device. The enclosing double quotes are required. Specify this option only if you plan to use device control mnemonics with the **READ** or **WRITE** command. If the mnemonic space does not exist, InterSystems IRIS issues a <NOROUTINE> error. For further details on mnemonic spaces, see I/O Devices and Commands in the *I/O Device Guide*.

Examples

In this example, the **USE** command sets the sequential file "STUDENTS" as the current device and sets the file pointer so that subsequent reads begin at offset 256 from the start of the file.

```
USE "STUDENTS":256
```

Notes

Device Ownership

Device ownership is established with the **OPEN** command. The only exception is the principal device, which is assigned to the process and is usually the terminal at which you sign on. If the device specified in the **USE** command is not owned by the process, InterSystems IRIS issues a <NOTOPEN> error message.

The Current Device

The current device is the device used for I/O operations by the **READ** and **WRITE** commands. The **READ** command acquires input from the current device and the **WRITE** command sends output to the current device.

InterSystems IRIS maintains the ID of the current device in the **$IO** special variable. If the **USE** request is successful, InterSystems IRIS sets **$IO** to the ID of the specified device. The **GetType()** method of the %Library.Device class returns the device type of the current device.

The Principal Device

The special device number 0 (zero) refers to the principal device. Each process has one principal device. InterSystems IRIS maintains the ID of the principal device in the **$PRINCIPAL** special variable. The principal device is automatically opened when you start up InterSystems IRIS. Initially, the principal device (**$PRINCIPAL**) and the current device (**$IO**) are the same.

After you issue a **USE** command, your current device (**$IO**) is normally the one named in the last **USE** command you executed.

While many processes can have the same principal device, only one at a time can own it. After a process successfully issues an **OPEN** command for a device, no other process can issue **OPEN** for that device until the first process releases it, either by explicitly issuing a **CLOSE** command, by halting, or because that user ends the session.

Although you can issue **OPEN** and **USE** for a device other than your principal device from the Terminal, each time InterSystems IRIS returns to the > prompt, it implicitly issues **USE 0**. To continue using a device other than 0, you must issue a **USE** command in each line you enter at the > prompt.

Your principal device automatically becomes your current device when you do any of the following:

- Log on.
- Issue a **USE 0** command.
- Cause an error when an error trap is not set.
- Close the current device.
- Return to the Terminal prompt.
- Exit InterSystems IRIS by issuing a **HALT** command.

USE 0 implies an **OPEN** command to the principal device. If another process owns the device, this process hangs on the implicit **OPEN** as it does when it encounters any **OPEN**.

Although **USE 0** implies **OPEN 0** for the principal device, issuing a **USE** command for any other device that the process does not own (due to a previous **OPEN** command) produces a <NOTOPEN> error.

Note: While most InterSystems IRIS platforms allow you to close your principal input device, InterSystems IRIS for UNIX® does not. Therefore, when a job that is the child of another job tries to perform I/O on your login terminal, it hangs until you log off InterSystems IRIS. At that time, the output may or may not appear.

Using the Null Device on UNIX®

When you issue an **OPEN** and **USE** command to the null device (/dev/null on UNIX®), InterSystems IRIS treats the null device as a dummy device. Subsequent **READ** commands immediately return a null string (""). Subsequent **WRITE** commands immediately return success. No actual data is read or written. On systems based on UNIX®, the device /dev/null bypasses the UNIX® open, write, and read system calls entirely.

Processes started by other processes with the **JOB** command have a principal device of /dev/null by default.

If you open /dev/null other than within InterSystems IRIS for example, by redirecting InterSystems IRIS output to /dev/null from the UNIX® shell the UNIX® system calls operate as they do for any other device.

See Also

- OPEN command
- CLOSE command
- $IO special variable
- $PRINCIPAL special variable
- I/O Devices and Commands in *I/O Device Guide*
- Terminal I/O in *I/O Device Guide*
- TCP Client/Server Communication in *I/O Device Guide*

- Sequential File I/O in *I/O Device Guide*
- The Spool Device in *I/O Device Guide*

VIEW

Reads and writes database blocks and modifies data in memory.

```
VIEW:pc viewargument
V:pc viewargument
```

where *viewargument* is one of the following:

```
block
offset:mode:length:newvalue
```

Arguments

pc	*Optional* — A postconditional expression.
block	A block location, specified as an integer.
offset	An offset, in bytes, from a base address within the memory region specified by *mode*.
mode	The memory region whose base address will be used to calculate the data to be modified.
length	The length of the data to be modified.
newvalue	The replacement value to be stored at the memory location.

Description

The **VIEW** command reads and writes database blocks and writes locations in memory. **VIEW** has two argument forms:

- **VIEW** *block* transfers data between the InterSystems IRIS database and memory.
- **VIEW** *offset*:*mode*:*length*:*newvalue* places *newvalue* in the memory location identified by *offset*, *mode*, and *length*.

You can examine data in memory with the $VIEW function.

Note: InterSystems recommends that you avoid use of the **VIEW** command. When used in any environment, it can corrupt memory structures.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

block

A block location, specified as an integer. If *block* is a positive integer, **VIEW** reads that number block into the view buffer. If *block* is a negative integer, **VIEW** writes the block currently in the view buffer to that block address. The *block* and the *offset*:*mode*:*length*:*newvalue* arguments are mutually exclusive.

If the block is already in a memory buffer, the current contents of the buffer will be copied.

Block location 0 is not a valid location. Attempting to specify **VIEW 0** results in a <BLOCKNUMBER> error.

offset

An offset, in bytes, from a base address within the memory region specified by *mode*.

mode

The memory region whose base address will be used to calculate the data to be modified. See Modifying Data in Memory for a description of the possible values.

length

The length of the data to be modified.

Specify the number of bytes as an integer from 1 to 4, or 8. You can also use the letters C or P to indicate the size of an address field (pointer) on the current platform.

If *newvalue* defines a string, specify the number of bytes as a negative integer, counting from 1. If the length of *newvalue* exceeds this number, InterSystems IRIS ignores the extraneous characters. If the length of *newvalue* is less than this number, InterSystems IRIS stores the supplied characters and leaves the rest of the memory location unchanged.

To store a byte value in reverse order (low-order byte at lowest address) append the letter O to the length number and enclose both in double quotes.

newvalue

The replacement value to be stored at the memory location.

Examples

The following example reads the sixth block from the InterSystems IRIS database into the view buffer:

```
VIEW 6
```

The following example writes the view buffer back to the sixth block of the InterSystems IRIS database, presumably after the data has been modified:

```
VIEW -6
```

The following example copies the string "WXYZ" into four bytes starting at offset ADDR in the view buffer. The expression `$VIEW(ADDR,0,-4)` would then result in the value "WXYZ":

```
VIEW ADDR:0:-4:"WXYZ"
```

Notes

Use VIEW with Caution

Use the **VIEW** command with caution. It is usually used for debugging and repair of InterSystems IRIS databases and InterSystems IRIS system information. It is easy to corrupt memory or your InterSystems IRIS database by using **VIEW** incorrectly.

VIEW Usage Restricted

The **VIEW** command is a restricted system capability. It is a protected command because the invoked code is located in the IRISSYS database. For further details, refer to the “IRISSYS Special Capabilities” in the Assets and Resources chapter of the *Security Administration Guide*.

The View Buffer

When used to read and write database buffers, the **VIEW** command works with the view buffer (device 63). The view buffer is a special memory area that you must open before you can perform any **VIEW** operations.

When you open the view buffer (with the **OPEN** command), you indicate the InterSystems IRIS database (IRIS.DAT) to be associated with the view buffer. Using the **VIEW** command, you can then read individual blocks from the InterSystems IRIS database into the view buffer.

After reading a block into the view buffer, you can use the $VIEW function to examine the data. Or, you can use the **VIEW** command to modify the data. If you modify the data, you can use the **VIEW** command again to write the modified block back to the InterSystems IRIS database.

Reading and Writing Data in an InterSystems IRIS Database

Before you can read and write data blocks in an InterSystems IRIS database with **VIEW**, you must first use the **OPEN** command to open the view buffer.

1. Open the view buffer. The view buffer is designated as device number 63. Hence the command is:

   ```
   OPEN 63:location
   ```

   where *location* is the namespace that contains the IRIS.DAT file to be associated with the view buffer. The location is implementation specific. The **OPEN 63** command creates the view buffer by allocating a region of system memory whose size is equal to the block size used by the InterSystems IRIS database.

2. Use the **VIEW** *block* form to read in a block from the associated InterSystems IRIS database. Specify *block* as a positive integer. For example:

   ```
   VIEW 4
   ```

   This example reads the fourth block from the InterSystems IRIS database into the view buffer. Because the size of the view buffer equals the block size used in the InterSystems IRIS database, the view buffer can contain only one block at any given time. As you read in subsequent blocks, each new block overwrites the current block. To determine which blocks to read in from the InterSystems IRIS database, you should be familiar with the structure of the file.

3. Examine the data in the block with the **$VIEW** function or modify it with the **VIEW** command.

4. If you changed any of the data in the view buffer, write it back to the InterSystems IRIS database. To write data, use the **VIEW** *block* form but specify a negative integer for *block*. The block number usually matches the number of the current block in the view buffer, but it does not have to. The specified block number identifies which block in the file will be replaced (overwritten) by the block in the view buffer. For example, **VIEW -5** replaces the fifth block in the InterSystems IRIS database with the current block in the view buffer.

5. Close the view buffer using **CLOSE 63**.

Transferring a Block between InterSystems IRIS Databases

When you open the view buffer, InterSystems IRIS does not automatically clear the existing block. This allows you to transfer a block of data from one InterSystems IRIS database to another using the following sequence:

1. Use **OPEN 63** and specify the namespace that contains the first InterSystems IRIS database.
2. Use **VIEW** to read the desired block from the file into the view buffer.
3. If necessary, use **VIEW** to modify the data in the view buffer.
4. Use **OPEN 63** again and specify the namespace that contains the second InterSystems IRIS database.
5. Use **VIEW** to write the block from the view buffer to the second InterSystems IRIS database.
6. Use **CLOSE 63** to close the view buffer.

Modifying Data in Memory

In addition to reading and writing data from an InterSystems IRIS database, the **VIEW** command allows you to modify data in memory either in the view buffer or in other system memory areas.

To modify data, use the following form:

VIEW *offset*:*mode*:*length*:*newvalue*

All four arguments are required.

You modify data by storing a new value into a memory location, which is specified as a byte offset from the base address indicated by *mode*. You specify the amount of memory affected in the *length* argument.

The possible values for *mode* are shown in the following table:

Mode	Memory Management Region	Base Address
n>0	Address space of process *n*, where *n* is the value of **$JOB** for that process, a process ID (pid).	0
0	The view buffer	Beginning of view buffer
-1	The process's partition	Beginning of partition
-2	The system table	Beginning of system table
-3	The process's address space	0
-6	Reserved for InterSystems use	
-7	Used only by the integrity checking utility	Special. See the High Availability Guide.

See Also

- OPEN command
- CLOSE command
- $VIEW function

WHILE

Executes code while a condition is true.

```
WHILE expression,... {
  code
}
```

Arguments

expression	A test condition. You can specify one or more comma-separated test conditions, all of which must be TRUE for execution of the code block.
code	A block of ObjectScript commands enclosed in curly braces.

Description

WHILE tests *expression* and, if *expression* evaluates to TRUE, it then executes the block of code (one or more commands) between the opening and closing curly braces. **WHILE** can execute a block of code repeatedly, as long as *expression* evaluates to TRUE. If *expression* is not TRUE, the block of code within the curly braces is not executed, and the next command following the closing curly brace (}) is executed.

Programmers must be careful to avoid a **WHILE** infinite loop.

An opening or closing curly brace may appear on its own code line or on the same line as a command. An opening or closing curly brace may even appear in column 1 (though this is not recommended). It is a recommended programming practice to indent curly braces to indicate the beginning and end of a nested block of code. No whitespace is required before or after an opening curly brace. No whitespace is required before a closing curly brace, including a curly brace that follows an argumentless command. There is only one whitespace requirement for curly braces: a closing curly brace must be separated from the command that follows it by a space, tab, or line return.

The block of code within the curly braces can consist of one or more ObjectScript commands and function calls. This block of code may span several lines. Indents, line returns, and blank spaces are permitted within the block of code. Commands within this code block and arguments within commands may be separated by one or more blank spaces or line returns.

Arguments

expression

A boolean test condition. It can take the form of a single expression or a comma-separated list of expressions. InterSystems IRIS executes the **WHILE** loop if it evaluates *expression* as TRUE (any non-zero numeric value). Commonly *expression* is a condition test, such as x<10 or "apple"="apple", but any value that evaluates to a non-zero number is TRUE. For example 7, 00.1, “700”, “7dwarves” all evaluate to TRUE. Any value that evaluates to zero is FALSE. For example, 0, -0, and any non-numeric string all evaluate to FALSE.

For an *expression* list, InterSystems IRIS evaluates the individual expressions in left-to-right order. It stops evaluation if it encounters an expression that evaluates to 0 (FALSE). Any expressions to the right of an expression that evaluates to FALSE are not validated or tested.

If all expressions evaluate to a non-zero numeric value (TRUE), InterSystems IRIS executes the **WHILE** loop code block. As long as *expression* evaluates to TRUE, InterSystems IRIS continues to execute the **WHILE** loop repeatedly, testing *expression* at the top of each loop. If any expression evaluates to FALSE, InterSystems IRIS executes the next line of code after the **WHILE** closing curly brace.

Examples

The following example performs a **WHILE** loop a specified number of times. It tests the *expression* before executing the loop:

```
Mainloop
   SET x=1
   WHILE x<10 {
      WRITE !," Looping",x
      SET x=x+1
   }
   WRITE !,"DONE"
   QUIT
```

The following pair of examples perform two *expression* tests. The two tests are separated by a comma. If both tests evaluate to true, it executes **WHILE** loop. Thus, these programs either return all of the items in a list, or a specified sample size of the items in a list:

```
  SET mylist=$LISTBUILD("a","b","c","d","e")
  SET ptr=0,sampcnt=1,sampmax=4
  WHILE 1=$LISTNEXT(mylist,ptr,value),sampcnt<sampmax {
    WRITE value," is item ",sampcnt,!
    SET sampcnt=sampcnt+1
  }
  IF sampcnt<sampmax {WRITE "This is the whole list"}
  ELSE {WRITE "This is a ",sampcnt-1," item sample of the list"}

  SET mylist=$LISTBUILD("a","b","c","d","e")
  SET ptr=0,sampcnt=1,sampmax=10
  WHILE 1=$LISTNEXT(mylist,ptr,value),sampcnt<sampmax {
    WRITE value," is item ",sampcnt,!
    SET sampcnt=sampcnt+1
  }
  IF sampcnt<sampmax {WRITE "This is the whole list"}
  ELSE {WRITE "This is a ",sampcnt-1," item sample of the list"}
```

Notes

WHILE and FOR

You can use either a FOR or a **WHILE** to perform the same operation: loop until an event causes execution to break out of the loop. However, which loop construct you use has consequences for performing single-step (**BREAK "S+"** or **BREAK "L+"**) debugging on the code module.

A **FOR** loop pushes a new level onto the stack. A **WHILE** loop does not change the stack level. When debugging a **FOR** loop, popping the stack from within the **FOR** loop (using `BREAK "C" GOTO` or `QUIT 1`) allows you to continue single-step debugging with the command immediately following the end of the **FOR** command construct. When debugging a **WHILE** loop, issuing a using `BREAK "C" GOTO` or `QUIT 1` does not pop the stack, and therefore single-step debugging does not continue following the end of the **WHILE** command. The remaining code executes without breaking.

For further details, refer to the BREAK command and Debugging with BREAK in the "Command-line Routine Debugging" chapter of *Using ObjectScript*.

WHILE and DO WHILE

The **WHILE** command tests *expression* before executing the loop. The **DO WHILE** command executes the loop once and then tests *expression*.

WHILE and CONTINUE

Within the code block of a **WHILE** command, encountering a **CONTINUE** command causes execution to immediately jump back to the **WHILE** command. The **WHILE** command then evaluates its *expression* test condition, and, based on that evaluation, determines whether to re-execute the code block loop. Thus, the **CONTINUE** command has exactly the same effect on execution as reaching the closing curly brace of the code block.

WHILE, QUIT, and RETURN

The QUIT command within the *code* block ends the **WHILE** loop and transfers execution to the command following the closing curly brace, as shown in the following example:

```
Testloop
   SET x=1
   WHILE x < 10
   {
      WRITE !,"Looping",x
      QUIT:x=5
      SET x=x+1
    }
    WRITE !,"DONE"
```

This program writes `Looping1` through `Looping5` and then `DONE`.

WHILE code blocks may be nested. That is, a **WHILE** code block may contain another flow-of-control loop (another **WHILE**, or a **FOR** or **DO WHILE** code block). A **QUIT** in an inner nested loop breaks out of the inner loop, to the next enclosing outer loop. This is shown in the following example:

```
Nestedloops
  SET x=1,y=1
  WHILE x<6 {
     WRITE "outer loop ",!
     WHILE y<100 {
        WRITE "inner loop "
        WRITE " y=",y,!
        QUIT:y=7
        SET y=y+2
        }
     WRITE "back to outer loop x=",x,!!
     SET x=x+1
     }
  WRITE "Done"
```

You can use RETURN to terminate execution of a routine at any point, including from within a **WHILE** loop or nested loop structure. **RETURN** always exits the current routine, returning to the calling routine or terminating the program if there is no calling routine. **RETURN** always behaves the same, regardless of whether it is issued from within a code block.

WHILE and GOTO

A **GOTO** command within the block of code may direct execution to a label outside the loop, terminating the loop. A **GOTO** command within the block of code may direct execution to a label within the same block of code; this label may be in a nested code block.

A **GOTO** command should not direct execution to a label within another code block. While such a construct may execute, it is considered “illegal” because it defeats the test condition for the code block it is entering.

The following forms of **GOTO** are legal:

```
mainloop ; GOTO to outside of the code block
  WHILE 1=1 {
      WRITE !,"In an infinite WHILE loop"
      GOTO label1
      WRITE !,"This should not display"
  }
  WRITE !,"This should not display"
label1
  WRITE !,"Went to label1 and quit"

mainloop ; GOTO to elsewhere within the same code block
  SET x=1
  WHILE x<3 {
      WRITE !,"In the WHILE loop"
      GOTO label1
      WRITE !,"This should not display"
label1
      WRITE !,"Still in the WHILE loop after GOTO"
      SET x=x+1
      WRITE !,"x=",x
      }
  WRITE !,"WHILE loop done"
```

```
mainloop ; GOTO from an inner to an outer nested code block
   SET x=1,y=1
   WHILE x<6 {
     WRITE !,"Outer loop",!
     SET x=x+1
label1
     WRITE "outer loop iteration ",x-1,!
        WHILE y<4 {
           WRITE !,"   Inner loop iteration ",y,!
           SET y=y+1
           WRITE "   return to "
           GOTO label1
           WRITE "   This should not display",!
        }
   WRITE "Inner loop completed",!
   }
   WRITE "All done"

mainloop ; GOTO from an outer to an inner nested code block
   SET x=1,y=1
   WHILE x<6 {
     WRITE !,"Outer loop",!
     SET x=x+1
     WRITE "outer loop iteration ",x-1,!
     WRITE "Jumping into the "
     GOTO label1
     WRITE "This should not display",!
         WHILE y<4 {
           WRITE !,"   Inner loop iteration ",y,!
           SET y=y+1
label1
           WRITE "inner loop ",!
        }
   WRITE "Inner loop completed",!
   }
   WRITE "All done"
```

The following forms of **GOTO** may execute, but they are considered “illegal” because they defeat (ignore) the condition test for the block that the **GOTO** enters into:

```
mainloop ; GOTO into a code block
  SET x=1
  WRITE "Jumped into the "
  GOTO label1
  WHILE x>1,x<6 {
      WRITE "Top of WHILE loop x=",x,!
label1
      WRITE "Bottom of WHILE loop x=",x,!!
      SET x=x+1
  }

mainloop ; GOTO from a code block into an IF clause block
  SET x=1
  WHILE x<6 {
      WRITE !,"WHILE loop interation=",x,!
      SET x=x+1
      GOTO label1
      WRITE "This should never display",!
    IF x#2 { WRITE "in the IF clause",!
label1
    WRITE "GOTO entry into the IF clause",!
    WRITE x," is an odd number",!
    }
    ELSE {WRITE "in the ELSE clause",!
          WRITE x," is an even number",! }
  WRITE "Bottom of WHILE loop",!
  }
    WRITE "All done"
```

See Also

- DO WHILE command
- FOR command
- IF command
- CONTINUE command

- GOTO command
- QUIT command
- RETURN command

WRITE

Displays output to current device.

```
WRITE:pc writeargument,...
W:pc writeargument,...
```

where *writeargument* can be:

```
expression
f
*integer
*-integer
```

Arguments

pc	*Optional* — A postconditional expression.
expression	*Optional* — The value to write to the output device. Any valid ObjectScript expression, including literals, variables, object methods, and object properties that evaluates to either a numeric or a quoted string.
f	*Optional* — One or more format control characters that position the output on the target device. Format control characters include !, #, ?, and /.
**integer*	*Optional* — An integer code representing a character to write to the output device. For ASCII, integers in the range 0 to 255; for Unicode, integers in the range 0 to 65534. Any valid ObjectScript expression that evaluates to an integer in the appropriate range. The asterisk is mandatory.
**-integer*	*Optional* — A negative integer code specifying a device control operation. The asterisk is mandatory.

Description

The **WRITE** command displays the specified output on the current I/O device. (To set the current I/O device, use the **USE** command, which sets the value of the **$IO** special variable.) **WRITE** has two forms:

- **WRITE** without an argument
- **WRITE** with arguments

Argumentless WRITE

Argumentless **WRITE** lists the names and values of all defined local variables. It does not list process-private globals, global variables, or special variables. It lists defined local variables one variable per line in the following format:

```
varname1=value1
varname2=value2
```

Argumentless **WRITE** displays local variable values of all types as quoted strings. The exceptions are canonical numbers and object references. A canonical number is displayed without enclosing quotes. An object reference (OREF) is displayed as follows: `myoref=<OBJECT REFERENCE>[1@%SQL.Statement]`; a JSON array or JSON object is displayed as an object reference (OREF). Bit string values and List values are displayed as quoted strings with the data value displayed in encoded form.

The display of numbers and numeric strings is shown in the following example:

```
SET str="fred"
SET num=+123.40
SET canonstr="456.7"
SET noncanon1="789.0"
SET noncanon2="+999"
WRITE
```

```
canonstr=456.7
noncanon1="789.0"
noncanon2="+999"
num=123.4
str="fred"
```

Argumentless **WRITE** displays local variables in case-sensitive string collation order, as shown in the following **WRITE** output example:

```
A="Apple"
B="Banana"
a="apple varieties"
a1="macintosh"
a10="winesap"
a19="northern spy"
a2="golden delicious"
aa="crabapple varieties"
```

Argumentless **WRITE** displays the subscripts of a local variable in subscript tree order, using numeric collation, as shown in the following **WRITE** output example:

```
a(1)="United States"
a(1,1)="Northeastern Region"
a(1,1,1)="Maine"
a(1,1,2)="New Hampshire"
a(1,2)="Southeastern Region"
a(1,2,1)="Florida"
a(2)="Canada"
a(2,1)="Maritime Provinces"
a(10)="Argentina"
```

Argumentless **WRITE** executes control characters, such as Formfeed (`$CHAR(12)`) and Backspace (`$CHAR(8)`). Therefore, local variables that define control characters would display as shown in the following example:

```
SET name="fred"
SET number=123
SET bell=$CHAR(7)
SET formfeed=$CHAR(10)
SET backspace=$CHAR(8)
WRITE
```

```
backspace="
bell=""
formfeed="
         "

name="fred"
number=123
```

Multiple backspaces display as follows, given a local variable named *back*: 1 backspace: `back="`; 2 backspaces: `back""`; 3 backspaces: `bac"="`; 4 backspaces: `ba"k="`; 5 backspaces: `b"ck="`; 6 backspaces: `"ack="`; 7 or more backspaces: `"ack="`.

An argumentless **WRITE** must be separated by at least two blank spaces from a command following it on the same line. If the command that follows it is a **WRITE** with arguments, you must provide the **WRITE** with arguments with the appropriate line return *f* format control arguments. This is shown in the following example:

```
SET myvar="fred"
WRITE  WRITE          ; note two spaces following argumentless WRITE
WRITE  WRITE myvar    ; formatting needed
WRITE  WRITE !,myvar  ; formatting provided
```

Argumentless **WRITE** listing can be interrupted by issuing a **CTRL-C**, generating an <INTERRUPT> error.

You can use argumentless **WRITE** to display all defined local variables. You can use the $ORDER function to return a limited subset of the defined local variables.

WRITE with Arguments

WRITE can take a single *writeargument* or a comma-separated list of *writearguments*. A **WRITE** command can take any combination of *expression*, *f*, **integer*, and **-integer* arguments.

- **WRITE** *expression* displays the data value corresponding to the expression argument. An *expression* can be the name of a variable, a literal, or any expression that evaluates to a literal value.
- **WRITE** *f* provides any desired output formatting. Because the argumented form of **WRITE** provides no automatic formatting to separate argument values or indicate strings, *expression* values will display as a single string unless separated by *f* formatting.
- **WRITE** **integer* displays the character represented by the integer code.
- **WRITE** **-integer* provides device control operations.

WRITE arguments are separated by commas. For example:

```
WRITE "numbers",1,2,3
WRITE "letters","ABC"
```

displays as:

```
numbers123lettersABC
```

Note that **WRITE** does not append a line return to the end of its output string. In order to separate **WRITE** outputs, you must explicitly specify *f* argument formatting characters, such as the line return (!) character.

```
WRITE "numbers ",1,2,3,!
WRITE "letters ","ABC"
```

displays as:

```
numbers 123
letters ABC
```

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). You can specify a postconditional expression for an argumentless **WRITE** or a **WRITE** with arguments. For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

expression

The value you wish to display. Most commonly this is either a literal (a quoted string or a numeric) or a variable. However, *expression* can be any valid ObjectScript expression, including literals, variables, arithmetic expressions, object methods, and object properties. For more information on expressions, see Using ObjectScript.

An *expression* can be a variable of any type, including local variables, process-private globals, global variables, and special variables. Variables can be subscripted; **WRITE** only displays the value of the specified subscript node.

Data values, whether specified as a literal or a variable, are displayed as follows:

- Character strings display without enclosing quotes. Some non-printing characters do not display: $CHAR 0, 1, 2, 14, 15, 28, 127. Other non-printing characters display as a placeholder character: $CHAR 3, 16–26. Control characters are executed: $CHAR 7–13, 27. For example, $CHAR(8) performs a backspace, $CHAR(11) performs a vertical tab.

- Numbers display in canonical form. Arithmetic operations are performed.
- Extended global references display as the value of the global, without indicating the namespace in which the global variable is defined. If you specify a nonexistent namespace, InterSystems IRIS issues a <NAMESPACE> error. If you specify a namespace for which you do not have privileges, InterSystems IRIS issues a <PROTECT> error, followed by the global name and database path, such as the following: `<PROTECT> ^myglobal,c:\intersystems\IRIS\mgr\`.
- ObjectScript List structured data displays in encoded form.
- InterSystems IRIS bitstrings display in encoded form.
- Object References display as the OREF value. For example, `##class(%SQL.Statement).%New()` displays as the OREF `2@%SQL.Statement`. A JSON dynamic object or a JSON dynamic array displays as an OREF value. For information on OREFs, see "OREF Basics" in *Defining and Using Classes*.
- Object methods and properties display the value of the property or the value returned by the method. The value returned by a Get method is the current value of the argument; the value returned by a Set method is the prior value of the argument. You can specify a multidimensional property with subscripts; specifying a non-multidimensional property with a subscript (or empty parentheses) results in an <OBJECT DISPATCH> error.
- %Status displays as either 1 (success), or a complex encoded failure status, the first character of which is 0.

f

A format control to position the output on the target device. You can specify any combination of format control characters without intervening commas, but you must use a comma to separate a format control from an expression. For example, when you issue the following **WRITE** to a terminal:

```
WRITE #!!!?6,"Hello",!,"world!"
```

The format controls position to the top of a new screen (#), then issue three line returns (!!!), then indent six columns (?6). The **WRITE** then displays the string `Hello`, performs a format control line return (!), then displays the string `world!`. Note that the line return repositions to column 1; thus in this example, `Hello` is displayed indented, but `world!` is not.

Format control characters cannot be used with an argumentless **WRITE**.

For further details, see Using Format Controls with WRITE .

**integer*

The **integer* argument allows you to use a positive integer code to write a character to the current device. It consists of an asterisk followed by any valid ObjectScript expression that evaluates to a positive integer that corresponds to a character. The **integer* argument may correspond to a printable character or a control character. An integer in the range of 0 through 255 evaluates to the corresponding 8-bit ASCII character. An integer in the range of 256 through 65534 evaluates to the corresponding 16-bit Unicode character.

As shown in the following example, **integer* can specify an integer code, or specify an expression that resolves to an integer code. The following examples all return the word "touché":

```
WRITE !,"touch",*233
WRITE !,*67,*97,*99,*104,*233
SET accent=233
WRITE !,"touch",*accent    ; variables are evaluated
WRITE !,"touch",*232+1     ; arithmetic operations are evaluated
WRITE !,"touch",*00233.999 ; fractional numbers are truncated to integers
```

To write the name of the composer Anton Dvorak with the proper Czech accent marks, use:

```
WRITE "Anton Dvo",*345,*225,"k"
```

The integer resulting from the expression evaluation may correspond to a control character. Such characters are interpreted according to the target device. A **integer* argument can be used to insert control characters (such as the form feed: *12) which govern the appearance of the display, or special characters such as *7, which rings the bell on a terminal.

For example, if the current device is a terminal, the integers 0 through 30 are interpreted as ASCII control characters. The following commands send ASCII codes 7 and 12 to the terminal.

```
WRITE *7 ; Sounds the bell
WRITE *12 ; Form feed (blank line)
```

Here's an example combining *expression* arguments with **integer* specifying the form feed character:

```
WRITE "stepping",*12,"down",*12,"the",*12,"stairs"
```

*integer and $X, $Y

An integer expression does not change the **$X** and **$Y** special variables when writing to a terminal. Thus, `WRITE "a"` and `WRITE $CHAR(97)` both increment the column number value contained in **$X**, but `WRITE *97` does not increment **$X**.

You can issue a backspace (ASCII 8), a line feed (ASCII 10), or other control character without changing the **$X** and **$Y** values by using **integer*. The following Terminal examples demonstrate this use of integer expressions.

Backspace:

```
WRITE $X,"/",$CHAR(8),$X   ; displays: 01
WRITE $X,"/",*8,$X         ; displays: 02
```

Linefeed:

```
WRITE $Y,$CHAR(10),$Y
   /* displays: 1
                2  */
WRITE $Y,*10,$Y
   /* displays: 4
                4  */
```

For further details, see the $X and $Y special variables, and "Terminal I/O" in *I/O Device Guide*.

*-integer

An asterisk followed by a negative integer is a device control code. **WRITE** supports the following general device control codes:

Code	Device Operation
*-1	Clears the input buffer upon the next **READ**.
*-2	Disconnects a TCP device or a named pipe. See TCP Client/Server Communication and Local Interprocess Communication in the *I/O Device Guide*.
*-3	Flushes the output buffer to the device. This forces a write to the file on disk.
*-9	Truncates the contents of a sequential file at the current file pointer position. In order to truncate a file, the file must be open (using the **OPEN** command with at least "RW" access) and must be established as the current device (using the **USE** command). See Sequential File I/O in the *I/O Device Guide*.
*-10	Clears the input buffer immediately.
*-99	Sends compressed stream data. See TCP Client/Server Communication in the *I/O Device Guide*.

Input Buffer Controls

The `*-1` and `*-10` controls are used for input from a terminal device. These controls clear the input buffer of any characters that have not yet been accepted by a **READ** command. The `*-1` control clears the input buffer upon the next **READ**. The `*-10` control clears the input buffer immediately. If there is a pending **CTRL-C** interrupt when **WRITE *-1** or **WRITE *-10** is invoked, **WRITE** dismisses this interrupt before clearing the input buffer.

An input buffer holds characters as they arrive from the keyboard, even those the user types before the routine executes a **READ** command. In this way, the user can type-ahead the answers to questions even before the prompts appear on the screen. When the **READ** command takes characters from the buffer, InterSystems IRIS echoes them to the terminal so that questions and answers appear together. When a routine detects errors it may use the `*-1` or `*-10` control to delete these type-ahead answers. For further details, see Terminal I/O in the *I/O Device Guide*.

For use of `*-1` in TCP Client/Server Communication refer to the *I/O Device Guide*.

Output Buffer Controls

The `*-3` control is used to flush data from an output buffer, forcing a write operation on the physical device. Thus it first flushes data from the device buffer to the operating system I/O buffer, then forces the operating system to flush its I/O buffer to the physical device. This control is commonly used when forcing an immediate write to a sequential file on disk. `*-3` is supported on Windows and UNIX platforms. On other operating system platforms it is a no-op.

For use of `*-3` in TCP Client/Server Communication refer to the *I/O Device Guide*.

Examples

In the following example, the **WRITE** command sends the current value in variable *var1* to the current output device.

```
SET var1="hello world"
WRITE var1
```

In the following example, both **WRITE** commands display the Unicode character for pi. The first uses the **$CHAR** function, the second a **integer* argument:

```
WRITE !,$CHAR(960)
WRITE !,*960
```

The following example writes first name and last name values along with an identifying text for each. The **WRITE** command combines multiple arguments on the same line. It is equivalent to the two **WRITE** commands in the example that follows it. The ! character is a format control that produces a line break. (Note that the ! line break character is still needed when the text is output by two different **WRITE** commands.)

```
SET fname="Bertie"
SET lname="Wooster"
WRITE "First name: ",fname,!,"Last name: ",lname
```

is equivalent to:

```
SET fname="Bertie"
SET lname="Wooster"
WRITE "First name: ",fname,!
WRITE "Last name: ",lname
```

In the following example, assume that the current device is the user's terminal. The **READ** command prompts the user for first name and last name and stores the input values in variables *fname* and *lname*, respectively. The **WRITE** command displays the values in *fname* and *lname* for the user's confirmation. The string containing a space character (" ") is included to separate the output names.

```
Test
  READ !,"First name: ",fname
  READ !,"Last name: ",lname
  WRITE !,fname," ",lname
  READ !,"Is this correct? (Y or N) ",check#1
  IF "Nn"[check {
    GOTO Test
  }
```

The following example writes the current values in the client(1,*n*) nodes.

```
SetElementValues
   SET client(1,1)="Betty Smith"
   SET client(1,2)="123 Primrose Path"
   SET client(1,3)="Johnson City"
   SET client(1,4)="TN"
DisplayElementValues
   SET n=1
   WHILE $DATA(client(1,n)) {
      WRITE client(1,n),!
      SET n=n+1
    }
    RETURN
```

The following example writes the current value of an object instance property:

```
   SET myoref=##class(%SYS.NLS.Format).%New()
   WRITE myoref.MonthAbbr
```

where myoref is the object reference (OREF), and MonthAbbr is the object property name. Note that dot syntax is used in object expressions; a dot is placed between the object reference and the object property name or object method name.

The following example writes the value returned by the object method **GetFormatItem()**:

```
   SET myoref=##class(%SYS.NLS.Format).%New()
   WRITE myoref.GetFormatItem("MonthAbbr")
```

The following example writes the value returned by the object method **SetFormatItem()**. Commonly, the value returned by a Set method is the prior value for the argument:

```
   SET myoref=##class(%SYS.NLS.Format).%New()
   SET oldval=myoref.GetFormatItem("MonthAbbr")
   WRITE myoref.SetFormatItem("MonthAbbr"," J F M A M J J A S O N D")
   WRITE myoref.GetFormatItem("MonthAbbr")
   WRITE myoref.SetFormatItem("MonthAbbr",oldval)
   WRITE myoref.GetFormatItem("MonthAbbr")
```

A write command for objects can take an expression with cascading dot syntax, as shown in the following example:

```
   WRITE patient.Doctor.Hospital.Name
```

In this example, the patient.Doctor object property references the Hospital object, which contains the Name property. Thus, this command writes the name of the hospital affiliated with the doctor of the specified patient. The same cascading dot syntax can be used with object methods.

A write command for objects can be used with system-level methods, such as the following data type property method:

```
   WRITE patient.AdmitDateIsValid(date)
```

In this example, the **AdmitDateIsValid()** property method returns its result for the current patient object. **AdmitDateIsValid()** is a boolean method for data type validation of the AdmitDate property. Thus, this command writes a 1 if the specified date is a valid date, and writes 0 if the specified date is not a valid date.

Note that any object expression can be further specified by declaring the class or superclass to which the object reference refers. Thus, the above examples could also be written:

```
   WRITE ##class(Patient)patient.Doctor.Hospital.Name
```

```
   WRITE ##class(Patient)patient.AdmitDateIsValid(date)
```

Notes

WRITE with $X and $Y

A **WRITE** displays the characters resulting from the expression evaluation one at a time in left-to-right order. InterSystems IRIS records the current output position in the **$X** and **$Y** special variables, with **$X** defining the current column position and **$Y** defining the current row position. As each character is displayed, **$X** is incremented by one.

In the following example, the **WRITE** command gives the column position after writing the 11–character string `Hello world`.

```
WRITE "Hello world"," "_$X," is the column number"
```

Note that writing a blank space between the displayed string and the **$X** value (`," ",$X`) would cause that blank space to increment **$X** before it is evaluated; but concatenating a blank space to **$X** (`," "_$X`) displays the blank space, but does not increment the value of **$X** before it is evaluated.

Even using a concatenated blank, the display from **$X** or **$Y** does, of course, increment **$X**, as shown in the following example:

```
WRITE $Y," "_$X
WRITE $X," "_$Y
```

In the first **WRITE**, the value of **$X** is incremented by the number of digits in the **$Y** value (which is probably not what you wanted). In the second **WRITE**, the value of **$X** is 0.

With **$X** you can display the current column position during a **WRITE** command. To control the column position during a **WRITE** command, you can use the ? format control character. The ? format character is only meaningful when **$X** is at column 0. In the following **WRITE** commands, the ? performing indenting:

```
WRITE ?5,"Hello world",!
WRITE "Hello",!?5,"world"
```

Using Format Controls with WRITE

The *f* argument allows you to include any of the following format control characters. When used with output to the terminal, these controls determine where the output data appears on the screen. You can specify any combination of format control characters.

! Format Control Character

Advances one line and positions to column 0 (**$Y** is incremented by 1 and **$X** is set to 0). The actual control code sequence is device-dependent; it generally either ASCII 13 (RETURN), or ASCII 13 and ASCII 10 (LINE FEED).

InterSystems IRIS does not perform an implicit new line sequence for **WRITE** with arguments. When writing to a terminal it is a good general practice to begin (or end) every **WRITE** command with a ! format control character.

You can specify multiple ! format controls. For example, to advance five lines, `WRITE !!!!!`. You can combine ! format controls with other format controls. However, note that the following combinations, though permitted, are not in most cases meaningful: !# or !,# (advance one line, then advance to the top of a new screen, resetting **$Y** to 0) and ?5,! (indent by 5, then advance one line, undoing the increment). The combination ?5! is not legal.

If the current device is a TCP device, ! does not output a RETURN and LINE FEED. Instead, it flushes any characters that remain in the buffer and sends them across the network to the target system.

Format Control Character

Produces the same effect as sending the CR (ASCII 13) and FF (ASCII 12) characters to a pure ASCII device. (The exact behavior depends on the operating system type, device, and record format.) On a terminal, the # format control character clears the current screen and starts at the top of the new screen in column 0. (**$Y** and **$X** are reset to 0.)

You can combine # format controls with other format controls. However, note that the following combinations, though permitted, are not in most cases meaningful: !# or !,# (advance one line, then advance to the top of a new screen, resetting **$Y** to 0) and ?5,# (indent by 5, then advance to the top of a new screen, undoing the increment). The combination ?5# is not legal.

?n Format Control Character

This format control consists of a question mark (?) followed by an integer, or an expression that evaluates to an integer. It positions output at the *n*th column location (counting from column 0) and resets **$X**. If this integer is less than or equal to the current column location (*n*<**$X**), this format control has no effect. You can reference the **$X** special variable (current column) when setting a new column position. For example, ?$X+3.

/mnemonic Format Control Character

This format control consists of a slash (/) followed by a mnemonic keyword, and (optionally) a list parameters to be passed to the mnemonic.

```
/mnemonic(param1,param2,...)
```

InterSystems IRIS interprets *mnemonic* as an entry point name defined in the active mnemonic space. This format control is used to perform such device functions as positioning the cursor on a screen. If there is no active mnemonic space, an error results. A *mnemonic* may (or may not) require a parameter list.

You can establish the active mnemonic space in either of the following ways:

- Go to the Management Portal, select **System Administration**, **Configuration**, **Device Settings**, **IO Settings**. View and edit the mnemonic space setting.
- Include the /mnemonic space parameter in the **OPEN** or **USE** command for the device.

The following are some examples of mnemonic device functions:

Mnemonic	Description
/IC(n)	Inserts spaces for *n* characters at the current cursor location, moving the rest of the line to the right
/DC(n)	Deletes *n* characters to the right of the cursor and collapses the line
/EC(n)	Erases *n* characters to the right of the cursor, leaving blanks in their stead

For further details on mnemonics, see the I/O Device Guide.

Specifying a Sequence of Format Controls

InterSystems IRIS allows you to specify a sequence of format controls and to intersperse format controls and expressions. When specifying a sequence of format controls it is not necessary to include the comma separator between them (though commas are permitted.) A comma separator is required to separate format controls from expressions.

In the following example, the **WRITE** command advances the output by two lines and positions the first output character at the column location established by the input for the **READ** command.

```
READ !,"Enter the number: ",num
SET col=$X
SET ans=num*num*num
WRITE !!,"Its cube is: ",?col,ans
```

Thus, the output column varies depending on the number of characters input for the **READ**.

Commonly, format controls are specified as literal operands for each **WRITE** command. You cannot specify format controls using variables, because they will be parsed as strings rather than executable operands. If you wish to create a sequence of format controls and expressions to be used by multiple **WRITE** commands, you can use the #Define preprocessor directive to define a macro, as shown in the following example:

```
#Define WriteMacro "IF YOU ARE SEEING THIS",!,"SOMETHING HAS GONE WRONG",##Continue
  $SYSTEM.Status.DisplayError($SYSTEM.Status.Error(x)),!!
   SET x=83
Module1
   /* code */
   WRITE $$$WriteMacro
Module2
   /* code */
   WRITE $$$WriteMacro
```

Escape Sequences with WRITE

The **WRITE** command, like the **READ** command, provides support for escape sequences. Escape sequences are typically used in format and control operations. Their interpretation is specific to the current device type.

To output an escape sequence, use the form:

```
WRITE *27,"char"
```

where *27 is the ASCII code for the escape character, and *char* is a literal string consisting of one or more control characters. The enclosing double quotes are required.

For example, if the current device is a VT-100 compatible terminal, the following command erases all characters from the current cursor position to the end of the line.

```
WRITE *27,"[2J"
```

To provide device independence for a program that can run on multiple platforms, use the **SET** command at the start of the program to assign the necessary escape sequences to variables. In your program code, you can then reference the variables instead of the actual escape sequences. To adapt the program for a different platform, simply make the necessary changes to the escape sequences defined with the **SET** command.

WRITE Compared with Other Write Commands

For a comparison of **WRITE** with the ZWRITE, ZZDUMP, and ZZWRITE commands, refer to the Display (Write) Commands features tables in the “Commands” chapter of *Using ObjectScript*.

See Also

- USE command
- READ command
- ZWRITE command
- ZZDUMP command
- ZZWRITE command
- $X special variable
- $Y special variable
- Writing escape sequences for Terminal I/O and Interprocess Communications in the *I/O Device Guide*
- Terminal I/O in *I/O Device Guide*
- Sequential File I/O in *I/O Device Guide*
- The Spool Device in *I/O Device Guide*

XECUTE

Executes the specified commands.

```
XECUTE:pc xecutearg,...
X:pc xecutearg,...
```

where *xecutearg* can be either of the following:

```
"cmdline":pc
("(fparams) cmdline",params):pc
```

Arguments

pc	*Optional* — A postconditional expression.
cmdline	An expression that resolves to a command line consisting of one or more valid ObjectScript commands. Note that the *cmdline* or (*fparams*) *cmdline* must be specified as a quoted string.
fparams	*Optional* — A formal parameters list, specified as a comma-separated list enclosed in parentheses. Formal parameters are variables use by *cmdline*, the values of which are supplied by passing *params*. Note that the *fparams* are the first item within the quoted code string.
params	*Optional* — A parameters list, specified as a comma-separated list. These are the parameters passed to *fparams*. If *params* are specified, an equal or greater number of *fparams* must be specified.

Description

XECUTE executes one or more ObjectScript command lines, each command line specified by an *xecutearg*. You can specify multiple *xecutearg*s, separated by commas. These *xecutearg* are executed in left-to-right sequence, the execution of each being governed by an optional postconditional expression. There are two syntactical forms of *xecutearg*:

- Without parameter passing. This form uses no parentheses.
- With parameter passing. This form requires enclosing parentheses.

An **XECUTE** can contain any combination of these two forms of *xecutearg*.

You can use the **CheckSyntax()** method of the %Library.Routine class to perform syntax checking on an *xecutearg* command line string. **CheckSyntax()** requires one or more spaces before an executable line of ObjectScript code. **CheckSyntax()** parses a line with no indentation as a label, or a label followed by executable code. **XECUTE** permits, but does not require indentation of executable code; it does not permit specifying a label name. Neither **XECUTE** nor **CheckSyntax()** parse macro preprocessor code.

In effect, each *xecutearg* is like a one-line subroutine called by a **DO** command and terminated when the end of the argument is reached or a **QUIT** command is encountered. After InterSystems IRIS executes the argument, it returns control to the point immediately after the *xecutearg*.

Each invocation of **XECUTE** places a new context frame on the call stack for your process. The **$STACK** special variable contains the current number of context frames on the call stack.

The **XECUTE** command performs substantially the same operation as the **$XECUTE** function, with the following differences: The command can use postconditionals, the function cannot. The command can specify multiple *xecutearg*s, the function can specify only one *xecutearg*. The command does not require a **QUIT** to complete execution; the function requires an argumented **QUIT** for every execution path.

Arguments

pc

An optional postconditional expression. If a postconditional expression is appended to the command keyword, InterSystems IRIS only executes the **XECUTE** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the **XECUTE** command if the postconditional expression is false (evaluates to zero).

If a postconditional expression is appended to an *xecutearg*, InterSystems IRIS evaluates the argument only if the postconditional expression is true (evaluates to a nonzero numeric value). If the postconditional expression is false, InterSystems IRIS skips that *xecutearg* and evaluates the next *xecutearg* (if one exists). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

cmdline

Each *cmdline* must evaluate to a string containing one or more ObjectScript commands. Note that in some cases two spaces must be inserted between a command and the command following it. The *cmdline* string must not contain a tab character at the beginning or a <Return> at the end. To specify quotation marks within the *cmdline* string, double the quotation marks. The following example shows a single *cmdline* containing two commands:

```
XECUTE "WRITE ""hello "",!  WRITE ""world"",!"
```

Because a *cmdline* is a string, it cannot be simply broken across multiple code lines. You can divide a single *cmdline* argument into separate strings joined with the concatenate operator:

```
XECUTE "WRITE ""hello "",!"_
       " WRITE ""world"",!"
```

You can divide a single *cmdline* argument into multiple separate comma-separated *cmdline* arguments:

```
XECUTE "WRITE ""hello "",!",
       "WRITE ""world"",!"
```

The maximum length for *cmdline* depends on the following considerations: InterSystems IRIS stores both the source *cmdline* string and its generated object code as a single string. This resulting string must not exceed the InterSystems IRIS maximum string length. For further details, refer to Maximum String Length in the “Data Types and Values” chapter of *Using ObjectScript*.

You can embed `/* text */` comments within a *cmdline*, between concatenated *cmdline* strings, or between comma-separated *cmdline* arguments:

```
XECUTE "SET x=""hello "" /* 1st val */ SET y=""world"" /* 2nd val */ "_
       " WRITE x,! /* part of 1st cmdline */ ",
       "WRITE y,! /* 2nd cmdline */ "
```

A *cmdline* can evaluate to a null string (""). In this case, InterSystems IRIS performs no action and continues execution with the next *xecutearg* (if one exists).

If you are passing parameters, the *fparams* formal parameter list must precede the *cmdline* commands, with both elements enclosed in the same quotation marks. While it is recommended that you separate *fparams* from the *cmdline* by one or more spaces, no space is required.

```
SET x=1
XECUTE ("(in,out) SET out=in+3", x, .y)
WRITE y
QUIT
```

By default, all local variables used in *cmdline* are public variables. You can designate variables within the command line as private variables by enclosing the command setting them within curly braces. For example:

```
  SET x=1
  XECUTE ("(in,out) { SET out=in+3 }", x, .y)
  WRITE y
  QUIT
```

You can override this designation of private variables for specific variables by specifying a public variable list, enclosed in square brackets, immediately after the *fparams* formal parameter list. The following example specifies a public variable list containing the variable x:

```
  SET x=1
  XECUTE ("(in,out) [x] { SET out=in+3 }", x, .y)
  WRITE y
  QUIT
```

fparams

A list of formal parameters, separated by commas and enclosed by parentheses. Formal parameter names must be valid identifiers. Because these formal parameters are executed in another context, they must only be unique within their *xecutearg*; they have no effect on local variables with the same name in the program that issued the **XECUTE**, or in another *xecutearg*. You do not have to use any or all of the *fparams* in *cmdline*. However, the number of *fparams* must equal or exceed the number of *params* specified, or a <PARAMETER> error is generated.

params

The actual parameters to be passed from the invoking program to *fparams*, specified as a comma-separated list. The *params* must be defined variables within the calling program.

You can use a dot prefix to pass a parameter by reference. This is useful for passing a value out from a *cmdline*. An example is provided below. For further details, refer to Passing by Reference in the "User-defined Code" chapter of *Using ObjectScript*.

Examples

The following example passes a parameter to a command line that sets a global. Two command lines are provided. Execution of each depends upon their postconditional setting.

```
  SET bad=0,good=1
  SET val="paid in full"
  XECUTE ("(pay) SET ^acct1=pay",val):bad,("(pay) SET ^acct2=pay",val):good
```

Here the first *xecutearg* is skipped because of the value of the *bad* postconditional. The second *xecutearg* is executed with *val* being passed in as a parameter, supplying a value to the *pay* formal parameter used in the command line.

The following example uses passing by reference (`.y`) to pass a local variable value from the *cmdline* to the invoking context.

```
CubeIt
  SET x=5
  XECUTE ("(in,out) SET out=in*in*in",x,.y)
  WRITE !,x," cubed is ",y
```

In the following example, the **XECUTE** command references the local variables *x* and *y*. *x* and *y* each contain a string literal consisting of three separate ObjectScript commands that **XECUTE** invokes.

```
   SET x="SET id=ans QUIT:ans="""" DO Idcheck"
   SET y="SET acct=num QUIT:acct="""" DO Actcheck"
   XECUTE x,y
```

The following example uses **XECUTE** with a **$SELECT** construction.

```
   XECUTE "SET A=$SELECT(A>100:B,1:D)"
```

The following example executes the subroutine that is the value of A.

```
SET A="WRITE ! FOR I=1:1:5 { WRITE ?I*5,I+1 }"
XECUTE A
```

Notes

XECUTE and Objects

You can use **XECUTE** to call object methods and properties and execute the returned value, as shown in the following examples:

```
XECUTE patient.Name
XECUTE "WRITE patient.Name"
```

XECUTE and FOR

If an **XECUTE** argument contains a **FOR** command, the scope of the **FOR** is the remainder of the argument. When the outermost **FOR** in an **XECUTE** argument is terminated, the **XECUTE** argument is also terminated.

XECUTE and DO

If an **XECUTE** command contains a **DO** command, InterSystems IRIS executes the routine or routines specified in the **DO** argument or arguments. When it encounters a **QUIT**, it returns control to the point immediately following the **DO** argument.

For example, in the following commands, InterSystems IRIS executes the routine ROUT and returns to the point immediately following the **DO** argument to write the string “DONE”.

```
XECUTE "DO ^ROUT WRITE !,""DONE"""
```

XECUTE and GOTO

If an **XECUTE** argument contains a **GOTO** command, InterSystems IRIS transfers control to the point specified in the **GOTO** argument. When it encounters a **QUIT**, it does not return to the point immediately following the **GOTO** argument that caused the transfer. Instead, InterSystems IRIS returns control to the point immediately following the **XECUTE** argument that contained the **GOTO**.

In the following example, InterSystems IRIS transfers control to the routine ROUT and returns control to the point immediately following the **XECUTE** argument to write the string “FINISH”. It never writes the string “DONE”.

```
XECUTE "GOTO ^ROUT WRITE !,""DONE""" WRITE !,"FINISH"
```

XECUTE and QUIT

There is an implied **QUIT** at the end of each **XECUTE** argument.

XECUTE with $TEXT

If you include a **$TEXT** function within a *cmdline*, it designates lines of code in the routine that contains the **XECUTE**. For example, in the following program, the **$TEXT** function retrieves and executes a line.

```
A
   SET H="WRITE !!,$PIECE($TEXT(HELP+1),"","",3)"
   XECUTE H
   QUIT
HELP
   ;; ENTER A NUMBER FROM 1 TO 5
```

Running routine A extracts and writes “ENTER A NUMBER FROM 1 TO 5”.

Nested Invocation of XECUTE

ObjectScript supports the use of **XECUTE** within an **XECUTE** argument. However, you should use nested invocation of **XECUTE** with caution because it can be difficult to determine the exact flow of processing at execution time.

Execution Time for Commands Called by XECUTE

The execution time for code called within **XECUTE** can be slower than the execution time for the same code encountered in the body of a routine. This is because InterSystems IRIS compiles source code that is specified with the **XECUTE** command or that is contained in a referenced global variable each time it processes the **XECUTE**.

Implementing Generalized Operations

A typical use for **XECUTE** is to implement generalized operations within an application. For example, assume that you want to implement an inline mathematical calculator that would allow the user to perform mathematical operations on any two numbers and/or variables. To make the calculator available from any point in the application, you might use a specific function key (say, **F1**) to trigger the calculator subroutine.

A simplified version of the code to implement such a calculator might appear as follows.

```
Start  SET ops=$CHAR(27,21)
  READ !,"Total amount (or F1 for Calculator): ",amt
  IF $ZB=ops { DO Calc
    ; . . .
  }
Calc  READ !,"Calculator"
  READ !,"Math operation on two numbers and/or variables."
  READ !,"First number or variable name: ",inp1
  READ !,"Mathematical operator (+,-,*,/): ",op
  READ !,"Second number or variable name: ",inp2
  SET doit="SET ans="_inp1_op_inp2
  XECUTE doit
  WRITE !,"Answer (ans) is: ",ans
  READ !,"Repeat? (Y or N) ",inp
  IF (inp="Y")!(inp="y") { GOTO Calc+2 }
  QUIT
```

When executed, the **Calc** routine accepts the user inputs for the numbers and/or variables and the desired operation and stores them as a string literal defining the appropriate **SET** command in variable *doit*. The **XECUTE** command references *doit* and executes the command string that it contains. This code sequence can be called from any number of points in the application, with the user supplying different inputs each time. The **XECUTE** performs the **SET** command each time, using the supplied inputs.

XECUTE and ZINSERT

You use the **XECUTE** command to define and insert a single line of executable code from within a routine. You can use the **ZINSERT** command from the Terminal to define and insert by line position a single line of executable code into the current routine. You can use the **ZREMOVE** command from the Terminal to delete by line position one or more lines of executable code from the current routine.

An **XECUTE** command cannot be used to define a new label. Therefore, **XECUTE** does not require an initial blank space before the first command in its code line. **ZINSERT** can be used to define a new label. Therefore, **ZINSERT** does require an initial blank space (or the name of a new label) before the first command in its command line.

See Also

- DO command
- GOTO command
- QUIT command
- ZINSERT command
- $TEXT function
- $XECUTE function
- $STACK special variable

ZKILL

Deletes a node while preserving the node's descendants.

```
ZKILL:pc array-node,...
ZK:pc array-node,...
```

Arguments

pc	*Optional* — A postconditional expression.
array-node	A local variable, a process-private global, or a global that is an array node, or a comma-separated list of local, process-private global, or global array nodes.

Description

The **ZKILL** command removes the value of a specified *array-node* without killing that node's descendants. In contrast, the **KILL** command removes the value of a specified array node and all of that node's descendants. An array node can be a local variable, a process-private global, or a global variable.

By default, any subsequent reference to this killed *array-node* generates an <UNDEFINED> error. You can change InterSystems IRIS behavior to not generate an <UNDEFINED> error when referencing an undefined subscripted variable by setting the **%SYSTEM.Process.Undefined()** method.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

array-node

A local, process-private global, or global array node. You can specify a single array node, or a comma-separated list of array nodes. For further details on subscripts and nodes, refer to Global Structure in *Using Globals*.

Attempting to use **ZKILL** on a structured system variable (SSVN) (such as **^$GLOBAL**) results in a <COMMAND> error.

Example

In this example, the **ZKILL** command deletes node a(1), but does not remove node a(1,1).

```
SET a(1)=1,a(1,1)=11
SET x=a(1)
SET y=a(1,1)
ZKILL a(1)
SET z=a(1,1)
WRITE "x=",x," y=",y," z=",z
```

returns x=1 y=11 z=11. However, then issuing a:

```
WRITE a(1)
```

generates an <UNDEFINED> error.

See Also

- KILL command

ZNSPACE

Sets the current namespace.

```
ZNSPACE:pc nspace
ZN:pc nspace
```

Arguments

pc	*Optional* — A postconditional expression.
nspace	A string expression that evaluates to the name of an existing namespace.

Description

ZNSPACE *nspace* changes the current namespace to the *nspace* value. *nspace* can be an explicit namespace name or an implied namespace.

- From the Terminal command prompt **ZNSPACE** is the preferred way to change namespaces.
- Within a code routine **NEW $NAMESPACE** followed by **SET $NAMESPACE**=*namespace* is the preferred way to change the current namespace. See $NAMESPACE special variable for details.

The following methods may assist you when using **ZNSPACE**:

- To return the name of the current namespace: return the **$NAMESPACE** or **$ZNSPACE** special variable value, or invoke the **NameSpace()** method of the %SYSTEM.SYS class, as follows:

  ```
  WRITE $SYSTEM.SYS.NameSpace()
  ```

- To list all namespaces (explicit and implicit) available to the current process: invoke the **ListAll()** method of the %SYS.Namespace class, as follows:

  ```
  DO ##class(%SYS.Namespace).ListAll(.result)
  ZWRITE result
  ```

  When **ListAll()** lists an implied namespace, it delimits the system name using caret (^) delimiters.

  To list all local and (optionally) remotely-mapped namespaces, invoke the List query of the %SYS.Namespace class, as follows:

  ```
  SET ListRemote=1
  SET stmt=##class(%SQL.Statement).%New()
  SET status=stmt.%PrepareClassQuery("%SYS.Namespace","List")
     IF status'=1 {WRITE "%Prepare failed:" DO $System.Status.DisplayError(status) QUIT}
  SET rset= stmt.%Execute(ListRemote)
  DO rset.%Display()
  ```

  This query returns each namespace name, its status (available or not), and whether it is mapped to a remote system.

  Note that both of these listings list all namespaces, including those for which the user does not have access privileges.

- To test whether a namespace is defined: use the **Exists()** method of %SYS.Namespace class, as follows:

  ```
  WRITE ##class(%SYS.Namespace).Exists("USER"),!  ; an existing namespace
  WRITE ##class(%SYS.Namespace).Exists("LOSER")   ; a non-existent namespace
  ```

These methods are described in the *InterSystems Class Reference*.

For UNIX® systems, the system-wide default namespace is established as a System Configuration option. For Windows systems, it is set using a command line start-up option.

For namespace naming conventions and namespace name translation, see Namespaces in the “Syntax Rules” chapter of *Using ObjectScript*. For information on using namespaces, see Namespaces and Databases in the *Orientation Guide for Server-Side Programming*. For information on creating and modifying namespaces, see Configuring Namespaces in the *System Administration Guide*.

Changing the Current Namespace

You can change the current namespace by using the **ZNSPACE** command, the %CD utility (`DO ^%CD`), or by setting the **$NAMESPACE** or **$ZNSPACE** special variables. From the Terminal prompt use of **ZNSPACE** or %CD is preferable, because these provide more extensive error checking.

When you wish to temporarily change the current namespace, perform some operation, then revert to the prior namespace, use **NEW $NAMESPACE** then **SET $NAMESPACE**. By using **NEW $NAMESPACE** and **SET $NAMESPACE** you establish a namespace context that automatically reverts to the prior namespace when the routine concludes or an unexpected error occurs.

Implied Namespace

An implied namespace specifies the namespace by system name and directory path. There are three forms:

- `"^^."` for the current namespace. This can be used to change the namespace prompt from an explicit namespace to the corresponding implied namespace.
- `"^^`*dir*`"` specifying the namespace directory path *dir* on the current system.
- `"^`*system*^*dir*`"` specifying the namespace directory path *dir* on a specified remote system.

For *dir*, specify a directory path. This is shown in the following examples:

Windows example:

```
ZNSPACE "^^c:\InterSystems\IRIS\mgr\user\"
WRITE $NAMESPACE
```

Linux example:

```
ZNSPACE "^RemoteLinuxSystem^/usr/IRIS/mgr/user/"
WRITE $NAMESPACE
```

To return the full pathname of the current namespace, you can invoke the **NormalizeDirectory()** method, as shown in the following example:

```
WRITE ##class(%Library.File).NormalizeDirectory("")
```

Arguments

pc

Optional — An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

nspace

Any valid string expression that evaluates to the name of the new namespace. *nspace* can be an explicit namespace name or an implied namespace.

Namespace names are not case-sensitive. InterSystems IRIS always displays explicit namespace names in all uppercase letters, and implied namespace names in all lowercase letters.

If *nspace* does not exist, the system generates a <NAMESPACE> error. If you do not have access privileges to a namespace, the system generates a <PROTECT> error, followed by the database path. For example, the %Developer role does not have access privileges to the %SYS namespace. If you have this role and attempt to access this namespace, InterSystems IRIS issues the following error (on a Windows system): `<PROTECT> *c:\intersystems\iris\mgr\`.

Examples

The following example assumes that a namespace called "accounting" already exists. Otherwise, you receive a <NAMESPACE> error.

From the Terminal:

```
USER>ZNSPACE "Accounting"
ACCOUNTING>
```

By default, as shown in this example, the Terminal prompt displays the current namespace name. Namespace names are always displayed in uppercase letters.

The following example tests for the existence of a namespace, then uses ZNSPACE to set the current namespace and uses the **TerminalPrompt()** method to set the Terminal prompt either to the specified namespace or to USER:

```
   WRITE !,"Current namespace is ",$NAMESPACE
   SET ns="ACCOUNTING"
   IF 1=##class(%SYS.Namespace).Exists(ns) {
     WRITE !,"Changing namespace to: ",ns
     ZNSPACE ns
     DO ##class(%SYSTEM.Process).TerminalPrompt(2)
     WRITE !,"and ",$NAMESPACE," will display at the prompt"
     }
   ELSE {
     WRITE !,"Namespace ",ns," does not exist"
     SET ns="USER"
     WRITE !,"Changing namespace to: ",ns
     ZNSPACE ns
     DO ##class(%SYSTEM.Process).TerminalPrompt(2)
     WRITE !,"and ",$NAMESPACE," will display at the prompt"
     }
```

Notes

Namespaces with Default Directories

If the namespace you select has a default directory on a remote machine, **ZNSPACE** does not change the current directory of your process to that namespace's directory. Thus, your current namespace becomes the namespace you selected, but your current directory remains the directory that was current before you issued the **ZNSPACE** command.

Implied Namespace Mapping

ZNSPACE creates additional default mappings from an implied namespace. These mappings are the same as for a normal (explicit) namespace. They allow a process to find and execute the % routines and % globals that are physically located in the IRISSYS and IRISLIB databases (the IRIS\mgr\ and IRIS\mgr\irislib directories).

Setting the **$NAMESPACE** or **$ZNSPACE** special variable or running the %CD routine with an implied namespace is the same as issuing a **ZNSPACE** command.

% Routine Mapping

When a process switches namespaces using the **ZNSPACE** command, the system routines path mapping is normally reset. This is true for both a normal (explicit) namespace and an implied namespace. The only exception to this is when the process switches from an implied namespace to an implied namespace, in which case the existing mapping is preserved. For further information on implied namespaces, see Global Structure in *Using Globals*.

You can override this remapping of system routines by using the **SysRoutinePath()** method of the %SYSTEM.Process class. This can be used to override an existing system routine. Commonly, this is used to create an additional mapping when debugging a % routine. The process must have Write permission for the IRISSYS database. This method should be used with extreme caution.

CAUTION: Changing the mapping of a system routine supplied by InterSystems is strongly discouraged. Doing so could break current or future library routines and methods supplied by InterSystems.

% Global Mapping

The first time a user uses **ZNSPACE** (or its equivalent) to go to an implied namespace, the system creates a mapping for that implied namespace, as follows: InterSystems IRIS first maps to existing % globals in that implied namespace. InterSystems IRIS then maps all other % globals to IRISSYS.

Once this mapping has been created for an implied namespace, the mapping is stored in shared memory. This means that when any subsequent user goes to that implied namespace, InterSystems IRIS uses this pre-existing global mapping.

To update an implied namespace global mapping you must clear this shared memory storage. A system restart is one way to clear shared memory.

Controlling Namespace Display

Terminal Prompt

By default, the Terminal prompt displays the current namespace name. This default is configurable:

Go to the Management Portal, select **System Administration**, **Configuration**, **Additional Settings**, **Startup**. View and edit the current setting of **TerminalPrompt**. This also sets the prompt for Telnet windows.

To set this behavior for the current process, use the **TerminalPrompt()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *TerminalPrompt* property of the Config.Startup class.

The Terminal prompt can represent the current namespace as the explicit namespace name or the implied namespace. If the implied namespace path is longer than 27 characters, the prompt is truncated to display an ellipsis, followed by the last 24 characters of the implied namespace path. For example: `...ersystems\iris\mgr\user\>`

$NAME and $QUERY Functions

The **$NAME** and **$QUERY** functions can return the extended global reference form of a global variable, which includes the namespace name. You can control whether these functions return namespace names as part of the global variable name. You can set this extended global reference switch for the current process using the **RefInKind()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *RefInKind* property of the Config.Miscellaneous class. For further information on extended global references, see Global Structure in *Using Globals*.

Changing Namespaces within Application Code

Object and SQL code assumes that it is running in a single namespace; hence, changing namespaces with open object instances or SQL cursors can lead to code running incorrectly. Typically, there is no need to explicitly change namespaces, as the various Object, SQL, and CSP servers automatically ensure that application code is run in the correct namespace.

Also, changing namespaces demands a relatively high amount of computing power compared to other commands; if possible, application code should avoid it.

See Also

- JOB command
- $NAMESPACE special variable
- $ZNSPACE special variable
- Configuring Namespaces in *System Administration Guide*

ZTRAP

Forces an error with a specified error code.

```
ZTRAP:pc ztraparg

ZTRAP:pc $ZERROR
ZTRAP:pc $ZE
```

Arguments

pc	*Optional* — A postconditional expression.
ztraparg	*Optional* — An error code string. An error code string is specified as a string literal or an expression that evaluates to a string; only the first four characters of the string are used.
$ZERROR	The special variable **$ZERROR**, which can be abbreviated **$ZE**.

Description

The **ZTRAP** command accepts both a command postconditional and argument indirection. **ZTRAP** has three forms:

- Without an argument
- With a string argument
- With **$ZERROR**

ZTRAP without an argument forces an error with the error code <ZTRAP>.

ZTRAP *ztraparg* forces an error with the error code <Zxxxx>, where xxxx is the first four characters of the string specified by *ztraparg*. If you specify an expression, rather than a quoted string literal, the compiler evaluates the expression and uses the first four characters of the resulting string. When evaluating an expression, InterSystems IRIS strips the plus sign and leading and trailing zeros from numbers. All remaining characters of *ztraparg* are ignored.

ZTRAP $ZERROR does not force a new error. It stops execution at the current program stack level and pops stack levels until another error handler is found. Execution then continues in that error handler with the current error code.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

ztraparg

A string literal or an expression that evaluates to a string. Any of the following values can be specified for *ztraparg*:

- A quoted string of any length containing any characters. **ZTRAP** uses only the first four characters to generate an error code; if there are fewer than four characters, it uses the characters provided. Unlike system error codes, which are always uppercase, case is preserved. Thus:

```
ZTRAP "FRED"  ; generates <ZFRED>
ZTRAP "Fred"  ; generates <ZFred>
ZTRAP "Freddy"  ; generates <ZFred>
ZTRAP "foo"  ; generates <Zfoo>
ZTRAP " foo"  ; generates <Z foo>
ZTRAP "@#$%"  ; generates <Z@#$%>
ZTRAP ""  ; generates <Z>
ZTRAP """"  ; generates <Z">
```

- An expression that evaluates to a string.

```
ZTRAP 1234  ; generates <Z1234>
ZTRAP 2+2  ; generates <Z4>
ZTRAP 10/3  ; generates <Z3.33>
ZTRAP +0.700  ; generates <Z.7>
ZTRAP $ZPI  ; generates <Z3.14>
ZTRAP $CHAR(64)_$CHAR(37)  ; generates <Z@%>
ZTRAP ""  ; generates <Z>
ZTRAP """"  ; generates <Z">
```

The **ZTRAP** command accepts argument indirection. For more information, refer to Indirection in *Using ObjectScript*.

Passing Control to an Error Handler with $ZERROR

When the **ZTRAP** argument is the special variable **$ZERROR**, special processing is performed which is useful in **$ZTRAP** error handlers. **ZTRAP $ZERROR** does not force a new error. It stops execution at the current program stack level and pops stack levels until another error handler is found. Execution then continues in that error handler with the current error code. This error handler may be located in a different namespace.

Examples

This example shows how you use the **ZTRAP** command with an expression to produce an error code:

```
; at this point the routine discovers an error ...
ZTRAP "ER23"
...
```

When the routine is run and it discovers the anticipated error condition, the output appears as follows:

`<ZER23>label+offset^routine`

This example shows how the use of a postconditional affects the **ZTRAP** command:

```
;
ZTRAP:y<0 "yNEG"
;
```

When the routine is run and *y* is negative, the output is:

`<ZyNEG>label+offset^routine`

This example shows how you use argument indirection in the **ZTRAP** command:

```
;
SET ERPTR="ERMSG"
SET ERMSG="WXYZ"
;
;
ZTRAP @ERPTR
```

The output is:

`<ZWXYZ>label+offset^routine`

The following example shows a **ZTRAP** command that invokes a **$ZTRAP** error trap handler defined at a previous context level.

```
Main
   NEW $ESTACK
   SET $ZTRAP="OnErr"
   WRITE !,"$ZTRAP set to: ",$ZTRAP
   WRITE !,"Main $ESTACK= ",$ESTACK   // 0
   WRITE !,"Main $ECODE= ",$ECODE," $ZERROR=",$ZERROR
   DO SubA
   WRITE !,"Returned from SubA"   // not executed
   WRITE !,"MainReturn $ECODE= ",$ECODE," $ZERROR=",$ZERROR
   QUIT
SubA
   WRITE !,"SubA $ESTACK= ",$ESTACK   // 1
   ZTRAP
   WRITE !,"SubA $ECODE= ",$ECODE," $ZERROR=",$ZERROR
   QUIT
OnErr
   WRITE !,"OnErr $ESTACK= ",$ESTACK   // 0
   WRITE !,"OnErr $ECODE= ",$ECODE," $ZERROR=",$ZERROR
   QUIT
```

See Also

- $ZERROR special variable
- $ZTRAP special variable
- Error Handling in *Using ObjectScript*
- Labels in *Using ObjectScript*

ZWRITE

Displays variable names and their values and/or expression values.

```
ZWRITE:pc expression,...
ZW:pc expression,...
```

Arguments

pc	*Optional* — A postconditional expression.
expression	*Optional* — A variable or expression to display, or a comma-separated list of variables and/or expressions to display. A comma-separated list can contain any combination of variables and expressions.

Description

The **ZWRITE** command lists names of variables and their values. It lists these variables and their descendents in the format *varname=value* in canonical order, one variable per line, on the current device. **ZWRITE** also lists the values of expressions. Expressions are listed as *value*, one per line, in the order specified. The **ZWRITE** command has two forms:

- Without an argument
- With arguments

ZWRITE can take an optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

ZWRITE listing can be interrupted by issuing a **CTRL-C**, generating an <INTERRUPT> error.

ZWRITE without an Argument

ZWRITE without an *expression* argument is functionally identical to WRITE without an argument. It displays the names and values of all variables in the local variable environment (local variables), including private variables. It does not display process-private globals or special variables. It lists variables by name in ASCII order. It lists subscripted variables in subscript tree order.

ZWRITE without an argument displays an OREF value assigned to a local variable as `variable=<OBJECT REFERENCE>[oref]`. It displays the same result for a local variable set to a JSON array or JSON object. It does not display any further details about the OREF. For information on OREFs, see "OREF Basics" in *Defining and Using Classes*.

ZWRITE without an argument displays a bitstring assigned to a local variable as a compressed character string, which (because it contains non-printing characters) may appear to be an empty string. It does not display any further details about the bitstring.

For further details, refer to the WRITE command.

ZWRITE with Arguments

ZWRITE with an argument can specify one *expression* argument or a comma-separated list of *expression* arguments. These arguments are evaluated in left-to-right order. Each argument can specify a variable or an expression. If *expression* is a comma-separated list, each variable or expression is displayed on a separate line.

- Variables: displayed as `varname=value`
- Expressions: evaluated and the results displayed as `value`

- Special Variables: displayed as `value`
- InterSystems IRIS List Structures: displayed as `$lb(element1,element2)`
- Subscripted Globals, including those used to store SQL data values and SQL index values, displayed as `$lb()` List structures
- Object References: displayed as `<OBJECT REFERENCE>[oref]`. This is the value displayed by **ZWRITE** without an argument; **ZWRITE** with an object reference argument displays this value plus additional “general information”, “attribute values”, and (where appropriate) “swizzled references” and “calculated references” information.
- JSON Arrays and JSON Objects: displayed as JSON values.
- Bit Strings: displayed as both the **$ZWCHAR** compressed binary string, and a user-readable representation of all of the “1” bits in the bitstring.

ZWRITE displays a string containing one or more non-numeric characters as a quoted string.

ZWRITE displays a numeric value as a canonical number. **ZWRITE** displays a numeric string containing a number in canonical form as an unquoted canonical number. **ZWRITE** displays a numeric string not in canonical form as a quoted string. Note however that any arithmetic operation on a non-canonical numeric string converts it to a canonical number. This is shown in the following example:

```
SET numcanon=7.9     // returns number
SET num=+007.90      // returns number
SET strnum="+7.9"    // returns string
SET strcanon="7.9"   // returns number
SET strnumop=+"+7.90" // returns number
ZWRITE numcanon,num,strnum,strcanon,strnumop
```

ZWRITE truncates the display of very long strings and appends `...` to indicate that the string display was truncated.

ZWRITE displays values containing control characters (including those created with $LISTBUILD and $BIT) in a readable format. If this formatting causes very long string values to exceed the maximum string length, **ZWRITE** truncates the displayed string and appends `...` to indicate that the string was truncated.

For a comparison of **ZWRITE** with the WRITE, ZZDUMP, and ZZWRITE commands, refer to the Display (Write) Commands features tables in the “Commands” chapter of *Using ObjectScript*.

Variables

If *expression* is a variable, **ZWRITE** writes *varname*=*value* on a separate line. The variable can be a local variable, process-private global, global variable, or object reference (OREF).

ZWRITE ignores undefined variables. It does not issue an error. If you specify one or more undefined variables in a comma-separated list of variables, **ZWRITE** ignores the undefined variables and returns the defined variables. This behavior allows you to display multiple variables without checking to determine if all of them are defined. If you specify an undefined variable to WRITE, ZZDUMP, or ZZWRITE InterSystems IRIS issues an <UNDEFINED> error.

Variables can be subscripted. If the variable has defined subnodes, **ZWRITE** writes a separate *varname*=*value* line for each subnode in subscript tree order. When you specify a root node, **ZWRITE** displays all of its subnodes, even when the root node is undefined.

You can use extended global reference to specify a global variable not mapped to the current namespace. **ZWRITE** displays extended global references even when the **RefInKind()** method of the %SYSTEM.Process class or the *RefInKind* property of the Config.Miscellaneous class has been set to strip extended global references. If you specify a nonexistent namespace, InterSystems IRIS issues a <NAMESPACE> error. If you specify a namespace for which you do not have privileges, InterSystems IRIS issues a <PROTECT> error, followed by the global name and database path, such as the following: `<PROTECT> ^myglobal,c:\intersystems\iris\mgr\`. For further information on subscripted variables and extended global reference, refer to Global Structure in *Using Globals*.

Non-Display Characters

ZWRITE displays all printable characters. It displays non-printable characters using the $CHAR function, representing each non-printable character as a concatenated $c(n) value. It does not execute non-printing control characters. This is shown in the following example:

```
SET charstr=$CHAR(65,7,66,67,0,68,11,49,50)
ZWRITE charstr
```

Expressions

If *expression* is a literal expression, **ZWRITE** evaluates the expression and writes the resulting *value* on a separate line. If the expression contains an undefined variable, InterSystems IRIS issues an <UNDEFINED> error.

If the expression is a multidimensional property, **ZWRITE** will not display the property descendents. To display an entire multidimensional property with **ZWRITE**, either MERGE it into a local array and display the array, or display the entire object.

InterSystems IRIS List Structures

You can specify an InterSystems IRIS list structure (%List) to **ZWRITE** as a variable or an expression. **ZWRITE** displays a list structure as `$lb(element1,element2)`. This is shown in the following example:

```
SET FullList = $LISTBUILD("Red","Blue","Green","Yellow")
SET SubList = $LIST(FullList,2,4)
SET StrList = $LISTFROMSTRING("Crimson^Azure^Lime","^")
ZWRITE FullList,SubList,StrList
```

A Subscripted Global and its Descendants

The following example shows **ZWRITE** displaying the contents of a subscripted global variable and all of its descendent nodes. This example displays the data defined for the Sample.Person persistent class that projects to an SQL table. The global variable takes its name from the persistent class name (not the SQL table name) and is case-sensitive; a “D” is appended to indicate a data global. Note that the descendent nodes contain list structures, which are displayed as $LISTBUILD ($lb) constructions:

```
ZWRITE ^Sample.PersonD
```

To display a single data record, you can specify the RowID value as the global subscript, as shown in the following:

```
ZWRITE ^Sample.PersonD(22)
```

To display the contents of an index, you can specify the persistent class name with an “I” appended, supplying the index name as the subscript. The index name is case-sensitive:

```
ZWRITE ^Sample.PersonI("NameIDX")
```

Additional non-printing characters used in lists are also displayed.

The following example shows **ZWRITE** using extended global reference to display the contents of a subscripted global variable located in a specified namespace:

```
ZWRITE ^["USER"]Sample.PersonD
```

The namespace name can be a different namespace or the current namespace. Namespace names are not case-sensitive.

ZWRITE always displays the extended global reference, regardless of the setting of the RefInKind method or property, which can be set to strip extended global references from globals returned by **$QUERY** or **$NAME**.

Object References

You can specify an object reference (OREF) to **ZWRITE** as either a variable or an expression. If you have specified an object reference, **ZWRITE** displays `variable=<OBJECT REFERENCE>[oref]` or `<OBJECT REFERENCE>[oref]` and also displays General Information, Attribute Values, and (when appropriate) Swizzled References and Calculated References for the properties of the object, one attribute per line.

Note: The <OBJECT REFERENCE> identifier prefix may not be displayed when executing **ZWRITE** through a browser interface, because browsers interpret angle brackets as tags.

If the **ZWRITE** argument is an embedded object property, **ZWRITE** displays General Information and Attribute Values for the array elements of the container property, one attribute per line. The display format is the same as the **%SYSTEM.OBJ.Dump()** method.

The following example displays the OREF, followed by “general information”, “attribute values” and “swizzled references”:

```
SET oref = ##class(%SQL.Statement).%New()
ZWRITE oref
```

The following example displays the OREF, followed by “general information”, “attribute values”, and “calculated references”:

```
SET doref=##class(%iKnow.Domain).%New("mytempdomain")
DO doref.%Save()
SET domId=doref.Id
ZWRITE doref
SET stat=##class(%iKnow.Domain).%DeleteId(domId)
```

The following examples displays the OREF, followed by “general information”, “attribute values”, “swizzled references”, and “calculated references”:

```
SET poref=##class(Sample.Person).%OpenId(1)
ZWRITE poref
```

```
SET myquery = "SELECT TOP 2 Name,DOB FROM Sample.Person"
SET oref = ##class(%SQL.Statement).%New()
SET qStatus = oref.%Prepare(myquery)
  IF qStatus'=1 {WRITE "%Prepare failed:" DO $System.Status.DisplayError(qStatus) QUIT}
SET rset = oref.%Execute()
ZWRITE rset
```

For information on OREFs, see “OREF Basics” in *Defining and Using Classes*.

JSON Arrays and JSON Objects

ZWRITE *without an argument* displays JSON dynamic arrays and JSON dynamic objects as object references, for example:

```
USER>SET jarray = ["apples","oranges"]
USER>SET jobj = {"fruit":"apples","count":24}
USER>ZWRITE
jarray=<OBJECT REFERENCE>[1@%Library.DynamicArray]
jobj=<OBJECT REFERENCE>[2@%Library.DynamicObject]
```

ZWRITE with an argument displays the values of JSON dynamic arrays and JSON dynamic objects. This is shown in the following example:

A JSON array:

```
USER>SET jarray = ["apples","oranges"]
USER>SET jobj = {"fruit":"apples","count":24}
USER>ZWRITE jarray
jarray = ["apples","oranges"]  ; <DYNAMIC ARRAY>
USER>ZWRITE jobj
jobj = {"fruit":"apples","count":24}  ; <DYNAMIC OBJECT>
```

ZWRITE displays a NaN value using the representation ($DOUBLE(\"NAN\")) — an ObjectScript $DOUBLE(\"NAN\") call inside of parentheses; it displays +INF as ($DOUBLE(\"INF\")), and –INF as ($DOUBLE(\"-INF\")).

ZWRITE displays an OREF value within a JSON object using a format like ("6@%SQL.Statement"), as shown in the following example:

```
USER>SET oref = ##class(%SQL.Statement).%New()
USER>SET jobj = {"ObjRef":(oref)}
USER>ZWRITE jobj
jobj={"ObjRef":("6@%SQL.Statement")}  ;  <DYNAMIC OBJECT>
```

For further details on handling JSON in ObjectScript, refer to the SET command. For information on object references (OREFs), see "OREF Basics" in *Defining and Using Classes*.

Bitstrings

You can specify a bitstring to **ZWRITE** as either a variable or an expression. If the **ZWRITE** argument is an InterSystems IRIS compressed bitstring (created using the $BIT function), **ZWRITE** displays the decimal representation of the compressed binary string as **$ZWCHAR** ($zwc) two-byte (wide) characters.

ZWRITE also displays a comment that lists the uncompressed "1" bits in left-to-right order as a comma-separated list. If there are three or more consecutive "1" bits, it lists them as a range (inclusive) with two dot syntax (`n..m`). For example, the bitstring [1,0,1,1,1,1,0,1] is shown as `/*$bit(1,3..6,8)*/`. The bitstring [1,1,1,1,1,1,1,1] is shown as `/*$bit(1..8)*/`. The bitstring [0,0,0,0,0,0,0,0] is shown as `/*$bit()*/`. The following example shows **ZWRITE** bitstring output:

```
  SET $BIT(a,1) = 0
  SET $BIT(a,2) = 0
  SET $BIT(a,3) = 1
  SET $BIT(a,4) = 0
  SET $BIT(a,5) = 1
  SET $BIT(a,6) = 1
  SET $BIT(a,7) = 1
  SET $BIT(a,8) = 0
  ZWRITE a
```

Examples

ZWRITE Without an Argument

In following example, **ZWRITE** without an argument lists all defined local variables in ASCII name order.

```
   SET A="A",a="a",AA="AA",aA="aA",aa="aa",B="B",b="b"
   ZWRITE
```

returns:

```
A="A"
AA="AA"
B="B"
a="a"
aA="aA"
aa="aa"
b="b"
```

In the following example **ZWRITE** without an argument lists canonical and non-canonical numeric values:

```
   SET w=10
   SET x=++0012.00
   SET y="6.5"
   SET z="007"
   SET a=w+x+y+z
   ZWRITE
```

returns:

```
a=35.5
w=10
x=12
y=6.5
z="007"
```

ZWRITE with Arguments

In the following example, **ZWRITE** displays three variables as *varname*=*value*, each on its own line:

```
SET alpha="abc"
SET x=100
SET y=80
SET sum=x+y
ZWRITE x,sum,alpha
```

In the following example, **ZWRITE** evaluates an expression in the first argument. It returns the expression as *value*, and the variable as *varname*=*value*:

```
SET x=100
SET y=80
ZWRITE x+y,y
```

The following example compares **ZWRITE** and **WRITE** when displaying different variable values. **ZWRITE** returns quotation marks delimiting strings, **WRITE** does not:

```
SET a=+007.00
SET b=9E3
SET c="+007.00"
SET d=""
SET e="Rhode Island"
SET f="Rhode"_"Island"
ZWRITE a,b,c,d,e,f
WRITE !,a,!,b,!,c,!,d,!,e,!,f
```

ZWRITE Displaying Subscript Subnodes

The following example shows **ZWRITE** displaying the contents of subscripted process-private global variables. **ZWRITE** displays the subscripts of the variable in hierarchical order:

```
SET ^||fruit(1)="apple",^||fruit(4)="banana",^||fruit(8)="cherry"
SET ^||fruit(1,1)="Macintosh",^||fruit(1,2)="Delicious",^||fruit(1,3)="Granny Smith"
SET ^||fruit(1,2,1)="Red Delicious",^||fruit(1,2,2)="Golden Delicious"
SET ^||fruit="Fruits"
WRITE "global arg ZWRITE:",!
ZWRITE ^||fruit
```

Note that specifying a root node displays all subnodes, even when the root node itself is undefined:

```
SET fruit(1)="apple",fruit(4)="banana",fruit(8)="cherry"
SET fruit(1,1)="Macintosh",fruit(1,2)="Delicious",fruit(1,3)="Granny Smith"
SET fruit(1,2,1)="Red Delicious",fruit(1,2,2)="Golden Delicious"
WRITE "global arg ZWRITE:",!
ZWRITE fruit
```

See Also

- WRITE command
- ZZDUMP command
- ZZWRITE command
- Display (Write) Commands in the “Commands” chapter of *Using ObjectScript*

ZZDUMP

Displays an expression in hexadecimal dump format.

```
ZZDUMP:pc expression,...
```

Arguments

pc	*Optional* — A postconditional expression.
expression	The data to be displayed in hexadecimal dump format. You can specify a number, a string (enclosed in quotation marks), or a variable that resolves to one of these. You can specify a single *expression*, or a comma-separated list of expressions.

Description

ZZDUMP displays an expression in hexadecimal dump format. **ZZDUMP** is primarily of interest to system programmers, but it can be useful in viewing strings that contain control characters.

ZZDUMP returns a number or string value in the following format:

```
position: hexdata printdata
```

Arguments

pc

InterSystems IRIS executes the **ZZDUMP** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

expression

You can specify *expression* as a numeric, a string literal, or a variable that resolves to one of these. You can specify a single expression, or a comma-separated list of expressions. Specifying a comma-separated list of expressions is parsed as issuing a separate **ZZDUMP** command for each expression. Execution of a comma-separated list stops when the first error occurs.

An *expression* can be a variable of any type, including local variables, process-private globals, global variables, and special variables. You can use extended reference to specify a global variable in another namespace. If you specify a nonexistent namespace, InterSystems IRIS issues a <NAMESPACE> error. If you specify a namespace for which you do not have privileges, InterSystems IRIS issues a <PROTECT> error, followed by the global name and database path, such as the following: `<PROTECT> ^myglobal,c:\intersystems\iris\mgr\`.

Non-printing characters are represented in *hexdata* by their hexadecimal value, and in *printdata* by a placeholder dot (.). Control characters are not executed.

Examples

The following example shows **ZZDUMP** returning hex dumps for two single-character string variables. Note that each comma-separated expression is treated as a separate invocation of **ZZDUMP**:

```
   SET x="A"
   SET y="B"
   ZZDUMP x,y
```

```
0000: 41                                                A
0000: 42                                                B
```

The following example shows **ZZDUMP** returning a hex dump for a string variable too long for a single dump line. Note that the *position* for the second dump line (0010:) is in hexadecimal:

```
   SET z="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
   ZZDUMP z

0000: 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F 50      ABCDEFGHIJKLMNOP
0010: 51 52 53 54 55 56 57 58 59 5A                        QRSTUVWXYZ
```

The following example shows **ZZDUMP** returning hex dumps for three variables. Note that no hex dump (not even a blank line) is returned for a null string variable. Also note that a number is converted to canonical form (leading and trailing zeros and plus sign removed); a string containing a number is not converted to canonical form:

```
   SET x=+007
   SET y=""
   SET z="+007"
   ZZDUMP x,y,z

0000: 37                                         7
0000: 2B 30 30 37                                +007
```

Notes

Unicode

If one or more characters in a **ZZDUMP** expression is a wide (Unicode) character, all characters in that expression are represented as wide characters. The following examples show variables containing a Unicode characters. In all cases, all characters are displayed as wide characters.

```
   SET x=$CHAR(987)
   SET y=$CHAR(987)_"ABC"
   ZZDUMP x,y

0000: 03DB                                                  ?
0000: 03DB 0041 0042 0043                                   ?ABC
```

ZZDUMP Compared with Write Commands

For tables comparing **ZZDUMP** with the WRITE, ZWRITE, and ZZWRITE commands, refer to the Display (Write) Commands in the "Commands" chapter of *Using ObjectScript*.

See Also

- WRITE command
- ZWRITE command
- ZZWRITE command
- $CHAR function
- $DOUBLE function
- $LISTBUILD function
- $ZHEX function
- Display (Write) Commands in the "Commands" chapter of *Using ObjectScript*

ZZWRITE

Displays the values of variables or expressions.

```
ZZWRITE:pc expression,...
```

Arguments

pc	*Optional* — A postconditional expression.
expression	A variable or expression to display, or a comma-separated list of variables and/or expressions to display. A comma-separated list can contain any combination of variables and expressions.

Description

The **ZZWRITE** command evaluates an expression and displays a value on the current device. This expression can be a literal, local variable, process-private global, global variable, or special variable. **ZZWRITE** can evaluate a comma-separated list of expressions; it displays the results in the order specified, one *expression* per line. **ZZWRITE** displays the result of each expression as `%val=`*value*.

ZZWRITE without an argument is a no-op. It performs no operation and issues no error.

ZZWRITE and ZWRITE

ZZWRITE, like **ZWRITE**, displays non-printing characters and encoded data such as InterSystems IRIS lists, bitstrings, and %Status strings in a human-readable format. It does not execute control characters. Both commands provide an extensive display of object reference (oref) values, consisting of the oref value followed by the same "general information", "attribute values", and (where appropriate) "swizzled references" and "calculated references" returned by the **%SYSTEM.OBJ.Dump()** method.

ZZWRITE displays the same data values as ZWRITE with an argument, with the following differences:

- Variable Names: **ZZWRITE** displays the value of every expression or variable as `%val=`*value*. **ZWRITE** displays local, process-private, and global variables as `varname=`*value*, and literals, expressions, and special variables as *value*.
- Undefined Variables: **ZZWRITE** issues an <UNDEFINED> error for an undefined variable. **ZWRITE** ignores undefined variables.
- Subscripts: **ZZWRITE** displays the value of the specified subscript node. **ZWRITE** displays the subscript node and all defined subnodes in subscript tree order.
- Extended Global Reference: **ZZWRITE** displays the value of an extended global reference as `%val=`*value* (like any other *expression*), giving no indication that the value is defined in another namespace. **ZWRITE** displays an extended global reference variable name showing the namespace that contains the global.

For further details on how various data values are displayed, refer to ZWRITE.

For tables comparing **ZZWRITE** with the WRITE, ZWRITE, and ZZDUMP commands, refer to the Display (Write) Commands features tables in the "Commands" chapter of *Using ObjectScript*.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

expression

An expression to evaluate, or a comma-separated list of expressions. An *expression* can consist of, or contain local variables, process-private globals, global variables, or special variables. It cannot be a private variable. Variables can be subscripted. Expressions are evaluated in strict left-to-right order.

You can use extended global reference to specify a global variable not mapped to the current namespace. If you specify a nonexistent namespace, InterSystems IRIS issues a <NAMESPACE> error. If you specify a namespace for which you do not have privileges, InterSystems IRIS issues a <PROTECT> error, followed by the global name and database path, such as the following: `<PROTECT> ^myglobal,c:\intersystems\iris\mgr\`. For further information on subscripted variables and extended global reference, refer to Global Structure in *Using Globals*.

See Also

- WRITE command
- ZWRITE command
- ZZDUMP command
- Display (Write) Commands in the “Commands” chapter of *Using ObjectScript*

Routine and Debugging Commands

The following are reference pages for routine and debugging commands supported by ObjectScript. These commands supplement the ObjectScript general commands described earlier in this document. Commands are listed in alphabetical order.

Further introductory information on ObjectScript command syntax and conventions is provided at the beginning of the general commands reference pages. Additional information on ObjectScript commands can be found in the Commands chapter of *Using ObjectScript*.

PRINT

Displays lines of code from the current routine on the current device.

```
PRINT:pc lineref1:lineref2
ZP:pc lineref1:lineref2
```

Arguments

pc	*Optional* — A postconditional expression.
lineref1	*Optional* — The line to be displayed, or the first line in a range of lines to be displayed, specified as a literal. Can be a label name, a numeric offset (+n) or a label name and a numeric offset. If omitted, the entire current routine is displayed.
:lineref2	*Optional* — The last line in a range of lines to be displayed, specified as a literal. To define a range, *lineref1* must be specified.

Description

The **PRINT** command displays lines of code from the currently loaded routine. Use ZLOAD to load a routine. **ZLOAD** loads the INT code version of a routine. For the name of the current routine, access the $ZNAME special variable.

The output is sent to the current device. When invoked from the Terminal, the current output device defaults to the Terminal. You can establish the current device with the **USE** command. For the device ID of the current device, access the $IO special variable.

Note: The **PRINT** and ZPRINT commands are functionally identical.

PRINT displays the INT code version of a routine. INT code does not count or include preprocessor statements. Completely blank lines from the MAC version of the routine, whether in the source code or within a multiline comment, are removed by the compiler and are therefore neither displayed nor counted in the INT routine. For this reason, **PRINT** displays and counts the following multi-line comment in the MAC routine as two lines, not three:

```
/* This comment includes

   a blank line */
```

The `#;`, `##;`, and `///` comments in the MAC code may not appear in the INT code, and thus may affect line counts and offsets. Refer to Comments in MAC Code for Routines and Methods for further details.

PRINT sets the edit pointer to the end of the lines it printed. For example, specifying `PRINT` then `ZINSERT " SET y=2"` inserts the line at the end of the routine; specifying `PRINT +1:+4` then `ZINSERT " SET y=2"` inserts the line as line 5. The $TEXT function prints a single line from the current routine but does not change the edit pointer.

PRINT has two forms:

- Without arguments
- With arguments

PRINT without arguments displays all the lines of code in the currently loaded routine.

PRINT with arguments displays the specified lines of code. **PRINT** *lineref1* displays the line specified by *lineref1*. **PRINT** *lineref1*:*lineref2* displays the range of lines starting with *lineref1* and ending with *lineref2* (inclusive).

The *lineref* arguments count lines and line offsets using the INT code version of the routine. After modifying a routine, you must re-compile the routine for **PRINT** to correctly count lines and line offsets that correspond to the source (MAC) version.

You can use the $TEXT function to return a single line of INT code.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the **PRINT** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

lineref1

The line to be printed or the first in a range of lines to be displayed or printed. Can be specified in either of the following syntactical forms:

- *+offset* where *offset* is a positive integer specifying the line number within the current routine. +1 is the first line in the routine, which may be a label line. +0 always returns the empty string.
- *label[+offset]* where *label* is a label within the routine and *offset* is the line number counting from the label (with the label itself counting as offset 0). If you omit the *offset* option, or specify *label+0*, InterSystems IRIS prints the label line. *label+1* prints the line after the label.

A label may be longer than 31 characters, but must be unique within the first 31 characters. **PRINT** matches only the first 31 characters of a specified *label*. Label names are case-sensitive, and may contain Unicode characters.

lineref2

The last line in a range of lines to be displayed. Specify in the same way as *lineref1*.*lineref1* must be specified to specify *lineref2*. *lineref1* and *lineref2* are separated by a colon (:) character. No whitespace may appear between the colon and *lineref2*.

If *lineref2* specifies a label or offset earlier in the line sequence than *lineref1*, **PRINT** ignores *lineref2* and displays the single line of code specified by *lineref1*.

If *lineref2* specifies a non-existent label or offset, **PRINT** displays from *lineref1* to the end of the routine.

Examples

Given the following lines of code:

```
AviationLetters
Abc
  WRITE "A is Abel",!
  WRITE "B is Baker",!
  WRITE "C is Charlie",!
Def WRITE "D is Delta",!
  WRITE "E is Epsilon",!
  /* Not sure about E */
  WRITE "F is Foxtrot",!
```

PRINT with no *lineref* arguments displays all nine lines, including the comment line.

PRINT +0 displays the empty string.

PRINT +1 displays the `AviationLetters` label.

PRINT +8 displays the `/* Not sure about E */` comment line.

PRINT +10 displays the empty string.

PRINT Def or **PRINT Def+0** display the `Def WRITE "D is Delta",!` line. This is a label line that also includes executable code.

PRINT Def+1 displays the `WRITE "E is Epsilon",!` line.

Range Examples

PRINT +0:+3 displays the empty string.

PRINT +1:+3 displays the first three lines.

PRINT +3:+3 displays the third line.

PRINT +3:+1 displays the third line; *lineref2* is ignored.

PRINT +3:Abc+1 displays the third line. Both *lineref1* and *lineref2* are specifying the same line.

PRINT +3:abc+1 displays from the third line to the end of the routine. Line labels are case-sensitive, so the range endpoint was not found.

PRINT Abc+1:+4 displays lines 3 and 4.

PRINT Abc+1:Abc+2 displays lines 3 and 4.

PRINT Abc:Def displays lines 2, 3, 4, 5, and 6.

PRINT Abc+1:Def displays lines 3, 4, 5, and 6.

PRINT Def:Abc displays the `Def WRITE "D is Delta",!` line. Because *lineref2* is earlier in the code, it is ignored.

See Also

- ZPRINT command
- ZINSERT command
- ZLOAD command
- ZREMOVE command
- ZSAVE command
- ZZPRINT command
- $TEXT function
- $IO special variable
- $ZNAME special variable
- Comments in *Using ObjectScript*
- Labels in *Using ObjectScript*
- The Spool Device in *I/O Device Guide*

ZBREAK

Sets a breakpoint or watchpoint.

```
ZBREAK:pc
ZB:pc

ZBREAK:pc location:action:condition:execute_code
ZB:pc location:action:condition:execute_code

ZBREAK:pc /command:option
ZB:pc /command:option
```

Arguments

pc	*Optional* — A postconditional expression.
location	Specifies a code line location (that sets a breakpoint), a local variable `*var` (which sets a watchpoint), or `$` (the single step breakpoint). If the location specified already has a breakpoint/watchpoint defined, the new specification completely replaces the old one. You can optionally preface *location* with a sign: +, –, or – –. A *location* without a sign prefix sets the specified breakpoint/watchpoint. A – (minus) prefix disables the breakpoint/watchpoint. A + (plus) prefix re-enables a disabled breakpoint/watchpoint. A — (minus-minus) prefix removes the breakpoint/watchpoint. The following signs can be specified without a *location*: – (minus) = disable all breakpoints and watchpoints. + (plus) = re-enable all disabled breakpoints and watchpoints.
:*action*	*Optional* — Specifies the action to take when the breakpoint/watchpoint is triggered, specified as an alphabetic code. Action code letters may be uppercase or lowercase, but must be enclosed in quotation marks. If omitted, default is "B". If omitted, and either :*condition* or :*execute_code* is specified, the colon must appear as a placeholder.
:*condition*	*Optional* — Specifies an expression that will be evaluated to a boolean value when the breakpoint/watchpoint is triggered. The expression must be surrounded by quotation marks. If true, *action* is carried out. If not specified, the default is true. If omitted, and :*execute_code* is specified, the colon must appear as a placeholder.
:*execute_code*	*Optional* — Specifies ObjectScript code to be executed if :*condition* is true. The code must be surrounded by quotation marks if it is a literal.
/*command*:*option*	A command governing all breakpoints and watchpoints. The slash (/) prefix is mandatory. Available commands are: /CLEAR, /DEBUG, /TRACE, /ERRORTRAP, /INTERRUPT, /STEP, and /NOSTEP. All except /CLEAR take an *option*, as described below. Most /*command* names can be specified as a single-letter abbreviation: /C, /T, and so forth.

Description

ZBREAK sets breakpoints at specific lines of code and watchpoints on specific local variables to allow you to interrupt program execution for debugging. Once established, a breakpoint or watchpoint persists for the duration of the current process, or until explicitly removed or cleared. Breakpoints and watchpoints are persistent across namespaces. You can establish a maximum of 20 breakpoints and 20 watchpoints per process. These maximums include both enabled and disabled breakpoints and watchpoints. Attempting to set more than 20 breakpoints or watchpoints results in a <COMMAND> error.

Various ways to use the **ZBREAK** command are described in the Debugging chapter in *Using ObjectScript*. The use of watchpoints in a **FOR** loop is described in "FOR and Watchpoints" section of the FOR command reference page.

Required Permission

To use **ZBREAK** statements when running code, the user must be assigned to a role (such as %Developer or %Manager) that provides the %Development resource with U (use) permission. A user is assigned to a role either through the SQL GRANT statement, or by using the Management Portal **System Administration**, **Security**, **Users** option. Select a user name to edit its definition, then select the **Roles** tab to assign that user to a role.

To use **ZBREAK** the user must have WRITE access for the database in which the code resides. Otherwise, stepping, breakpoints, and watchpoints will be disabled. For example, a user who does not have WRITE access to the %SYS (IRISSYS) or the IRISLIB database will not be able to debug routines in that database. InterSystems IRIS disables debugging when a routine in one of these databases is entered, and only restores debugging once the routine quits. This has the effect that any other code called by that routine will also have debugging disabled, regardless of whether the user has WRITE access for that code's database.

Listing Breakpoints

The argumentless **ZBREAK** command lists the current breakpoints and watchpoints. It lists both enabled and disabled breakpoints and watchpoints.

Listing Local Variable Values

You can follow any **ZBREAK** command with an argumentless WRITE command on the same line. (Note that an argumentless **ZBREAK** must be followed by two spaces.) The argumentless **WRITE** lists the values of all local variables at the time when the **ZBREAK** line is encountered; not when it is put into effect.

Disable/Enable All Existing Breakpoints/Watchpoints

A **ZBREAK** command can be followed by a sign with no *location* specification. A minus sign (–) argument disables all current breakpoints and watchpoints. A plus sign (+) argument re-enables all previously disabled breakpoints and watchpoints. The following **ZBREAK** without *location* commands are supported:

`ZBREAK -`	Disables all existing breakpoints and watchpoints.
`ZBREAK +`	Re-enables all previously disabled breakpoints and watchpoints. You cannot re-enable removed breakpoints/watchpoints.

ZBREAK Help Text

To view online help text about **ZBREAK** at the terminal prompt, specify a question mark, as follows:

```
USER>ZBREAK ?
```

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

location

The *location* argument is required if you wish to set or unset breakpoints or watchpoints. It can consist of a sign (plus, minus, or minus-minus) followed by a breakpoint or watchpoint specification. Various combinations of signs and breakpoint/watchpoint specifications are supported:

- **varname*: a local variable. Establishes a watchpoint each time the variable value is set. The asterisk prefix is mandatory. Setting a watchpoint for an undefined local variable does not generate an error. You can optionally specify an *action*, *condition*, and/or *execute_code* for each watchpoint. Any of these optional arguments may be omitted, but if specified or skipped, the mandatory colon separators (:) must be specified.
- $: a single step breakpoint.
- A line reference, specified as `label+offset^routine` to specify a breakpoint. You can specify any combination of `label`, `+offset`, and `^routine` (in that order). If you omit `label`, the breakpoint location is counted by offset from the top of the routine (**ZBREAK** statements are counted as offset lines). If you omit `+offset`, the breakpoint location is the specified label line. If you omit `^routine`, the breakpoint location is assumed to be in the currently loaded routine; you can use ^*routine* to specify a routine location other than the currently loaded routine. Setting a breakpoint for a nonexistent label, offset, or routine does not generate an error.

  To set a breakpoint, specify the `label+offset^routine` location and, optionally, the *action*, *condition*, and/or *execute_code*, as follows: `label+offset^routine:action:condition:execute_code`. Any of these optional arguments may be omitted, but if an argument is skipped, the mandatory colon separator (:) must be specified.

  ZBREAK does not move the edit pointer.

Optionally, a location argument may be prefixed by a sign which indicates what to do with an existing breakpoint or watchpoint at the specified location. You can specify no sign (set), a minus sign (disable), a plus sign (re-enable), or two minus signs (remove). You can also specify a sign before a $ single-step breakpoint. Attempting to disable, re-enable, or remove a non-existent breakpoint or watchpoint generates a <COMMAND> error.

Sign Prefix	Meaning
location	Set breakpoint/watchpoint at *location*.
–location#delay	Disable breakpoint/watchpoint at *location*. The optional *#delay* integer specifies the number of iterations to disable this breakpoint or watchpoint before breaking. The default is to disable all encounters with the breakpoint or watchpoint. No spaces are permitted before the # symbol.
+location	Re-enable breakpoint/watchpoint at *location*.
-–location	Remove breakpoint/watchpoint at *location*. To remove all breakpoints and watchpoints use `ZBREAK /CLEAR`.

A line reference *location* must occur on a command boundary. A variable that is set within a command expression cannot be used as a *location*. This type of variable setting occurs in the *target* parameters of the $DATA, $ORDER, and $QUERY functions.

action

A code that specifies the action to take when the breakpoint/watchpoint is triggered. For breakpoints, the action occurs before the line of code is executed. For watchpoints, the action occurs after the command that modifies the local variable. An *action* can only be specified when setting a breakpoint/watchpoint; not when disabling or re-enabling.

Action Code	Description
“B”	Suspends execution and displays the line at which the break occurred, with a caret (^) indicating the location within the line. A **GOTO** resumes execution. “B” is the default.
“L”	Suspends execution for single-step execution of lines using **GOTO**. Single-step mode suspended during **DO**, **XECUTE**, or user-defined functions.
“L+”	Suspends execution for single-step execution of lines using **GOTO**. Single-step mode also applies to **DO**, **XECUTE**, and user-defined functions.
“S”	Suspends execution for single-step execution of commands using **GOTO**. Single-step mode suspended during **DO**, **FOR**, **XECUTE**, or user-defined functions.
“S+”	Suspends execution for single-step execution of commands using **GOTO**. Single-step mode also applies to **DO**, **FOR**, **XECUTE**, and user-defined functions.
“T”	Outputs a trace message to the trace device. Can be combined with any other action code. For example “TB” means suspend execution (“B”) and output trace message (“T”). “T” by itself does not suspend execution. This action only works if a previous **ZBREAK** command or the current **ZBREAK** specifies ZBREAK /TRACE:ON. See /TRACE below.
“N”	Take no action at this breakpoint or watchpoint.

condition

A boolean expression. When true (1), the *action* should be taken and the *execute_code* (if present) executed. When false (0), the *action* and *execute_code* are ignored. Default is true (1).

execute_code

The ObjectScript code to be executed. This code is executed before the *action* being carried out. Before the code is executed, the value of **$TEST** is saved. After the code has executed, the value of **$TEST** as it existed in the program being debugged is restored.

The *execute_code* is performed internally by an XECUTE command. An **XECUTE** can access only public variables. However, you can specify parameter passing in the *execute_code* to pass private variables to the **XECUTE**.

Because an **XECUTE** argument contains a quoted string, quotes must be doubled when the code is passed via the **ZBREAK** *execute_code* argument. The easiest way to do this correctly is to first write the code as an actual **XECUTE** command, then double all the quotes to create the corresponding the **ZBREAK** *execute_code*.

For example, to display the new value of the variable *var* when it is changed, first write an **XECUTE** command to display it:

```
XECUTE ("(arg) WRITE ""now var="",arg,!",$GET(var,"<UNDEFINED>"))
```

Then the equivalent **ZBREAK** command will be:

```
ZBREAK *var:::"(""(arg) WRITE """"now var="""",arg,!"",$GET(var,""<UNDEFINED>""))"
```

/command:option

A command keyword used to set the **ZBREAK** environment for subsequent **ZBREAK** commands. The /CLEAR command takes no option. The other command keywords are followed by an option, separated by a colon. No spaces are permitted.

Keyword	Description
/CLEAR	Remove all breakpoints.

Keyword	Description
/DEBUG:*device*	Clear or set debug device.
/TRACE	Enable or disable sending trace messages to the trace device (the "T" action in subsequent **ZBREAK** commands.) Options are :ON=enable trace. :OFF=disable trace. :ALL=trace all lines. You can redirect output with the :ON or :ALL options by specifying a device. For example ZBREAK /TRACE:ON:device.
/ERRORTRAP	Enable or disable $ZTRAP and TRY / CATCH error trapping. Options are :ON and :OFF.
/INTERRUPT	Specify Ctrl-C action. Options are :NORMAL and :BREAK. If NORMAL, a Ctrl-C interrupts execution with an <INTERRUPT> error. If BREAK, a Ctrl-C interrupts execution with a <BREAK> error and establishes a new stack frame.
/STEP	Enable stepping through code modules. Options are :EXT (user language extensions); :METHOD (object methods); :DESTRUCT (the %Destruct object method).
/NOSTEP	Disable stepping through code modules. Options are :EXT (user language extensions); :METHOD (object methods); :DESTRUCT (the %Destruct object method).

/TRACE

The /TRACE command keyword specifies a trace output device that is used to receive trace messages. It must be specified before issuing a **ZBREAK** with *action*="T". It can be specified as a separate **ZBREAK** command (`ZBREAK /TRACE:ON:device`) , or these two commands can be combined `ZBREAK S:"T",/TRACE:ON:device`.

Only one trace output device can be active at a time. Only trace messages are written to the trace output device; normal WRITE operations continue to write to the user terminal.

- `/TRACE:ON` activates the InterSystems Terminal as the recipient for trace messages.
- `/TRACE:ON:device` activates an existing output device (commonly a .txt file) as the recipient for trace messages. You must use the OPEN command to open the device before invoking `ZBREAK /TRACE:ON:device`. If you specify a device that is not open, InterSystems IRIS issues a <NOTOPEN> error. To open a sequential file, the directory must exist, and either the file must exist, or the **OPEN** command must specify the "N" option to create the file. This sequence of operations is shown in the following Windows example of a Terminal session:

  ```
   USER>SET btrace="C:\Logs\mydebugtrace.txt"

  USER>OPEN btrace:"WN"

  USER>ZBREAK /TRACE:ON:btrace

  USER>ZBREAK
  BREAK: Trace ON
   Trace device=C:\Logs\mydebugtrace.txt
   No breakpoints
   No watchpoints
  ```

  If a prior `ZBREAK /TRACE:ON:device1` has already activated a trace output device, `ZBREAK /TRACE:ON:device2` replaces the *device1* trace device with the *device2* trace device.
- `/TRACE:ALL` enables line stepping, writing a message to the trace device for each line. This line stepping does not stop, but proceeds through the code being debugged. You can specify either `ZBREAK /TRACE:ALL` or `ZBREAK /TRACE:ALL:device`. /TRACE:ALL enables trace line stepping; you can invoke this option before or after activating a trace device using /TRACE:ON:device. /TRACE:ALL:device both activates a trace device and enable line stepping to that trace device. You must use the OPEN command to open the device before invoking /TRACE:ALL:device. If you specify a device that is not open, InterSystems IRIS issues a <NOTOPEN> error. To open a sequential file, the

directory must exist, and either the file must exist, or the **OPEN** command must specify the "N" option to create the file. This sequence of operations is shown in the following Windows example of a Terminal session:

```
 USER>SET steptrace="C:\Logs\mysteptrace.txt"

USER>OPEN steptrace:"WN"

USER>ZBREAK /TRACE:ALL:steptrace

USER>ZBREAK
ZBREAK
BREAK:L+ Trace ON
 Trace device=C:\Logs\mysteptrace.txt
$ (single step) F:ET S:0 C: E:
 No watchpoints

USER>
```

- `/TRACE:OFF` de-activates the current trace output device; it does not close the device. You can specify either `ZBREAK /TRACE:OFF` or `ZBREAK /TRACE:OFF:device`. /TRACE:OFF deactivates the current trace output device; if no trace device is active, InterSystems IRIS performs no operation and issues no error. /TRACE:OFF:device deactivates the specified trace output device. If the specified *device* is not the current trace output device, /TRACE:OFF:device issues a <NOTOPEN> error.

/STEP and /NOSTEP

The /STEP and /NOSTEP command keywords control whether the debugger steps through certain types of code modules:

- The :EXT option governs user-written language extensions created in %ZLANG. To an application, these language extensions appear as a single command or function call. By default, the debugger does not step through these %ZLANG routines, regardless of the *action* argument setting.
- The :METHOD option governs stepping through object methods called by the application. By default, the debugger steps through object method code.
- The :DESTRUCT option governs stepping through the %Destruct object method. The %Destruct method is implicitly called whenever an object is destroyed. By default, the debugger does not step through %Destruct object method code.

You can specify more than one /STEP or /NOSTEP option, as shown in the following example:

```
ZBREAK /STEP:METHOD:DESTRUCT
```

Examples

The following example shows how **ZBREAK** with no arguments lists breakpoints and watchpoints. The first **ZBREAK** lists no breakpoints or watchpoints. The program then sets two watchpoints on the x and y local variables, and **ZBREAK** displays this. Next the program sets a $ single-step breakpoint, and **ZBREAK** displays the breakpoint and the two watchpoints. Next the program disables the x local variable watchpoint; this has no effect on the **ZBREAK** display. Finally, the program removes the x local variable watchpoint; this watchpoint disappears from the **ZBREAK** display:

```
ZBREAK
  ZBREAK *x:"B"
  ZBREAK *y:"B"
ZBREAK
  ZBREAK $
ZBREAK
  ZBREAK -*x
ZBREAK
  ZBREAK --*x
ZBREAK
  ZBREAK /CLEAR
```

For further examples of **ZBREAK** usage, refer to the Debugging chapter in *Using ObjectScript*.

See Also

- BREAK command
- FOR command
- OPEN command
- USE command
- Debugging chapter in *Using ObjectScript*

ZINSERT

Inserts one or more lines of code into the current routine.

```
ZINSERT:pc  "code":location ,...
ZI:pc  "code":location ,...
```

Arguments

pc	*Optional* — A postconditional expression.
code	A line of ObjectScript code, specified as a string literal (enclosed in quotation marks) or a variable that contains a string literal. For executable code, the first character must be a space. A line beginning with no space is treated as a label name. A line of code can include a label name followed by executable code.
:*location*	*Optional* — The line after which **ZINSERT** inserts the code. Can be a label name, a numeric offset (+n) or a label name and a numeric offset. If you omit *location*, the *code* is inserted at the current line location (edit pointer).

Description

This command inserts a line of ObjectScript source code into the currently loaded routine and advances the edit pointer to immediately after the inserted line. You can insert multiple lines of ObjectScript source code as a comma-separated series of *code*:*location* arguments. Lines of code are inserted as separate insert operations in the order specified.

From the Terminal, use ZLOAD to load a routine. **ZLOAD** loads the INT code version of a routine. INT code does not count or include preprocessor statements. INT code does not count or include completely blank lines from the MAC version of the routine, whether in the source code or within a multiline comment. Once a routine is loaded, it becomes the currently loaded routine for the current process in all namespaces. Therefore, you can insert or remove lines, display, execute, or unload the currently loaded routine from any namespace, not just the namespace from which it was loaded.

You can only use the **ZINSERT** command when you enter it from the Terminal or when you call it using an **XECUTE** command or a **$XECUTE** function. Specifying **ZINSERT** in the body of a routine results in a compile error. Any attempt to execute **ZINSERT** from within a routine also generates an error.

- **ZINSERT** "*code*" inserts a specified line of ObjectScript code in the current routine at the current edit pointer position.
- **ZINSERT** "*code*":*location* inserts the specified line of code in the current routine after the specified line *location*. You can specify a line location as the number of lines offset from the beginning of the routine, as a label, or as the number of lines offset from a specified label.

After **ZINSERT** inserts a line of code, it resets the edit pointer to the end of this new line of code. This means the next **ZINSERT** (or the next line of code in a **ZINSERT** comma-separated sequence of arguments) places its line of code directly after the last inserted line, unless the next **ZINSERT** explicitly specifies a *location*.

ZINSERT incrementally compiles each line. You can execute the current routine using the DO command.

ZINSERT effects only the local copy of the current routine. It does not change the routine as stored on disk. To store inserted lines, you must use the **ZSAVE** command to save the current routine.

You can access the $ZNAME special variable to determine the name of the current routine. You can use ZPRINT to display multiple lines of the currently loaded routine.

The Edit Pointer

CAUTION: **ZINSERT** moves the edit pointer.

The edit pointer is set as follows:

- **ZLOAD** sets the edit pointer to the beginning of the routine.
- **ZINSERT** sets the edit pointer to immediately after the line it inserts. For example, specifying `ZINSERT " SET x=1":+4` then `ZINSERT " SET y=2"` inserts lines 5 and 6.
- **ZREMOVE** sets the edit pointer to the line it removes. For example, specifying `ZREMOVE +4` then `ZINSERT " SET y=2"` removes line 4 and replaces line 4 with the inserted line.
- **ZPRINT** (or **PRINT**) sets the edit pointer to the end of the lines it printed. For example, specifying `ZPRINT` then `ZINSERT " SET y=2"` inserts the line at the end of the routine; specifying `ZPRINT +1:+4` then `ZINSERT " SET y=2"` inserts the line as line 5. The $TEXT function prints a single line from the current routine but does not change the edit pointer.
- **ZSAVE** does not change the edit pointer.
- **DO** does not change the edit pointer.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

code

A line of ObjectScript code, specified as a string literal (in quotes), or a variable that contains a string literal. This line of code can contain one or more ObjectScript commands, a new label name, or both a label and one or more commands. Because the code is inserted into a routine, it must follow ObjectScript formatting. Therefore, the first character of the *code* string literal must either be a blank space (standard ObjectScript indentation) or a label. The enclosing quotation marks are required. Since quotation marks enclose the line of code you are inserting, quotes within the code itself must be doubled.

You can use the **CheckSyntax()** method of the %Library.Routine class to perform syntax checking on a line of *code* before inserting it. Both **CheckSyntax()** and **ZINSERT** require one or more spaces before an executable line of ObjectScript code, and parse a line with no indentation as a label, or a label followed by executable code. Neither **CheckSyntax()** nor **ZINSERT** parse macro preprocessor code.

location

The line after which **ZINSERT** will insert the code. It can take either of the following forms:

+offset	An expression that resolves to a positive integer that identifies a line location as an offset number of lines from the beginning of the routine. **ZINSERT** inserts its code line immediately after this specified line. To insert a line at the beginning of the routine, specify +0. The plus sign is mandatory. If you omit *+offset*, the line identified by *label* is located.
label	A existing line label in the current routine. Must be a literal value; a variable cannot be used to specify *label*. Line labels are case-sensitive. If omitted, *+offset* is counted from the beginning of the routine.
label+offset	Specifies a label and a line count offset within the labelled section. If you omit the *+offset* value, or specify *label+0*, InterSystems IRIS locates the label line and inserts immediately after it.

Note: **ZINSERT** is only for use with the current routine. Attempting to specify *label^routine* for the location generates a <SYNTAX> error.

Lines of code are numbered beginning with 1. Thus a location of +1 inserts a line of code after the first line of the routine. To insert a line at the start of the routine or the start of a labelled section (before the existing first line), use an offset of +0. For example:

```
ZINSERT "Altstart SET c=12,d=8":+0
```

inserts the code line at the start of the routine. By using an offset of +0 (or omitting the *location*), you can insert a line into an otherwise empty current routine.

You can use the ^ROUTINE global to return the line numbering for an INT routine. Note that ^ROUTINE returns the version of the INT routine saved on disk; it does not return any unsaved changes made to the current routine. ^ROUTINE does not change the edit pointer.

A label may be longer than 31 characters, but must be unique within the first 31 characters. **ZINSERT** matches only the first 31 characters of a specified *label*. Label names are case-sensitive, and may contain Unicode characters.

The INT code lines include all labels, comments, and whitespace, with the exception that entirely blank lines in a MAC routine, which are removed by the compiler, are neither displayed nor counted. Blank lines in a multi-line comment are also removed. The `#;`, `##;`, and `///` comments in the MAC code may not appear in the INT code, and thus may affect line counts and offsets. Refer to Comments in MAC Code for Routines and Methods for further details.

Examples

The following example inserts the code line `SET x=24` after the fourth line within the current routine. Because this inserted code line does not begin with a label, an initial space must be included as the required line start character.

```
ZINSERT " SET x=24":+4
```

The following example inserts three code lines. It inserts `SET x=24` after the fourth line within the current routine. It then inserts `SET z=1` at the current edit pointer position (just after `SET x=24`) because the second code line does not specify a *location* It then sets `SET y=1` at the new line location +5 (between `SET x=24` and `SET z=1`):

```
ZINSERT " SET x=24":+4," SET z=1"," SET y=1":+5
```

In the following example, assume that the currently loaded routine contains a label called "Checktest". The **ZINSERT** command inserts a new line after the sixth line within Checktest (Checktest+6). This new line contains the label "Altcheck" and the command `SET y=0`.

```
ZINSERT "Altcheck SET y=0":Checktest+6
```

Note that because the inserted code line begins with the label “Altcheck”, no initial space is required after the quotation mark.

The following example inserts the code line `SET x=24 WRITE !,"x is set to ",x` after the fourth line within the current routine. Because an inserted code line is enclosed in quotation marks, the quotation marks in the WRITE command must be doubled.

```
ZINSERT " SET x=24 WRITE !,""x is set to "",x":+4
```

Notes

ZINSERT and ZREMOVE

You can use the **ZREMOVE** command to remove one or more lines of code from the currently executing routine. Thus by using **ZREMOVE** and **ZINSERT**, you can substitute a new code line for an existing code line. These operations only affect the copy of the routine currently being run by your process.

Note: **ZINSERT** inserts a line *after* the specified *location*. **ZREMOVE** removes a line *at* the specified location. For example, if you insert a line with `ZINSERT " SET x=1":+4`, to remove this line you must specify `ZREMOVE +5`.

ZINSERT, XECUTE, and $TEXT

You use the **XECUTE** command to define and insert a single line of executable code from within a routine. You use the **ZINSERT** command to define and insert by line position a single line of executable code from outside a routine.

An **XECUTE** command cannot be used to define a new label. Therefore, **XECUTE** does not require an initial blank space before the first command in its code line. **ZINSERT** can be used to define a new label. Therefore **ZINSERT** does require an initial blank space (or the name of a new label) before the first command in its command line.

The **$TEXT** function permits you to extract a line of code by line position from within a routine. **$TEXT** simply copies the specified line of code as a text string; it does not affect the execution of that line or change the current line location (edit pointer) when extracting from the current routine. (Using **$TEXT** to extract code from a routine other than the current routine *does* change the current line location.) **$TEXT** can supply a line of code to the **XECUTE** command. **$TEXT** can also supply a line of code to a **WRITE** command, and thus supply a code line to the Terminal.

Using ZINSERT to Create a Routine

If there is no current routine, you can use **ZINSERT** to create an unnamed routine as the current routine.

1. At the Terminal prompt, issue a **ZINSERT** command specifying the first line of ObjectScript code. Commonly, this line is either a label name or a label name followed by executable ObjectScript code. If this first line contains a label name, you can use DO to execute this routine without saving it. Otherwise, you must use ZSAVE *routine* to name and save this routine before you can execute this code.
2. At the Terminal prompt, issue additional ZINSERT commands to add lines to the current routine.
3. If you wish to save the routine, issue ZSAVE *routine* at the Terminal prompt to save this routine with the specified name.
4. When done, use argumentless ZREMOVE to unload the current routine.

See Also

- XECUTE command
- ZLOAD command
- ZPRINT command
- ZREMOVE command
- ZSAVE command
- $TEXT function
- $ZNAME special variable

ZLOAD

Loads a routine into the current routine buffer.

```
ZLOAD:pc routine
ZL:pc routine
```

Arguments

pc	*Optional* — A postconditional expression.
routine	*Optional* — The routine to be loaded, specified as a simple literal. The *routine* value is not enclosed with quotes. It is does not have a caret (^) prefix or a file type suffix. It cannot be specified using a variable or expression. If omitted, InterSystems IRIS loads an unnamed routine from the current device.

Description

The **ZLOAD** command loads the INT code version of an ObjectScript routine as the current routine. **ZLOAD** has two forms:

- ZLOAD without an argument
- ZLOAD with an argument

You can only use the **ZLOAD** command when you enter it from the Terminal or when you call it using an **XECUTE** command or a **$XECUTE** function. It should not be coded into the body of a routine because its operation would affect the execution of that routine. Specifying **ZLOAD** in a routine results in a compile error. Any attempt to execute **ZLOAD** from within a routine also generates an error.

Once you use **ZLOAD** to load a routine as the current routine, you can execute the current routine using the DO command, edit the current routine using ZINSERT and argumented ZREMOVE, display routine lines with ZPRINT, save (and optionally rename) the edited current routine using ZSAVE, and finally unload the current routine using an argumentless ZREMOVE.

ZLOAD without an Argument

The **ZLOAD** command without an argument loads an unnamed ObjectScript routine into the routine buffer as the current routine for the current process. You can subsequently name this routine using ZSAVE *routine*. Note that because the routine is unnamed you cannot use the $ZNAME special variable to determine if a current routine is loaded.

Argumentless **ZLOAD** can be used in two ways:

- To load a routine from a sequential file or other device.
- To create a routine using the Terminal.

An argumentless **ZLOAD** command can specify a postconditional expression.

Load a Routine from a Device

To load a routine from a device, execute the following:

1. Issue an **OPEN** command to open the device.
2. Issue a **USE** command to make the device the current device.
3. Issue an argumentless **ZLOAD** command to load the routine from the device as the current routine.

Line loading will continue until InterSystems IRIS reads a null string line (""). This loaded routine has no name until you file it with the **ZSAVE** *routine* command.

Create a Routine from the Terminal

You can use an argumentless **ZLOAD** to create an unnamed routine as the current routine from the Terminal:

1. At the Terminal prompt, issue an argumentless **ZLOAD** command.
2. On the line following, type the first ObjectScript command of the routine (not enclosed with quotes), then press **Enter** twice. Commonly, this line is a label name or a label name followed by executable ObjectScript code. Executable ObjectScript code must be indented.
3. At the Terminal prompt, issue ZINSERT commands to add more lines to this current routine.
4. Optionally, at the Terminal prompt, issue ZSAVE *routine* to save this routine with the specified name.
5. When done, use argumentless ZREMOVE to unload the current routine.

Alternatively, you can use ZINSERT to create an unnamed routine as the current routine from the Terminal.

ZLOAD with an Argument

ZLOAD *routine* loads the INT code version of an existing ObjectScript routine from the current namespace into the routine buffer as the current routine for the current process. INT code does not count or include preprocessor statements.

ZLOAD does an implicit argumentless **ZREMOVE** when it loads the routine. That is, **ZLOAD** deletes any routine previously loaded, replacing it with the specified *routine*. You can use the $ZNAME special variable to determine the currently loaded routine. When **ZLOAD** loads a routine, it positions the line pointer at the beginning of the routine.

Once loaded, a routine remains the current routine for the process until you load another routine explicitly with a **ZLOAD** command, remove it with an argumentless **ZREMOVE**, or implicitly load another routine with a **DO** or a **GOTO** command.

As long as the routine is current, you can edit the routine (with ZINSERT and ZREMOVE commands), display one or more lines with the ZPRINT command, or return a single line with the $TEXT function.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

routine

The name of an existing ObjectScript routine in the current namespace to be loaded as the current routine. Routine names are case-sensitive.

You must have execute permission for *routine* to be able to **ZLOAD** it. If you do not have this permission, InterSystems IRIS generates a <PROTECT> error.

If the specified routine does not exist, the system generates a <NOROUTINE> error. Note that a failed attempt to **ZLOAD** a routine removes the currently loaded routine.

All subsequent errors for this process append the name of the currently loaded routine. This occurs whether or not the error has any connection to the routine, and occurs across namespaces. For further details, refer to the $ZERROR special variable.

Notes

Namespaces

ZLOAD can only load a routine that exists in the current namespace. Once a routine is loaded, it becomes the currently loaded routine for this process in all namespaces. Therefore, you can insert or remove lines, display, execute, or unload the currently loaded routine from any namespace, not just the namespace from which it was loaded. **ZSAVE** saves the currently loaded routine in the current namespace. Therefore, if the **ZLOAD** namespace differs from the **ZSAVE** namespace, the modified version of the routine is saved in the namespace that is current when **ZSAVE** is issued. Changes are not saved in the version of the routine in the **ZLOAD** namespace.

Routine Behavior with ZLOAD

If you specify **ZLOAD** *routine*, InterSystems IRIS looks for the routine in the pool of routine buffers in memory. If the routine is not there, InterSystems IRIS loads the ObjectScript object code version of the routine into one of the buffers. The ObjectScript INT (intermediate) code remains in the corresponding ^ROUTINE global of the current namespace, but is updated if you make edits then use **ZSAVE** to save the changes.

For example, `ZLOAD MyTest` loads the object code version of the routine MyTest (if it is not already loaded). The MyTest routine must be in the current namespace.

In a multi-user environment, you should establish a LOCK protocol to prevent more than one user concurrently loading and modifying the same routine. Each user should acquire an exclusive lock before issuing a **ZLOAD** on the corresponding routine.

If you omit *routine*, `ZLOAD` loads new lines of code that you enter from the current device, usually the keyboard, until you terminate the code by entering a null line (that is, just press <Return>). This routine has no name until you save it with a subsequent **ZSAVE** command.

^rINDEX Routine Timestamp and Size

You can use the ^rINDEX global to return the local timestamp and number of characters for the MAC, INT, and OBJ code versions of a routine, as shown in the following Terminal example:

```
USER>ZWRITE ^rINDEX("MyTest")
^rINDEX("MyTest","INT")=$lb("2019-12-13 06:37:49",475)
^rINDEX("MyTest","MAC")=$lb("2019-12-13 06:34:04.235011",452)
^rINDEX("MyTest","OBJ")=$lb("2019-12-13 06:37:49",476)
USER>
```

The MAC timestamp is when the MAC code was last saved after being modified. The INT and OBJ timestamps are when the MAC code was last compiled. Issuing a ZSAVE after modifying the INT code version updates the INT and OBJ timestamps and character counts. Issuing a **ZSAVE** without modifying the INT code updates just the OBJ timestamp.

INT Code and the ^ROUTINE Global

The ObjectScript INT (intermediate) code for a routine is stored in the ^ROUTINE global. ^ROUTINE can only access routines in the current namespace. ^ROUTINE displays the INT code version of the routine on disk, not the currently loaded routine.

- You can display the INT code for the specified routine using the ZWRITE command:

  ```
  ZWRITE ^ROUTINE("MyRoutine")
  ```

  This display includes the following ^ROUTINE subscripts for the routine MyRoutine:

  – `^ROUTINE("MyRoutine",0)="65309,36923.81262"`: The local date and time in $HOROLOG format when the INT code version of this routine was last compiled. This timestamp is updated even if no changes were made to the MAC code before re-compiling. If the specified routine is the currently loaded routine, issuing a **ZSAVE** updates this value if changes were made to the currently loaded routine.

– `^ROUTINE("MyRoutine",0,0)=8`: The number of lines in the INT code version of the routine.

– `^ROUTINE("MyRoutine",0,1)="Main"`: The first line of the INT code version of the routine. In this case, the label Main.

– `^ROUTINE("MyRoutine",0,2)=" WRITE ""This is line 2"",!"`: The second line of the INT code version of the routine. In this case, an indented line of executable ObjectScript code. Additional lines of code follow the same pattern.

^ROUTINE does not reflect **ZINSERT**, and **ZREMOVE** changes to the current routine until these changes are saved using **ZSAVE**.

If the routine was loaded from a MAC code source, the following ^ROUTINE subscripts are also displayed:

– `^ROUTINE("MyRoutine","GENERATED")=1`: Indicating that the INT code was generated.

– `^ROUTINE("MyRoutine","INC","%occStatus")="65301,60553"`: If the MAC version contains #Include files, one of these subscripts is included for each #Include file, specifying the timestamp when the #Include file was created.

– `^ROUTINE("MyRoutine","SIZE")=134`: The number of characters in the INT code version of the source file.

– `^ROUTINE("MyRoutine","MAC")="65309,36920.45721"`: The local date and time in $HOROLOG format when the MAC version of the routine was last saved. This timestamp is only updated if the MAC code was modified, saved, and then re-compiled.

- You can view and edit the contents of the ^ROUTINE global using the Management Portal. Select **System Explorer**, **Globals**, then select the desired namespace from the drop-down list of namespaces in the left-hand column.
- You can delete the ObjectScript INT (intermediate) code using the KILL command:

```
KILL ^ROUTINE("MyRoutine")
```

If the INT code for the routine is unavailable (has been KILLed), the routine can still be executed, but the INT code cannot be modified in the currently loaded routine. **ZLOAD**, **ZINSERT**, and **ZREMOVE** issue no errors, but **ZSAVE** fails with a <NO SOURCE> error.

ZLOAD and Language Modes

When a routine is loaded, the current language mode changes to the loaded routine's language mode. At the conclusion of called routines, the language mode is restored to the language mode of the calling routine. However, at the conclusion of a routine loaded with **ZLOAD** the language mode is not restored to the previous language mode. For further details on checking and setting language modes, refer to the **LanguageMode()** method of the %SYSTEM.Process class.

Examples

The following Terminal example establishes an exclusive lock, then loads the corresponding routine MyRoutine. It displays the first 10 lines of the source code, adds a line of ObjectScript code as line 2, re-displays the source code, saves the changes and releases the lock:

```
USER>LOCK +^ROUTINE("MyRoutine")

USER>ZLOAD MyRoutine

USER>ZPRINT +1:+10

USER>ZINSERT " WRITE ""Hello, World!""":+1

USER>ZPRINT +1:+11

USER>ZSAVE

USER>LOCK -^ROUTINE("MyRoutine")
```

The following Terminal example loads the first routine from the device *dev*:

```
USER>OPEN dev
USER>USE dev
USER>ZLOAD
```

See Also

- DO command
- OPEN command
- USE command
- XECUTE command
- ZREMOVE command
- ZSAVE command
- $XECUTE function
- $ZNAME special variable

ZPRINT

Displays lines of code from the current routine on the current device.

```
ZPRINT:pc lineref1:lineref2
ZP:pc lineref1:lineref2
```

Arguments

pc	*Optional* — A postconditional expression.
lineref1	*Optional* — The line to be displayed, or the first line in a range of lines to be displayed, specified as a literal. Can be a label name, a numeric offset (+n) or a label name and a numeric offset. If omitted, the entire current routine is displayed.
:lineref2	*Optional* — The last line in a range of lines to be displayed, specified as a literal. To define a range, *lineref1* must be specified.

Description

The **ZPRINT** command displays lines of code from the currently loaded routine. Use ZLOAD to load a routine. ZLOAD loads the INT code version of a routine. For the name of the current routine, access the $ZNAME special variable.

The output is sent to the current device. When invoked from the Terminal, the current output device defaults to the Terminal. You can establish the current device with the **USE** command. For the device ID of the current device, access the $IO special variable.

Note: The **ZPRINT** and PRINT commands are functionally identical.

ZPRINT displays the INT code version of a routine. INT code does not count or include preprocessor statements. Completely blank lines from the MAC version of the routine, whether in the source code or within a multiline comment, are removed by the compiler and are therefore neither displayed nor counted in the INT routine. For this reason, **ZPRINT** displays and counts the following multi-line comment in the MAC routine as two lines, not three:

```
/* This comment includes

   a blank line */
```

The `#;`, `##;`, and `///` comments in the MAC code may not appear in the INT code, and thus may affect line counts and offsets. Refer to Comments in MAC Code for Routines and Methods for further details.

ZPRINT sets the edit pointer to the end of the lines it printed. For example, specifying `ZPRINT` then `ZINSERT " SET y=2"` inserts the line at the end of the routine; specifying `ZPRINT +1:+4` then `ZINSERT " SET y=2"` inserts the line as line 5. The $TEXT function prints a single line from the current routine but does not change the edit pointer.

ZPRINT has two forms:

- Without arguments
- With arguments

ZPRINT without arguments displays all the lines of code in the currently loaded routine.

ZPRINT with arguments displays the specified lines of code. **ZPRINT** *lineref1* displays the line specified by *lineref1*. **ZPRINT** *lineref1*:*lineref2* displays the range of lines starting with *lineref1* and ending with *lineref2* (inclusive).

The *lineref* arguments count lines and line offsets using the INT code version of the routine. After modifying a routine, you must re-compile the routine for **ZPRINT** to correctly count lines and line offsets that correspond to the source (MAC) version.

You can use the $TEXT function to return a single line of INT code.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the **ZPRINT** command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

lineref1

The line to be printed or the first in a range of lines to be displayed or printed. Can be specified in either of the following syntactical forms:

- *+offset* where *offset* is a positive integer specifying the line number within the current routine. +1 is the first line in the routine, which may be a label line. +0 always returns the empty string.
- *label[+offset]* where *label* is a label within the routine and *offset* is the line number counting from the label (with the label itself counting as offset 0). If you omit the *offset* option, or specify *label+0*, InterSystems IRIS prints the label line. *label+1* prints the line after the label.

A label may be longer than 31 characters, but must be unique within the first 31 characters. **ZPRINT** matches only the first 31 characters of a specified *label*. Label names are case-sensitive, and may contain Unicode characters.

lineref2

The last line in a range of lines to be displayed. Specify in the same way as *lineref1*.*lineref1* must be specified to specify *lineref2*. *lineref1* and *lineref2* are separated by a colon (:) character. No whitespace may appear between the colon and *lineref2*.

If *lineref2* specifies a label or offset earlier in the line sequence than *lineref1*, **ZPRINT** ignores *lineref2* and displays the single line of code specified by *lineref1*.

If *lineref2* specifies a non-existent label or offset, **ZPRINT** displays from *lineref1* to the end of the routine.

Examples

Given the following lines of code:

```
AviationLetters
Abc
  WRITE "A is Abel",!
  WRITE "B is Baker",!
  WRITE "C is Charlie",!
Def WRITE "D is Delta",!
  WRITE "E is Epsilon",!
  /* Not sure about E */
  WRITE "F is Foxtrot",!
```

ZPRINT with no *lineref* arguments displays all nine lines, including the comment line.

ZPRINT +0 displays the empty string.

ZPRINT +1 displays the `AviationLetters` label.

ZPRINT +8 displays the `/* Not sure about E */` comment line.

ZPRINT +10 displays the empty string.

ZPRINT Def or **ZPRINT Def+0** display the `Def WRITE "D is Delta",!` line. This is a label line that also includes executable code.

ZPRINT Def+1 displays the `WRITE "E is Epsilon",!` line.

Range Examples

ZPRINT +0:+3 displays the empty string.

ZPRINT +1:+3 displays the first three lines.

ZPRINT +3:+3 displays the third line.

ZPRINT +3:+1 displays the third line; *lineref2* is ignored.

ZPRINT +3:Abc+1 displays the third line. Both *lineref1* and *lineref2* are specifying the same line.

ZPRINT +3:abc+1 displays from the third line to the end of the routine. Line labels are case-sensitive, so the range endpoint was not found.

ZPRINT Abc+1:+4 displays lines 3 and 4.

ZPRINT Abc+1:Abc+2 displays lines 3 and 4.

ZPRINT Abc:Def displays lines 2, 3, 4, 5, and 6.

ZPRINT Abc+1:Def displays lines 3, 4, 5, and 6.

ZPRINT Def:Abc displays the `Def WRITE "D is Delta",!` line. Because *lineref2* is earlier in the code, it is ignored.

See Also

- PRINT command
- ZINSERT command
- ZLOAD command
- ZREMOVE command
- ZSAVE command
- ZZPRINT command
- $TEXT function
- $IO special variable
- $ZNAME special variable
- Comments in *Using ObjectScript*
- Labels in *Using ObjectScript*
- The Spool Device in *I/O Device Guide*

ZREMOVE

Deletes a line or a range of lines from the current routine, or unloads the current routine.

```
ZREMOVE:pc lineref1:lineref2 ,...
ZR:pc lineref1:lineref2 ,...
```

Arguments

pc	*Optional* — A postconditional expression.
lineref1	*Optional* — The position of a single line, or the first line in a range of lines to be removed. Can be specified as a literal (+5) or a variable (+a). If you omit *lineref1*, **ZREMOVE** deletes the entire current routine.
:lineref2	*Optional* — The position of the last line in a range of lines to be removed.

Description

The **ZREMOVE** command operates on the currently loaded routine for the current process. Use ZLOAD to load the current routine. **ZLOAD** loads the INT code version of a routine. INT code does not count or include preprocessor statements. INT code does not count or include completely blank lines from the MAC version of the routine, whether in the source code or within a multiline comment. Once a routine is loaded, it becomes the currently loaded routine for the current process in all namespaces. Therefore, you can insert or remove lines, display, execute, or unload the currently loaded routine from any namespace, not just the namespace from which it was loaded.

You can only use the **ZREMOVE** command when you enter it from the Terminal or when you call it using an **XECUTE** command or a **$XECUTE** function. Specifying **ZREMOVE** in the body of a routine results in a compile error. Any attempt to execute **ZREMOVE** from within a routine also generates an error.

ZREMOVE has two forms:

- Without an argument unloads the current routine.
- With arguments removes one or more lines of ObjectScript source code from the current routine.

Without an Argument

ZREMOVE without an argument removes (unloads) the currently loaded routine. Following an argumentless **ZREMOVE**, $ZNAME returns the empty string rather than the name of the current routine, and ZPRINT displays no lines. Because the routine has been removed, you cannot use ZSAVE to save the routine; attempting to do so results in a <COMMAND> error.

The following Terminal session shows this operation:

```
USER>ZLOAD myroutine

USER>WRITE $ZNAME
myroutine
USER>ZREMOVE

USER>WRITE $ZNAME

USER>
```

An argumentless **ZREMOVE** can specify a postconditional expression.

ZREMOVE with an argument can remove all the lines of the current routine, but does not remove the current routine itself. For example, `ZREMOVE +1:NonexistentLabel` removes all of the lines of the current routine, but you can use **ZINSERT** to insert new lines and use **ZSAVE** to save the routine.

With Arguments

ZREMOVE with arguments erases code lines in the current routine. **ZREMOVE** *lineref1* erases the specified line. **ZREMOVE** *lineref1*:*lineref2* erases the range for lines starting with the first line reference and ending with the second line reference, inclusive. It advances the edit pointer to immediately after the removed line(s). Therefore a **ZREMOVE** *lineref1* followed by a **ZINSERT** replaces the specified line.

ZREMOVE can remove multiple lines (or multiple ranges) of ObjectScript source code by specifying a comma-separated series of any combination of *lineref1* or *lineref1*:*lineref2* arguments. Each specified line or range of lines of code is removed as a separate remove operation in the order specified.

You can use ZPRINT to display multiple lines of the currently loaded routine. You can execute the current routine using the DO command.

Only the local copy of the routine is affected, not the routine as stored on disk. To store the modified code, you must use the **ZSAVE** command to save the routine.

The following Terminal session shows this operation. This example uses a dummy routine (^myroutine) in which each line sets a variable to a string naming that line:

```
USER>ZLOAD myroutine

USER>ZPRINT +8
  WRITE "this is line 8",!
USER>ZREMOVE +8

USER>PRINT +8
  WRITE "this is line 9",!
USER>
```

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

lineref1

The line to be removed, or the first in a range of lines to be removed. It can take any of the following formats:

+offset	Specifies a line number within the routine. A positive integer, counting from 1.
label	Specifies a label within the routine. **ZREMOVE** *label* erases only the label line itself. This includes any code that follows the label on that line.
label+offset	Specifies a label and the number of line to offset within the labeled section, counting the label line as line 1.

A label may be longer than 31 characters, but must be unique within the first 31 characters. **ZREMOVE** matches only the first 31 characters of a specified *label*. Label names are case-sensitive, and may contain Unicode characters.

You can use *lineref1* to specify a single line of code to remove. You specify the code line either as an offset from the beginning of the routine (+*lineref1*) or as an offset from a specified label (*label*+*lineref1*).

- `ZREMOVE +7`: removes the 7th line counting from the beginning of the routine.
- `ZREMOVE +0`: performs no operation, generates no error.
- `ZREMOVE +999`: if 999 is greater than the number of lines in the routine, performs no operation, generates no error.
- `ZREMOVE Test1`: removes the label line Test1.

- `ZREMOVE Test1+0`: removes the label line Test1.
- `ZREMOVE Test1+1`: removes the first line following label line Test1.
- `ZREMOVE Test1+999`: removes the 999th line following label line Test1. This line may be in another labeled module. If 999 is greater than the number of lines from label Test1 to the end of the routine, performs no operation, generates no error.

The INT code lines include all labels, comments, and whitespace found in the MAC version of the routine, with the exception that entirely blank lines in a MAC routine, which are removed by the compiler, are neither displayed nor counted in INT code. Blank lines in a multi-line comment are also removed. The `#;`, `##;`, and `///` comments in the MAC code may not appear in the INT code, and thus may affect line counts and offsets. Refer to Comments in MAC Code for Routines and Methods for further details.

lineref2

The last line in a range of lines to be removed. Specify *lineref2* in any of the formats used for *lineref1*. The colon prefix (:) is mandatory.

You specify a range of lines as +*lineref1*:+*lineref2*. **ZREMOVE** removes the range of lines, inclusive of *lineref1* and *lineref2*. If *lineref1* and *lineref2* refer to the same line, **ZREMOVE** removes that single line.

If *lineref2* appears earlier in the routine code than *lineref1*, no operation is performed and no error is generated. For example: `ZREMOVE +7:+2`, `ZREMOVE Test1+1:Test1`, `ZREMOVE Test2:Test1` would perform no operation.

Note: Use caution when specifying a label name in *lineref2*. Label names are case-sensitive. If *lineref2* contains a label name that does not exist in the routine, **ZREMOVE** removes the range of lines from *lineref1* through the end of the routine.

Examples

This command erases the fourth line within the current routine.

```
ZREMOVE +4
```

This command erases the sixth line after the label Test1; Test1 is counted as the first line.

```
ZREMOVE Test1+6
```

This command erases lines three through ten, inclusive, within the current routine.

```
ZREMOVE +3:+10
```

This command erases the label line Test1 through the line that immediately follows it, within the current routine.

```
ZREMOVE Test1:Test1+1
```

This command erases all of the line from label Test1 through label Test2, inclusive of both labels, within the current routine.

```
ZREMOVE Test1:Test2
```

See Also

- PRINT command
- XECUTE command
- ZINSERT command
- ZLOAD command
- ZSAVE command

- $ZNAME special variable

ZSAVE

Saves the current routine.

```
ZSAVE:pc routine
ZS:pc routine
```

Arguments

pc	*Optional* — A postconditional expression.
routine	*Optional* — A new name for the routine, specified as a simple literal. Must be a valid identifier. Routine names are case-sensitive. The *routine* value is not enclosed with quotes. It is does not have a caret (^) prefix or a file type suffix. It cannot be specified using a variable or expression.

Description

The **ZSAVE** command saves the current routine. You use **ZLOAD** to load the routine, then use **ZSAVE** to save any changes you have made to the routine with **ZINSERT** and **ZREMOVE** commands.

You can only use the **ZSAVE** command when you enter it from the Terminal or when you call it using an **XECUTE** command or a **$XECUTE** function. It should not be coded into the body of a routine because its operation would affect the execution of that routine. Specifying **ZSAVE** in a routine results in a compile error. Any attempt to execute **ZSAVE** from within a routine also generates an error.

ZSAVE does not move the edit pointer.

If you **ZLOAD** a routine as the current routine, then:

- **ZSAVE** the current routine after modifying it using **ZINSERT** and/or **ZREMOVE**: InterSystems IRIS updates the `^rINDEX("MyRoutine","INT")` and `^rINDEX("MyRoutine","OBJ")` globals to the current timestamp and character count, and updates and the `^ROUTINE("MyRoutine",0)` global.
- **ZSAVE** the current routine without modifying the current routine: InterSystems IRIS updates the `^rINDEX("MyRoutine","OBJ")` global; it does not change the `^rINDEX("MyRoutine","INT")` global or the `^ROUTINE("MyRoutine",0)` global.

Refer to INT Code and the ^ROUTINE Global for further details.

ZSAVE has two forms:

- Without an argument
- With an argument

ZSAVE Without an Argument

ZSAVE without an argument saves the current routine under its current name. This is the name specified in **ZLOAD**, or the name under which you previously saved it using **ZSAVE**. **ZSAVE** saves the routine in the current namespace.

The following example loads a routine from the USER namespace, modifies the routine, then changes to a different namespace and performs a **ZSAVE**. The results of these operations are that there are now routines named MyRoutine in both the USER and SAMPLES namespace. The MyRoutine in SAMPLES contains the inserted line of code. The MyRoutine in USER does not contain the inserted line of code:

```
USER>ZLOAD MyRoutine

USER>ZPRINT +1:+4
```

```
   WRITE "this is line 1",!
   WRITE "this is line 2",!
   WRITE "this is line 3",!
   WRITE "this is line 4",!

USER>ZINSERT "  WRITE 123,!":+3

USER>ZPRINT +1:+5
   WRITE "this is line 1",!
   WRITE "this is line 2",!
   WRITE "this is line 3",!
   WRITE 123,!
   WRITE "this is line 4",!

USER>ZNSPACE "SAMPLES"

SAMPLES>ZPRINT +1:+5
   WRITE "this is line 1",!
   WRITE "this is line 2",!
   WRITE "this is line 3",!
   WRITE 123,!
   WRITE "this is line 4",!

SAMPLES>ZSAVE
```

If the current routine does not yet have a name, an argumentless **ZSAVE** generates a <COMMAND> error.

An argumentless **ZSAVE** command can specify a postconditional expression.

ZSAVE With an Argument

ZSAVE *routine* saves the current routine to disk as the specified *routine* name. It makes the specified *routine* the current routine. For example, if you load a routine named MyRoutine, modify it, then save it with **ZSAVE MyNewRoutine**, the current routine is now MyNewRoutine, which contains the changes. The routine named MyRoutine does not contain these changes, and it is no longer loaded as the current routine.

ZSAVE *routine* saves the current routine in the current namespace. For example, if you load a routine named MyRoutine from the USER namespace, modify the routine, then change to the SAMPLES namespace and performs a **ZSAVE MyNewRoutine**, MyNewRoutine is saved in namespace SAMPLES, not the USER namespace.

If use the **XECUTE** command to invoke **ZSAVE** *routine*, the system creates a Load frame to preserve the current routine. When the **XECUTE** command concludes, InterSystems IRIS uses this Load frame to restore the routine name prior to the **XECUTE** as the current routine. This is shown in the following example:

```
   WRITE "Current routine name",!
   WRITE "initial name: ",$ZNAME,!
     SET x = "WRITE $ZNAME"
     SET y = "ZSAVE mytest"
     SET z = "WRITE "" changed to "",$ZNAME,!"
   XECUTE x,y,z
   WRITE "restored name: ",$ZNAME,!
```

ZSAVE *routine* is used to name a routine loaded with an argumentless **ZLOAD**.

ZSAVE *routine* is used to name a nameless routine created by **ZINSERT** commands.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

routine

A name under which to save the routine. *routine* must be a valid routine name. You can use the $ZNAME("string",1) function to determine if *string* is a valid routine name. You can use the $ZNAME special variable to determine the name of the currently loaded routine.

Commonly, *routine* is a new name for the routine, but it can be the current routine name. If a routine by that name already exists in the current namespace, InterSystems IRIS overwrites it. Note that you are not asked to confirm the overwrite. A routine name must be unique within the first 255 characters; routine names longer than 220 characters should be avoided.

If you omit *routine*, the system saves the routine under its current name. If no current name exists, **ZSAVE** generates a <COMMAND> error.

Example

The following Terminal session example executes a **ZSAVE** command to save the currently loaded routine:

```
USER>DO ^myroutine
this is line 8
this is line 9
USER>ZLOAD myroutine

USER>PRINT +8
WRITE "this is line 8",!
USER>ZREMOVE +8

USER>PRINT +8
WRITE "this is line 9",!
USER>ZSAVE myroutine

USER>DO ^myroutine
this is line 9
USER>
```

Notes

ZSAVE and Routine Recompilation

If you have issued a command that modifies source code, **ZSAVE** recompiles and saves the routine. If the source code for the routine is unavailable, **ZSAVE** fails with a <NO SOURCE> error and does not replace the existing object code. For example, the following commands load the %SS object code routine, attempt to remove lines from the (nonexistent) source code, and then attempt to save to the ^test global. This operation fails with a <NO SOURCE> error:

```
ZLOAD %SS ZREMOVE +3 ZSAVE ^test
```

If you have *not* issued a command that modifies source code, **ZSAVE** saves the object code in the specified *routine*. (Obviously, no recompile occurs.) For example, the following commands load the %SS object code routine and then save it to the ^test global. This operation succeeds:

```
ZLOAD %SS ZSAVE ^test
```

ZSAVE with % Routines

You receive a <PROTECT> error if you try to **ZSAVE** a %routine to a remote dataset, even if that dataset is the current dataset for the process. The percent sign prefix is used for the names of non-modifiable routines, such as system utilities.

Concurrent ZSAVE Operations

When using **ZSAVE** in a networked environment, a situation may occur in which two different jobs might concurrently save a routine and assign it the same name. This operation has the potential for one routine overwriting part of the other, producing unpredictable results. When this possibility exists, acquire an advisory lock on the routine before the **ZSAVE** operation. For example, `LOCK ^ROUTINE("name")`. For further details, refer to the LOCK command. When running a job across ECP, the saved source is more vulnerable to such concurrent saves because local buffer protection is not visible to other clients.

See Also

- XECUTE command
- ZLOAD command

- ZINSERT command
- ZREMOVE command
- $ZNAME special variable

ZZPRINT

Displays one or more source code lines from a routine.

```
ZZPRINT:pc "entry+offset^routine":before:after
```

Arguments

pc	*Optional* — A postconditional expression.
entry	*Optional* — The name of an entry (label) within *routine*. If omitted, **ZZPRINT** begins at the start of *routine* (line 0).
offset	*Optional* — An integer specifying the number of lines to offset from *entry* (if specified), or from the beginning of *routine* (if *entry* is omitted). An *offset* requires the plus sign (+) prefix. Commonly *offset* is a positive integer. An *offset* can be a negative number; for example, `"subsect+-3^mytest"`, which displays the line 3 lines prior to `subsect`. If *offset* is omitted, display begins at start of *entry*.
routine	The routine from which to display source code lines. A *routine* name is always preceded by a caret (^) prefix.
before	*Optional* — A positive integer count specifying the number of lines before the line specified in `"entry+offset^routine"` to display. Does not include the `"entry+offset^routine"` line.
after	*Optional* — A positive integer count specifying the number of lines after the line specified in `"entry+offset^routine"` to display. Does not include the `"entry+offset^routine"` line.

Description

The **ZZPRINT** command displays one or more source code lines from a specified ObjectScript routine. It can display a designated line of code and a specified number of lines that appear before and/or after that designated line of source code, enabling you to see it in context. The *entry* value specifies a starting point for display. However, **ZZPRINT** does not limit its display to the specified *entry*; *offset*, *before*, and *after* may include source code lines in prior or subsequent entries.

The displayed lines include all labels, comments, and whitespace, with the exception of entirely blanks lines. A blank line, whether in code or within a multiline comment, is neither displayed nor counted. For this reason, **ZZPRINT** displays and counts the following multi-line comment as two lines, not three:

```
/* This comment includes

   a blank line */
```

ZZPRINT does not count or display preprocessor statements.

Command Delimiters and Blank Space Requirements

The delimiting quotation marks (" ") are required. The opening quotation mark must appear exactly one space after the command name or postconditional expression. Any number of spaces can appear following the opening quotation mark or proceeding or following the closing quotation mark.

The caret (^) prefix to the *routine* name is required. If you specify an *offset*, any number of spaces can precede the caret prefix. If you do not specify an *offset*, there must be no spaces between the *entry* name and caret prefix to the *routine* name.

The plus sign (+) is required to specify an *offset*. The plus sign must immediately follow the *entry* name (if specified). A plus sign not immediately followed by an integer represents an offset of zero. For example, a plus sign immediately followed by the caret (^) prefix, by a space, or by a non-number character all represent an offset of zero. A plus sign immediately followed by a integer represents a positive offset. A plus sign immediately followed by a negative integer represents a negative offset.

A colon (:) delimiter is required to specify a *before* line count. To specify an *after* line count you must specify both colon delimiters, whether or not you specify a *before* value. Any number of spaces are permitted before or after these colon delimiters.

Arguments

pc

An optional postconditional expression. InterSystems IRIS executes the command if the postconditional expression is true (evaluates to a nonzero numeric value). InterSystems IRIS does not execute the command if the postconditional expression is false (evaluates to zero). For further details, refer to Command Postconditional Expressions in *Using ObjectScript*.

entry

The name of an entry within *routine*. Entry names are case-sensitive. If *routine* does not contain the specified *entry*, the system generates a <NOLABEL> error.

offset

An integer specifying the number of lines to offset from the beginning of *entry* (if specified), or the beginning of *routine*. Omitting *offset* is the same as an offset of zero. An offset of zero from *entry* is the entry label line itself (line 1). An offset of zero from *routine* is the (nonexistent) line prior to the beginning of the routine (line 0). Therefore, to display a comment line at the beginning of a routine, you must specify an offset of 1 (`"+1^mytest"`).

Offset counts include all source code lines except preprocessor statements and completely blank lines. These are neither displayed nor counted. An offset that exceeds the available lines in *routine* when counting from the specified (or implied) *entry* point returns a null string.

routine

The name of the routine from which to display source code lines. Routine names are case-sensitive. If the specified routine does not exist, the system generates a <NOROUTINE> error.

You must have read permission for *routine* to be able to **ZZPRINT** it. If you do not have this permission, InterSystems IRIS generates a <PROTECT> error.

before

A positive integer specifying the number of lines to display before the specified line. This enables you to view a source code line in the context of the lines immediately prior to it. This is a count of lines backwards from a designated program line. The *before* count does not include the program line designated by `"entry+offset^routine"`. If the *before* count is larger than the number of available code lines, **ZZPRINT** displays the available code lines; it does not issue an error.

after

A positive integer specifying the number of lines to display after the specified line. This enables you to view a source code line in the context of the lines immediately following it. This is a count of lines forwards from a designated program line. The *after* count does not include the program line designated by `"entry+offset^routine"`. If the *after* count is larger than the number of available code lines, **ZZPRINT** displays the available code lines; it does not issue an error.

When you specify an *after* value, you can specify or omit a *before* value:

- To display a designated program line and a specified number of lines after that line, specify a positive integer for *after* and a value of 0 for *before*.

- To display all lines in the *routine* prior to the designated program line and a specified number of lines after that line, specify an *after* value without specifying a *before* value. (Just specify the placeholder colon.) If you specify an *after* without a *before*, **ZZPRINT** displays from the start of *routine* to the location after the designated program line specified by the *after* line count.
- To display a specified number of lines before and after a designated program line, specify a positive integer for *before* and a positive integer for *after*.

See Also

- PRINT command
- ZPRINT command
- $TEXT function
- Comments in *Using ObjectScript*
- Labels in *Using ObjectScript*

ObjectScript Functions

A function performs an operation and returns a value. This value may be the result of the operation, or an indicator that the operation completed successfully or failed. By convention, InterSystems IRIS® functions that set a variable to a value set the variable, then return the value of that variable *prior* to the operation.

This document describes system functions (also known as intrinsic functions). System functions are identified by a $ character prefix to the name and parentheses following the name. The parentheses are not specified when referring to a function in documentation. You can supplement these system functions by creating user-supplied functions (also known as extrinsic functions). User-supplied functions are identified by a $$ prefix.

The names of ObjectScript special variables also begin with a $ character, but special variables have no parentheses.

For more information on ObjectScript functions generally, see the Functions description in the "Introducing ObjectScript" chapter of *Using ObjectScript*; for more information on defining your own functions, see User-Defined Code in *Using ObjectScript*.

To invoke a system function, use the form:

$*name*(*parameters*)

name	The name of the function. The preceding dollar sign ($) is required. Function names are shown here in all uppercase letters, but they are, in fact, not case-sensitive. You can abbreviate most function names. In the Synopsis for each function, the full name syntax is first presented, and below it is shown the abbreviated name (if one exists).
parameters	One or more values to be passed to the function. Function arguments, or *parameters*, are always enclosed in parentheses and follow the function name. The parentheses are mandatory, even if the function has no parameters. Multiple parameters are separated from each other by commas. The parameters are positional and must match the order of the parameters expected by the function. Missing parameters in this sequence can be indicated by supplying the appropriate number of commas; no trailing commas are required for parameters missing from the end of the parameter list. Spaces are permitted anywhere in the parameter list. No spaces are permitted between *name* and the open parenthesis character.

The Synopsis for each function contains only literal syntactical punctuation. The Synopsis does not include punctuation for format conventions, such as what parameters of the syntax are optional. This information is provided in the table of parameters immediately following the Synopsis.

The one exception is the ellipsis (...). An ellipsis following a comma indicates that the parameter (or parameter group) preceding the comma can be repeated multiple times as a comma-separated list.

Any platform-specific function is marked with the name of the platform that supports it. Any function that is not marked with a platform abbreviation is supported by all InterSystems IRIS® platforms.

$ASCII

Converts a character to a numeric code.

```
$ASCII(expression,position)
$A(expression,position)
```

Parameters

expression	The character to be converted.
position	*Optional* — The position of a character within a character string, counting from 1. The default is 1.

Description

$ASCII returns the character code value for a single character specified in *expression*. This character can be an 8-bit (extended ASCII) character or a 16-bit (Unicode) character. The returned value is a positive integer.

The *expression* parameter may evaluate to a single character or to a string of characters. If *expression* evaluates to a string of characters, you can include the optional *position* parameter to indicate which character you want to convert.

Parameters

expression

An expression that evaluates to a quoted string of one or more characters. The expression can be specified as the name of a variable, a numeric value, a string literal, or any valid ObjectScript expression. If *expression* yields a string of more than one character, use *position* to select the desired character. If you omit *position* for a character string, **$ASCII** returns the numeric code for the first character. **$ASCII** returns -1 if the *expression* evaluates to a null string.

position

The position must be specified as a nonzero positive integer. It may be signed or unsigned. You can use a noninteger numeric value in *position*; however, InterSystems IRIS ignores the fractional portion and only considers the integer portion of the numeric value. If you do not include *position*, **$ASCII** returns the numeric value of the first character in *expression*. **$ASCII** returns -1 if the integer value of *position* is larger than the number of characters in *expression* or less than 1.

Examples

The following example returns 87, the ASCII numeric value of the character W.

```
WRITE $ASCII("W")
```

The following example returns 960, the numeric equivalent for the Unicode character "pi".

```
WRITE $ASCII($CHAR(959+1))
```

The following example returns 84, the ASCII numeric equivalent for the first character in the variable Z.

```
SET Z="TEST"
WRITE $ASCII(Z)
```

The following example returns 83, the ASCII numeric equivalent for the third character in the variable Z.

```
SET Z="TEST"
WRITE $ASCII(Z,3)
```

The following example returns a -1 because the second argument specifies a position greater than the number of characters in the string.

```
 SET Z="TEST"
 WRITE $ASCII(Z,5)
```

The following example uses **$ASCII** in a **FOR** loop to convert all of the characters in variable *x* to their ASCII numeric equivalents. The **$ASCII** reference includes the *position* parameter, which is updated for each execution of the loop. When *position* reaches a number that is greater than the number of characters in *x*, **$ASCII** returns a value of -1, which terminates the loop.

```
  SET x="abcdefghijklmnopqrstuvwxyz"
  FOR i=1:1 {
    QUIT:$ASCII(x,i)=-1
    WRITE !,$ASCII(x,i)
    }
  QUIT
```

The following example generates a simple checksum for the string *X*. When $CHAR(CS) is concatenated with the string, the checksum of the new string is always zero. Therefore, validation is simplified.

```
CXSUM
  SET x="Now is the time for all good men to come to the aid of their party"
  SET CS=0
  FOR i=1:1:$LENGTH(x) {
    SET CS=CS+$ASCII(x,i)
    WRITE !,"Checksum is:",CS
    }
  SET CS=128-CS#128
  WRITE !,"Final checksum is:",CS
```

The following example converts a lowercase or mixed-case alphabetic string to all uppercase.

```
ST
  SET String="ThIs Is a MiXeDCAse stRiNg"
  WRITE !,"Input: ",String
  SET Len=$LENGTH(String),Nstring=" "
  FOR i=1:1:Len { DO CNVT }
  QUIT
CNVT
  SET Char=$EXTRACT(String,i),Asc=$ASCII(Char)
  IF Asc>96,Asc<123 {
    SET Char=$CHAR(Asc-32)
    SET Nstring=Nstring_Char
    }
  ELSE {
    SET Nstring=Nstring_Char
    }
  WRITE !,"Output: ",Nstring
  QUIT
```

Notes

Unicode Support

The **$ASCII** function supports both 8-bit and 16-bit characters. For 8-bit characters, it returns the numeric values 0 through 255. For 16-bit (Unicode) characters it returns numeric codes up to 65535.

The Unicode value for a character is usually expressed as a 4-digit number in hexadecimal notation, using the digits 0-9 and the letters A-F (for 10 through 15, respectively). However, standard functions in the ObjectScript language generally identify characters according to ASCII numeric codes, which are base-10 decimal values, not hexadecimal.

Hence, the **$ASCII** function supports Unicode encoding by returning the decimal Unicode value of the inputted character, instead of the hexadecimal value that the Unicode standard recommends. This way, the function remains backward compatible, while also supporting Unicode. To convert a decimal number to hexadecimal, use the $ZHEX function.

For further details on InterSystems IRIS Unicode support, refer to Unicode in *Using ObjectScript*.

Surrogate Pairs

$ASCII does not recognize surrogate pairs. Surrogate pairs are used to represent some Chinese characters and to support the Japanese JIS2004 standard. You can use the **$WISWIDE** function to determine if a string contains a surrogate pair. The **$WASCII** function recognizes and correctly parses surrogate pairs. **$ASCII** and **$WASCII** are otherwise identical. However, because **$ASCII** is generally faster than **$WASCII**, **$ASCII** is preferable for all cases where a surrogate pair is not likely to be encountered.

Note: **$WASCII** should not be confused with **$ZWASCII**, which always parses characters in pairs.

Related Functions

The **$CHAR** function is the inverse of **$ASCII**. You can use it to convert an integer code to a character.

$ASCII converts a single character to an integer. To convert a 16-bit (wide) character string to an integer use **$ZWASCII**. To convert a 32-bit (long) character string to an integer use **$ZLASCII**. To convert a 64-bit (quad) character string to an integer use **$ZQASCII**. To convert a 64-bit character string to an IEEE floating-point number ($DOUBLE data type) use **$ZDASCII**.

See Also

- READ command
- WRITE command
- $CHAR function
- $WASCII function
- $WISWIDE function
- $ZLASCII function
- $ZWASCII function
- $ZQASCII function
- $ZDASCII function

$BIT

Returns and or sets the bit value of a specified position in a bitstring.

```
$BIT(bitstring,position)

SET $BIT(bitstring,position) = value
```

Parameters

bitstring	An expression that evaluates to a bitstring. For **$BIT**, *bitstring* can be any expression that resolves to a bitstring, including a variable of any type, **$FACTOR**, a user-defined function, or an `oref.prop`, `..prop`, or `i%prop` instance variable property reference. For **SET $BIT**, *bitstring* can be a variable of any type, including an i%Prop() property instance variable.
position	The bit position within *bitstring*. A literal or an expression that evaluates to a positive integer. Bit positions are counted from 1.
value	The bit value to set at *position*. A literal or an expression that evaluates to the integer 0 or 1.

Description

$BIT is used to return a bit value from a compressed bit string. **$BIT**(*bitstring,position*) returns the bit value (0 or 1) at the specified position, *position*, in the given bitstring expression *bitstring*. If no value has been defined for a *position*, **$BIT** returns 0 for that position. The *position* is counted from 1; if *position* is less than 1 (0 or a negative number) or is greater than the length of the bitstring, the function returns 0.

If *bitstring* is an undefined variable or the null string ("") the **$BIT** function returns 0. If *bitstring* is not a valid bitstring value an <INVALID BIT STRING> error occurs.

For general information on **$BIT** and other bitstring functions, see below.

SET $BIT

SET $BIT is used to set a specified bit value in a *bitstring* compressed bit string. If the *bitstring* is not defined, **SET $BIT** defines the *bitstring* variable as a compressed bit string and sets the specified bit value.

SET $BIT(*bitstring,position*) = *value* performs an atomic bit set on the bitstring specified by *bitstring*. If *value* is 1, then the bit at position *position* is set to 1. If *value* is 0, the bit is cleared (set to 0). Only an integer *value* of 0 or 1 should be used; InterSystems IRIS converts any non-numeric value, such as “true” or “false” to 0.

The bit *position* is counted from 1. If *bitstring* is shorter than the specified *position*, InterSystems IRIS pads the bitstring with 0 bits to the specified position. If you specify a *position* of 0, the system generates a <VALUE OUT OF RANGE> error.

The *bitstring* variable must be either an undefined variable, a variable already set to a bitstring value, or a variable set to the empty string (""). Attempting to use **SET $BIT** on a variable already set to a non-bitstring value results in an <INVALID BIT STRING> error.

The **SET $BIT** *bitstring* parameter does not support oref.property or .. property syntax.

The **SET $BIT** *bitstring* parameter supports i%property instance variable syntax for both local (non-inherited) properties and properties inherited from a super class. If attempting to set inherited property in existing code is generating a <FUNCTION> error, recompiling the routine should resolve this error and allow setting of the inherited property.

Displaying a Bitstring

As shown in the examples, you can you can use **WRITE** to display the contents of an individual bit in a bitstring as the return value of **$BIT**.

InterSystems IRIS has several commands to display the contents of a variable. However, because a **$BIT** bitstring is a compressed binary string, WRITE does not display a useful value. ZZDUMP displays the hexadecimal representation of the compressed binary string, which is also not a useful value for most purposes.

ZWRITE and ZZWRITE display the decimal representation of the compressed binary string as **$ZWCHAR** ($zwc) two-byte (wide) characters. However, they also display a comment that lists the uncompressed "1" bits in left-to-right order as a comma-separated list. If there are three or more consecutive "1" bits, it lists them as a range (inclusive) with two dot syntax (`n..m`). For example, the bitstring [1,0,1,1,1,1,0,1] is shown as `/*$bit(1,3..6,8)*/`. The bitstring [1,1,1,1,1,1,1,1] is shown as `/*$bit(1..8)*/`. The bitstring [0,0,0,0,0,0,0,0] is shown as `/*$bit()*/`.

$DATA returns 1 for a compressed binary string variable, including an all-zeros bitstring, such as [0,0,0,0,0,0,0,0]. $GET returns the empty string for a compressed binary string, regardless of its value; **$GET** also returns the empty string for an undefined variable.

Examples

Note in the following examples that a bit that has not been set always has a value of 0.

The following example uses **SET $BIT** to create a compressed bitstring. It then invokes **$BIT** repeatedly to display the bits in the bitstring:

```
SET $BIT(a,1) = 0
SET $BIT(a,2) = 0
SET $BIT(a,3) = 1
SET $BIT(a,4) = 0
SET $BIT(a,5) = 0
SET $BIT(a,6) = 1
SET $BIT(a,7) = 1
SET $BIT(a,8) = 0
// Test single bits within the bitstring
WRITE "bit #2 value: ",$BIT(a,2),!
WRITE "bit #7 value: ",$BIT(a,7),!
WRITE "bit #8 value: ",$BIT(a,8),!
WRITE "bit #13 value: ",$BIT(a,13),!
// Write the bitstring
WRITE "bitstring value: "
FOR x=1:1:8 {WRITE $BIT(a,x) }
WRITE !!,"compressed bitstring: "
ZZDUMP a
```

Because InterSystems IRIS pads the bitstring with 0 bits to the specified position, the following example returns the exact same bitstring data value. However, note that because the #8 bit is not defined, the compressed bitstring *a* is not identical to the compressed bitstring *b*:

```
SET $BIT(b,3) = 1
SET $BIT(b,6) = 1
SET $BIT(b,7) = 1
// Test single bits within the bitstring
WRITE "bit #2 value: ",$BIT(b,2),!
WRITE "bit #7 value: ",$BIT(b,7),!
WRITE "bit #8 value: ",$BIT(b,8),!
WRITE "bit #13 value: ",$BIT(b,13),!
// Write the bitstring
WRITE "bitstring value: "
FOR x=1:1:8 {WRITE $BIT(b,x) }
WRITE !!,"compressed bitstring: "
ZZDUMP b
```

For this reason, it is a recommended programming practice to always explicitly set the highest defined bit in the bitstring, even when its assigned value is 0.

You can use a FOR expr comma-separated list to set multiple bits, as shown in the following example:

```
FOR i=3,6,7 { SET $BIT(b,i) = 1 }
// Test single bits within the bitstring
WRITE "bit #2 value: ",$BIT(b,2),!
WRITE "bit #7 value: ",$BIT(b,7),!
WRITE "bit #8 value: ",$BIT(b,8),!
WRITE "bit #13 value: ",$BIT(b,13),!
// Write the bitstring
WRITE "bitstring value: "
FOR x=1:1:8 {WRITE $BIT(b,x) }
WRITE !!,"compressed bitstring: "
ZZDUMP b
```

In the following example, successive invocations of **$BIT** return the bits of the bitstring generated by $FACTOR:

```
FOR i=1:1:32 {WRITE $BIT($FACTOR(2*31-1),i) }
```

The following example returns a random 16-bit bitstring:

```
SET x=$RANDOM(65536)
FOR i=1:1:16 {WRITE $BIT($FACTOR(x),i) }
```

General Information on Bitstring Functions

Bitstring functions manipulate encoded bit-based data. Although a bitstring can be used with any ObjectScript command or function, it is generally meaningful only within the context of the bit functions.

The **$BIT** bitstring functions perform atomic operations. Therefore, no locking is required when performing bitstring operations.

The **$BIT** bitstring functions perform internal compression of bitstrings. Therefore, the actual data length of a bitstring and its physical space allocation may differ. **$BIT** bitstring functions use the data length of bitstrings. In most circumstances, the physical space allocation should be invisible to the user. bitstring compression is invisible to users of the **$BIT** functions.

However, because this compressed binary representation is optimized for each bitstring, one cannot assume that two "identical" bitstrings (which were created differently) have identical internal representations. InterSystems IRIS selects from four separate bitstring internal representations to optimize for both sparse bitstrings and non-sparse bitstrings. Therefore, while matching operations on individual bits yield predictable results, comparisons of entire bitstrings may not.

$BIT bitstring functions support a maximum bitstring length of 262,104 bits (32763 x 8) for InterSystems IRIS. (Unlike with certain InterSystems legacy products, it is not an error in InterSystems IRIS to perform an operation on a bit that is beyond the bitstring length.) However, it is strongly recommended for performance reasons that you divide long bitstrings into chunks of less than 65,280 bits. This is the maximum number of bits that can fit in a single 8KB database block.

Bits in a bitstring are numbered with the first (leftmost) bit as position 1. All bitstring comparisons are performed left-to-right.

In the examples, bitstrings are shown within matching square brackets ([...]), with the bits delimited by commas. For example, a bitstring of four 1 bits is shown as [1,1,1,1], with the least significant bits to the right.

In all the bitstring functions, variables named *bitstring* are bitstrings that can be specified as values, variables, or expressions.

See Also

- $BITCOUNT function
- $BITFIND function
- $BITLOGIC function
- $FACTOR function

- $ZBOOLEAN function

$BITCOUNT

Returns the number of bits in a bitstring.

```
$BITCOUNT(bitstring,bitvalue)
```

Parameters

bitstring	An expression that evaluates to a bitstring. Can be a variable of any type, **$FACTOR**, a user-defined function, or an `oref.prop`, `..prop`, or `i%prop` (instance variable) property reference.
bitvalue	*Optional* — The value (0 or 1) to count within the bitstring.

Description

The **$BITCOUNT** function counts the number of bits within a bitstring. A bitstring is an encoded string which is interpreted by the system as a series of bits. You can create a bitstring using **$BIT** or **$BITLOGIC**.

$BITCOUNT(*bitstring*) returns the number of bits in *bitstring*.

$BITCOUNT(*bitstring*, *bitvalue*) returns the number of bits of type *bitvalue* (0 or 1) in *bitstring*.

The maximum bitstring length is 262,104 bits (32763 x 8).

Specifying a *bitstring* value that is not an InterSystems IRIS encoded bitstring generates an <INVALID BIT STRING> error. For further information, refer to General Information on Bitstring Functions.

Examples

If *bitstring*= [0,0,1,1,0], then the result of **$BITCOUNT(bitstring)** is 5:

```
SET $BIT(a,1) = 0
SET $BIT(a,2) = 0
SET $BIT(a,3) = 1
SET $BIT(a,4) = 1
SET $BIT(a,5) = 0
WRITE !,$BITCOUNT(a)
```

If *bitstring* = [0,0,1,1,0], then the result of **$BITCOUNT(bitstring,0)** would be 3.

```
SET $BIT(a,1) = 0
SET $BIT(a,2) = 0
SET $BIT(a,3) = 1
SET $BIT(a,4) = 1
SET $BIT(a,5) = 0
WRITE !,"number of zero bits:",$BITCOUNT(a,0)
WRITE !,"number of one bits: ",$BITCOUNT(a,1)
```

The following example returns the number of 1 bits in a random 16-bit bitstring generated by $FACTOR:

```
 SET x=$RANDOM(65536)
 FOR i=1:1:16 {WRITE $BIT($FACTOR(x),i) }
 WRITE !,"Number of 1 bits=",$BITCOUNT($FACTOR(x),1)
```

See Also

- $BIT function
- $BITFIND function
- $BITLOGIC function
- $FACTOR function

- $ZBOOLEAN function

$BITFIND

Returns the position of the specified bit value within a bitstring.

```
$BITFIND(bitstring,bitvalue,position,direction)
```

Parameters

bitstring	An expression that evaluates to a bitstring. Can be a variable of any type, **$FACTOR**, a user-defined function, or an `oref.prop`, `..prop`, or `i%prop` (instance variable) property reference.
bitvalue	The value (0 or 1) to search for within the bitstring.
position	*Optional* — The bit position from which the search begins, specified as a positive integer. Bit positions are counted from 1 from the beginning of the bit string. Search is inclusive of this position. A *position* value of 0 is treated as specifying position 1.
direction	*Optional* — A direction flag. Available values are 1 and -1. 1 = Search forward (left to right) from the beginning of the bitstring (or from *position*) towards the end (this is the default). -1 = Search backward from the end of the bitstring (or from *position*) towards the beginning.

Description

$BITFIND(*bitstring*,*bitvalue*) returns the position of the first occurrence of the specified *bitvalue* (0 or 1) within the bitstring *bitstring*. Bit positions are counted from 1.

$BITFIND(*bitstring*,*bitvalue*,*position*) returns the position of the first occurrence at or after *position* of the specified *bitvalue* in *bitstring*.

If the desired bit value is not found, or if *position* (searching forward) is greater than the number of bits within the bitstring, the return value is 0. If the specified *bitstring* is an undefined variable, the return value is 0. If the specified *bitstring* is not a valid bitstring, an <INVALID BIT STRING> error is issued.

There is also general information on bitstring functions available.

Examples

If *bitstring* = [0,0,1,1,0], then the result of **$BITFIND(bitstring,1)** would be 3:

```
// Set a to [0,0,1,1,0]
SET $BIT(a,1) = 0
SET $BIT(a,2) = 0
SET $BIT(a,3) = 1
SET $BIT(a,4) = 1
SET $BIT(a,5) = 0
// Find first 1 bit within a
WRITE !,$BITFIND(a,1)
```

If *bitstring* = [0,0,1,1,0], when searching from *position* 3, the first bit of value 1 is bit position 3 (because search is inclusive of the *position* bit) and the first bit of value 0 is bit position 5:

```
// Set a to [0,0,1,1,0]
SET $BIT(a,1) = 0
SET $BIT(a,2) = 0
SET $BIT(a,3) = 1
SET $BIT(a,4) = 1
SET $BIT(a,5) = 0
// Find first 1 bit from position 3
WRITE !,"found a 1 at bit position:",$BITFIND(a,1,3)
// Find first 0 bit from position 3
WRITE !,"found a 0 at bit position:",$BITFIND(a,0,3)
```

If *bitstring* = [0,0,1,1,0], when searching backwards from *position* 99, the first bit of value 1 is bit position 4 and the first bit of value 0 is bit position 5:

```
// Set a to [0,0,1,1,0]
SET $BIT(a,1) = 0
SET $BIT(a,2) = 0
SET $BIT(a,3) = 1
SET $BIT(a,4) = 1
SET $BIT(a,5) = 0
WRITE !,"found a 1 at bit position:",$BITFIND(a,1,99,-1)
WRITE !,"found a 0 at bit position:",$BITFIND(a,0,99,-1)
```

The following example returns a list of all of the 1 bit positions and a list of all of the 0 bit positions:

```
// Set a to [0,0,1,1,0]
SET $BIT(a,1) = 0
SET $BIT(a,2) = 0
SET $BIT(a,3) = 1
SET $BIT(a,4) = 1
SET $BIT(a,5) = 0
SET pos=0
WRITE !,"Bit positions with value 1: "
FOR  { SET pos=$BITFIND(a,1,pos+1) QUIT:'pos  WRITE pos,", " }
WRITE !,"Bit positions with value 0: "
FOR  { SET pos=$BITFIND(a,0,pos+1) QUIT:'pos  WRITE pos,", " }
```

The following example returns the position of the first 1 bit in a random 16-bit bitstring generated by $FACTOR:

```
SET x=$RANDOM(65536)
FOR i=1:1:16 {WRITE $BIT($FACTOR(x),i) }
WRITE !,"The first 1 bit is at position ",$BITFIND($FACTOR(x),1)
```

See Also

- $BIT function
- $BITCOUNT function
- $BITLOGIC function
- $FACTOR function
- $ZBOOLEAN function

$BITLOGIC

Performs bit-wise operations on bitstrings.

```
$BITLOGIC(bitstring_expression,length)
```

Parameters

bitstring_expression	A logical expression consisting of one or more bitstring variables and the logical operators &, |, ^, and ~. A bitstring can be specified as a local variable, a process-private global, a global, an object property, or the constant "". The null string ("") has a bitstring length of 0. A bitstring cannot be specified using a function (such as **$FACTOR**) that returns a bitstring.
length	*Optional* — The length, in bits, of the resulting bitstring. If *length* is not specified it defaults to the length of the longest bitstring in *bitstring_expression*.

Description

$BITLOGIC evaluates a bit-wise operation on one or more bitstring values, as specified by *bitstring_expression*, and returns the resulting bitstring.

A bitstring is an encoded (compressed) string which is interpreted as a series of bits. Only bitstrings created using **$BIT**, **$FACTOR**, or **$BITLOGIC**, or the null string (""), should be supplied to the **$BITLOGIC** function. Typically, bitstrings are used for index operations. Refer to general information on bitstring functions in **$BIT** for further details.

$BITLOGIC and **$ZBOOLEAN** use different data formats. The results of one cannot be used as input to the other.

Bitstring Optimization

The most basic **$BITLOGIC** operation is `$BITLOGIC(a)`. Seemingly, this operation does not do anything: bitstring *a* is input and the same bitstring *a* is output. However, **$BITLOGIC** performs bitstring compression which it optimizes by selecting from several compression algorithms. Therefore, if bitstring *a* has undergone substantial changes since its creation, passing it through **$BITLOGIC** can result in re-optimization of the bitstring. Refer to $BIT for further details.

For example, following a large number of delete operations an index bitstring may have become a sparse bitstring, consisting wholly or mainly of zeros. Passing this index bitstring through **$BITLOGIC** may result in substantial performance improvements.

Bitstring Logical Operators

$BITLOGIC can evaluate only the bitstring operators listed in the following table:

Operator	Meaning
&	AND
|	OR
^	XOR (exclusive OR)
~	NOT (one's complement)

The *bitstring_expression* can contain a single bitstring (~A), two bitstrings (A&B), or more than two bitstrings (A&B|C), up to the current maximum of 31 bitstrings. Evaluation is performed left-to-right. Logical operations may be grouped by parentheses within the *bitstring_expression*, following standard ObjectScript order of operations. If a variable used within **$BITLOGIC** is undefined, it is treated as a null string ("").

$BITLOGIC treats a null string as a bitstring of indefinite length, in which all bits are set to 0's.

Note: When **$BITLOGIC** is supplied more than two bitstring operands, it must create bitstring temporaries to hold the intermediate results. Under some extreme circumstances (many bitstrings and/or extremely large bitstrings), it can exhaust the space allocated to hold such temporaries. Bitstring pair operations do not have this limitation, and are thus preferable for large bitstring operations.

The NOT (~) operator can be used as a unary operator (for example, ~A), or can be used in combination with other operators (for example, A&~B). It performs the one's complement operation on a string, turning all 1's to 0's and all 0's to 1's. Multiple NOT operators can be used (for example, ~~~A).

The length Argument

If *length* is not specified, it defaults to the length of the longest bitstring in *bitstring_expression*.

If *length* is specified, it specifies the logical length of the resulting bitstring.

- If *length* is larger than one or more of the bitstrings in *bitstring_expression*, those bitstrings are zero-filled to that length before bitstring logic operations are performed.
- If *length* is smaller than one or more of the bitstrings in *bitstring_expression*, those bitstrings are truncated to that length before bitstring logic operations are performed.
- If *length* is 0, a bitstring of length 0 (a null string) is returned.

Examples

The following example creates some simple bitstrings and demonstrates the use of **$BITLOGIC** on them:

```
// Set a to [1,1]
SET $BIT(a,1) = 1
SET $BIT(a,2) = 1
// Set b to [0,1]
SET $BIT(b,1) = 0
SET $BIT(b,2) = 1
WRITE !,"bitstring a=",$BIT(a,1),$BIT(a,2)
WRITE !,"bitstring b=",$BIT(b,1),$BIT(b,2)
SET c = $BITLOGIC(~b)
WRITE !,"The one's complement of b=",$BIT(c,1),$BIT(c,2)
// Find the intersection (AND) of a and b
SET c = $BITLOGIC(a&b)   // c should be [0,1]
WRITE !,"The AND of a and b=",$BIT(c,1),$BIT(c,2)
SET c = $BITLOGIC(a&~b)   // c should be [1,0]
WRITE !,"The AND of a and ~b=",$BIT(c,1),$BIT(c,2)
// Find the union (OR) of a and b
SET c = $BITLOGIC(a|b)   // c should be [1,1]
WRITE !,"The OR of a and b=",$BIT(c,1),$BIT(c,2)
SET c = $BITLOGIC(a^b)   // c should be [1,0]
WRITE !,"The XOR of a and b=",$BIT(c,1),$BIT(c,2)
QUIT
```

The following example shows the results of specifying a *length* greater than the input bitstring. The string is zero-filled before the logic operation is performed.

```
// Set a to [1,1]
SET $BIT(a,1) = 1
SET $BIT(a,2) = 1
WRITE !,"bitstring a=",$BIT(a,1),$BIT(a,2)
SET c = $BITLOGIC(~a,7)
WRITE !,"~a (length 7)="
WRITE $BIT(c,1),$BIT(c,2),$BIT(c,3),$BIT(c,4)
WRITE $BIT(c,5),$BIT(c,6),$BIT(c,7),$BIT(c,8)
```

Here the one's complement (~) of `11` is `0011111`. Bits 3 through 7 were set to zero before the ~ operation was performed. This example also displays an eighth bit, which is beyond the specified string length and thus unaffected by the **$BITLOGIC** operation. It is, of course, displayed as 0.

The following example shows the results of specifying a *length* less than the input bitstring. The bitstring is truncated to the specified length before logical operations are performed. All bits beyond the specified length default to 0.

```
// Set a to [1,1,1]
SET $BIT(a,1) = 1
SET $BIT(a,2) = 1
SET $BIT(a,3) = 1
WRITE !,"bitstring a=",$BIT(a,1),$BIT(a,2),$BIT(a,3)
SET c = $BITLOGIC(a,2)
WRITE !," a (length 2)="
WRITE $BIT(c,1),$BIT(c,2),$BIT(c,3),$BIT(c,4)
SET c = $BITLOGIC(~a,2)
WRITE !,"~a (length 2)="
WRITE $BIT(c,1),$BIT(c,2),$BIT(c,3),$BIT(c,4)
```

The following example shows that when *length* is not specified, it defaults to the length of the longest bitstring. Shorter bitstrings are zero-filled before the logical operation is performed.

```
// Set a to [1,1,1]
SET $BIT(a,1) = 1
SET $BIT(a,2) = 1
SET $BIT(a,3) = 1
// Set b to [1,1]
SET $BIT(b,1) = 1
SET $BIT(b,2) = 1
SET c = $BITLOGIC(a&~b)
WRITE !,"  a&~b="
WRITE $BIT(c,1),$BIT(c,2),$BIT(c,3)
SET c = $BITLOGIC(a&~b,3)
WRITE !,"a&~b,3="
WRITE $BIT(c,1),$BIT(c,2),$BIT(c,3)
```

Here the two **$BITLOGIC** operations (with and without a *length* argument) both return the same value: `001`.

See Also

- $BIT function
- $BITCOUNT function
- $BITFIND function
- $ZBOOLEAN function
- Operators in *Using ObjectScript*

$CASE

Compares expressions and returns the value of the first matching case.

```
$CASE(target,case:value,case:value,...,:default)
```

Parameters

target	A literal or expression the value of which is to be matched against cases.
case	A literal or expression the value of which is to be matched with the results of the evaluation of *target*.
value	The value to be returned upon a successful match of the corresponding *case*.
default	*Optional* — The value to be returned if no *case* matches *target*.

Description

The **$CASE** function compares *target* to a list of cases (literals or expressions), and returns the value of the first matching *case*. An unlimited number of *case*:*value* pairs can be specified. Cases are matched in the order specified (left-to-right); matching stops when the first exact match is encountered.

If there is no matching *case*, *default* is returned. If there is no matching *case* and no *default* is specified, InterSystems IRIS issues an <ILLEGAL VALUE> error.

InterSystems IRIS permits specifying **$CASE** with no *case*:*value* pairs. It always returns the *default* value, regardless of the *target* value.

Parameters

target

$CASE evaluates this expression once, then matches the result to each *case* in left-to-right order.

case

A *case* can be a literal or an expression; matching of literals is substantially more efficient than matching expressions, because literals can be evaluated at compile time. Each *case* must be paired with a *value*. An unlimited number of *case* and *value* pairs may be specified.

value

A *value* can be a literal or an expression. Using **$CASE** as an argument of a **GOTO** command or a **DO** command restricts *value* as follows:

- When using a **$CASE** statement with a **GOTO** command, each *value* must be a valid line label. It cannot be an expression.
- When using a **$CASE** statement with a **DO** command, each *value* must be a valid **DO** argument. These **DO** arguments can include parameters. Like all **DO** command arguments, **$CASE** can take a postconditional parameter when called by **DO**.

default

The *default* is specified like a *case*:*value* pair, except that there is no *case* specified between the comma (used to separate pairs) and the colon (used to pair items). The *default* is optional. If specified, it is always the final parameter in a **$CASE** function. The *default* value follows the same **GOTO** and **DO** restrictions as the *value* parameter.

If there is no matching *case* and no *default* is specified, InterSystems IRIS issues an <ILLEGAL VALUE> error.

Examples

The following example takes a day-of-week number and returns the corresponding day name. Note that a default value “entry error” is provided:

```
  SET daynum=$ZDATE($HOROLOG,10)
  WRITE $CASE(daynum,
              1:"Monday",2:"Tuesday",3:"Wednesday",
              4:"Thursday",5:"Friday",
              6:"Saturday",0:"Sunday",:"entry error")
```

The following example takes as input the number of bases achieved by a baseball batter and writes out the appropriate baseball term:

```
  SET hit=$RANDOM(5)
  SET atbat=$CASE(hit,1:"single",2:"double",3:"triple",4:"home run",:"strike out")
  WRITE hit," = ",atbat
```

The following example uses **$CASE** as the DO command argument. It calls the routine appropriate for the *exp* exponent value:

```
Start  ; Raise an integer to a randomly-selected power.
  SET exp=$RANDOM(6)
  SET num=4
  DO $CASE(exp,0:NoMul(),2:Square(num),3:Cube(num),:Exponent(num,exp))
  WRITE !,num," ",result,!
  RETURN
Square(n)
  SET result=n*n
  SET result="Squared = "_result
  RETURN
Cube(n)
  SET result=n*n*n
  SET result="Cubed = "_result
  RETURN
Exponent(n,x)
  SET result=n
  FOR i=1:1:x-1 { SET result=result*n }
  SET result="exponent "_x_" = "_result
  RETURN
NoMul()
  SET result="multiply by zero"
  RETURN
```

The following example tests whether the character input is a letter or some other character:

```
  READ "Input a letter: ",x
  SET chartype=$CASE(x?1A,1:"letter",:"other")
  WRITE chartype
```

The following example uses **$CASE** to determine which subscripted variable to return:

```
   SET dabbrv="W"
   SET wday(1)="Sunday",wday(2)="Monday",wday(3)="Tuesday",
       wday(4)="Wednesday",wday(5)="Thursday",wday(6)="Friday",wday(7)="Saturday"
   WRITE wday($CASE(dabbrv,"Su":1,"M":2,"Tu":3,"W":4,"Th":5,"F":6,"Sa":7))
```

The following example specifies no *case*:*value* pairs. It return the *default* string “not defined”:

```
  SET dummy=3
  WRITE $CASE(dummy,:"not defined")
```

See Also

- DO command
- GOTO command
- IF command

- $SELECT function

$CHAR

Converts the integer value of an expression to the corresponding ASCII or Unicode character.

```
$CHAR(expression,...)
$C(expression,...)
```

Parameter

expression	The integer value to be converted.

Description

$CHAR returns the character that corresponds to the decimal (base-10) integer value specified by *expression*. This character can be an 8-bit (ASCII) character, or a 16-bit (Unicode) character. For 8-bit characters, the value in *expression* must evaluate to a positive integer in the range 0 to 255. For 16-bit characters, specify integers in the range 256 through 65535 (hex FFFF). Values larger than 65535 return an empty string. Values from 65536 (hex 10000) through 1114111 (hex 10FFFF) are used to represent Unicode surrogate pairs; these characters can be returned using **$WCHAR**.

You can specify *expression* as a comma-separated list, in which case **$CHAR** returns the corresponding character for each expression in the list.

The $ASCII function is the inverse of **$CHAR**.

Parameter

expression

The expression can be an integer value, the name of a variable that contains an integer value, or any valid ObjectScript expression that evaluates to an integer value. To return characters for multiple integer values, specify a comma-separated list of expressions.

You can use the $ZHEX function to specify character using a hexadecimal character code, rather than a decimal (base-10) character code. In the following example, both **$CHAR** statements return the Greek letter pi:

```
  WRITE $CHAR(960),!
  WRITE $CHAR($ZHEX("3C0"))
```

Examples

The following example uses **$CHAR** in a **FOR** loop to output the characters for all ASCII codes in the range 65 to 90. These are the uppercase alphabetic characters.

```
 FOR i=65:1:90 {
    WRITE !,$CHAR(i) }
```

The following example uses **$CHAR** in a **FOR** loop to output the Japanese Hiragana characters:

```
 FOR i=12353:1:12435 {
    WRITE !,$CHAR(i) }
```

The following two examples show the use of multiple expression values. The first returns “AB” and the second returns “AaBbCcDdEeFfGgHhIiJjKk”:

```
 WRITE $CHAR(65,66),!
 FOR i=65:1:75 {
    WRITE $CHAR(i,i+32) }
```

Notes

$CHAR with the WRITE Command

When you use **$CHAR** to write characters with the **WRITE** command, the output characters reset the positions of the special variables **$X** and **$Y**. This is true even for the NULL character (ASCII 0), which is not the same as a null string (""). As a rule, you should use **$CHAR** with caution when writing nonprinting characters, because such characters may produce unpredictable cursor positioning and screen behavior.

$CHAR and %List Structures

Because a %List structure (%Library.List) is an encoded string using non-printing characters, certain **$CHAR** values result in a %List structure containing a single element. The **$CHAR** combinations that return a %List structure are as follows:

- **$CHAR(1)** returns an empty list: `$lb()`.
- **$CHAR(1,1)** returns a two-element empty list: `$lb(,)`.
- **$CHAR(2,1)**, **$CHAR(2,2)**, or **$CHAR(2,12)** returns a list containing the empty string: `$lb("")`.
- **$CHAR(2,4)** returns `$lb(0)`.
- **$CHAR(2,5)** returns `$lb(-1)`.
- **$CHAR(2,8)** or **$CHAR(2,9)** returns `$lb($double(0))`.

$CHAR combinations that involve more than two characters and result in a single-element list have the following syntax:

```
$CHAR(count,flag,string)
```

count is the total number of characters. For example, `$CHAR(5,1,65,66,67)` or `$CHAR(5,1)_"ABC"`.

flag is an integer specifying how *string* should be represented. Valid *flag* values include 1, 2, 4, 5, 6, 7, 8, 9, 12, and 13. These *flag* interpretations have nothing to do with the usual ASCII interpretation of this non-print character.

- *flag*=1, *flag*=12, and *flag*=13 return the literal *string* value as the list element.
- *flag*=2 is only valid if *count* is an even number. It returns a list element containing one or more wide Unicode characters derived from *string*, often one or more Chinese characters.
- *flag*=4 returns the positive ASCII numeric code for the character(s) as the list element. *flag*=4 cannot be used when *count*>10.
- *flag*=5 returns a negative integer ASCII numeric code for the character(s) as the list element. *flag*=5 cannot be used when *count*>10.
- *flag*=6 returns a positive integer derived from *string* as the list element:
  - **$CHAR(3,6,n)** always returns `$lb(0)`.
  - **$CHAR(count,6,string)** when *count* > 3 returns a (usually) large positive integer derived from the ASCII numeric value. The number of trailing zeros corresponds to the ASCII value of the first character in *string*, the leading numeric value to the ASCII value of the second character in string. For example, `$CHAR(4,6,0,7)` returns `$lb(7)`; `$CHAR(4,6,3,7)` returns `$lb(7000)`.

  flag=6 cannot be used when *count*>11.
- *flag*=7 returns a negative integer derived from *string* as the list element:
  - **$CHAR(3,7,n)** returns a negative number with the number of zeros corresponding to the value of *n*: 0 = –1, 1 = –10, 2= –100, 3 = –1000, etc.

– **$CHAR(count,7,string)** when *count* > 3 returns a (usually) large negative integer. The number of trailing zeros corresponds to the ASCII value of the first character in *string*.

flag=7 cannot be used when *count*>11.

- *flag*=8 returns $DOUBLE(x) where x is a small number. *flag*=8 cannot be used when *count*>6.
- *flag*=9 returns $DOUBLE(x) where x is a large number. *flag*=9 cannot be used when *count*>10.

string is a numeric or string of *count* – 2 characters. For example, a *string* of three characters can be represented as either `$CHAR(5,flag,65,66,67)` or `$CHAR(5,flag)_"ABC"`. The *string* value becomes the list element, its value represented as specified by *flag*.

For further details, refer to $LISTBUILD and $LISTVALID.

Numeric Values in $CHAR Arguments

You can use signed numeric values for *expression*. InterSystems IRIS ignores negative numbers and only evaluates positive or unsigned numbers. In the following example, the **$CHAR** with signed integers returns only the first and third expression, ignoring the second expression, which is a negative integer.

```
WRITE !,$CHAR(65,66,67)
WRITE !,$CHAR(+65,-66,67)
```

ABC

AC

You can use floating point numeric values for *expression*. InterSystems IRIS ignores the fractional portion of the argument and only considers the integer portion. In the following example, **$CHAR** ignores the fractional portion of the number and produces the character represented by character code 65, an uppercase A.

```
WRITE $CHAR(65.5)
```

Unicode Support

$CHAR supports Unicode characters represented by decimal (base-10) integers.

The Unicode value for a character is usually expressed as a 4-digit number in hexadecimal notation, using the digits 0-9 and the letters A-F. However, standard functions in the ObjectScript language generally identify characters according to ASCII codes, which are decimal values, not hexadecimal.

Hence, the **$CHAR** function supports Unicode encoding by returning a character based on the decimal Unicode value that was input, not the more standard hexadecimal value. You can specify a hexadecimal Unicode value using the $ZHEX function using quotes, as follows `$CHAR($ZHEX("hexnum"))`. You can also use $ZHEX without quotes to convert a decimal number to hexadecimal, as follows: `hexnum = $ZHEX(decnum)`.

For further details refer to Unicode in *Using ObjectScript*.

Surrogate Pairs

$CHAR does not recognize surrogate pairs. Surrogate pairs are used to represent some Chinese characters and to support the Japanese JIS2004 standard. You can use the **$WISWIDE** function to determine if a string contains a surrogate pair. The **$WCHAR** function recognizes and correctly parses surrogate pairs. **$CHAR** and **$WCHAR** are otherwise identical. However, because **$CHAR** is generally faster than **$WCHAR**, **$CHAR** is preferable for all cases where a surrogate pair is not likely to be encountered.

Note: **$WCHAR** should not be confused with **$ZWCHAR**, which always parses characters in pairs.

Functions Related to $CHAR

The **$ASCII** function is the inverse of **$CHAR**. You can use it to convert a character to its equivalent numeric value. **$ASCII** converts all characters, including Unicode characters. In addition, all InterSystems IRIS platforms support the related functions, **$ZLCHAR** and **$ZWCHAR**. They are similar to **$CHAR**, but operate on a word (two bytes) or a long word (four bytes). You can use **$ZISWIDE** to determine if there are any multibyte (“wide”) characters in the expression of **$CHAR**.

See Also

- READ command
- WRITE command
- $ASCII function
- $WCHAR function
- $WISWIDE function
- $ZHEX function
- $ZLCHAR function
- $ZWCHAR function
- $X special variable
- $Y special variable

$CLASSMETHOD

Executes a named class method in the designated class.

```
$CLASSMETHOD(classname, methodname, arg1, arg2, arg3, ... )
```

Parameters

classname	*Optional* — An expression that evaluates to a string. The content of the string must match exactly the name of an existing, accessible, previously compiled class. In the case of references to InterSystems IRIS classes, the name may be either in its canonical form (%Library.String), or its abbreviated form (%String). If *classname* is omitted, the current class context is used. (You can use $THIS to determine the current class context.) Note that when *classname* is omitted the placeholder comma must be specified.
methodname	An expression which evaluates to a string. The value of the string must match the name of an existing class method in the class identified by *classname*.
arg1, *arg2*, *arg3*, ...	*Optional* — A series of expressions to be substituted sequentially for the arguments to the designated method. The values of the expressions can be of any type. It is the responsibility of the implementor to make sure that the type of the supplied expressions match what the method expects, and have values within the bounds declared. (If the specified method expects no arguments then no arguments beyond the *methodname* need be given in the function invocation. If the method requires arguments, the rules that govern what must be supplied are those of the target method.)

Description

$CLASSMETHOD permits an ObjectScript program to invoke an arbitrary class method in an arbitrary class. Both the class name and the method name may be computed at runtime or supplied as string constants. To invoke an instance method rather than a class method, use the **$METHOD** function.

If the method takes arguments, they are supplied by the list of arguments that follow the method name. A maximum of 255 argument values may be passed to the method.

The invocation of **$CLASSMETHOD** as a function or a procedure determines the invocation of the target method. You can invoke **$CLASSMETHOD** using the **JOB** command or the **DO** command, discarding the return value. Like all **DO** command arguments, **$CLASSMETHOD** can take a postconditional parameter when called by **DO**.

An attempt to invoke a nonexistent class results in a `<CLASS DOES NOT EXIST>` error, followed by the current namespace name and the specified class name. For example, attempting to invoke the nonexistent *classname* "Fred" results in the error `<CLASS DOES NOT EXIST> *User.Fred`. Specifying the empty string for *classname* results in `<CLASS DOES NOT EXIST> *(No name)`.

An attempt to invoke a nonexistent class method results in a `<METHOD DOES NOT EXIST>` error.

Examples

The following example shows **$CLASSMETHOD** used as a function:

```
SET classname = "%Dictionary.ClassDefinition"
SET classmethodname = "NormalizeClassname"
SET singleargument = "%String"
WRITE $CLASSMETHOD(classname,classmethodname,singleargument),!
```

It returns `%Library.String`.

The following example shows **$CLASSMETHOD** with two parameters:

```
WRITE $CLASSMETHOD("%Library.Persistent","%PackageName"),!
WRITE $CLASSMETHOD("%Library.Persistent","%ClassName")
```

These calls return `%Library` and `%Persistent`.

The following example uses **$CLASSMETHOD** to execute a Dynamic SQL query:

```
 SET q1="SELECT Age,Name FROM Sample.Person "
 SET q2="WHERE Age > ? AND Age < ? "
 SET q3="ORDER by Age"
 SET myquery=q1_q2_q3
 SET rset=$CLASSMETHOD("%SQL.Statement","%ExecDirect",,myquery,12,20)
 DO rset.%Display()
 WRITE !,"Teenagers in Sample.Person"
```

See Also

- $CLASSNAME function
- $METHOD function
- $PARAMETER function
- $PROPERTY function
- $THIS special variable

$CLASSNAME

Returns the name of a class.

```
$CLASSNAME(n)
```

Parameter

n	*Optional* — An object reference (OREF) to an class instance. If omitted, the class name of the current class is returned.

Description

$CLASSNAME returns the name of a class. Commonly, it takes an object reference (OREF) and returns the corresponding class name. **$CLASSNAME** with no argument returns the name of the current class. **$CLASSNAME** always returns the full class name (for example, `%SQL.Statement`), not the short version of the class name omitting the package name (for example, `Statement`).

$CLASSNAME is functionally equivalent to the **%ClassName(1)** method of the %Library.Base superclass. The **$CLASSNAME** function gives better performance than the **%ClassName(1)** method for returning the full class name. To return the short version of the class name, you can use either **%ClassName()** or **%ClassName(0)**.

For information on OREFs, see "OREF Basics" in *Defining and Using Classes*.

Examples

The following example creates an instance of a class. **$CLASSNAME** takes the instance OREF and returns the corresponding class name:

```
   SET dynoref = ##class(%SQL.Statement).%New()
   WRITE "instance class name: ",$CLASSNAME(dynoref)
```

In the following example, **$CLASSNAME** with no parameter returns the class name of the current class context. In this case, it is the DocBook.Utils class. This is the same class name contained in the **$THIS** special variable:

```
   WRITE "class context: ",$CLASSNAME(),!
   WRITE "class context: ",$THIS
```

The following example shows that the **$CLASSNAME** function and the **%ClassName(1)** method return the same values. It also shows use of the **%ClassName()** method (with no argument or with a 0 argument) to return the short version of the class name:

```
CurrentClass
   WRITE "current full class name: ",$CLASSNAME(),!
   WRITE "current full class name: ",..%ClassName(1),!
   WRITE "current short class name: ",..%ClassName(0),!
   WRITE "current short class name: ",..%ClassName(),!!
ClassInstance
   SET x = ##class(%SQL.Statement).%New()
   WRITE "oref full class name: ",$CLASSNAME(x),!
   WRITE "oref full class name: ",x.%ClassName(1),!
   WRITE "oref short class name: ",x.%ClassName(0),!
   WRITE "oref short class name: ",x.%ClassName()
```

See Also

- $CLASSMETHOD function
- $METHOD function
- $PARAMETER function

- $PROPERTY function
- $THIS special variable

$COMPILE

Compiles source code, producing executable object code.

```
$COMPILE(source,language,errors,object)

$COMPILE(source,language,errors,object,,,rname)
```

Parameters

source	A local or global variable that specifies a subscripted array containing the source code to be compiled.
language	An integer flag specifying the programming language of the source code. 0 = ObjectScript.
errors	An unsubscripted local variable that receives any errors that occur during compilation. This variable is a List structure, with one element for each error reported. Each error is itself a List structure, specifying error location and type (see below).
object	*1st Syntax* — An unsubscripted local or global variable that is used to generate an array used to hold the compiled object code. *2nd Syntax* — This parameter is optional. If specified, *object* is cleared of its prior value, but not set. Commonly, 2nd syntax omits *object* and specifies a placeholder comma.
rname	*2nd Syntax* — A string specifying a routine name used to store the compiled object code in the ^rOBJ global.

Description

$COMPILE compiles source code and produces OBJ (object) code (the executable form of the routine). **$COMPILE** reports compilation errors, and can be used to check source code for compilation errors without actually producing object code. **$COMPILE** takes as input INT code, not MAC code. Therefore, before compiling, any macros in the source code must be resolved by a preprocessor such as the ObjectScript macro preprocessor.

Note: InterSystems IRIS provides several powerful tools for compiling source code, Studio being one of them. Commonly, source code compilation is performed using these tools, rather than this **$COMPILE** function.

$COMPILE has two syntactic forms:

- The first **$COMPILE** syntax form returns the object code in the *object* array. It first kills the *object* variable. After the compilation the *object* array is set to the size of the compiled object code.

  The *object* array contains the object code in the same format as it would be in the ^rOBJ global. The object code in ^rOBJ can be replaced with the new object code by the command `MERGE ^rOBJ(rname)=object(1)`. However, the MERGE command is not atomic when setting multiple nodes, so this operation could cause unpredictable results if another process is concurrently loading the same routine.

  If you omit the *object* parameter, the source code is compiled and checked for errors, but no object code is created.

- The second **$COMPILE** syntax form returns the object code directly into a routine named *rname* This OBJ code can be viewed by returning **^rOBJ(rname)**. The **$COMPILE** operation internally locks ^rOBJ(rname), preventing any other process from loading the routine object code until the new object code is completely stored.

  If you omit the *rname* parameter, the source code is compiled and checked for errors, but no object code is created.

Commonly, the *object* parameter (4th parameter) is omitted with this syntactic form. If you specify the *object* parameter, the *object* variable is killed, but is not set. The other omitted parameters (represented by placeholder commas) are for internal use and should not be specified.

$COMPILE returns an integer code as follows: 0 = no errors were detected and object code was created. 1 = errors were detected and object code was created. -1 = errors were detected and no object code was created. The same return codes are returned when the parameter that holds the object code (1st syntax: *object*; 2nd syntax *rname*) was omitted.

When the ObjectScript compiler detects an error, it creates object code at that point which throws an error when that line is executed.

To compile a class, use the **Compile()** method of the %SYSTEM.OBJ class.

Parameters

source

An array containing the source code to be compiled (in the format of an INT routine). The array element source(0) must contain the number of lines of source code, and each source(n) contains line number *n* of the source code. The source lines must be numbered consecutively from 1 through *n* with no omitted lines. Executable ObjectScript code must be indented. For example:

```
SET mysrc(0)=6
SET mysrc(1)="  SET x=1"
SET mysrc(2)="Main"  // a label
SET mysrc(3)="  WRITE ""x is:"",x,!"
SET mysrc(4)="  SET x=x+1"
SET mysrc(5)="  IF x=4 {WRITE ""x is:"",x,"" all done""   QUIT}"
SET mysrc(6)="  GOTO Main"
SET rtn=$COMPILE(mysrc,0,errs,,,,"myobj")
  IF rtn=0 {WRITE "OBJ code successfully generated",!}
  ELSE {WRITE "no OBJ code generated return code: ",rtn,!  QUIT}
WRITE "Running the code",!!
DO ^myobj
```

The *source* parameter can be an unsubscripted local variable name, or a possibly subscripted global name.

If source(0) is undefined, the system generates an <UNDEFINED> error, regardless of the **%SYSTEM.Process.Undefined()** method setting.

If a source(0) value is larger than the number of lines of source code, or a consecutive source code line is missing, the system generates an <UNDEFINED> error, followed by the name of the missing source code line. This behavior can be changed by setting the **%SYSTEM.Process.Undefined()** method. These types of errors are shown in the following examples:

```
SET src(0)=4,src(1)="TestA ",src(2)=" WRITE 123",src(3)=" WRITE 456,!"
SET stat=$COMPILE(src,0,errs,TestA)    /* generates <UNDEFINED> *src(4) */

SET src(0)=4,src(1)="TestA ",src(3)=" WRITE 123",src(4)=" WRITE 456,!"
SET stat=$COMPILE(src,0,errs,TestA)    /* generates <UNDEFINED> *src(2) */

SET src(0)=3,src(1)="TestA ",src(3)=" WRITE 123",src(4)=" WRITE 456,!"
SET stat=$COMPILE(src,0,errs,TestA)    /* generates <UNDEFINED> *src(2) */
```

language

The language mode specifying the type of source to be compiled. Use 0 for ObjectScript.

Other values specify legacy modes and should be used only after consultation with InterSystems support.

errors

An unsubscripted local variable that is set to any errors detected by the compiler. Any existing value is killed. If no errors are detected, the variable is set to the empty string (""). If errors are detected, the *errors* variable is set to a $LIST structure with one element for each error. Each error is itself a **$LIST** structure with the format $LISTBUILD(line,offset,errnum,text) where:

- *line* = the line number where the error was detected
- *offset* = the offset in the source line of the error
- *errnum* = an error number for the type of error
- *text* = text describing the error

object

An array that receives the object code output of the compiler. The *object* parameter can be an unsubscripted local variable name, or a possibly subscripted global name. The contents of the *object* array are described above.

rname

The routine name that specifies where the object code should saved in the ^rOBJ subscripted global. **$COMPILE** kills any existing contents of ^rOBJ(rname) before saving the new object code. In the following examples, *rname*=”myobj”:

To view the OBJ code:

```
WRITE ^rOBJ("myobj")
```

or

```
ZWRITE ^rOBJ("myobj")
```

To execute the OBJ code:

```
DO ^myobj
```

To list the creation timestamp and length of the OBJ code:

```
ZWRITE ^rINDEX("myobj")
```

Note that ^rINDEX() only list an OBJ code line, because code created by **$COMPILE** has no corresponding stored MAC or INT code version.

Interrupting a Compile

You can issue a **Ctrl-C** or invoke the ^RESJOB utility to interrupt a compile in progress. These compile interrupts are supported for all *language* modes.

Compiler Version

You can use the **%SYSTEM.Version.GetCompilerVersion()** method to return the current compiler version. InterSystems IRIS can only execute object code compiled with the same major compiler version number. It can execute object code compiled with any minor compiler version number that is less than or equal to the current minor compiler version.

Examples

The following example compiles a four-line ObjectScript program using the first **$COMPILE** format:

```
SourceCode
  SET src(0)=4
  SET src(1)="TestA "
  SET src(2)=" WRITE ""Hello "" "
  SET src(3)=" WRITE ""World"",!"
  SET src(4)=" QUIT"
CompileSource
  SET stat=$COMPILE(src,0,errs,TestA)
  IF stat=0 {WRITE "Compile successful" }
  ELSE {WRITE "status=",stat,!
        WRITE "number of compile errors=",$LISTLENGTH(errs) }
```

The following example compiles the same four-line ObjectScript program using the second **$COMPILE** format:

```
SourceCode
  SET src(0)=4
  SET src(1)="TestB "
  SET src(2)=" WRITE ""Hello "" "
  SET src(3)=" WRITE ""World"",!"
  SET src(4)=" QUIT"
CompileSource
  SET stat=$COMPILE(src,0,errs,,,,"TestB")
  IF stat=0 {WRITE "Compile successful",!
             DO ^TestB }
  ELSE {WRITE "status=",stat,!
        WRITE "number of compile errors=",$LISTLENGTH(errs) }
```

The following example performs compilation error checking on a seven-line ObjectScript program. Note that this **$COMPILE** only tests for errors; it does not provide a variable to receive the object code from a successful compile. In this example every line of source code contains an error; **$COMPILE** only returns the compile-time errors in lines 1, 3, 5, 6, and 7, not runtime errors such as a divide-by-zero error (line 2) or an undefined variable error (line 4):

```
SourceCode
  SET src(0)=7
  SET src(1)="?TestC "
  SET src(2)=" SET a=2/0"
  SET src(3)=" SET b=3+#2"
  SET src(4)=" SET c=xxx"
  SET src(5)=" SET? d=5"
  SET src(6)=" SET 123=""abc"""
  SET src(7)=" SETT f=7"
CompileSource
  SET stat=$COMPILE(src,0,errs)
  IF stat {WRITE $LISTLENGTH(errs)," Compile Errors ",!
    FOR i=1:1:$LISTLENGTH(errs) {
      WRITE !,i,": "
      SET errn=$LIST(errs,i)
      FOR j=1:1:$LISTLENGTH(errn) {
        WRITE $LIST(errn,j)," "
        }
    }
  }
  ELSE {WRITE "Compile successful",!
        WRITE "but no object code generated" }
```

See Also

- XECUTE command
- ZLOAD command
- ZSAVE command
- “ObjectScript Macros and the Macro Preprocessor” in *Using ObjectScript*
- Using Studio

$DATA

Checks if a variable contains data.

```
$DATA(variable,target)
$D(variable,target)
```

Parameters

variable	The variable whose status is to be checked. A local or global variable, subscripted or unsubscripted. The variable may be undefined. You cannot specify a simple object property reference as *variable*; you can specify a multidimensional property reference as *variable* with the syntax obj.property.
target	*Optional* — A variable into which **$DATA** returns the current value of *variable*.

Description

You can use **$DATA** to test whether a variable contains data before attempting an operation on it. **$DATA** returns status information about the specified variable. The *variable* parameter can be the name of any variable (local variable, process-private global, or global), and can include a subscripted array element. It can be a multidimensional object property; it cannot be a non-multidimensional object property.

The possible status values that may be returned are as follows:

Status Value	Meaning
0	The variable is undefined. Any reference would cause an <UNDEFINED> error.
1	The variable exists and contains data, but has no descendants. Note that the null string ("") qualifies as data.
10	The variable identifies an array element that has descendants (contains a downward pointer to another array element) but does not contain data. Any direct reference to such a variable will result in an <UNDEFINED> error. For example, if y(1) is defined, but y is not, $DATA(y) returns 10, set x=y will produce an <UNDEFINED> error.
11	The variable identifies an array element that has descendants (contains a downward pointer to another array element) and contains data. Variables of this type can be referenced in expressions.

You can use modulo 2 (#2) arithmetic to return a boolean value from **$DATA**: `$DATA(var)#2` returns 0 for the undefined status codes (0 and 10), and returns 1 for the defined status codes (1 and 11).

Status values 1 and 11 indicate only the presence of data, not the type of data.

You can use the **Undefined()** method of the %SYSTEM.Process class to set behavior when encountering an undefined variable. For more information on <UNDEFINED> errors, refer to the $ZERROR special variable.

$DATA Tests Locks, Routines, Jobs, and Globals

- **$DATA(^$LOCK(lockname))** tests for the existence of a lock. Note that the return values are different: 0 = lock does not exist; 10 = lock exists. Lock descendants cannot be determined. Values 1 and 11 are never returned. Refer to ^$LOCK for further details.

- **$DATA(^$ROUTINE(routinename))** tests for the existence of the OBJ code version of a routine. Note that the return values are different: 0 = routine OBJ code does not exist; 1 = routine OBJ code exists. Values 10 and 11 are never returned. Refer to ^$ROUTINE for further details.
- **$DATA(^$JOB(jobnum))** tests for the existence of a job. Note that the return values are different: 0 = job does not exist; 1 = job exists. Values 10 and 11 are never returned. Refer to ^$JOB for further details.
- **$DATA(^$GLOBAL(globalname))** tests for the existence of a global. The return codes are the same as for variables: 0, 1, 10, and 11. Refer to ^$GLOBAL for further details.

Parameters

variable

The variable that is being tested for the presence of data:

- *variable* can be a local variable, a global variable, or a process-private global (PPG) variable. It can be subscripted or unsubscripted.

  If a global variable, it can contain an extended global reference. If a subscripted global variable, it can be specified using a naked global reference. Even when referencing an undefined subscripted global variable, *variable* resets the naked indicator, affecting future naked global references, as described below.

- *variable* can be a multidimensional object property. It cannot be a non-multidimensional object property. Attempting to use **$DATA** on a non-multidimensional object property results in an <OBJECT DISPATCH> error.

  For example, the %SQL.StatementMetadata class has a multidimensional property columnIndex, and a non-multidimensional property columnCount. In the following example, the first **$DATA** returns a value; the second **$DATA** results in an <OBJECT DISPATCH> error:

  ```
  SET x=##class(%SQL.StatementMetadata).%New()
  WRITE "columnIndex defined: ",$DATA(x.columnIndex),!
  WRITE "columnCount defined: ",$DATA(x.columnCount)
  ```

- If *variable* is the ^$ROUTINE structured system variable, the possible returned status values are 1 or 0.

target

An optional parameter. Specify the name of a local variable, a process-private global, or a global. This *target* variable does not need to be defined. If *target* is specified, **$DATA** writes the current data value of *variable* into *target*. If *variable* is undefined, the *target* value remains unchanged.

The **ZBREAK** command cannot specify the *target* parameter as a watchpoint.

Examples

This example writes a selected range of records from the ^client array, a sparse array consisting of three levels. The first level contains the client's name, the second the client's address, and the third the client's accounts, account numbers, and balances. A client can have up to four separate accounts. Because ^client is a sparse array there may be undefined elements at any of the three levels. The contents for a typical record might appear as follows:

```
^client(5) John Jones
^client(5,1) 23 Bay Rd./Boston/MA 02049
^client(5,1,1) Checking/45673/1248.00
^client(5,1,2) Savings/27564/3270.00
^client(5,1,3) Reserve Credit/32456/125.00
^client(5,1,4) Loan/81263/460.00
```

The code below provides a separate subroutine to handle the output for each of the three array levels. It uses the **$DATA** function at the start of each subroutine to test the current array element.

The **$DATA**=0 test in Level1, Level2, and Level3 tests whether the current array element is undefined. If TRUE, it causes the code to **QUIT** and revert to the previous level.

The **$DATA**=10 test in Level1 and Level2 tests whether the current array element contains a pointer to a subordinate element, but no data. If TRUE, it causes the code to write out a "No Data" message. The code then skips to the **FOR** loop processing for the next lower level. There is no **$DATA**=10 test in Level3 because there are no elements subordinate to this level.

The **WRITE** commands in Level2 and Level3 use the $PIECE function to extract the appropriate information from the current array element.

```
Start  Read !,"Output how many records: ",n
  Read !,"Start with record number: ",s
  For i=s:1:s+(n1) {
    If $Data(^client(i)) {
      If $Data(^client(i))=10 {
        Write !," Name: No Data"
      }
      Else {
        Write !," Name: " ,^client(i)
      }
      If $Data(^client(i,1)) {
        If $Data(^client(i,1))=10 {
                            Write !,"Address: No Data"
        }
        Else {
            Write !,"Address: ",$Piece(^client(i,1),"/",1)
            Write " , ",$Piece(^client(i,1),"/",2)
          Write " , ",$Piece(^client(i,1),"/",3)
        }
      }
      For j=1:1:4 {
        If $Data(^client(i,1,j)) {
             Write !,"Account: ",$Piece(^client(i,1,j),"/",1)
          Write " #: ",$Piece(^client(i,1,j),"/",2)
          Write " Balance: ",$Piece(^client(i,1,j),"/",3)
        }
      }
    }
  }
  Write !,"Finished."
  Quit
```

When executed, this code might produce output similar to the following:

```
Output how many records: 3
Start with record number: 10
Name: Jane Smith
Address: 74 Hilltop Dr., Beverly, MA 01965
Account: Checking #: 34218 Balance: 876.72
Account: Reserve Credit #: 47821 Balance: 1200.00
Name: Thomas Brown
Address: 46 Huron Ave., Medford, MA 02019
Account: Checking #: 59363 Balance: 205.45
Account: Savings #: 41792 Balance: 1560.80
Account: Reserve Credit #: 64218 Balance: 125.52
Name: Sarah Copley
Address: No Data
Account: Checking #: 30021 Balance: 762.28
```

Notes

Naked Global References

$DATA sets the naked indicator when used with a global variable. The naked indicator is set even if the specified global variable is not defined (Status Value = 0).

Subsequent references to the same global variable can use a naked global reference, as shown in the following example:

```
   IF $DATA(^A(1,2,3))#2 {
     SET x=^(3)  }
```

For further details on using **$DATA** with global variables and naked global references, see Using Multidimensional Storage (Globals) in *Using Globals*.

Global References in a Networked Environment

Using **$DATA** to repeatedly reference a global variable that is not defined (for example, **`$DATA(^x(1))`** where ^*x* is not defined) always requires a network operation to test if the global is defined on the ECP data server.

Using **$DATA** to repeatedly reference undefined nodes within a defined global variable (for example, **`$DATA(^x(1))`** where any other node in ^*x* is defined) does not require a network operation once the relevant portion of the global (^*x*) is in the client cache.

For further details, refer to Developing Distributed Cache Applications in the *Scalability Guide*.

Functions Related to $DATA

For related information, see **$GET** and **$ORDER**. Since **$ORDER** selects the next element in an array that contains data, it avoids the need to perform **$DATA** tests when looping through array subscripts.

See Also

- KILL command
- SET command
- $GET function
- $ORDER function
- Using Multidimensional Storage (Globals) in *Using Globals*

$DECIMAL

Returns a number converted to an InterSystems IRIS floating point value.

```
$DECIMAL(num,digits)
```

Parameters

num	The numeric value to be converted. Commonly this is an IEEE floating point number.
digits	*Optional* — An integer that specifies the number of significant digits to return. **$DECIMAL** rounds the return value to that number of digits, using the IEEE floating point rounding algorithm. Valid values are 1 through 38, and 0. If *digits* is greater than the number of digits the value is returned unchanged. If *digits* is 0, no rounding is performed on *num* unless it has more than 20 significant digits (see below for details on 0 value).

Description

$DECIMAL returns a floating-point number converted to the InterSystems IRIS decimal floating-point data type. This function is used to convert a fractional number in IEEE double-precision (64-bit) binary floating-point format to the corresponding fractional number in InterSystems IRIS decimal floating-point format. This is the inverse of the operation performed by the $DOUBLE function.

The InterSystems IRIS SQL data types DOUBLE and DOUBLE PRECISION represent IEEE floating point numbers; the NUMERIC data type represents standard InterSystems IRIS fractional numbers.

IEEE floating point numbers are represented internally using 53 binary bits. Because most fractional decimal numbers have no exact binary representation, a fractional number in **$DOUBLE** format will usually differ slightly from its **$DECIMAL** conversion. Standard InterSystems IRIS fractional numbers have an approximate precision of 18.96 decimal digits on all supported InterSystems IRIS system platforms. When an IEEE floating point number is displayed as a fractional number the binary bits are often converted to a fractional number with far more than 18 decimal digits. This *does not* mean that IEEE floating point numbers are more precise than standard InterSystems IRIS fractional numbers.

The *num* value can be specified as a number or a numeric string. It is resolved to canonical form (leading and trailing zeros removed, multiple plus and minus signs resolved, etc.) before **$DECIMAL** conversion. If the *num* value is outside of the range of values that can be converted to NUMERIC data type, **$DECIMAL** generates a <MAXNUMBER> error. Specifying a nonnumeric string to *num* returns 0. Specifying a mixed-numeric string (for example "7dwarves" or "7.5.4") to *num* truncates the input value at the first nonnumeric character then converts the numeric portion.

Default rounding is done as follows:

- Fractional Numbers: If *digits* is not specified and *num* has more than 19 significant digits, **$DECIMAL** rounds the fractional portion so that the resulting number is 19 digits (or fewer, if the rounding results in trailing zeros). **$DECIMAL** always rounds to the nearest fractional value with the greater absolute value.
- Very Large Integer Numbers: If *digits* is not specified and *num* has more than 19 significant integer digits to the left of the decimal point, **$DECIMAL** rounds so that the resulting integer has 19 significant digits, with the remaining integer digits represented by zeros.
- Very Small Fractional Numbers less than 1: If *digits* is not specified and *num* is a fractional number with more than 19 zeroes to the right of the decimal point before the significant value, **$DECIMAL** preserves the zeros and then rounds so that the significant portion of the fraction is rounded to 19 significant digits.

- Integers with Very Small Fractional Numbers: If *digits* is not specified and *num* is a number contains a non-zero integer portion with more than 19 zeroes to the right of the decimal point before a significant value, **$DECIMAL** rounds to the integer.

The *digits* argument can be used to round the return value to a specified number of digits. Trailing zeros are always deleted. If *digits* is a positive integer, rounding is done using the IEEE rounding standard. If *num* has more than 38 significant digits (and *digits*=38) **$DECIMAL** rounds the fractional portion of the number at the 38th digit and represents all of the following *num* digits with zeros. If *digits* is greater than 38, an <ILLEGAL VALUE> error is generated.

If *digits* is 0, the number is cast to string collation; this is equivalent to `(+num)_""`. If *num* is 20 digits or less, *digits*=0 is the same as *digits*=20.

However, if *digits* is 0 and *num* is more than 20 digits, special rounding (*not* IEEE rounding) is performed, as follows. Rounding is performed to return 20 digits. Special rounding is then performed on the 20th digit if it rounds to a 0 or a 5. In the case when the 20th digit would round up to a 0 or a 5, InterSystems IRIS rounds it down to a 9 or a 4, respectively. In the case when the 20th digit would round down to a 0 or a 5, InterSystems IRIS rounds it up to a 1 or a 6, respectively. Other 20th digit values are returned unchanged. This rounding algorithm is used to provide correct numeric collation and avoid rounding inconsistencies.

Integer Divide

With certain values, InterSystems IRIS decimal floating-point and IEEE double numbers yield a different integer divide product. For example:

```
WRITE !,"Integer divide operations:"
WRITE !,"IRIS  \: ",$DECIMAL(4.1)\.01  // 410
WRITE !,"Double \: ",$DOUBLE(4.1)\.01   // 409
```

For further details on arithmetic operations involving IEEE double numbers, see the appendix "Numeric Computing in InterSystems Applications" in the *Orientation Guide for Server-Side Programming*.

INF and NAN

If *num* is INF, a <MAXNUMBER> error is generated. If *num* is NAN, an <ILLEGAL VALUE> error is generated. These invalid values are shown in the following example:

```
SET i=$DOUBLE("INF")
SET n=$DOUBLE("NAN")
WRITE $DECIMAL(i),!
WRITE $DECIMAL(n)
```

Examples

The following example demonstrates that **$DECIMAL** has no effect when applied to a fractional number that is already in InterSystems IRIS format:

```
SET x=$DECIMAL($ZPI)
SET y=$ZPI
  IF x=y { WRITE !,"Identical:"
           WRITE !,"IRIS $DECIMAL: ",x
           WRITE !,"Native IRIS:   ",y }
 ELSE { WRITE !,"Different:"
        WRITE !,"IRIS $DECIMAL: ",x
        WRITE !,"Native IRIS:   ",y }
```

The following example returns the value of pi as a $DOUBLE value and as a standard InterSystems IRIS numeric value. This example shows that equality operations should not be attempted between **$DOUBLE** and standard InterSystems IRIS numbers, and that equivalence cannot be restored by using **$DECIMAL** to convert IEEE back to InterSystems IRIS:

```
SET x=$DECIMAL($ZPI)
SET y=$DOUBLE($ZPI)
SET z=$DECIMAL(y)
IF x=y { WRITE !,"IRIS & IEEE Same" }
ELSEIF x=z { WRITE !,"IRIS & IEEE-to-IRIS same" }
ELSE { WRITE !,"All three different"
       WRITE !,"IRIS decimal: ",x
       WRITE !,"IEEE float:    ",y
       WRITE !,"IEEE to IRIS: ",z }
```

The following example returns the **$DECIMAL** conversion of pi as a $DOUBLE value. These conversions are rounded by different *digits* argument values:

```
SET x=$DOUBLE($ZPI)
WRITE !,$DECIMAL(x)
 /* returns 3.141592653589793116 (19 digits) */
WRITE !,$DECIMAL(x,1)
 /* returns 3 */
WRITE !,$DECIMAL(x,8)
 /* returns 3.1415927 (note rounding) */
WRITE !,$DECIMAL(x,12)
 /* returns 3.14159265359 (note rounding) */
WRITE !,$DECIMAL(x,18)
 /* returns 3.14159265358979312 */
WRITE !,$DECIMAL(x,19)
 /* returns 3.141592653589793116 (19 digits) */
WRITE !,$DECIMAL(x,20)
 /* returns 3.141592653589793116 (19 digits) */
WRITE !,$DECIMAL(x,21)
 /* returns 3.141592653589793116 (19 digits) */
WRITE !,$DECIMAL(x,0)
 /* returns 3.1415926535897931159 (20 digits) */
```

See Also

- ZZDUMP command
- $DOUBLE function
- $FNUMBER function
- $NUMBER function
- Data Types in *InterSystems SQL Reference*
- Operators in *Using ObjectScript*
- Numeric Computing in InterSystems Applications in *Orientation Guide for Server-Side Programming*

$DOUBLE

Returns a number converted to a 64-bit floating-point value.

```
$DOUBLE(num)
```

Parameter

num	The numeric value to be converted. You can also specify the strings “NAN” and “INF” (and their variants).

Description

$DOUBLE returns a number converted to the IEEE double-precision (64-bit) binary floating-point data type. This type of floating-point number can contain up to 20 digits. If *num* has more than 20 digits, **$DOUBLE** rounds the fractional portion to the appropriate number of digits. If the integer portion of *num* is more than 20 digits, **$DOUBLE** rounds the integer to 20 significant digits and represents the additional digits with zeros.

$DOUBLE converts an InterSystems IRIS floating-point number to an IEEE double-precision floating-point number. **$DECIMAL** performs the inverse operation, converting an IEEE double-precision floating-point number to a standard InterSystems IRIS floating-point number (NUMERIC data type).

$DOUBLE generates floating-point numeric values that accord with the IEEE double-precision (64-bit) binary floating point standard. It is primarily intended for interchange and compatibility with applications that use this data type standard. IEEE floating-point numbers are represented using binary notation. They have a precision of 53 binary bits, which corresponds to 15.95 decimal digits. (Note that the binary representation does not correspond exactly to a decimal fraction.)

IEEE floating-point numbers have greater min/max value range than standard InterSystems IRIS floating-point numbers. However, standard InterSystems IRIS floating-point numbers have a greater degree of precision. In most cases, standard InterSystems IRIS floating-point numbers are preferable.

Note: An InterSystems IRIS numeric string literal that exceeds the min/max range supported by InterSystems IRIS floating-point data types (for example, “1E128”) is automatically converted to an IEEE double-precision floating-point number. This conversion is only performed on numeric literals; it is *not* performed on the results of mathematical operations. This automatic conversion can be controlled on a per-process basis using the **TruncateOverflow()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *TruncateOverflow* property of the Config.Miscellaneous class.

The *num* value can be specified as a number or a numeric string. It is resolved to canonical form (leading and trailing zeros removed, multiple plus and minus signs resolved, etc.) before **$DOUBLE** conversion. Specifying a nonnumeric string to *num* returns 0. Specifying a mixed-numeric string (for example "7dwarves" or "7.5.4") to *num* truncates the input value at the first nonnumeric character then converts the numeric portion. A **$DOUBLE** numeric value supplied to a JSON array or JSON object follows different validation and conversion rules.

The InterSystems SQL data types DOUBLE and DOUBLE PRECISION represent IEEE floating-point numbers; the NUMERIC data type represents standard InterSystems IRIS floating-point numbers.

Equality Comparisons and Mixed Arithmetic

Because numbers generated by **$DOUBLE** are converted to a binary representation that does not correspond exactly to decimal digits, equality comparisons between **$DOUBLE** values and standard InterSystems IRIS floating-point number values may yield unexpected results and should generally be avoided. Comparisons between **$DOUBLE** values and standard InterSystems IRIS floating-point number values are performed exactly, without rounding.

Mixed arithmetic operations involving a **$DOUBLE** value and one or more standard InterSystems IRIS numbers return a **$DOUBLE** value. In mixed arithmetic, InterSystems IRIS automatically converts all of the numbers to **$DOUBLE** values before performing the arithmetic operation. InterSystems IRIS handles conversions to/from **$DOUBLE** numeric representations and comparisons between numeric representations; these operations are, therefore, the same on all platforms. However, arithmetic operations involving **$DOUBLE** values are governed by the underlying operating system, and thus may occasionally differ between platforms. For further details on arithmetic operations involving IEEE double numbers, see the appendix "Numeric Computing in InterSystems Applications" in the *Orientation Guide for Server-Side Programming*.

Integer Divide

With certain values, InterSystems IRIS decimal floating-point and IEEE double numbers yield a different integer divide product. For example:

```
WRITE !,"Divide operations:"
WRITE !,"IRIS   /: ",4.1/.01           // 410
WRITE !,"Double /: ",$DOUBLE(4.1)/.01  // 410
WRITE !,"Integer divide operations:"
WRITE !,"IRIS   \: ",4.1\.01           // 410
WRITE !,"Double \: ",$DOUBLE(4.1)\.01  // 409
```

Platform Independence

Standard InterSystems IRIS decimal floating-point numbers (**$DECIMAL** numbers) have an approximate precision of 18.96 decimal digits. This precision is consistent across all system platforms that InterSystems IRIS supports.

IEEE double-precision floating-point numbers (**$DOUBLE** numbers) have a standard internal representation that is platform-independent. Conversions and comparisons between **$DOUBLE** and **$DECIMAL** numbers are consistent across all system platforms that InterSystems IRIS supports. However, other computations on **$DOUBLE** numbers may show slight differences based on the system platform.

INF and NAN

Following the IEEE standard, **$DOUBLE** can return the strings INF (infinity) and NAN (not a number). INF can be positive or negative (INF and -INF); NAN is always unsigned. While these are valid IEEE return values, they are not actual numbers.

INF and NAN as Input Values

One way to cause **$DOUBLE** to return INF and NAN is to specify the corresponding string as the *num* input value. These input strings are not case-sensitive, and can take leading plus and minus signs (INF resolves signs, NAN ignores signs). To return NAN, specify "NAN", "sNAN", "+NAN", "-NAN". To return INF, specify "INF", "+INF", "Infinity". To return -INF, specify "-INF", "+-INF".

IEEEError

IEEEError controls how **$DOUBLE** responds to a numeric conversion that cannot be resolved. If IEEEError is set to 0, **$DOUBLE** returns INF and NAN when it cannot resolve a conversion. If IEEEError is set to 1, **$DOUBLE** generates standard InterSystems IRIS error codes when it cannot resolve a conversion. The default is 1.

This behavior can be controlled on a per-process basis using the **IEEEError()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *IEEEError* property of the Config.Miscellaneous class.

Returning INF and NAN

$DOUBLE can return INF and NAN when you specify an extremely large number, or when you specify an unresolvable arithmetic operation. These values are only returned when IEEEError is set to return INF and NAN.

Extremely large floating-point numbers are not supported. The maximum supported value for a **$DOUBLE** binary floating-point number is 1.7976931348623158079e308. The minimum supported value for a **$DOUBLE** binary floating-point number is 1.0E-323. A *num* value smaller than this returns 0.

Note: The maximum supported value for an InterSystems IRIS decimal floating-point number is 9.223372036854775807e145. The minimum supported value for an InterSystems IRIS decimal floating-point number is either 2.2250738585072013831e-308 (normal) or 4.9406564584124654417e-324 (denormalized).

The following table shows the value returned or error generated by unresolvable arithmetic operations:

Input Value	IEEEError=0	IEEEError=1
> 1.0E308	INF	<MAXNUMBER>
< 1.0E-323	0	0
1/$DOUBLE(0)	INF	<DIVIDE>
1/$DOUBLE(–0)	–INF	<DIVIDE>
$DOUBLE(1)/0	INF	<DIVIDE>
$DOUBLE(0)/0	NAN	<ILLEGAL VALUE>
$ZLOG($DOUBLE(0))	–INF	<DIVIDE>

Comparing INF and NAN

INF can be compared as if it were a numerical value. Thus INF = INF, INF '= –INF, –INF = –INF, and INF > –INF.

NAN cannot be compared as if it were a numerical value. Because NAN (Not A Number) cannot be meaningfully compared using numerical operators, InterSystems IRIS operations (such as equal to, less than, or greater than) that attempt to compare $DOUBLE(“NAN”) to another $DOUBLE(“NAN”) fail. Comparisons with NAN <= or >= are a special case, which is described in the appendix “Numeric Computing in InterSystems Applications” in the *Orientation Guide for Server-Side Programming*.

$LISTSAME does consider a $DOUBLE(“NAN”) list element to be identical to another $DOUBLE(“NAN”) list element.

InterSystems IRIS does not distinguish between different NAN representations (NAN, sNAN, etc.). InterSystems IRIS considers all NANs to be the same, regardless of their binary representation.

$ISVALIDNUM, $INUMBER, and $FNUMBER

These ObjectScript functions provide support for **$DOUBLE** numbers.

$ISVALIDNUM supports INF and NAN. Although these strings are not numbers, **$ISVALIDNUM** returns 1 for these values, just as if they were numbers. When **$DOUBLE** is specified with a nonnumeric string, for example **$DOUBLE("")**, InterSystems IRIS returns a value of 0. For this reason, **$ISVALIDNUM($DOUBLE(""))** returns 1, because 0 is a number.

$INUMBER and $FNUMBER provide a “D” format option that supports **$DOUBLE** values. $INUMBER converts a numeric to a IEEE floating-point number. $FNUMBER “D” support includes case conversion of INF and NAN, and choosing whether `$DOUBLE(-0)` should return 0 or -0.

INF and NAN with Operators

You can perform arithmetic and logical operations on INF and NAN. Use of operators with INF and NAN is not recommended; if such an operation is performed, the following are the results:

Arithmetic operators:

Addition	Subtraction	Multiplication	Division (/, \, or # operators)
NAN+NAN=NAN	NAN-NAN=NAN	NAN*NAN=NAN	NAN/NAN=NAN
NAN+INF=NAN	NAN-INF=NAN	NAN*INF=NAN	NAN/INF=NAN
	INF-NAN=NAN		INF/NAN=NAN
INF+INF=INF	INF-INF=NAN	INF*INF=INF	INF/INF=NAN

Logical operators:

Equality (=)	NAN	INF
NAN	0	0
INF	0	1

Less Than (<) or Greater Than (>)	NAN	INF
NAN	0	0
INF	0	0

Other operators, such as pattern matching and concatenation, treat NAN and INF as three-character alphabetic strings.

For further details on operations involving IEEE double numbers, see the appendix "Numeric Computing in InterSystems Applications" in the *Orientation Guide for Server-Side Programming*.

INF and NAN Examples

$DOUBLE returns an INF value (or a -INF for negative numbers) when the numeric value exceeds the available precision, as shown in the following example:

```
SET rtn=##class(%SYSTEM.Process).IEEEError(0)
SET x=$DOUBLE(1.2e300)
WRITE !,"Double: ",x
WRITE !,"Is number? ",$ISVALIDNUM(x)
SET y= $DOUBLE(x*x)
WRITE !,"Double squared: ",y
WRITE !,"Is number? ",$ISVALIDNUM(y)
```

$DOUBLE returns a NAN (not a number) value when the numeric value is invalid. For example, when an arithmetic expression involves two INF values, as shown in the following example. (An arithmetic expression involving a single INF value returns INF.)

```
SET rtn=##class(%SYSTEM.Process).IEEEError(0)
SET x=$DOUBLE(1.2e500)
WRITE !,"Double: ",x
WRITE !,"Is number? ",$ISVALIDNUM(x)
SET y= $DOUBLE(x-x)
WRITE !,"Double INF minus INF: ",y
WRITE !,"Is number? ",$ISVALIDNUM(y)
```

JSON Numeric Literals

JSON validation of numeric literals is described in the SET command. **$DOUBLE** numeric literals specified in a JSON array or JSON object are subject to the following additional rules:

- INF, -INF, and NAN values can be stored in JSON structures, but cannot be returned by %ToJSON(). Attempting to do so results in an <ILLEGAL VALUE> error, as shown in the following example:

```
SET jary=[123,($DOUBLE("INF"))]  // executes successfully
WRITE jary.%ToJSON()            // fails with <ILLEGAL VALUE> error
```

- `$DOUBLE(-0)` is stored in a JSON structure as `-0.0`. `$DOUBLE(0)` or `$DOUBLE(+0)` is stored in a JSON structure as `0.0`. This is shown in the following example:

```
SET jary=[0,-0,($DOUBLE(0)),($DOUBLE(-0))]
WRITE jary.%ToJSON()  // returns [0,-0,0.0,-0.0]
```

Examples

The following example returns floating-point numbers of 20 digits:

```
WRITE !,$DOUBLE(999.12345678987654321)
WRITE !,$DOUBLE(.99912345678987654321)
WRITE !,$DOUBLE(999123456789.87654321)
```

The following example returns the value of pi as a $DOUBLE value and as a standard InterSystems IRIS numeric value. This example shows that equality operations should not be attempted between **$DOUBLE** and standard InterSystems IRIS numbers, and that the number of digits returned is greater for standard InterSystems IRIS numbers:

```
SET x=$ZPI
SET y=$DOUBLE($ZPI)
IF x=y { WRITE !,"Same" }
ELSE { WRITE !,"Different"
       WRITE !,"standard:   ",x
       WRITE !,"IEEE float: ",y }
```

The following examples show that a floating-point number is not necessarily equivalent to a numeric string of the same value:

```
SET x=123.4567891234560
SET y=123.4567891234567
IF x=$DOUBLE(x) { WRITE !,"Same" }
ELSE { WRITE !,"Different" }
IF y=$DOUBLE(y) { WRITE !,"Same" }
ELSE { WRITE !,"Different" }

SET x=1234567891234560
SET y=1234567891234567
IF x=$DOUBLE(x) { WRITE !,"Same" }
ELSE { WRITE !,"Different" }
IF y=$DOUBLE(y) { WRITE !,"Same" }
ELSE { WRITE !,"Different" }
```

See Also

- ZZDUMP command
- $DECIMAL function
- $FNUMBER function
- $NUMBER function
- Data Types in *InterSystems SQL Reference*
- Operators in *Using ObjectScript*
- Numeric Computing in InterSystems Applications in *Orientation Guide for Server-Side Programming*

$EXTRACT

Extracts a substring from a character string by position, or replaces a substring by position.

```
$EXTRACT(string,from,to)
$E(string,from,to)

SET $EXTRACT(string,from,to)=value
SET $E(string,from,to)=value
```

Parameters

string	The target string in which substrings are identified. Specify *string* as an expression that evaluates to a quoted string or a numeric value. In **SET $EXTRACT** syntax, *string* must be a variable or a multi-dimensional property.
from	*Optional* — Specifies the starting position within the target *string*. Characters are counted from 1. Permitted values are *n* (a positive integer specifying the character count from the beginning of *string*), * (specifying the last character in *string*), and *-*n* (offset integer count of characters backwards from end of *string*). **SET $EXTRACT** syntax also supports *+*n* (offset integer count of characters to append beyond the end of *string*). A *from* without a *to* specifies a single character. A *from* with a *to* specifies a range of characters. If *from* is not specified, it defaults to 1.
to	*Optional* — Specifies the end position (inclusive) for a range of characters. Must be used with *from*. Permitted values are *n* (a positive integer specifying the character count from the beginning of *string*), * (specifying the last character in *string*), and *-*n* (offset integer count of characters backwards from end of *string*). **SET $EXTRACT** syntax also supports *+*n* (offset integer count of the end of a range of characters to append beyond the end of *string*).

Description

$EXTRACT identifies substrings within *string* by character count, either from the beginning of *string* or the end of *string*. A substring can be a single character or a range of characters.

$EXTRACT can be used in two ways:

- To return a substring from *string*. This uses the `$EXTRACT(string,from,to)` syntax.
- To replace a substring within *string*. The replacement substring may be the same length, longer, or shorter than the original substring. This uses the `SET $EXTRACT(string,from,to)=value` syntax.

Returning a Substring

$EXTRACT returns a substring by character position from *string*. The nature of this substring extraction depends on the parameters used.

- **$EXTRACT**(*string*) extracts the first character in the string.

```
SET mystr="ABCD"
WRITE $EXTRACT(mystr)
```

- **$EXTRACT**(*string*,*from*) extracts a single character in the position specified by *from*. The *from* value can be an integer count from the beginning of the string, an asterisk specifying the last character of the string, or an asterisk with a negative integer specifying a count backwards from the end of the string.

  The following example extracts single letters from the string “ABCD”:

```
SET mystr="ABCD"
WRITE !,$EXTRACT(mystr,2)    // "B" the 2nd character
WRITE !,$EXTRACT(mystr,*)    // "D" the last character
WRITE !,$EXTRACT(mystr,*-2)  // "B" the offset 2 characters from end
WRITE !,$EXTRACT(mystr,*-0)  // "D" the last character by 0 offset
```

- **$EXTRACT**(*string*,*from*,*to*) extracts the range of characters starting with the *from* position and ending with the *to* position (inclusive). For example, if variable *var2* contains the string "1234Alabama567", the following **$EXTRACT** functions both return the string "Alabama":

```
SET var2="1234Alabama567"
WRITE !,$EXTRACT(var2,5,11)
WRITE !,$EXTRACT(var2,*-9,*-3)
```

Parameters

string

The target string in which the substring is identified.

When **$EXTRACT** is used to return a substring, *string* can be a string literal enclosed in quotation marks, a canonical numeric, a variable, an object property, or any valid ObjectScript expression that evaluates to a string or a numeric. If you specify a null string ("") as the target string, **$EXTRACT** always returns the null string, regardless of the other parameter values.

When **$EXTRACT** is used with **SET** on the left hand side of the equals sign to replace a substring, *string* can be a variable name or a multidimensional property reference; it cannot be a non-multidimensional object property.

from

The *from* parameter can specify a single character, or the beginning of a range of characters.

- If *from* is *n* (a positive integer), **$EXTRACT** counts characters from the beginning of *string*.
- If *from* is * (asterisk), **$EXTRACT** returns the last character in *string*.
- If *from* is `*-n` (an asterisk followed by a negative number), **$EXTRACT** counts characters by offset from the end of *string*. Thus, `*-0` is the last character in *string*, `*-1` is the next-to-last character in *string* (an offset of 1 from the end).
- For **SET $EXTRACT** syntax only — If *from* is `*+n` (an asterisk followed by a positive number), **SET $EXTRACT** appends characters by offset beyond the end of *string*. Thus, `*+1` appends a character beyond the end of *string*, `*+2` appends a character two positions beyond the end of *string*, padding the skipped position with a blank space. `*+0` is the last character in *string*.

If the *from* integer value is greater than the number of characters in the string, **$EXTRACT** returns a null string. With a *from* `*-n` value, if *n* is equal to or greater than the number of characters in the string, **$EXTRACT** returns a null string. If the *from* value is 0 or a negative number, **$EXTRACT** returns a null string; however, if *from* is used with *to*, a *from* value of 0 or a negative number is treated as a value of 1.

If *from* is used with the *to* parameter, *from* identifies the start of the range to be extracted and must be less than the value of *to*. If *from* equals *to*, **$EXTRACT** returns the single character at the specified position. If *from* is greater than *to*, **$EXTRACT** returns a null string. If used with the *to* parameter, a *from* value less than 1 (zero, or a negative number) is treated as if it were the number 1.

to

The *to* parameter must be used with the *from* parameter. It must be a positive integer, * (asterisk), or `*-n` (an asterisk followed by a negative integer). If the *to* value is an integer greater than or equal to the *from* value, **$EXTRACT** returns the specified substring. If the *to* value is an asterisk, **$EXTRACT** returns the substring beginning with the *from* character through the end of the string. If *to* is an integer greater than the length of the string, **$EXTRACT** also returns the substring beginning with the *from* character through the end of the string.

If the *from* and *to* positions are the same,**$EXTRACT** returns a single character. If the *to* position is closer to the beginning of the string than the *from* position, **$EXTRACT** returns the null string.

If you omit the *to* parameter, only one character is returned. If *from* is specified, **$EXTRACT** returns the character identified by *from*. If both *to* and *from* are omitted, **$EXTRACT** returns the first character of *string*.

For **SET $EXTRACT** syntax only — If *to* is `*+n`, **SET $EXTRACT** appends a range of characters by offset beyond the end of *string*, padding with blank spaces as needed. If *from* represents a character position after the end of *string*, **SET $EXTRACT** appends characters. If *from* represents a character position before the end of *string*, **SET $EXTRACT** may both replace and append characters.

Specifying *-n and *+n Parameter Values

When using a variable to specify `*-n` or `*+n`, you must always specify the asterisk and a sign character in the parameter itself.

The following are valid specifications of `*-n`:

```
SET count=2
SET alph="abcd"
WRITE $EXTRACT(alph,*-count)

SET count=-2
SET alph="abcd"
WRITE $EXTRACT(alph,*+count)
```

The following is a valid specification of `*+n`:

```
SET count=2
SET alph="abcd"
SET $EXTRACT(alph,*+count)="F"
WRITE alph
```

Whitespace is permitted within these parameter values.

Examples: Returning a Substring

The following example returns “D”, the fourth character in the string:

```
SET x="ABCDEFGHIJK"
WRITE $EXTRACT(x,4)
```

The following example returns “K”, the last character in the string:

```
SET x="ABCDEFGHIJK"
WRITE $EXTRACT(x,*)
```

In the following example, all the **$EXTRACT** functions return “J” the next-to-last character in the string:

```
SET n=-1
SET m=1
SET x="ABCDEFGHIJK"
WRITE !,$EXTRACT(x,*-1)
WRITE !,$EXTRACT(x,*-m)
WRITE !,$EXTRACT(x,*+n)
WRITE !,$EXTRACT(x,*-1,*-1)
```

Note that a minus or plus sign is needed between the asterisk and the integer variable.

The following example shows that the one-argument format is equivalent to the two-argument format when the *from* value is “1”. Both **$EXTRACT** functions return “H”.

```
SET x="HELLO"
WRITE !,$EXTRACT(x)
WRITE !,$EXTRACT(x,1)
```

The following example returns a substring “THIS IS” which is composed of the first through seventh characters.

```
SET x="THIS IS A TEST"
WRITE $EXTRACT(x,1,7)
```

The following example also returns the substring “THIS IS”. When the *from* variable contains a value less than 1, **$EXTRACT** treats that value as 1. Thus, the following example returns a substring composed of the first through seventh characters.

```
SET X="THIS IS A TEST"
WRITE $EXTRACT(X,-1,7)
```

The following example returns the last four characters of the string:

```
SET X="THIS IS A TEST"
WRITE $EXTRACT(X,*-3,*)
```

The following example also returns the last four characters of the string:

```
SET X="THIS IS A TEST"
WRITE $EXTRACT(X,*-3,14)
```

The following example extracts a substring from an object property:

```
SET tStatement = ##class(%SQL.Statement).%New()
SET tStatement.%SchemaPath="MyTests,Sample,Cinema"
WRITE "whole schema path: ",tStatement.%SchemaPath,!
WRITE "start of schema path: ",$EXTRACT(tStatement.%SchemaPath,1,10),!
```

Replacing a Substring Using SET $EXTRACT

You can use **$EXTRACT** with the **SET** command to replace a specified character or range of characters with another value. You can also use it to append characters to the end of a string.

When **$EXTRACT** is used with **SET** on the left hand side of the equals sign, *string* can be a valid variable name. If the variable does not exist, **SET $EXTRACT** defines it. The *string* parameter can also be a multidimensional property reference; it cannot be a non-multidimensional object property. Attempting to use **SET $EXTRACT** on a non-multidimensional object property results in an <OBJECT DISPATCH> error.

You cannot use **SET (a,b,c,...)=value** syntax with **$EXTRACT** (or **$PIECE** or **$LIST**) on the left of the equals sign, if the function uses relative offset syntax: `*` representing the end of a string and `*-n` or `*+n` representing relative offset from the end of the string. You must instead use **SET a=value,b=value,c=value,...** syntax.

The simplest form of `SET $EXTRACT` is a one-for-one substitution:

```
SET alph="ABZD"
SET $EXTRACT(alph,3)="C"
WRITE alph        ; "ABCD"
```

You can append characters to *string* either by specifying *to* as a positive integer that is 1 larger than the length of *string*, or by specifying *to* as `*+1`, as shown in the following examples:

```
SET alph="ABCD"
SET $EXTRACT(alph,5)="E"
WRITE alph        ; "ABCDE"

SET alph="ABCD"
SET $EXTRACT(alph,*+1)="E"
WRITE alph        ; "ABCDE"
```

If you specify *to* larger than the string plus 1, **$EXTRACT** pads with blank spaces:

```
SET alph="ABCD"
SET len=$LENGTH(alph)
SET $EXTRACT(alph,len+2)="F"
WRITE alph        ; "ABCD F"

SET alph="ABCD"
SET $EXTRACT(alph,*+2)="F"
WRITE alph        ; "ABCD F"
```

You can also extract a string and replace it with a string of a different length. For example, the following command extracts the string “Rhode Island” from *foo* and replaces it with the string “Texas”, with no padding.

```
SET foo="Deep in the heart of Rhode Island"
SET $EXTRACT(foo,22,33)="Texas"
WRITE foo      ; "Deep in the heart of Texas"
```

You can extract a string and set it to the null string, removing the extracted characters from the string:

```
SET alph="ABCzzzzzD"
SET $EXTRACT(alph,4,8)=""
WRITE alph        ; "ABCD"
```

If you specify *from* larger than *to*, no replacement occurs:

```
SET alph="ABCD"
SET $EXTRACT(alph,4,3)="X"
WRITE alph        ; "ABCD"
```

In the following example, assume that variable *x* does not exist.

```
KILL x
SET $EXTRACT(x,1,4)="ABCD"
WRITE x         ; "ABCD"
```

The **SET** command creates variable *x* and assigns it the value “ABCD”.

SET $EXTRACT performs leading padding with blank spaces as required, but does not perform trailing padding. The following example inserts the value “F” in the sixth position past the end of the string, but inserts no additional characters in positions 7 and 8:

```
SET alph="ABCD"
SET $EXTRACT(alph,6,8)="F"
WRITE alph        ; "ABCD F"
```

The following example inserts the value “F” in the sixth position and adds characters past the specified range:

```
SET alph="ABCD"
SET $EXTRACT(alph,6,8)="FGHIJ"
WRITE alph        ; "ABCD FGHIJ"
```

The following example shortens a character string by extracting a *from,to* range larger than the number of values in the replacement string.

```
SET x="ABCDEFGH"
SET $EXTRACT(x,3,6)="Z"
WRITE x
```

inserts the value “Z” in the third position and removes positions 4, 5 and 6. Variable *x* now contains the value “ABZGH” and has a length of 5.

Notes

$EXTRACT and Unicode

The **$EXTRACT** function operates on characters, not bytes. Therefore, Unicode strings are handled the same as ASCII strings, as shown in the following example using the Unicode character for “pi” ($CHAR(960)):

```
SET a="QT PIE"
SET b="QT "_$CHAR(960)
SET a1=$EXTRACT(a,-33,4)
SET a2=$EXTRACT(a,4,4)
SET a3=$EXTRACT(a,4,99)
SET b1=$EXTRACT(b,-33,4)
SET b2=$EXTRACT(b,4,4)
SET b3=$EXTRACT(b,4,99)
WRITE !,"ASCII form returns ",!,a1,!,a2,!,a3
WRITE !,"Unicode form returns ",!,b1,!,b2,!,b3
```

For further details, refer to Unicode in *Using ObjectScript*.

Surrogate Pairs

$EXTRACT does not recognize surrogate pairs. Surrogate pairs are used to represent some Chinese characters and to support the Japanese JIS2004 standard. You can use the **$WISWIDE** function to determine if a string contains a surrogate pair. The **$WEXTRACT** function recognizes and correctly parses surrogate pairs. **$EXTRACT** and **$WEXTRACT** are otherwise identical. However, because **$EXTRACT** is generally faster than **$WEXTRACT**, **$EXTRACT** is preferable for all cases where a surrogate pair is not likely to be encountered.

$EXTRACT Compared with $PIECE and $LIST

$EXTRACT determines a substring by counting characters from the beginning of a string. **$EXTRACT** takes as input any ordinary character string. **$PIECE** and **$LIST** both work on specially prepared strings.

$PIECE determines a substring by counting user-defined delimiter characters within the string.

$LIST determines an element from an encoded list by counting elements (not characters) from the beginning of the list. **$LIST** cannot be used on ordinary strings, and **$EXTRACT** cannot be used on encoded lists.

See Also

- SET command
- $FIND function
- $LENGTH function
- $PIECE function
- $REVERSE function
- $WEXTRACT function
- $WFIND function
- $WISWIDE function

$FACTOR

Converts an integer to a $BIT bitstring.

```
$FACTOR(num,scale)
```

Parameters

num	An expression that evaluates to a number. *num* is converted to a positive integer before bitstring conversion. A negative number is converted to a positive number (its absolute value). A fractional number is rounded to an integer.
scale	*Optional* — An integer used as a power-of-ten exponent (scientific notation) multiplier for *num*. The default is 0.

Description

$FACTOR returns the $BIT format bitstring that corresponds to the binary representation of the supplied integer. It performs the following operations:

- If you specify a negative number, **$FACTOR** takes the absolute value of the number.
- If you specify a *scale* **$FACTOR** multiplies the integer by 10***scale*.
- If you specify a fractional number **$FACTOR** rounds this number to an integer. When rounding numbers, InterSystems IRIS rounds the fraction .5 up to the next highest integer.
- **$FACTOR** converts the integer to its binary representation.
- **$FACTOR** converts this binary number to **$BIT** encoded binary format.

The binary string returned specifies bit positions starting from the least significant bit at position 1 (one's place at position 1). This corresponds to the bitstrings used by the various $BIT functions.

Parameters

num

A number (or an expression that evaluates to a number). **$FACTOR** applies the *scale* parameter (if supplied), converts this number to an integer by rounding, and then returns the corresponding bitstring. *num* can be positive or negative. If *num* is a mixed numeric string (for example “7dwarves” or “5.6.8”) **$FACTOR** converts the numeric part of the string (in our example, 7 and 5.6) until it encounters a nonnumeric character. If *num* is zero, or rounds to zero, or is the null string (""), or a nonnumeric string, **$FACTOR** returns an empty string. The **$DOUBLE** values INF, –INF, and NAN return the empty string.

scale

An integer that specifies the scientific notation exponent to apply to *num*. For example, if *scale* is 2, then *scale* represents 10 exponent 2, or 100. This *scale* value is multiplied by *num*. For example, **$FACTOR(7,2)** returns the bitstring that corresponds to the integer 700. This multiplication is done before rounding *num* to an integer. By default, *scale* is 0.

Examples

The following example show the conversion of the integers 1 through 9 to bitstrings:

```
   SET x=1
   WHILE x<10 {
   WRITE !,x,"="
   FOR i=1:1:8 {
     WRITE $BIT($FACTOR(x),i) }
   SET x=x+1 }
```

The following example show **$FACTOR** conversion of negative numbers and fractions to positive integers:

```
  FOR i=1:1:8 {WRITE $BIT($FACTOR(17),i)}
  WRITE " Positive integer",!
  FOR i=1:1:8 {WRITE $BIT($FACTOR(-17),i)}
  WRITE " Negative integer (absolute value)",!
  FOR i=1:1:8 {WRITE $BIT($FACTOR(16.5),i)}
  WRITE " Positive fraction (rounded up)",!
  FOR i=1:1:8 {WRITE $BIT($FACTOR(-16.5),i)}
  WRITE " Negative fraction (rounded up)"
```

The following example show the bitstring returned when the *scale* parameter is specified:

```
 SET x=2.7
   WRITE !,x," scaled then rounded to an integer:",!!
   FOR i=1:1:12 {
     WRITE $BIT($FACTOR(x),i) }
   WRITE " binary = ",$NORMALIZE(x,0)," decimal",!
 SET scale=1
   SET y=x*(10**scale)
   FOR i=1:1:12 {
     WRITE $BIT($FACTOR(x,scale),i) }
   WRITE " binary = ",$NORMALIZE(y,0)," decimal",!
 SET scale=2
   SET y=x*(10**scale)
   FOR i=1:1:12 {
     WRITE $BIT($FACTOR(x,scale),i) }
   WRITE " binary = ",$NORMALIZE(y,0)," decimal"
```

See Also

- $BIT function
- $BITCOUNT function
- $BITFIND function
- $BITLOGIC function
- $DOUBLE function

$FIND

Finds a substring by value and returns an integer specifying its end position in the string.

```
$FIND(string,substring,position)
$F(string,substring,position)
```

Parameters

string	The target string that is to be searched. It can be a variable name, a numeric value, a string literal, or any valid ObjectScript expression that resolves to a string.
substring	The substring that is to be searched for. It can be a variable name, a numeric value, a string literal, or any valid ObjectScript expression that resolves to a string.
position	*Optional* — A position within the target string at which to start the search. It must be a positive integer.

Description

$FIND returns an integer specifying the end position of a substring within a string. **$FIND** searches *string* for *substring*. **$FIND** is case-sensitive. If *substring* is found, **$FIND** returns the integer position of the first character following *substring*. If *substring* is not found, **$FIND** returns a value of 0.

Because **$FIND** returns the position of the character following the *substring*, when *substring* is a single character that matches the first character of *string* **$FIND** returns 2. When *substring* is the null string (""), **$FIND** returns 1.

You can include the *position* option to specify a starting position for the search. If *position* is greater than the number of characters in *string*, **$FIND** returns a value of 0.

$FIND counts characters, not bytes. Therefore, it can be used with strings containing 8-bit or 16-bit (Unicode) characters. For further details on InterSystems IRIS Unicode support, refer to Unicode in *Using ObjectScript*.

Examples

For example, if variable *var1* contains the string “ABCDEFG” and variable *var2* contains the string “BCD,” the following **$FIND** returns the value 5, indicating the position of the character (“E”) that follows the *var2* string:

```
SET var1="ABCDEFG",var2="BCD"
WRITE $FIND(var1,var2)
```

The following example returns 4, the position of the character immediately to the right of the substring “FOR”.

```
SET X="FOREST"
WRITE $FIND(X,"FOR")
```

In the following examples, **$FIND** searches for a substring that is not in *string*, for a null substring, and for a substring that is the first character of *string*. The examples return 0, 1, and 2, respectively:

```
WRITE !,$FIND("aardvark","z")  ; returns 0
WRITE !,$FIND("aardvark","")   ; returns 1
WRITE !,$FIND("aardvark","a")  ; returns 2
```

The following examples show what happens when *string* is a null string:

```
WRITE !,$FIND("","z")  ; returns 0
WRITE !,$FIND("","")   ; returns 1
```

The following example returns 14, the position of the character immediately to the right of the first occurrence of “R” after the seventh character in *X*.

```
SET X="EVERGREEN FOREST",Y="R"
WRITE $FIND(X,Y,7)
```

In the following example, **$FIND** begins its search after the last character in string. It returns zero (0):

```
SET X="EVERGREEN FOREST",Y="R"
WRITE $FIND(X,Y,20)
```

The following example uses **$FIND** with **$REVERSE** to perform a search operation from the end of the string. This example locates the last example of a string within a line of text. It returns the position of that string as 33:

```
SET line="THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG."
SET position=$LENGTH(line)+2-$FIND($REVERSE(line),$REVERSE("THE"))
WRITE "The last THE in the line begins at ",position
```

The following example uses name indirection to return 6, the position of the character immediately to the right of the substring "THIS":

```
SET Y="x",x="""THIS IS A TEST"""
WRITE $FIND(@Y,"THIS")
```

For more information, refer to Indirection in *Using ObjectScript*.

Notes

$FIND, $EXTRACT, $PIECE, and $LIST

- **$FIND** locates a substring by value and returns a position.
- **$EXTRACT** locates a substring by position and returns the substring value.
- **$PIECE** locates a substring by a delimiter character or delimiter string, and returns the substring value.
- **$LIST** operates on specially encoded strings. It locates a substring by substring count and returns the substring value.

The **$FIND**, **$EXTRACT**, **$LENGTH**, and **$PIECE** functions operate on standard character strings. The various **$LIST** functions operate on encoded character strings, which are incompatible with standard character strings. The sole exception is the one-argument and two-argument forms of **$LIST**, which take an encoded character string as input, but output a single element value as a standard character string.

Surrogate Pairs

$FIND does not recognize surrogate pairs. Surrogate pairs are used to represent some Chinese characters and to support the Japanese JIS2004 standard. You can use the **$WISWIDE** function to determine if a string contains a surrogate pair. The **$WFIND** function recognizes and correctly parses surrogate pairs. **$FIND** and **$WFIND** are otherwise identical. However, because **$FIND** is generally faster than **$WFIND**, **$FIND** is preferable for all cases where a surrogate pair is not likely to be encountered.

See Also

- $EXTRACT function
- $LENGTH function
- $LIST function
- $PIECE function
- $REVERSE function
- $WEXTRACT function
- $WFIND function

- $WISWIDE function

$FNUMBER

Formats a numeric value with a specified format; optionally rounds or zero fills to a specified precision.

```
$FNUMBER(inumber,format,decimal)
$FN(inumber,format,decimal)
```

Parameters

inumber	The number to be formatted. It can be a numeric literal, a variable, or any valid ObjectScript expression that evaluates to a numeric value.
format	*Optional* — Specifies how the number is to be formatted. Specified as a quoted string consisting of zero or more format codes, in any order. Format codes are described below. Note that some format codes are incompatible and result in an error. For default formatting, with or without the *decimal* parameter, you can specify the empty string (""). If omitted, defaults to the empty string ("").
decimal	*Optional* — The number of fractional decimal digits to be included in the returned number. If *format* is omitted, include a placeholder comma before specifying *decimal*.

Description

$FNUMBER returns the number specified by *inumber* in the specified *format*.

Parameters

inumber

An expression that resolves to a number. Before **$FNUMBER** performs any operation, InterSystems IRIS performs its standard numeric resolution on *inumber* as follows: it resolves variables, performs string operations such as concatenation, converts strings to numerics, performs numeric expression operations, then converts the resulting numeric to canonical form. This is the number that **$FNUMBER** formats.

If *inumber* is a string, InterSystems IRIS first converts it to a number, truncating at the first non-numeric character. If the first character of the string is a non-numeric character, InterSystems IRIS converts the string to 0.

format

The possible format codes are as follows. You can specify them singly or in combination. Alphabetic codes are not case-sensitive.

Code	Description
""	Empty string. Returns *inumber* in canonical number format. This format is the same as "L" format.
+	Returns a nonnegative number prefixed by the PlusSign property of the current locale (“+” by default). If the number is negative, it returns the number prefixed by the MinusSign property of the current locale (“-” by default).
-	Returns the absolute value of a number. Always returns a negative number without the MinusSign character. Returns a positive number without the PlusSign character. When combined with the “+” format code (`"-+"`, returns positive numbers with a plus sign, negative numbers with no sign. This code cannot be used with the “P” format code; attempting to do so results in a <SYNTAX> error.

Code	Description
,	Returns the number with the value of the NumericGroupSeparator property of the current locale inserted every NumericGroupSize numerals to the left of the decimal point. Combining “,” with either “.” or “N” formats results in a <FUNCTION> error.
.	Returns the number using standard European formatting, regardless of the current locale settings. Sets DecimalSeparator to comma (,), NumericGroupSeparator to period (.), NumericGroupSize to 3, PlusSign to plus (+), MinusSign to minus (-). Combining “.” with either “,” or “O” formats results in a <FUNCTION> error.
D	$DOUBLE special formatting. This code has two effects: “D” specifies that $DOUBLE(-0) should return -0; otherwise, $DOUBLE(-0) returns 0. However, “-D” overrides the negative sign and returns 0. You can specify “D” or “d” for this code; a returned INF or NAN will be expressed in the corresponding uppercase or lowercase letters. The default is upper case.
E	E-notation (scientific notation). Returns the number in scientific notation. If you omit the *decimal* number of fractional digits, 6 is used as the default. You can specify “E” or “e” for this code; the returned value will contain the corresponding uppercase or lowercase symbol. The exponent portion of the returned value is two digits in length with a leading sign, unless three exponent digits are required. “E” and “G” are incompatible and result in a <FUNCTION> error.
G	E-notation or fixed decimal notation. If the number of fractional digits that would result from conversion to scientific notation is larger than the *decimal* value (or the default of 6 decimal digits), the number is returned in scientific notation. For example, `$FNUMBER(1234.99,"G",2)` returns 1.23E+03. If the number of fractional digits that would result from conversion to scientific notation is equal to or smaller than the *decimal* value (or the default of 6 decimal digits), the number is returned in fixed decimal (standard) notation. For example, `$FNUMBER(1234.99,"G",3)` returns 1235. You can specify “G” or “g” for this code; the returned scientific notation value will contain the corresponding uppercase “E” or lowercase “e”. “E” and “G” are incompatible and result in a <FUNCTION> error.
L	Leading sign. Sign, if present, must precede the numerical portion of *inumber*. Parentheses are not permitted. This code cannot be used with the “P” or “T” format codes; attempting to do so results in a <SYNTAX> or <FUNCTION> error. Leading sign is the default format.
N	No NumericGroupSeparator. Does not allow the use of a numeric group separator. This format code is incompatible with the comma (,) format code. When used with the dot format code (`"N."`) the number is formatted with the European decimal separator but no numeric group separators.
O	ODBC locale. Overrides the current locale, and instead uses the standard ODBC locale with the following values: PlusSign=+; MinusSign=-; DecimalSeparator=.; NumericGroupSeparator=,; NumericGroupSize=3. By itself, the “O” format code uses only the ODBC MinusSign and DecimalSeparator. This format code is incompatible with the dot (.) format code. When used with the comma format code (`"O,"`) the number is formatted with the ODBC decimal separator and ODBC numeric group separators.
P	Parentheses sign. Returns a negative number in parentheses and without a leading MinusSign locale property value. Otherwise, it returns the number without parentheses, but with a leading and trailing space character. This code cannot be used with the “+”, “-”, “L”, or “T” format codes; attempting to do so results in a <SYNTAX> error.

Code	Description
T	Trailing sign. Returns the number with a trailing sign if a prefix sign would otherwise have been generated. However, it does not force a trailing sign. To produce a trailing sign for a nonnegative number (positive or zero), you must also specify the “+” format code. To produce a trailing sign for a negative number, you must *not* specify the “-” format code. The trailing sign used is determined by the PlusSign and MinusSign properties of the current locale respectively. A trailing space character, but no sign, is inserted in the case of a nonnegative number with “+” omitted or in the case of a negative number with “-” specified. Parentheses are not permitted. This code cannot be used with the “L” or “P” format codes; attempting to do so results in a <SYNTAX> or <FUNCTION> error.

In InterSystems IRIS, fractional numbers less than 1 are represented in InterSystems IRIS canonical form without a zero integer: 0.66 becomes .66. This is the **$FNUMBER** default. However, most **$FNUMBER** *format* options return fractional numbers less than 1 with a leading zero integer: .66 becomes 0.66. Two-parameter **$FNUMBER** with a *format* of "" (empty string), "L" (which is functionally identical to empty string), and "D" return fractional numbers less than 1 in canonical form: .66. All other two-parameter **$FNUMBER** *format* options, and all three-parameter **$FNUMBER** *format* options, return fractional numbers less than 1 with a single leading zero integer: 000.66 or .66 both becomes 0.66. This is the fractional number format for JSON numbers.

The **$DOUBLE** function can return the values INF (infinite) and NAN (not a number). INF can take a negative sign; format codes represent INF as if it were a number. For example: `+INF`, `INF-`, `(INF)`. NAN does not take a sign; the only format code that affects NAN is “d”, which returns it in lowercase letters. The “E” and “G” codes have no effect on INF and NAN values.

decimal

The *decimal* parameter specifies the number of fractional digits to include in the returned value. Specify *decimal* as a positive integer, or any valid ObjectScript variable or expression that evaluates to a positive integer. If *decimal* is a negative number, InterSystems IRIS treats it as a 0 value. If *decimal* is a fractional number, InterSystems IRIS truncates to its integer component.

- If *decimal* is greater than the number of fractional digits in *inumber*, the remaining positions are zero filled.
- If *decimal* is less than the number of fractional digits in *inumber*, InterSystems IRIS rounds *inumber* to the appropriate number of fractional digits.
- If *decimal* is 0, *inumber* is returned as an integer with no decimal separator character. InterSystems IRIS rounds *inumber* to the appropriate integer.

If *inumber* is less than 1 and *decimal* greater than 0, **$FNUMBER** always returns a single zero in the integer position before the decimal separator character, regardless of the *format* value. This representation of fractional numbers differs from InterSystems IRIS canonical form.

You can specify the *decimal* parameter to control the number of fractional digits returned, after rounding is performed. For example, assume that variable *c* contains the number 6.25198.

```
SET c="6.25198"
SET x=$FNUMBER(c,"+",3)
SET y=$FNUMBER(c,"+",8)
WRITE !,x,!,y
```

The first **$FNUMBER** returns +6.252 and the second returns +6.25198000.

Examples

The following examples show how the different formatting designations can affect the behavior of **$FNUMBER**. These examples assume that the current locale is the default locale.

The following example shows the effects of sign codes on a positive number:

```
SET a=1234
WRITE $FNUMBER(a),!       ; returns 1234
WRITE $FNUMBER(a,""),!    ; returns 1234
WRITE $FNUMBER(a,"+"),!   ; returns +1234
WRITE $FNUMBER(a,"-"),!   ; returns 1234
WRITE $FNUMBER(a,"L"),!   ; returns 1234
WRITE $FNUMBER(a,"T"),!   ; returns 1234 (with a trailing space)
WRITE $FNUMBER(a,"T+"),! ; returns 1234+
```

The following example shows the effects of sign codes on a negative number:

```
SET b=-1234
WRITE $FNUMBER(b,""),!  ; returns -1234
WRITE $FNUMBER(b,"+"),! ; returns -1234
WRITE $FNUMBER(b,"-"),! ; returns 1234
WRITE $FNUMBER(b,"L"),! ; returns -1234
WRITE $FNUMBER(b,"T"),! ; returns 1234-
```

The following example shows the effects of the “P” format code on positive and negative numbers. This example writes asterisks before and after the number to show that a positive number is returned with a leading and a trailing blank:

```
WRITE "*",$FNUMBER(-123,"P"),"*",!  ; returns *(123)*
WRITE "*",$FNUMBER(123,"P"),"*",!   ; returns * 123 *
```

The following example returns 1,234,567.81. The `","` *format* returns *x* in American format, inserting commas as numeric group separators and a period as the decimal separator:

```
SET x=1234567.81
WRITE $FNUMBER(x,",")
```

The following example returns 1.234.567,81. The `"."` *format* returns *x* in European format, inserting periods as numeric group separators and a comma as the decimal separator:

```
SET x=1234567.81
WRITE $FNUMBER(x,".")
```

The following 3-parameter example returns 124,329.00. **$FNUMBER** inserts a comma as numeric group separator, adds a period as the decimal separator, and appends two zeros as fractional digits to the value of *x*.

```
SET x=124329
WRITE $FNUMBER(x,",",2)
```

The following 3-parameter example returns 124329.00. The omitted *format* is represented by a placeholder comma; *decimal* appends two zeros as fractional digits to the value of *x*.

```
SET x=124329
WRITE $FNUMBER(x,,2)
```

The following 3-parameter example returns 0.78. The omitted *format* is represented by a placeholder comma; *decimal* rounds to 2 fractional digits; *decimal* also appends the integer 0, overriding the *format* default:

```
SET x=.7799
WRITE $FNUMBER(x,,2)
```

Notes

Decimal Separator

$FNUMBER uses the DecimalSeparator property value for the current locale (“.” by default) as the delimiter character between the integer part and the fractional part of the returned number. When the “.” format code is specified, this delimiter is a “,” regardless of the current locale setting.

To determine the DecimalSeparator character for your locale, invoke the **GetFormatItem()** method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DecimalSeparator")
```

Numeric Group Separator and Size

When the *format* string includes "," **$FNUMBER** uses the NumericGroupSeparator property value from the current locale as the delimiter between groups of digits in the integer part of the returned number. The size of these groups is determined by the NumericGroupSize property of the current locale.

The English language locale defaults to a comma (",") as the NumericGroupSeparator and 3 as the NumericGroupSize. Many European locales use a period (".") as the NumericGroupSeparator. The Russian (rusw), Ukrainian (ukrw), and Czech (csyw) locales use a blank space as the NumericGroupSeparator. The NumericGroupSize defaults to 3 for all locales, including Japanese. (Users of Japanese may wish to group integer digits in units of either 3 or 4, depending upon context.)

When the *format* string includes "." (and does not include "N") **$FNUMBER** uses NumericGroupSeparator="." and NumericGroupSize=3 to format the return value, regardless of your current locale settings.

To determine the NumericGroupSeparator character and NumericGroupSize number for your locale, invoke the **GetFormatItem()** method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("NumericGroupSeparator"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("NumericGroupSize")
```

Plus Sign and Minus Sign

$FNUMBER uses the PlusSign and MinusSign property values for the current locale ("+" and "-" by default). When the "." format code is specified, these signs are set to "+" and "-", regardless of the current locale.

To determine the PlusSign and MinusSign characters for your locale, invoke the **GetFormatItem()** method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("PlusSign"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MinusSign")
```

Differences between $FNUMBER and $INUMBER

Most format codes have similar meanings in the **$FNUMBER** and **$INUMBER** functions, but the exact behavior triggered by each code differs by function because of the nature of the validations and conversions being performed.

In particular, the "-" and "+" format codes do not have quite the same meaning for **$FNUMBER** as they do for **$INUMBER**. With **$FNUMBER**, "-" and "+" are not mutually exclusive, and "-" only affects the MinusSign (by suppressing it), and "+" only affects the PlusSign (by inserting it). With **$INUMBER**, "-" and "+" are mutually exclusive. "-" means no sign is permitted, and "+" means there must be a sign.

See Also

- $DOUBLE function
- $JUSTIFY function
- $INUMBER function
- $ISVALIDNUM function
- $NORMALIZE function
- $NUMBER function
- More information on locales in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$GET

Returns the data value of a specified variable.

```
$GET(variable,default)
$G(variable,default)
```

Parameters

variable	A local variable, global variable, or process-private global variable, subscripted or unsubscripted. The variable may be undefined. *variable* may be specified as a multidimensional object property with the syntax obj.property.
default	*Optional* — The value to be returned if the variable is undefined. If a variable, it must be defined.

Description

$GET returns the data value of a specified variable. The handling of undefined variables depends on whether you specify a *default* parameter.

- **$GET**(*variable*) returns the value of the specified variable, or the null string if the variable is undefined. The *variable* parameter value can be the name of any variable, including a subscripted array element (either local or global).
- **$GET**(*variable*,*default*) provides a default value to return if the variable is undefined. If the variable is defined, **$GET** returns its value.

Parameters

variable

The variable whose data value is to be returned.

- *variable* can be a local variable, a global variable, or a process-private global (PPG) variable. It can be subscripted or unsubscripted. It cannot be an ObjectScript special variable or a structured system variable (SSVN).

  The variable does not need to be a defined variable. **$GET** returns the null string for an undefined variable; it does not define the variable. A variable can be defined and set to the null string (""). If a global variable, it can contain an extended global reference. If a subscripted global variable, it can be specified using a naked global reference. Even when referencing an undefined subscripted global variable, *variable* resets the naked indicator, affecting future naked global references, as described below.

- *variable* can be a multidimensional object property; it cannot be a non-multidimensional object property. Attempting to use **$GET** on a non-multidimensional object property results in an <OBJECT DISPATCH> error.

  For example, the %SQL.StatementMetadata class has a multidimensional property columnIndex, and a non-multidimensional property columnCount. In the following example, the first **$GET** returns a value; the second **$GET** results in an <OBJECT DISPATCH> error:

  ```
  SET x=##class(%SQL.StatementMetadata).%New()
  WRITE $GET(x.columnIndex,"columnIndex property is undefined"),!
  WRITE $GET(x.columnCount,"columnCount property is undefined")
  ```

default

The data value to be returned if *variable* is undefined. It can any expression, including a local variable or a global variable, either subscripted or unsubscripted. If a global variable, it can contain an extended global reference. If a subscripted global variable, it can be specified using a naked global reference. If present, *default* resets the naked indicator, affecting future naked global references, as described below.

If *default* is an undefined variable, by default **$GET** issues an <UNDEFINED> error, even when *variable* is defined. You can change InterSystems IRIS behavior to not generate an <UNDEFINED> error when referencing an undefined variable by setting the **%SYSTEM.Process.Undefined()** method. If the **Undefined()** method is set to not generate an <UNDEFINED> error, **$GET** returns *variable* when *default* is undefined.

You can specify an ObjectScript special variable as *default*. However, specifying $ZORDER may result in an <UNDEFINED> error, even when *variable* is defined.

Examples

In the following example, the variable *test* is defined and the variable *xtest* is undefined. (The ZWRITE command is used because it explicitly returns a null string value.)

```
KILL xtest
SET test="banana"
SET tdef=$GET(test),tundef=$GET(xtest)
ZWRITE tdef    ; $GET returned value of test
ZWRITE tundef  ; $GET returned null string for xtest
WRITE !,$GET(xtest,"none")
  ; $GET returns default of "none" for undefined variable
```

Notes

$GET Compared to $DATA

$GET provides an alternative to **$DATA** tests for both undefined variables ($DATA=0) and array nodes that are downward pointers without data ($DATA=10). If the variable is either undefined or a pointer array node without data, **$GET** returns a null string ("") without an undefined error. For example, you can recode the following lines:

```
IF $DATA(^client(i))=10 {
   WRITE !!,"Name: No Data"
   GOTO Level1+3
}
```

as:

```
IF $GET(^client(i))="" {
   WRITE !!,"Name: No Data"
   GOTO Level1+3
}
```

Note that **$DATA** tests are more specific than **$GET** tests because they allow you to distinguish between undefined elements and elements that are downward pointers only. For example, the lines:

```
IF $DATA(^client(i))=0 { QUIT }
ELSEIF $DATA(^client(i))=10 {
  WRITE !!,"Name: No Data"
  GOTO Level1+3
}
```

could *not* be re-coded as:

```
IF $GET(^client(i))="" { QUIT }
ELSEIF $GET(^client(i))="" {
   WRITE !!,"Name: No Data"
   GOTO Level1+3
}
```

The two lines perform different actions depending on whether the array element is undefined or a downward pointer without data. If **$GET** were used here, only the first action (QUIT) would ever be performed. You could use **$DATA** for the first test and **$GET** for the second, but not the reverse (**$GET** for the first test and **$DATA** for the second).

Defaults with $GET and $SELECT

$GET(*variable*,*default*) allows you to return a default value when a specified variable is undefined. The same operation can be performed using a **$SELECT** function.

However, unlike **$SELECT**, the second argument in **$GET** is always evaluated.

The fact that **$GET** always evaluates both of its arguments is significant if *variable* and *default* both make subscripted global references and thus both modify the naked indicator. Because the arguments are evaluated in left-to-right sequence, the naked indicator is set to the *default* global reference, regardless of the whether **$GET** returns the *default* value. For further details on using **$GET** with global variables and the naked indicator, see Using Multidimensional Storage (Globals) in *Using Globals*.

Handling Undefined Variables

$GET defines handling behavior if a *specified* variable is undefined. The basic form of **$GET** returns a null string ("") if the specified variable is undefined.

$DATA tests if a specified variable is defined. It returns 0 if the variable is undefined.

You can define handling behavior for *all* undefined variables on a per-process basis using the **Undefined()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *Undefined* property of the Config.Miscellaneous class. Setting Undefined has no effect on **$GET** or **$DATA** handling of specified variables.

See Also

- $DATA function
- $SELECT function
- Using Multidimensional Storage (Globals) in *Using Globals*

$INCREMENT

Adds a specified increment to the numeric value of a variable.

```
$INCREMENT(variable,num)
$I(variable,num)
```

Parameters

variable	The variable whose value is to be incremented. It can specify a local variable, a process-private global, or a global variable and can be either subscripted or unsubscripted. The variable need not be defined. If the variable is not defined, or is set to the null string (""), **$INCREMENT** treats it as having an initial value of zero and increments accordingly. A literal value cannot be specified here. You cannot specify a simple object property reference as *variable*; you can specify a multidimensional property reference as *variable* with the syntax obj.property.
num	*Optional* — The numeric increment you want to add to *variable*. The value can be a number (integer or non-integer, positive or negative), a string containing a number, or any expression which evaluates to a number. Leading and trailing blanks and multiple signs are evaluated. A string is evaluated until the first nonnumeric character is encountered. The null string ("") is evaluated as zero. If you do not specify *num* for the second argument, InterSystems IRIS defaults to incrementing *variable* by 1.

Description

$INCREMENT resets the value of a variable by adding a specified increment to the existing value of the variable and returning the incremented value. This is shown in the following example:

```
SET a=7
SET result=$INCREMENT(a)
WRITE !,result   /* result is 8 (a+1)        */
WRITE !,a        /* variable a is also now 8 */
```

You can use the **$GET** function to return the current value of a variable.

$INCREMENT performs this increment as an atomic operation, which does not require the use of the **LOCK** command.

If multiple processes simultaneously increment the same global through **$INCREMENT**, each process receives a unique, increasing number (or decreasing number if *num* is negative). In some situations, certain numbers may be skipped due to timing issues. For further details on using **$INCREMENT** with global variables, see Using Multidimensional Storage (Globals) in *Using Globals*.

InterSystems IRIS *does not* restore the original, non-incremented value if **$INCREMENT** is in a transaction that is rolled back.

Parameters

variable

The variable whose data value is to be incremented. It must be a variable, it cannot be a literal. The variable does not need to be defined. **$INCREMENT** defines an undefined variable, setting its value to *num* (1, by default).

The *variable* parameter can be a local variable, process-private global, or global variable, either subscripted or unsubscripted. If a global variable, it can contain an extended global reference. If a subscripted global variable, it can be specified using a naked global reference.

The *variable* parameter can be a multidimensional property reference. For example, `$INCREMENT(..Count)`. It cannot be a non-multidimensional object property. Attempting to increment a non-multidimensional object property results in an <OBJECT DISPATCH> error.

$INCREMENT cannot increment special variables, even those that can be modified using **SET**. Attempting to increment a special variable results in a <SYNTAX> error.

num

The amount to increment (or decrement) by. The *num* parameter can be a positive number, incrementing the value of *variable*, or a negative number, decrementing the value of *variable*. It can be an integer or a fractional number. *num* can be zero (no increment). A numeric string is treated as a number. An empty string ("") or a non-numeric string is treated as an increment of zero. If you do not specify an increment, InterSystems IRIS uses the default increment of one (1).

$INCREMENT or $SEQUENCE

$SEQUENCE and **$INCREMENT** can be used as alternatives, or can be used in combination with each other. **$SEQUENCE** is intended specifically for integer increment operations involving multiple simultaneous processes. **$INCREMENT** is a more general increment/decrement function.

- **$SEQUENCE** increments global variables. **$INCREMENT** increments local variables, global variables, or process-private globals.
- **$SEQUENCE** increments an integer by 1. **$INCREMENT** increments or decrements any numeric value by any specified numeric value.
- **$SEQUENCE** can allocate a range of increments to a process. **$INCREMENT** allocates only a single increment.
- **SET $SEQUENCE** can be used to change or undefine (kill) a global. **$INCREMENT** cannot be used on the left side of the **SET** command.

$INCREMENT and Global Variables

You can use **$INCREMENT** on a global variable or a subscript node of a global variable. You can access a global variable mapped to another namespace using an extended global reference. You can access a subscripted global variable using a naked global reference.

InterSystems IRIS evaluates parameters in left-to-right order. If *num* (the amount to increment) is a subscripted global, InterSystems IRIS uses this global reference to set the naked indicator, affecting all subsequent naked global references.

DO $INCREMENT

You can execute **$INCREMENT** as an argument of the DO command. **DO $INCREMENT** differs in two ways from calling **$INCREMENT** as a function:

- **DO** ignores the return value from a function. Therefore, **DO $INCREMENT(variable,num)** increments *variable*, but does not return the incremented value.
- **DO $INCREMENT(variable,num)** never issues a <MAXINCREMENT> error. In circumstances where **$INCREMENT** fails to increment the **DO** command completes without error and *variable* is not incremented.

You can append an argument postconditional expression to **DO $INCREMENT**. For example, `DO $INCREMENT(myvar):x` does not increment *myvar* when *x*=0. A postconditional expression prevents execution, but does not prevent argument evaluation. Therefore, `DO $INCREMENT(myvar($INCREMENT(subvar))):x` when *x*=0 does not increment *myvar*, but does increment *subvar*.

Incrementing Strings

$INCREMENT is generally used for incrementing a variable containing a numeric value. However, it does accept a *variable* containing a string. The following rules apply when using **$INCREMENT** on a string:

- A null string ("") is treated as having a value of zero.
- A numeric string ("123" or "+0012.30") is treated as having that numeric value. The string is converted to canonical form: leading and trailing zeros and the plus sign are removed.
- A mixed numeric/nonnumeric string ("12AB" or "1,000") is treated as the numeric value up to the first nonnumeric character and then truncated at that point. (Note that a comma is a nonnumeric character.) The resulting numeric substring is converted to canonical form: leading and trailing zeros and the plus sign are removed.
- A nonnumeric string ("ABC" or "$12") is treated as having a value of zero.
- Scientific notation conversion is performed. For example, if *strvar*="3E2", **$INCREMENT** treats it as having a value of 300.
- Arithmetic operations are not performed. For example, if *strvar*="3+7", **$INCREMENT** will truncate the string at the plus sign (treating it as a nonnumeric character) and increment *strvar* to 4.
- Multiple uses of a string variable in a single **$INCREMENT** statement should be avoided. For example, avoid concatenating a string variable to the increment of that variable: `strvar_$INCREMENT(strvar)`. This returns unpredictable results.

Failure to Increment

If **$INCREMENT** cannot increment *variable*, it issues a <MAXINCREMENT> error. This only occurs when the *num* increment value is extremely small, and/or the *variable* value is extremely large.

An increment by zero (*num*=0) always returns the original number, regardless of its size. It does not issue a <MAXINCREMENT> error.

<MAXINCREMENT> occurs when the numeric types of the parameters differ and the resulting type conversion and rounding would result in no increment. If you use **$INCREMENT** on a very large number, the default increment of 1 (or some other small positive or negative value of *num*) is too small to be significant. Similarly, if you specify a very small fractional *num* value, its value is too small to be significant. Rather than returning the original *variable* number without incrementing it, **$INCREMENT** generates a <MAXINCREMENT> error.

In the following example, 1.2E18 is a number that can be incremented or decremented by 1; 1.2E20 is a number that is too large to be incremented or decremented by 1. The first three **$INCREMENT** functions successfully increment or decrement the number 1.2E18. The fourth and fifth **$INCREMENT** functions increment by zero, and so always return the original number unchanged, regardless of the size of the original number. The sixth and seventh **$INCREMENT** functions provide a *num* increment sufficiently large to successfully increment or decrement the number 1.2E20. The eighth **$INCREMENT** function attempts to increment 1.2E20 by 1, and thus generates a <MAXINCREMENT> error.

```
  SET x=1.2E18
  WRITE "E18      :",x,!
  WRITE "E18+1    :",$INCREMENT(x),!
  WRITE "E18+4    :",$INCREMENT(x,4),!
  WRITE "E18-6    :",$INCREMENT(x,-6),!
  WRITE "E18+0    :",$INCREMENT(x,0),!
  SET y=1.2E20
  WRITE "E20      :",y,!
  WRITE "E20+0    :",$INCREMENT(y,0),!
  WRITE "E20-10000:",$INCREMENT(y,-10000),!
  WRITE "E20+10000:",$INCREMENT(y,10000),!
  WRITE "E20+1    :",$INCREMENT(y),!
```

A <MAXINCREMENT> is only issued when **$INCREMENT** is called as a function. **DO $INCREMENT** does not issue a <MAXINCREMENT> error.

Locking and Simultaneous Global Increments

$INCREMENT does not perform a lock operation when it increments *variable* nor does using the **LOCK** command on *variable* prevent **$INCREMENT** from incrementing or decrementing its value. For example, suppose process 1 executes a lock on ^COUNTER:

```
LOCK ^COUNTER
```

Then suppose, process 2 increments ^COUNTER:

```
SET x=$INCREMENT(^COUNTER,VAL)
```

Process 2 is not prevented from incrementing ^COUNTER by the lock held by process 1.

The two processes are not guaranteed their own unique ^COUNTER values unless both are using **$INCREMENT**.

$INCREMENT and Transaction Processing

The common usage for **$INCREMENT** is to increment a counter before adding a new entry to a database. **$INCREMENT** provides a way to do this very quickly, avoiding the use of the **LOCK** command.

The trade off for this is that the counter is *not* locked. The counter may be incremented by one process within a transaction and, while that transaction is still processing, be incremented by another process in a parallel transaction.

In the event either transaction (or any other transaction that uses **$INCREMENT**) must be rolled back (with the **TROLLBACK** command), counter increments are ignored. The counter variables are not decremented since it is not clear whether the resulting counter value would be valid. In all likelihood, such a rollback would be disastrous for other transactions.

For further details on using **$INCREMENT** in a distributed database environment, refer to "The $INCREMENT Function and Application Counters" in the "Horizontally Scaling Systems for User Volume with InterSystems Distributed Caching" chapter of the *Scalability Guide*.

Examples

The following example increments the value of *myvar* by *n*. Note that *myvar* does not have to be a prior defined variable:

```
SET n=4
KILL myvar
SET VAL=$INCREMENT(myvar,n)       ; returns 4
WRITE !,myvar
SET VAL=$INCREMENT(myvar,n)       ; returns 8
WRITE !,myvar
SET VAL=$INCREMENT(myvar,n)       ; returns 12
WRITE !,myvar
```

The following example adds incremental values to the process-private global ^||xyz using **$INCREMENT**. The one-argument form of **$INCREMENT** increments by 1; the two-argument form increments by the value specified in the second argument. In this case, the second argument is a non-integer value.

```
KILL ^||xyz
WRITE !,$INCREMENT(^||xyz)       ; returns 1
WRITE !,$INCREMENT(^||xyz)       ; returns 2
WRITE !,$INCREMENT(^||xyz)       ; returns 3
WRITE !,$INCREMENT(^||xyz,3.14)  ; returns 6.14
```

The following example shows the effects of incrementing by zero (0) and incrementing by a negative number:

```
KILL xyz
WRITE !,$INCREMENT(xyz,0)  ; initialized as zero
WRITE !,$INCREMENT(xyz,0)  ; still zero
WRITE !,$INCREMENT(xyz)    ; increments by 1 (default)
WRITE !,$INCREMENT(xyz)    ; increments by 1 (=2)
WRITE !,$INCREMENT(xyz,-1) ; decrements by -1 (=1)
WRITE !,$INCREMENT(xyz,-1) ; decrements by -1 (=0)
WRITE !,$INCREMENT(xyz,-1) ; decrements by -1 (=-1)
```

The following example shows the effects of incrementing using mixed (numeric and nonnumeric) *num* strings and the null string:

```
KILL xyz
WRITE !,$INCREMENT(xyz,"")
        ; null string initializes to 0
WRITE !,$INCREMENT(xyz,2)
        ; increments by 2
WRITE !,$INCREMENT(xyz,"")
        ; null string increments by 0 (xyz=2)
WRITE !,$INCREMENT(xyz,"3A4")
        ; increments by 3 (rest of string ignored)
WRITE !,$INCREMENT(xyz,"A4")
        ; nonnumeric string evaluates as zero (xyz=5)
WRITE !,$INCREMENT(xyz,"1E2")
        ; increments by 100 (scientific notation)
```

See Also

- $SEQUENCE function
- $GET function
- TROLLBACK command
- Using ObjectScript for Transaction Processing in *Using ObjectScript*

$INUMBER

Validates a numeric value and converts it to internal format.

```
$INUMBER(fnumber,format,erropt)
$IN(fnumber,format,erropt)
```

Parameters

fnumber	The numeric value to be converted to the internal format. It can be a numeric or string value, a variable name, or any valid ObjectScript expression.
format	A format specification indicating which external numeric formats are valid representations of numbers. Specified as a quoted string consisting of zero or more format codes, in any order. Format codes are described below. Note that some format codes are incompatible and result in an error. For default formatting, with or without the *erropt* parameter, you can specify the empty string ("").
erropt	*Optional* — The expression returned if *fnumber* is considered invalid based on *format*.

Description

The **$INUMBER** function validates the numeric value *fnumber* using the formats specified in *format*. It then converts it to the internal InterSystems IRIS format.

If *fnumber* does not correspond to the specified *format* and you have not specified *erropt*, the system generates an <ILLEGAL VALUE> error. If you have specified *erropt*, an invalid numeric value returns the *erropt* string.

Parameters

format

The possible format codes are as follows. You can specify them singly or in combination to instruct **$INUMBER** to adhere strictly to the format rules. If no format codes are entered, **$INUMBER** will be as flexible as possible in validating *fnumber* (see Null Format Provides Maximum Flexibility for more information).

Code	Description
+	Mandatory sign. The *fnumber* value must have a explicit sign. Even the number 0 must be signed (+0 or -0). The sign can be either leading or trailing, unless restricted by either an "L" or a "T" format code. Parentheses cannot be used. The only value that does not require a sign is NAN, which can be specified with or without a sign when using code "D+".
-	Unsigned. No sign may be present in *fnumber*.
D	$DOUBLE numbers. This code converts *fnumber* to an IEEE floating point number. This is equivalent to `$DOUBLE(fnumber)`. If "D" is specified, you can input the quoted strings "INF" and "NAN" as an *fnumber* value. INF and NAN can be specified in any combination of uppercase and lowercase letters, with or without leading or trailing signs or enclosing parentheses. (Signs are accepted, but ignored, for NAN.) The variant forms INFINITY and SNAN are also supported.
E or G	E-notation (scientific notation). This code allows you to specify *fnumber* as a string in scientific notation format. This code permits, but does not require, that you specify *fnumber* in scientific notation.
N	No NumericGroupSeparator. Does not allow the use of a numeric group separator. This format code is incompatible with the comma (,) format code.
O	ODBC locale. Overrides the current locale, and instead uses the standard ODBC locale with the following values: PlusSign=+; MinusSign=-; DecimalSeparator=.; NumericGroupSeparator=,; NumericGroupSize=3. This format code is incompatible with the dot (.) format code.
P	Negative numbers must be enclosed in parentheses. Nonnegative numbers must be unsigned, and may have or omit leading and trailing spaces.
L	Leading sign. Sign, if present, must precede the numerical portion of *fnumber*. Parentheses are not permitted.
T	Trailing sign. Sign, if present, must follow the numerical portion of *fnumber*. Parentheses are not permitted.
,	Expects *fnumber* to use the format specified by properties in the current locale. The NumericGroupSeparator ("," by default) may or may not appear in *fnumber*, but if present, it must consistently appear every NumericGroupSize (3 by default) digits to the left of the decimal point.
.	Requires standard European formatting, regardless of the current locale settings. Requires DecimalSeparator as comma (,), NumericGroupSeparator as period (.), NumericGroupSize as 3, PlusSign as plus (+), MinusSign as minus (-). Periods are optional, but if present must consistently appear every three digits to the left of the decimal comma.

When "+", "-" and "P" Format Codes are Absent

When *format* does not include any of the "+", "-", or "P" codes, then *fnumber* may contain any one of the following:

- No sign or parentheses.
- Either the PlusSign locale property ("+" by default) or the MinusSign locale property ("-" by default) but not both. The position of this sign is determined by the "L" or the "T" format code if specified.
- Leading and trailing parentheses.

When “L”, “T” and “P” Format Codes are Absent

When *format* does not include any of the “L”, “T”, or “P” format codes, any sign present in *fnumber* may be either leading or trailing (but not both).

When “,” and “.” Format Codes are Absent

When *format* does not include either the “,” or “.” format codes, *fnumber* may optionally have NumericGroupSeparator symbols appear anywhere to the left or right of the DecimalSeparator, if any. However, each NumericGroupSeparator must have at least one digit to its immediate left and one to its immediate right. When *format* includes “N”, no NumericGroupSeparator symbols are permitted.

Mutually Exclusive Format Codes

Some format codes conflict with each other. Each of the following pairs of format codes are mutually exclusive and result in an error:

- “-+” results in a <FUNCTION> error
- “-P” or “+P” result in a <SYNTAX> error
- “TP” or “LP” result in a <SYNTAX> error
- “TL” results in a <FUNCTION> error
- “,.” results in a <FUNCTION> error
- “,N” results in a <FUNCTION> error
- “.O” results in a <FUNCTION> error

A <FUNCTION> error is also generated if you specify an invalid format code character.

Null Format Provides Maximum Flexibility

You can specify *format* as a null string. This is called a null format. When a null format is specified, **$INUMBER** accepts a *fnumber* value with any one of the following sign conventions:

- No sign or parentheses.
- Either a leading or trailing MinusSign, but not both.
- Either a leading or trailing PlusSign, but not both.
- Leading and trailing parentheses.

When a null format is specified, *fnumber* may optionally have NumericGroupSeparator symbols appear anywhere to the left or right of the DecimalSeparator, if any. However, each NumericGroupSeparator must have at least one digit to its immediate left and one to its immediate right. Sign rules are flexible, and leading and trailing blanks and zeros are ignored. Thus, the following two commands:

```
WRITE !,$INUMBER("+1,23,456,7.8,9,100","")
WRITE !,$INUMBER("0012,3456,7.891+","")
```

are both valid and return the same number, formatted according to the default locale. However,

```
WRITE $INUMBER("1,23,,345,7.,8,9,","")
```

is invalid because of the adjacent commas, the adjacent period and comma, and the trailing comma. It generates an <ILLEGAL VALUE> error.

Behavior Common to All Formats

Regardless of the specified format codes, **$INUMBER** always ignores leading and trailing blank spaces or zeros, but considers *fnumber* to be invalid if it has any of the following characteristics:

- Both a PlusSign and a MinusSign
- More than one PlusSign or MinusSign
- Parentheses and a PlusSign
- Parentheses and a MinusSign
- More than one DecimalSeparator
- Embedded Spaces
- Any characters other than the following:
  - Numeric digits
  - “(“
  - “)”
  - Leading or trailing spaces
  - The DecimalSeparator specified by the current locale (if *format* does not include “.”)
  - The NumericGroupSeparator specified by the current locale (if *format* does not include “.”)
  - The PlusSign property specified by the current locale (if *format* does not include “.”)
  - The MinusSign property specified by the current locale (if *format* does not include “.”)
  - “.” (if *format* includes “.”)
  - “,” (if *format* includes “.”)
  - “+” (if *format* includes “.”)
  - “-” (if *format* includes “ .”)
- The strings “INF” and “NAN” (and their variants) if *format* includes “D”.

Examples

These examples illustrate how different formats affect the behavior of **$INUMBER**. All of these examples assume the current locale is the default locale.

In the following example, **$INUMBER** accepts a leading minus sign because of the “L” format code and returns -123456789.12345678:

```
WRITE $INUMBER("-123,4,56,789.1234,5678","L")
```

In the following example, **$INUMBER** generates an <ILLEGAL VALUE> error because the sign is leading but the “T” format code specifies that trailing signs must be used:

```
WRITE $INUMBER("-123,4,56,789.1234,5678","T")
```

In the following example, the first **$INUMBER** succeeds and returns a negative number. The second **$INUMBER** generates an <ILLEGAL VALUE> error because *fnumber* includes a sign but the “P” format code specifies that negative numbers must be enclosed in parentheses rather than signed:

```
WRITE !,$INUMBER("(123,4,56,789.1234,5678)","P")
WRITE !,$INUMBER("-123,4,56,789.1234,5678","P")
```

In the following example, **$INUMBER** generates an <ILLEGAL VALUE> error because a sign is present but the "-" format code specifies that numbers must be unsigned:

```
WRITE $INUMBER("-123,4,56,789.1234,5678","-")
```

In the following example, **$INUMBER** fails but does not generate an error due to the illegal use of a sign, but instead returns as its value the string "ERR" specified as the *erropt*:

```
WRITE $INUMBER("-123,4,56,789.1234,5678","-","ERR")
```

The following example returns -23456789.123456789; **$INUMBER** accepts the specified *fnumber* as valid because the leading sign follows the formatting specified by "L" and the strict spacing of commas every three digits to the left of the decimal place with no commas to its right follows the strict formatting specified by the "," code:

```
WRITE $INUMBER("-23,456,789.123456789","L,")
```

In the following example, the "E" code permits conversion of a scientific notation string to a number. Note that all format codes support scientific notation as a numeric literal, but only "E" (or "G") support scientific notation as a string. This example uses variables and concatenation to provide the scientific notation string values:

```
SET num=1.234
SET exp=-14
WRITE $INUMBER(1.234E-14,"E","E-lit-err"),!
WRITE $INUMBER(num_"E"_exp,"E","E-string-err"),!
WRITE $INUMBER(1.234E-14,"L","L-lit-err"),!
WRITE $INUMBER(num_"E"_exp,"L","L-string-err"),!
```

The following example compares the values returned by "L" code and a "D" code for a fractional number and for the constant pi. The "D" code converts to an IEEE floating point ($DOUBLE) number:

```
WRITE $INUMBER(1.23E-23,"L"),!
WRITE $INUMBER(1.23E-23,"D"),!
WRITE $INUMBER($ZPI,"L"),!
WRITE $INUMBER($ZPI,"D"),!
```

Notes

Differences between $INUMBER and $FNUMBER

Most format codes have similar meanings in the **$INUMBER** and **$FNUMBER** functions, but the exact behavior triggered by each code differs by function because of the nature of the validations and conversions being performed.

In particular, the "-" and "+" format codes do not have quite the same meaning for **$INUMBER** as they do for **$FNUMBER**. With **$FNUMBER**, "-" and "+" are not mutually exclusive, and "-" only affects the MinusSign (by suppressing it), and "+" only affects the PlusSign (by inserting it). With **$INUMBER**, "-" and "+" are mutually exclusive. "-" means no sign is permitted, and "+" means there must be a sign.

Decimal Separator

$INUMBER uses the DecimalSeparator property value for the current locale ("." by default) as the delimiter character between the integer part and the fractional part of *fnumber*. When the "." format code is specified, this delimiter is a "," regardless of the current locale.

To determine the DecimalSeparator character for your locale, invoke the **GetFormatItem()** method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DecimalSeparator")
```

Numeric Group Separator and Size

$INUMBER uses the NumericGroupSeparator property value from the current locale ("," by default) as the delimiter between groups of digits in the integer part of *fnumber*. The size of these groups is determined by the NumericGroupSize property of the current locale (“3” by default). When the “.” format code is specified, this delimiter is a “.” and appears every three digits regardless of the current locale.

To determine the NumericGroupSeparator character and NumericGroupSize number for your locale, invoke the **GetFormatItem()** method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("NumericGroupSeparator"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("NumericGroupSize")
```

Plus Sign and Minus Sign

$INUMBER uses the PlusSign and MinusSign property values from the current locale (“+” and “-” by default). When the “.” format code is specified, these signs are set to “+” and “-”, regardless of the current locale.

To determine the PlusSign and MinusSign characters for your locale, invoke the **GetFormatItem()** method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("PlusSign"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MinusSign")
```

See Also

- $DOUBLE function
- $FNUMBER function
- $ISVALIDNUM function
- $NORMALIZE function
- $NUMBER function
- More information on locales in the section on “System Classes for National Language Support” in *Specialized System Tools and Utilities*.

$ISOBJECT

Returns whether an expression is an object reference (OREF).

```
$ISOBJECT(expr)
```

Parameter

expr	A ObjectScript expression.

Description

$ISOBJECT returns 1 if *expr* is an object reference (OREF). **$ISOBJECT** returns 0 if *expr* is not an object reference (OREF).

$ISOBJECT returns –1 if *expr* is a reference to an invalid object. Invalid objects should not occur in normal operations; an invalid object could be caused, for example, by recompiling the class while instances of the class are active.

To remove an object reference, set the variable to the null string (""). The obsolete %Close() method cannot be used to remove an object reference. %Close() performs no operation and always returns successful completion. Do not use %Close() when writing new code.

For information on OREFs, see "OREF Basics" in *Defining and Using Classes*.

Parameter

expr

Any ObjectScript expression.

Examples

The following example shows the values returned by **$ISOBJECT** for an object reference and a non-object reference (in this case, a string reference):

```
SET a="certainly not an object"
SET o=##class(%SQL.Statement).%New()
WRITE !,"non-object a: ",$ISOBJECT(a)
WRITE !,"object ref o: ",$ISOBJECT(o)
```

The following example shows that JSON values are object references:

```
SET a=["apple","banana","orange"]
SET b={"fruit":"orange","color":"orange"}
WRITE !,"JSON array: ",$ISOBJECT(a)
WRITE !,"JSON object: ",$ISOBJECT(b)
```

The following Dynamic SQL example shows that a stream field is an OID, not an object reference. You need to use the SQL %OBJECT function to return the object reference:

```
SET myquery=2
SET myquery(1)="SELECT TOP 1 Name,Notes,%OBJECT(Notes) AS NoteObj "
SET myquery(2)="FROM Sample.Employee WHERE Notes IS NOT NULL"
SET tStatement = ##class(%SQL.Statement).%New()
SET qStatus = tStatement.%Prepare(.myquery)
  IF qStatus'=1 {WRITE "%Prepare failed:" DO $System.Status.DisplayError(qStatus) QUIT}
SET rset = tStatement.%Execute()
WHILE rset.%Next() {
   WRITE "Stream field oid: ",$ISOBJECT(rset.Notes),!
   WRITE "Stream field oref: ",$ISOBJECT(rset.NoteObj),!
   }
```

The following example shows how to remove an object reference. The %Close() method *does not* change the object reference. Setting an object reference to the null string deletes the object reference:

```
SET o=##class(%SQL.Statement).%New()
WRITE !,"objref o: ",$ISOBJECT(o)
DO o.%Close()  ; this is a no-op
WRITE !,"objref o: ",$ISOBJECT(o)
SET o=""
WRITE !,"objref o: ",$ISOBJECT(o)
```

See Also

- $SYSTEM special variable

$ISVALIDDOUBLE

Validates a $DOUBLE numeric value and returns a boolean; optionally provides range checking.

```
$ISVALIDDOUBLE(num,scale,min,max)
```

Parameters

num	The numeric value to be validated. It can be a numeric or string value, a variable name, or any valid ObjectScript expression. If a valid number, *num* is converted to a IEEE double-precision floating point type.
scale	*Optional* — The number of significant decimal digits for *min* and *max* range comparisons.
min	*Optional* — The minimum permitted numeric value. The value you supply is converted to a IEEE double-precision floating point type. If not specified, *min* defaults to **$DOUBLE("-INF")**.
max	*Optional* — The maximum permitted numeric value. The value you supply is converted to a IEEE double-precision floating point type. If not specified, *max* defaults to **$DOUBLE("INF")**.

Description

The **$ISVALIDDOUBLE** function determines whether *num* passes validation tests for an IEEE double-precision floating point number and returns a boolean value. It optionally performs a range check using *min* and *max* values, which are automatically converted to IEEE numbers. The *scale* parameter is used during range checking to specify how many fractional digits to compare. A boolean value of 1 means that *num* is a properly formed IEEE double-precision number value and passes the range check, if one is specified. **$ISVALIDDOUBLE** is a validation function; it does not determine if *num* is a number of data type DOUBLE, or if it has been generated using the **$DOUBLE** function.

$ISVALIDDOUBLE validates American format numbers, which use a period (.) as the decimal separator. It does not validate European format numbers, which use a comma (,) as the decimal separator. **$ISVALIDDOUBLE** does not consider valid a number that contains numeric group separators; it returns 0 (invalid) for any number containing a comma or a blank space, regardless of the current locale.

Parameters

num

The number to be validated may be an integer, a fractional number, a number in scientific notation (with the letter "E" or "e"). It may be a string, expression, or variable that resolves to a number. It may be signed or unsigned, and may contain leading or trailing zeros.

ObjectScript converts a number to canonical form before supplying it to **$ISVALIDDOUBLE** for validation. Therefore, any arithmetic expression, numeric concatenation, or multiple leading + and – signs are resolved prior to evaluation by the function. ObjectScript does not convert a numeric string to canonical form prior to evaluation. However, prefacing a numeric string with a + sign forces numeric evaluation (and thus canonical conversion) of a numeric string.

Validation fails (**$ISVALIDDOUBLE** returns 0) if:

- *num* contains any characters other than the digits 0–9, a leading + or – sign, a decimal point (.), and a letter "E" or "e".
- *num* contains more than one + or – sign, decimal point, or letter "E" or "e". If *num* is a number, ObjectScript resolves multiple leading + and – signs. If *num* is a numeric string, it cannot contain more than one leading + or – sign.
- The optional + or – sign is not the first character of *num*.
- The letter "E" or "e" indicating a base-10 exponent is not followed by an integer in a numeric string. With a number, "E" not followed by an integer results in a <SYNTAX> error.

- *num* is the null string.

If *num* is INF (with or without a + or – sign), it is a valid **$DOUBLE** number; the boolean value returned by **$ISVALIDDOUBLE** depends on whether *num* passes the specified range check.

If *num* is NAN **$ISVALIDDOUBLE** returns 1.

scale

The *scale* parameter is used during range checking to specify how many fractional digits to compare. Specify an integer value for *scale*; any fractional digits in the *scale* value are ignored. You can specify a *scale* value larger than the number of fractional digits specified in the other parameters. You can specify a *scale* value of –1; all other negative *scale* values result in a <FUNCTION> error.

A nonnegative *scale* value causes *num* to be rounded to that number of fractional digits before performing *min* and *max* range checking. A *scale* value of 0 causes *num* to be rounded to an integer value (3.9 = 4) before performing range checking. A *scale* value of –1 causes *num* to be truncated to an integer value (3.9 = 3) before performing range checking. To compare all specified digits without rounding or truncating, omit the *scale* parameter. A *scale* value that is nonnumeric or the null string is equivalent to a *scale* value of 0.

Rounding is performed for all *scale* values except –1. A value of 5 or greater is always rounded up.

The *scale* parameter value causes evaluation using rounded or truncated versions of the *num* value. The actual value of the *num* variable is not changed by **$ISVALIDDOUBLE** processing.

If you omit the *scale* parameter, retain the comma as a place holder.

min and max

You can specify a minimum allowed value, a maximum allowed value, neither, or both. If specified, the *num* value (after the *scale* operation) must be greater than or equal to the *min* value, and less than or equal to the *max* value. The values are converted to IEEE floating point numbers before being used for range checking. A null string as a *min* or *max* value is equal to zero. If a value does not meet these criteria, **$ISVALIDDOUBLE** returns 0.

The NAN value is always valid, regardless of the *min* or *max* value.

If you omit a parameter, retain the comma as a place holder. For example, when omitting *scale* and specifying *min* or *max*, or when omitting *min* and specifying *max*. Trailing commas are ignored.

Examples

In the following example, each invocation of **$ISVALIDDOUBLE** returns 1 (valid number):

```
WRITE !,$ISVALIDDOUBLE(0)        ; All integers OK
WRITE !,$ISVALIDDOUBLE(4.567)    ; Fractional numbers OK
WRITE !,$ISVALIDDOUBLE("4.567")  ; Numeric strings OK
WRITE !,$ISVALIDDOUBLE(-.0)      ; Signed numbers OK
WRITE !,$ISVALIDDOUBLE(-+--123)  ; Multiple signs resolved for numbers OK
WRITE !,$ISVALIDDOUBLE(+004.500) ; Leading/trailing zeroes OK
WRITE !,$ISVALIDDOUBLE(4E2)      ; Scientific notation OK
```

In the following example, each invocation of **$ISVALIDDOUBLE** returns 0 (invalid number):

```
WRITE !,$ISVALIDDOUBLE("")         ; Null string is invalid
WRITE !,$ISVALIDDOUBLE("4,567")    ; Commas are not permitted
WRITE !,$ISVALIDDOUBLE("4A")       ; Invalid character
WRITE !,$ISVALIDDOUBLE("-+--123") ; Multiple signs not resolved for strings
```

In the following example, each invocation of **$ISVALIDDOUBLE** returns 1 (valid number), even though INF (infinity) and NAN (Not A Number) are, strictly speaking, not numbers:

```
WRITE !,$ISVALIDDOUBLE($DOUBLE($ZPI))  ; DOUBLE numbers OK
WRITE !,$ISVALIDDOUBLE($DOUBLE("INF")) ; DOUBLE INF OK
WRITE !,$ISVALIDDOUBLE($DOUBLE("NAN")) ; DOUBLE NAN OK
```

In the following example, specifying a *min* value eliminates -INF but not INF:

```
WRITE !,$ISVALIDDOUBLE($DOUBLE("-INF"),,99999999999)
WRITE !,$ISVALIDDOUBLE($DOUBLE("INF"),,99999999999)
```

The following example shows the use of the *min* and *max* parameters. All of the following return 1 (number is valid and also passes the range check):

```
WRITE !,$ISVALIDDOUBLE(4,,3,5)    ; scale can be omitted
WRITE !,$ISVALIDDOUBLE(4,2,3,5)   ; scale can be larger than
                                  ; number of fractional digits
WRITE !,$ISVALIDDOUBLE(4,0,,5)    ; min or max can be omitted
WRITE !,$ISVALIDDOUBLE(4,0,4,4)   ; min and max are inclusive
WRITE !,$ISVALIDDOUBLE(-4,0,-5,5) ; negative numbers
WRITE !,$ISVALIDDOUBLE(4.00,2,04,05) ; leading/trailing zeros
WRITE !,$ISVALIDDOUBLE(.4E3,0,3E2,400) ; base-10 exponents expanded
```

The following example shows the use of the *scale* parameter with *min* and *max*. All of the following return 1 (number is valid and also passes the range check):

```
WRITE !,$ISVALIDDOUBLE(4.55,,4.54,4.551)
  ; When scale is omitted, all digits of num are checked.
WRITE !,$ISVALIDDOUBLE(4.1,0,4,4.01)
  ; When scale=0, num is rounded to an integer value
  ; (0 fractional digits) before min & max check.
WRITE !,$ISVALIDDOUBLE(3.85,1,3.9,5)
  ; num is rounded to 1 fractional digit,
  ; (with values of 5 or greater rounded up)
  ; before min check.
WRITE !,$ISVALIDDOUBLE(4.01,17,3,5)
  ; scale can be larger than number of fractional digits.
WRITE !,$ISVALIDDOUBLE(3.9,-1,2,3)
  ; When scale=-1, num is truncated to an integer value
```

Notes

$ISVALIDDOUBLE and $ISVALIDNUM Compared

The **$ISVALIDDOUBLE** and $ISVALIDNUM functions both validate American format numbers and return a boolean value (0 or 1).

- Both functions accept as valid numbers the INF, –INF, and NAN values returned by **$DOUBLE**. **$ISVALIDDOUBLE** also accepts as valid numbers the not case-sensitive strings “NAN” and “INF”, as well as the variants “Infinity” and “sNAN”, and any of these strings beginning with a single plus or minus sign. **$ISVALIDNUM** rejects all of these strings as invalid, and returns 0.

  ```
  WRITE !,$ISVALIDNUM($DOUBLE("NAN"))    ; returns 1
  WRITE !,$ISVALIDDOUBLE($DOUBLE("NAN")) ; returns 1
  WRITE !,$ISVALIDNUM("NAN")             ; returns 0
  WRITE !,$ISVALIDDOUBLE("NAN")          ; returns 1
  ```

- Both functions parse signed and unsigned integers (including –0), scientific notation numbers (with “E” or “e”), real numbers (123.45) and numeric strings (“123.45”).
- Neither function recognizes the European DecimalSeparator character (comma (,)) or the NumericGroupSeparator character (American format: comma (,); European format: period (.)). For example, both reject the string “123,456” as an invalid number, regardless of the current locale setting.
- Both functions parse multiple leading signs (+ and –) for numbers. Neither accepts multiple leading signs in a quoted numeric string.

See Also

- $DOUBLE function
- $FNUMBER function

- $INUMBER function
- $ISVALIDNUM function
- $NORMALIZE function
- $NUMBER function
- More information on locales in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$ISVALIDNUM

Validates a numeric value and returns a boolean; optionally provides range checking.

```
$ISVALIDNUM(num,scale,min,max)
```

Parameters

num	The numeric value to be validated. It can be a numeric or string value, a variable name, or any valid ObjectScript expression.
scale	*Optional* — The number of significant fractional digits for *min* and *max* range comparisons.
min	*Optional* — The minimum permitted numeric value.
max	*Optional* — The maximum permitted numeric value.

Description

The **$ISVALIDNUM** function validates *num* and returns a boolean value. It optionally performs a range check using *min* and *max* values. The *scale* parameter is used during range checking to specify how many fractional digits to compare. A boolean value of 1 means that *num* is a properly formed number and passes the range check, if one is specified.

$ISVALIDNUM validates American format numbers, which use a period (.) as the decimal separator. It does not validate European format numbers, which use a comma (,) as the decimal separator. **$ISVALIDNUM** does not consider valid a number that contains numeric group separators; it returns 0 (invalid) for any number containing a comma or a blank space, regardless of the current locale.

Parameters

num

The number to be validated may be an integer, a real number, or a scientific notation number (with the letter "E" or "e"). It may be a string, expression, or variable that resolves to a number. It may be signed or unsigned, and may contain leading or trailing zeros. Validation fails (**$ISVALIDNUM** returns 0) if:

- *num* is the empty string ("").
- *num* contains any characters other than the digits 0–9, a leading + or – sign, a decimal point (.), and a letter "E" or "e".
- *num* contains more than one + or – sign, decimal point, or letter "E" or "e".
- The optional + or – sign is not the first character of *num*.
- The letter "E" or "e" indicating a base-10 exponent is not followed by an integer in a numeric string.

With the exception of **$ISVALIDNUM**, specifying a base-10 number with a non-integer exponent in any expression results in a <SYNTAX> error. For example, `WRITE 7E3.5`.

The *scale* parameter value causes evaluation using rounded or truncated versions of the *num* value. The actual value of the *num* variable is not changed by **$ISVALIDNUM** processing.

If *num* is the INF, –INF, or NAN value returned by $DOUBLE, **$ISVALIDNUM** returns 1.

The largest floating point number that InterSystems IRIS supports is 1.7976931348623157081E308. Specifying a larger number in any InterSystems IRIS numeric operation generates a <MAXNUMBER> error. The largest InterSystems IRIS decimal floating point number specified as a string that **$ISVALIDNUM** supports is 9.223372036854775807E145. For floating point number strings larger than this, use $ISVALIDDOUBLE. For further details, refer to "Extremely Large Numbers" in the "Data Types and Values" chapter of *Using ObjectScript*.

scale

The *scale* parameter is used during range checking to specify how many fractional digits to compare. Specify an integer value for *scale*; fractional digits in the *scale* value are ignored. You can specify a *scale* value larger than the number of fractional digits specified in the other parameters. You can specify a *scale* value of –1; all other negative *scale* values result in a <FUNCTION> error.

A nonnegative *scale* value causes *num* to be rounded to that number of fractional digits before performing *min* and *max* range checking. A *scale* value of 0 causes *num* to be rounded to an integer value (3.9 = 4) before performing range checking. A *scale* value of –1 causes *num* to be truncated to an integer value (3.9 = 3) before performing range checking. To compare all specified digits without rounding or truncating, omit the *scale* parameter. A *scale* value that is nonnumeric or the null string is equivalent to a *scale* value of 0.

Rounding is performed for all *scale* values except –1. A value of 5 or greater is always rounded up.

If you omit the *scale* parameter, retain the comma as a place holder.

When rounding numbers, be aware that IEEE floating point numbers and standard InterSystems IRIS fractional numbers differ in precision. **$DOUBLE** IEEE floating point numbers are encoded using binary notation. They have a precision of 53 binary bits, which corresponds to 15.95 decimal digits of precision. (Note that the binary representation does not correspond exactly to a decimal fraction.) Because most decimal fractions cannot be exactly represented in this binary notation, an IEEE floating point number may differ slightly from the corresponding standard InterSystems IRIS floating point number. Standard InterSystems IRIS fractional numbers have a precision of 18 decimal digits on all supported InterSystems IRIS system platforms. When an IEEE floating point number is displayed as a fractional number, the binary bits are often converted to a fractional number with far more than 18 decimal digits. This *does not* mean that IEEE floating point numbers are more precise than standard InterSystems IRIS fractional numbers.

min and max

You can specify a minimum allowed value, a maximum allowed value, neither, or both. If specified, the *num* value (after the *scale* operation) must be greater than or equal to the *min* value, and less than or equal to the *max* value. A null string as a *min* or *max* value is equal to zero. If a value does not meet these criteria, **$ISVALIDNUM** returns 0.

If you omit a parameter, retain the comma as a place holder. For example, when omitting *scale* and specifying *min* or *max*, or when omitting *min* and specifying *max*. Trailing commas are ignored.

If the *num*, *min*, or *max* value is a **$DOUBLE** number, then all three of these numbers are treated as a **$DOUBLE** number for this range check. This prevents unexpected range errors caused by the small generated fractional part of a **$DOUBLE** number.

Examples

In the following example, each invocation of **$ISVALIDNUM** returns 1 (valid number):

```
WRITE !,$ISVALIDNUM(0)        ; All integers OK
WRITE !,$ISVALIDNUM(4.567)    ; Real numbers OK
WRITE !,$ISVALIDNUM("4.567")  ; Numeric strings OK
WRITE !,$ISVALIDNUM(-.0)      ; Signed numbers OK
WRITE !,$ISVALIDNUM(+004.500) ; Leading/trailing zeroes OK
WRITE !,$ISVALIDNUM(4E2)      ; Scientific notation OK
```

In the following example, each invocation of **$ISVALIDNUM** returns 0 (invalid number):

```
WRITE !,$ISVALIDNUM("")      ; Null string is invalid
WRITE !,$ISVALIDNUM("4,567") ; Commas are not permitted
WRITE !,$ISVALIDNUM("4A")    ; Invalid character
```

In the following example, each invocation of **$ISVALIDNUM** returns 1 (valid number), even though INF (infinity) and NAN (Not A Number) are, strictly speaking, not numbers:

```
DO ##class(%SYSTEM.Process).IEEEError(0)
WRITE !,$ISVALIDNUM($DOUBLE($ZPI))  ; DOUBLE numbers OK
WRITE !,$ISVALIDNUM($DOUBLE("INF")) ; DOUBLE INF OK
WRITE !,$ISVALIDNUM($DOUBLE("NAN")) ; DOUBLE NAN OK
WRITE !,$ISVALIDNUM($DOUBLE(1)/0)   ; generated INF OK
```

The following example shows the use of the *min* and *max* parameters. All of the following return 1 (number is valid and also passes the range check):

```
WRITE !,$ISVALIDNUM(4,,3,5)    ; scale can be omitted
WRITE !,$ISVALIDNUM(4,2,3,5)   ; scale can be larger than
                               ; number of fractional digits
WRITE !,$ISVALIDNUM(4,0,,5)    ; min or max can be omitted
WRITE !,$ISVALIDNUM(4,0,4,4)   ; min and max are inclusive
WRITE !,$ISVALIDNUM(-4,0,-5,5) ; negative numbers
WRITE !,$ISVALIDNUM(4.00,2,04,05) ; leading/trailing zeros
WRITE !,$ISVALIDNUM(.4E3,0,3E2,400) ; base-10 exponents expanded
```

The following example shows the use of the *scale* parameter with *min* and *max*. All of the following return 1 (number is valid and also passes the range check):

```
WRITE !,$ISVALIDNUM(4.55,,4.54,4.551)
  ; When scale is omitted, all digits of num are checked.
WRITE !,$ISVALIDNUM(4.1,0,4,4.01)
  ; When scale=0, num is rounded to an integer value
  ; (0 fractional digits) before min & max check.
WRITE !,$ISVALIDNUM(3.85,1,3.9,5)
  ; num is rounded to 1 fractional digit,
  ; (with values of 5 or greater rounded up)
  ; before min check.
WRITE !,$ISVALIDNUM(4.01,17,3,5)
  ; scale can be larger than number of fractional digits.
WRITE !,$ISVALIDNUM(3.9,-1,2,3)
  ; When scale=-1, num is truncated to an integer value
```

Notes

$ISVALIDNUM and $ISVALIDDOUBLE Compared

The **$ISVALIDNUM** and $ISVALIDDOUBLE functions both validate numbers and return a boolean value (0 or 1).

- Both functions accept as valid numbers the INF, –INF, and NAN values returned by **$DOUBLE**. **$ISVALIDDOUBLE** also accepts as valid numbers the not case-sensitive strings “NAN” and “INF”, as well as the variants “Infinity” and “sNAN”, and any of these strings beginning with a single plus or minus sign. **$ISVALIDNUM** rejects all of these strings as invalid, and returns 0.

  ```
  WRITE !,$ISVALIDNUM($DOUBLE("NAN"))    ; returns 1
  WRITE !,$ISVALIDDOUBLE($DOUBLE("NAN")) ; returns 1
  WRITE !,$ISVALIDNUM("NAN")             ; returns 0
  WRITE !,$ISVALIDDOUBLE("NAN")          ; returns 1
  ```

- Both functions parse signed and unsigned integers (including –0), scientific notation numbers (with “E” or “e”), real numbers (123.45) and numeric strings (“123.45”).
- Neither function recognizes the European DecimalSeparator character (comma (,)) or the NumericGroupSeparator character (American format: comma (,); European format: period (.)). For example, both reject the string “123,456” as an invalid number, regardless of the current locale setting.
- Both functions parse multiple leading signs (+ and –) for numbers. Neither accepts multiple leading signs in a quoted numeric string.

If a numeric string is too big to be represented by an InterSystems IRIS floating point number, the default is to automatically convert it to an IEEE double-precision number. However, such large numbers fail the **$ISVALIDNUM** test, as shown in the following example:

```
WRITE !,"E127 no IEEE conversion required"
WRITE !,$ISVALIDNUM("9223372036854775807E127")
WRITE !,$ISVALIDDOUBLE("9223372036854775807E127")
WRITE !,"E128 automatic IEEE conversion"
WRITE !,$ISVALIDNUM("9223372036854775807E128")
WRITE !,$ISVALIDDOUBLE("9223372036854775807E128")
```

$ISVALIDNUM, $NORMALIZE, and $NUMBER Compared

The **$ISVALIDNUM**, **$NORMALIZE**, and **$NUMBER** functions all validate numbers. **$ISVALIDNUM** returns a boolean value (0 or 1). **$NORMALIZE** and **$NUMBER** return a validated version of the specified number.

These three functions offer different validation criteria. Select the one that best meets your needs.

- American format numbers are validated by all three functions. European format numbers are only validated by the **$NUMBER** function.
- All three functions parse signed and unsigned integers (including –0), scientific notation numbers (with “E” or “e”), and numbers with a fractional part. However, **$NUMBER** can be set (using the “I” format) to reject numbers with a fractional part (including scientific notation with a negative base-10 exponent). All three functions parse both numbers (123.45) and numeric strings (“123.45”).
- Leading and trailing zeroes are stripped out by all three functions. The decimal character is stripped out unless followed by a nonzero value.
- DecimalSeparator: **$NUMBER** validates the decimal character (American format: period (.) or European format: comma (,)) based on its *format* parameter (or the default for the current locale). The other functions only validate American format decimal numbers, regardless of the current locale setting.
- NumericGroupSeparator: **$NUMBER** accepts NumericGroupSeparator characters (in American format: comma (,) or blank space; in European format: period (.) or blank space). It accepts and strips out any number of NumericGroupSeparator characters, regardless of position. For example, in American format it validate “12 3,,4,56.9,9” as the number 123456.99. **$NORMALIZE** does not recognize NumericGroupSeparator characters. It validates character-by-character until it encounters a nonnumeric character; for example, it validates “123,456.99” as the number 123. **$ISVALIDNUM** rejects the string “123,456” as an invalid number.
- Multiple leading signs (+ and –) are interpreted by all three functions for numbers. However, only **$NORMALIZE** accepts multiple leading signs in a quoted numeric string.
- Trailing + and – signs: All of the three functions reject trailing signs in numbers. However, in a quoted numeric string **$NUMBER** parses one (and only one) trailing sign, **$NORMALIZE** parses multiple trailing signs, and **$ISVALIDNUM** rejects any string containing a trailing sign as an invalid number.
- Parentheses: **$NUMBER** parses parentheses surrounding an unsigned number in a quoted string as indicating a negative number. **$NORMALIZE** and **$ISVALIDNUM** reject parentheses.
- Numeric strings containing multiple decimal characters: **$NORMALIZE** validates character-by-character until it encounters the second decimal character. For example, in American format it validates “123.4.56” as the number 123.4. **$NUMBER** and **$ISVALIDNUM** reject any string containing more than one decimal character as an invalid number.

  Numeric strings containing other nonnumeric characters: **$NORMALIZE** validates character-by-character until it encounters an alphabetic character. It validates “123A456” as the number 123. **$NUMBER** and **$ISVALIDNUM** validate the entire string, they reject “123A456” as an invalid number.
- The null string: **$NORMALIZE** parses the null string as zero (0). **$NUMBER** and **$ISVALIDNUM** reject the null string.

The **$ISVALIDNUM** and **$NUMBER** functions provide optional min/max range checking.

$ISVALIDNUM, **$NORMALIZE**, and **$NUMBER** all provide rounding of numbers to a specified number of fractional digits. **$ISVALIDNUM** and **$NORMALIZE** can round fractional digits, and round or truncate a number with a fractional part to return an integer. For example, **$NORMALIZE** can round 488.65 to 488.7 or 489, or truncate it to 488. **$NUMBER** can round both fractional digits and integer digits. For example, **$NUMBER** can round 488.65 to 488.7, 489, 490 or 500.

See Also

- $DOUBLE function
- $FNUMBER function
- $INUMBER function
- $ISVALIDDOUBLE function
- $NORMALIZE function
- $NUMBER function
- More information on locales in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$JUSTIFY

Right-aligns an expression within a specified width, rounding to a specified number of fractional digits.

```
$JUSTIFY(expression,width,decimal)
$J(expression,width,decimal)
```

Parameters

expression	The value that is to be right-aligned. It can be a numeric value, a string literal, the name of a variable, or any valid ObjectScript expression.
width	The number of characters within which *expression* is to be right-aligned. A positive integer or an expression that evaluates to a positive integer.
decimal	*Optional* — The number of fractional digits. A positive integer or an expression that evaluates to a positive integer. InterSystems IRIS rounds or pads the number of fractional digits in *expression* to this value. If you specify *decimal*, InterSystems IRIS treats *expression* as a numeric.

Description

$JUSTIFY returns the value specified by *expression* right-aligned within the specified *width*. You can include the *decimal* parameter to decimal-align numbers within *width*.

- `$JUSTIFY(expression,width)`: the 2-parameter syntax right-justifies *expression* within *width*. It does not perform any conversion of *expression*. The *expression* can be a numeric or a nonnumeric string.
- `$JUSTIFY(expression,width,decimal)`: the 3-parameter syntax converts *expression* to a canonical number, rounds or zero pads fractional digits to *decimal*, then right-justifies the resulting numeric value within *width*. If *expression* is a nonnumeric string, InterSystems IRIS converts it to 0, pads it, then right-justifies it.

$JUSTIFY recognizes the DecimalSeparator character for the current locale. It adds or deletes a DecimalSeparator character as needed. The DecimalSeparator character depends upon the locale; commonly it is either a period (.) for American-format locales, or a comma (,) for European-format locales. To determine the DecimalSeparator character for your locale, invoke the following method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DecimalSeparator")
```

Commonly, **$JUSTIFY** is used to format numbers with fractional digits: every number is given the same number of fractional digits, and the numbers are right-aligned so that the DecimalSeparator characters align in a column of numbers. **$JUSTIFY** is especially useful for outputting formatted values using the **WRITE** command.

Parameters

expression

The value to be right-justified, and optionally expressed as a numeric with a specified number of fractional digits.

- If string justification is desired, do not specify *decimal*. The *expression* can contain any characters. **$JUSTIFY** right-justifies *expression*, as described in *width*. You can specify the null string ("") to create a string of blank spaces of the specified *width*.
- If numeric justification is desired, specify *decimal*. If *decimal* is specified, **$JUSTIFY** converts *expression* to a canonical number. It resolves leading plus and minus signs and removes leading and trailing zeros. It truncates *expression* at the first nonnumeric character. If *expression* begins with a nonnumeric character (such as a currency symbol), **$JUSTIFY** converts the *expression* value to 0. For further details on how InterSystems IRIS converts a numeric to a

canonical number, and InterSystems IRIS handling of a numeric string containing nonnumeric characters, refer to the Numbers section of the "Data Types and Values" chapter of *Using ObjectScript*.

After **$JUSTIFY** converts *expression* to a canonical number, it zero-pads or rounds this canonical number to *decimal* number of fractional digits, then right-justifies the result, as described in *width*. **$JUSTIFY** does not recognize NumericGroupSeparator characters, currency symbols, multiple DecimalSeparator characters, or trailing plus or minus signs.

width

The *width* in which to right-justify the converted *expression*. If *width* is greater than the length of *expression* (after numeric and fractional digit conversion), InterSystems IRIS right-justifies to width, left-padding as needed with blank spaces. If *width* is less than the length of *expression* (after numeric and fractional digit conversion), InterSystems IRIS sets *width* to the length of the *expression* value.

Specify *width* as a positive integer. A *width* value of 0, the null string (""), or a nonnumeric string is treated as a *width* of 0, which means that InterSystems IRIS sets *width* to the length of the *expression* value.

decimal

The number of fractional digits. If *expression* contains more fractional digits, **$JUSTIFY** rounds the fractional portion to this number of fractional digits. If *expression* contains fewer fractional digits, **$JUSTIFY** pads the fractional portion with zeros to this number of fractional digits, adding a Decimal Separator character, if needed. If *decimal*=0, **$JUSTIFY** rounds *expression* to an integer value and deletes the Decimal Separator character.

If the *expression* value is less than 1, **$JUSTIFY** inserts a leading zero before the DecimalSeparator character.

The $DOUBLE values INF, -INF, and NAN are returned unchanged by **$JUSTIFY**, regardless of the *decimal* value.

$JUSTIFY and $FNUMBER

You can use $FNUMBER to format a number for display. Both **$JUSTIFY** and **$FNUMBER** can round (or zero pad) to a specified number of fractional digits. **$FNUMBER** can also be used to add NumericGroupSeparator characters. However, note the following:

- **$FNUMBER** cannot format a number once it has been right-aligned using **$JUSTIFY**. (**$FNUMBER** interprets the leading spaces as nonnumeric characters.)
- **$JUSTIFY** cannot perform numeric justification on a number once you have added NumericGroupSeparator characters or have prepended a currency symbol. (**$JUSTIFY** interprets NumericGroupSeparators or currency symbols as non-numeric characters.)

Therefore, to properly add NumericGroupSeparators, round fractional digits, prepend a currency symbol, and right-align the resulting number, you use **$FNUMBER** to perform rounding and inserting of NumericGroupSeparators. You then use **$JUSTIFY** with 2-parameter syntax to right-align the resulting string:

```
SET num=123456.789
SET fmtnum=$FNUMBER(num,",",2)
SET money="$"_fmtnum
SET rmoney=$JUSTIFY(money,15)
WRITE ">",rmoney,"<"
```

Examples

The following example performs right-justification on strings. No numeric conversion is performed:

```
WRITE ">",$JUSTIFY("right",10),"<",!
WRITE ">",$JUSTIFY("aligned",10),"<",!
WRITE ">",$JUSTIFY("+0123.456",10),"<",!
WRITE ">",$JUSTIFY("string longer than width",10),"<",!
```

The following example performs numeric right-justification with a specified number of fractional digits:

```
SET var1 = 250.50999
SET var2 = 875
WRITE !,$JUSTIFY(var1,20,2),!,$JUSTIFY(var2,20,2)
WRITE !,$JUSTIFY("_________",20)
WRITE !,$JUSTIFY("TOTAL",9),$JUSTIFY(var1+var2,11,2)
```

return the following lines:

```
               250.51
               875.00
              _______
TOTAL         1125.51
```

The following example performs numeric right-justification with the **$DOUBLE** values INF and NAN:

```
SET rtn=##class(%SYSTEM.Process).IEEEError(0)
SET x=$DOUBLE(1.2e500)
WRITE !,"Double: ",x
WRITE !,">",$JUSTIFY(x,12,2),"<"
SET y=$DOUBLE(x-x)
WRITE !,"Double INF minus INF: ",y
WRITE !,">",$JUSTIFY(y,12,2),"<"
```

See Also

- $FNUMBER function
- $X special variable

$LENGTH

Returns the number of characters or delimited substrings in a string.

```
$LENGTH(expression,delimiter)
$L(expression,delimiter)
```

Parameters

expression	The target string. It can be a numeric value, a string literal, a variable name, or any valid expression that resolves to a string.
delimiter	*Optional* — A string that demarcates separate substrings in the target string. It can be a variable name, a numeric value, a string literal, or any valid expression that resolves to a string.

Description

$LENGTH returns the number of characters in a specified string or the number of delimited substrings in a specified string, depending on the parameters used. Note that length counts the number of *characters*; an 8-bit character and a 16-bit wide (Unicode) character are both counted as one character. For further details, refer to Unicode in *Using ObjectScript*.

- **$LENGTH**(*expression*) returns the number of characters in the string. If the expression is a null string, **$LENGTH** returns a 0. If *expression* is a numeric expression, it is converted to canonical form before determining its length. If *expression* is a string numeric expression, no conversion is performed. If *expression* is the $DOUBLE values INF, -INF, or NAN, the lengths returned are 3, 4, and 3, respectively.

  This syntax can be used with the **$EXTRACT** function, which locates a substring by position and returns the substring value.

- **$LENGTH**(*expression*,*delimiter*) returns the number of substrings within the string. **$LENGTH** returns the number of substrings separated from one another by the indicated *delimiter*. This number is always equal to the number of delimiters in the string, plus one.

  This syntax can be used with the **$PIECE** function, which locates a substring by a delimiter and returns the substring value.

  If the *delimiter* is the null string, **$LENGTH** returns a 0. If the delimiter is any other valid string literal and the string is a null string, **$LENGTH** returns a 1.

Encoded Strings

InterSystems IRIS supports strings that contain internal encoding. Because of this encoding, **$LENGTH** should not be used to determine the data content of a string.

- **$LENGTH** should not be used for a List structure string created using **$LISTBUILD** or **$LIST**. Because an InterSystems IRIS List string is encoded, the length returned does not meaningfully indicate the number of characters in the list elements. The sole exception is the one-argument and two-argument forms of **$LIST**, which take an encoded InterSystems IRIS List string as input, but outputs a single List element value as a standard character string. You can use the $LISTLENGTH function to determine the number of substrings (list elements) in an encoded list string.

- **$LENGTH** should not be used for a bit string. Because an InterSystems IRIS bit string is encoded, the length returned does not meaningfully indicate the number of bits in the bit string. You can use the $BITCOUNT function, which returns the number of bits in the string.

- **$LENGTH** should not be used for a JSON string. The value assigned by setting a variable to a JSON object or a JSON array is an object reference. Therefore the length of that variable value would be the length of the object reference, which has no connection to the length of the data encoded in the JSON string.

Surrogate Pairs

$LENGTH does not recognize surrogate pairs. Surrogate pairs are used to represent some Chinese characters and to support the Japanese JIS2004 standard. You can use the **$WISWIDE** function to determine if a string contains a surrogate pair. The **$WLENGTH** function recognizes and correctly parses surrogate pairs. **$LENGTH** and **$WLENGTH** are otherwise identical. However, because **$LENGTH** is generally faster than **$WLENGTH**, **$LENGTH** is preferable for all cases where a surrogate pair is not likely to be encountered.

Examples

In the following example, both **$LENGTH** functions return 4, the number of characters in the string.

```
SET roman="test"
WRITE !,$LENGTH(roman)," characters in: ",roman
SET greek=$CHAR(964,949,963,964)
WRITE !,$LENGTH(greek)," characters in: ",greek
```

In the following example, the first **$LENGTH** returns 5. This is the length of 74000, the canonical version of the specified number. The second **$LENGTH** returns 8, the length of the string “+007.4e4”.

```
WRITE !,$LENGTH(+007.4e4)
WRITE !,$LENGTH("+007.4e4")
```

In the following example, the first **WRITE** returns 11 the number of characters in *var1* (including, of course, the space character). The second **WRITE** returns 2, the number of substrings in *var1* using the space character as the substring delimiter.

```
SET var1="HELLO WORLD"
WRITE !,$LENGTH(var1)
WRITE !,$LENGTH(var1," ")
```

The following example returns 3, the number of substrings within the string, as delimited by the dollar sign ($) character.

```
SET STR="ABC$DEF$EFG",DELIM="$"
WRITE $LENGTH(STR,DELIM)
```

If the specified delimiter is not found in the string **$LENGTH** returns 1, because the only substring is the string itself.

The following example returns a 0 because the string tested is the null string.

```
SET Nstring = ""
WRITE $LENGTH(Nstring)
```

The following example shows the values returned when a delimiter or its string is the null string.

```
SET String = "ABC"
SET Nstring = ""
SET Delim = "$"
SET Ndelim = ""
WRITE !,$LENGTH(String,Delim)   ; returns 1
WRITE !,$LENGTH(Nstring,Delim)  ; returns 1
WRITE !,$LENGTH(String,Ndelim)  ; returns 0
WRITE !,$LENGTH(Nstring,Ndelim) ; returns 0
```

See Also

- $EXTRACT function
- $PIECE function
- $WISWIDE function

- $WLENGTH function

$LIST

Returns or replaces elements in a list.

```
$LIST(list,position,end)
$LI(list,position,end)

$LIST(list,start1:end1,start2:end2...)
$LI(list,position1:end1,position2:end2...)

SET $LIST(list,position,end)=value
SET $LI(list,position,end)=value
```

Parameters

list	An expression that evaluates to a valid list. Because lists contain encoding, *list* must be created using $LISTBUILD or $LISTFROMSTRING, or extracted from another list using **$LIST**. In **SET $LIST** syntax, *list* must be a variable or a multi-dimensional property.
position	*Optional* **$LIST(list,position,end)** syntax — An integer code specifying the starting position in *list* from which to retrieve a sublist. Permitted values are *n* (integer count from beginning of *list*), * (last element in *list*), and *-*n* (relative offset count backwards from end of *list*). **SET $LIST** syntax also supports *+*n* (relative offset integer count of elements to append beyond the end of *list*). Thus, the first element in the list is 1, the second element is 2, the last element in the list is *, and the next-to-last element is *-1. If *position* is omitted, it defaults to 1. -1 may be used in older code to specify the last element in the list. This deprecated use of -1 should not be combined with *, *-*n*, or *+*n* relative offset syntax.
end	*Optional* **$LIST(list,position,end)** syntax — A code specifying the ending position of a sublist of *list*. Can be a positive integer specifying position count from the beginning of *list* or a symbolic code counting from the end of *list*. Used with *position* and uses the same code values as *position*. If omitted, only the single element specified by *position* is returned.
start1:*end1*	*Optional* **$LIST(list,start1:end1,start2:end2)** syntax — A pair of integers specifying the starting and ending position of a range to retrieve from *list*. *start* and *end* are connected by a colon. Only positive integers counts of elements from the beginning of *list* may be specified. A range pair may include integer counts beyond the end of *list*. *start* must be less than or equal to *end*. You can specify any number of *start*:*end* range pairs as a comma-separated list. Range pairs may be specified in any order. Range pairs may overlap or may repeat *list* elements.

Description

$LIST can be used in three ways:

- To retrieve a single range of elements) from *list*. This uses the `$LIST(list,position,end)` syntax. It locates elements by offset from either the beginning or the end of *list*. It returns a single element as a string. It return a range of elements as a list.
- To retrieve multiple ranges of elements) from *list*. This uses the `$LIST(list,position1:end1,position2:end2)` syntax. It locates elements by offset from the beginning of *list*. It concatenates the ranges retrieved and returns the concatenated results as a list.

- To replace an element (or elements) within *list*. The replacement element may be the same length, longer, or shorter than the original element. This uses the `SET $LIST(list,position,end)=value` syntax.

Returning a Single Sublist

$LIST(list,position,end) syntax:

$LIST returns a single sublist of elements. This sublist can contain one or more elements. The elements returned depend on the parameters used.

- **$LIST**(*list*) returns the first element in *list* as a string.
- **$LIST**(*list*,*position*) returns the element of *list* specified by *position* as a string. The specified *position* cannot be a positive integer count beyond the end of *list* or a negative integer count before the beginning of *list*.
- **$LIST**(*list*,*position*,*end*) returns a "sublist" (an encoded list string) containing a range of elements retrieved from *list*. The range is from the specified start *position* through the specified *end* position (inclusive). If *position* and *end* specify the same element, **$LIST** returns this element as an encoded list.

  The specified *position* cannot be a positive integer count beyond the end of *list* or a negative integer count before the beginning of *list*. The specified *end* can be a positive integer count beyond the end of *list* but only the existing *list* elements are returned; no element padding is performed.

Note: **$LIST** should *not* be used in a loop structure to return multiple successive element values. While this will work, it is highly inefficient, because **$LIST** must evaluate the list from the beginning with each iteration. The $LISTNEXT function is a far more efficient way to return multiple successive element values.

Returning Multiple Sublists

$LIST(list,start1:end1,start2:end2) syntax:

$LIST retrieves multiple range sublists of elements, then concatenates them into a single returned list. You can specify one or more *start*:*end* ranges; multiple ranges are separated by a comma. The retuned value is always a list structure, even if only one element is returned.

A range pair must consist of two positive integers, paired using a colon. This specifies a range of elements counting from the beginning of *list*; the *start* and *end* values are inclusive. The *start* value must be less than or equal to the *end* value. For example, 3:4 retrieves the third and fourth elements of *list*; 3:3 retrieves the third element of *list*; 4:3 is an invalid range and is skipped over without retrieving any elements. No values other than positive integers are permitted for *start* and *end*. Elements are counted from 1, zero should be avoided. If zero is specified it is converted to 1; therefore, 1:1, 0:1, 0:0, and 1:0 all retrieve the first element of *list*.

The specified *start* and/or *end* values can be a positive integer count beyond the end of *list*. A range sublist containing that range of elements is generated; if the range includes existing *list* elements they are included in the sublist, if the range includes elements beyond the end of *list* the sublist is padded with the appropriate number of null elements. Note that ZWRITE or $LISTTOSTRING(list,,1) must be used to display results that include null elements; **WRITE** does not display null elements, **$LISTTOSTRING** (by default) generates a <NULL VALUE> error.

The most efficient use of this syntax is to specify non-overlapping range pairs in ascending order: `$LIST(mylist,2:2,4:7,10:20)`. However, comma-separated range pairs can be specified in any order. An element of *list* can be retrieved multiple times by different range pairs.

The following example retrieves four range pairs and concatenates them into a single list:

```
SET mylist=$LISTBUILD("a","b","c","d","e","f","g")
SET result=$LIST(mylist,2:2,1:4,7:9,1:2)
ZWRITE result
```

returns: `result=$lb("b","a","b","c","d","g",,,"a","b")`

Parameters

list

An encoded list string containing one or more elements. Lists can be created using **$LISTBUILD** or **$LISTFROMSTRING**, or extracted from another list by using the **$LIST** function. (The empty string ("") and certain $CHAR non-printing character combinations, such as `$CHAR(1)`, `$CHAR(2,1)`, and `$CHAR(3,1,asciicode)` can also return an encoded empty or one-element list.)

When returning an element (or elements), *list* can be a variable or an object property.

When **$LIST** is used with **SET** on the left hand side of the equals sign to replace an element (or elements), *list* can be a variable or a multidimensional property reference; it cannot be a non-multidimensional object property.

The following are valid *list* arguments:

```
SET myList = $LISTBUILD("Red","Blue","Green","Yellow")
WRITE !,$LIST(myList,2)   ; prints Blue
SET subList = $LIST(myList,2,4)
WRITE !,$LIST(subList,2)  ; prints Green
```

In the following example, *subList* is not a valid *list* argument, because it is a single element returned as an ordinary string, not an encoded list string:

```
SET myList = $LISTBUILD("Red","Blue","Green","Yellow")
SET subList = $LIST(myList,2)
WRITE $LIST(subList,1)
```

In **SET $LIST** syntax form, *list* cannot be a non-multidimensional object property.

position

The position (element count) of the list element to return (or replace). A single element is returned as a string. List elements are counted from 1. If *position* is omitted, **$LIST** returns the first element.

- If *position* is a positive integer, **$LIST** counts elements from the beginning of *list*. If *position* is greater than the number of elements in *list*, InterSystems IRIS issues a <NULL VALUE> error.
- If *position* is * (asterisk), **$LIST** returns the last element in *list*.
- If *position* is `*-n` (an asterisk followed by a negative number), **$LIST** counts elements by offset backwards from the end of *list*. Thus, *-0 is the last element in the list, *-1 is the next-to-last list element (an offset of 1 from the end). If the *position* relative offset count is equal to the number of elements in *list* (and thus specifies the 0th element), InterSystems IRIS issues a <NULL VALUE> error. If the *position* relative offset count is greater than the number of elements in *list*, InterSystems IRIS issues a <RANGE> error.
- For **SET $LIST** syntax only — If *position* is `*+n` (an asterisk followed by a positive number), **SET $LIST** appends elements by offset beyond the end of *list*. Thus, *+1 appends an element beyond the end of *list*, *+2 appends an element two positions beyond the end of *list*, padding with a null string element.
- If *position* is 0 or -0, InterSystems IRIS issues a <NULL VALUE> error.

If the *end* parameter is specified, *position* specifies the first element in a range of elements. A range of elements is always returned as an encoded list string. Even when only one element is returned (when *position* and *end* are the same number) this value is returned as an encoded list string. Thus, $LIST(x,2) is the same element, but not the same data value as $LIST(x,2,2).

end

The position of the last element in a range of elements, specified as an integer. You must specify *position* to specify *end*. If *end* is a fractional number, it is truncated to its integer part.

When *end* is specified, the value returned is an encoded list string. Because of this encoding, such strings should only be processed by other $LIST functions.

- *position* < *end*: If *end* and *position* are positive integers, and *position* < *end*, **$LIST** returns an encoded sublist containing the specified list of elements, inclusive of the *position* and *end* elements. If *position* is 0 or 1, the sublist begins with the first element in *list*. If *end* is greater than the number of elements in *list*, **$LIST** returns an encoded sublist containing all of the elements from *position* through the end of the list. If *end* is `*-n`, *position* can be a positive integer or a `*-n` value greater than or equal to this *end* position. Thus, `$LIST(fourlist,*-1,*)`, `$LIST(fourlist,*-3,*-2)`, `$LIST(fourlist,2,*-1)` are all valid sublists.
- *position* = *end*: If *end* and *position* evaluate to the same element, **$LIST** returns an encoded sublist containing that single element. For example, in a list with four elements, *end* and *position* may be identical (`$LIST(fourlist,2,2)`, `$LIST(fourlist,*,*)`, or `$LIST(fourlist,*-2,*-2)`) or they may specify the same element (`$LIST(fourlist,4,*)`, `$LIST(fourlist,3,*-1)`).
- *position* > *end*: If *position* > *end*, **$LIST** returns the null string (""). For example, in a list with four elements, `$LIST(fourlist,3,2)`, `$LIST(fourlist,7,*)`, or `$LIST(fourlist,*-1,*-2)` all return the null string.
- *position*=0, with *end*: If *end* is specified, and *position* is zero (0) or a negative offset that evaluates to position zero, *position* 0 is equivalent to 1. Therefore, if *end* evaluates to an element position greater than zero, **$LIST** returns an encoded sublist containing the elements from *position* 1 through the *end* position. If *end* also evaluates to element position zero, **$LIST** returns the null string (""), because *position* > *end*.
- For **SET $LIST** syntax only — If *end* is `*+n` (an asterisk followed by a positive number), **SET $LIST** appends a range of elements by offset beyond the end of *list*. If *position* is `*+n`, **SET $LIST** appends a range of values. If *position* is a positive integer, or `*-n` **SET $LIST** both replaces and appends values. To replace the last element and append elements, specify `SET $LIST(mylist,*+0,*+n)`. If the start of the specified range is beyond the end of *list*, the list is padded with a null string elements as needed. If *end* is larger than the supplied range of values, trailing padding is *not* performed.

Deprecated –1 Values

In older code, a *position* or *end* value of -1 represents the last element in the list. A value of -1 cannot be used with `*`, `*+n`, or `*-n` syntax.

Specifying *-n and *+n Parameter Values

When using a variable to specify `*-n` or `*+n`, you must always specify the asterisk and a sign character in the parameter itself.

The following are valid specifications of `*-n`:

```
SET count=2
SET alph=$LISTBUILD("a","b","c","d")
WRITE $LIST(alph,*-count)

SET count=-2
SET alph=$LISTBUILD("a","b","c","d")
WRITE $LIST(alph,*+count)
```

The following is a valid specification of `*+n`:

```
SET count=2
SET alph=$LISTBUILD("a","b","c","d")
SET $LIST(alph,*+count)="F"
WRITE $LISTTOSTRING(alph,"^",1)
```

Whitespace is permitted within these parameter values.

$LIST Errors

The following **$LIST** parameter values generate an error:

- If the *list* parameter does not evaluate to a valid list, **$LIST** generates a <LIST> error. You can use the $LISTVALID function to determine if a list is valid.
- If the *list* parameter evaluate to a valid list that contains a null value, or concatenates a list and a null value, **$LIST**(*list*) syntax generates a <NULL VALUE> error because this syntax is trying to return a null value as a string. All of the following are valid lists (according to $LISTVALID) for which **$LIST** generate a <NULL VALUE> error:

```
WRITE $LIST(""),!
WRITE $LIST($LB()),!
WRITE $LIST($LB(UndefinedVar)),!
WRITE $LIST($LB(,))
WRITE $LIST($LB()_$LB("a","b","c"))
```

  If the **$LIST**(*list*,*position*) syntax *position* parameter specifies a null (non-existent) element, **$LIST** generates a <NULL VALUE> error because this syntax is trying to return a null value as a string:

```
SET mylist=$LISTBUILD("A",,"C")
ZZDUMP $LIST(mylist,2)  ; generates a <NULL VALUE> error

SET mylist2=$LISTBUILD("A","B","C")
WRITE $LIST(mylist2,4) ; generates a <NULL VALUE> error
```

- If the **$LIST**(*list*,*position*) syntax specifies a *position* parameter of 0, or a negative relative offset that specifies the 0th element, **$LIST** generates a <NULL VALUE> error. If *end* is specified, 0 is a valid *position* value and is parsed as 1.
- If the `*-n` value of the *position* or *end* parameter specifies an *n* value larger than the number of element positions in *list*, **$LIST** generates a <RANGE> error.

```
SET list2=$LISTBUILD("Brown","Black")
WRITE $LIST(list2,*-2) ; generates a <NULL VALUE> error
WRITE $LIST(list2,*-3) ; generates a <RANGE> error
```

  Because `$LISTLENGTH("")` is 0, a *position* or *end* of *-1 or greater results in a <RANGE> error:

```
WRITE $LIST("",*-0)    ; generates a <NULL VALUE> error
WRITE $LIST("",*-1)    ; generates a <RANGE> error
WRITE $LIST("",0,*-1) ; generates a <RANGE> error
```

- If the value of the *position* parameter or the *end* parameter is less than -1, **$LIST** generates a <RANGE> error.

Replacing Elements Using SET $LIST

- You can use **SET $LIST**(*list*,*position*) to remove an element, replace an element's value, or append an element to the list. In this two-parameter form, you specify the new element value as a string.
- You can use **SET $LIST**(*list*,*position*,*end*) to remove one or more elements, replace one or more element values, or append one or more elements to the list. In this three-parameter form, you *must* specify the new element value(s) as an encoded list.

(**SET $LIST** does not support **$LIST(list,start1:end1,start2:end2)** syntax.)

When **$LIST** is used with **SET** on the left hand side of the equals sign, *list* can be a valid variable name. If the variable does not exist, **SET $LIST** defines it. The *list* parameter can also be a multidimensional property reference; it cannot be a non-multidimensional object property. Attempting to use **SET $LIST** on a non-multidimensional object property results in an <OBJECT DISPATCH> error.

You cannot use **SET (a,b,c,...)=value** syntax with **$LIST** (or **$PIECE** or **$EXTRACT**) on the left of the equals sign, if the function uses relative offset syntax: `*` representing the end of a string and `*-n` or `*+n` representing relative offset from the end of the string. You must instead use **SET a=value,b=value,c=value,...** syntax.

You can also use $LISTUPDATE to replace one or more elements in a list or append element to a list by element position. **$LISTUPDATE** replaces list elements, performing a boolean test for each element replacement. Unlike **SET $LIST**, **$LISTUPDATE** does not modify the initial list, but returns a copy of that list with the specified element replacements.

Two Parameter Operations

You can perform the following two-parameter operations. Note that two-parameter operations specify an element value as a string. Specifying an element value as a list creates a sublist within the list.

- Replace one element value with a new value:

```
SET $LIST(fruit,2)="orange"   ; count from beginning of list
SET $LIST(fruit,*)="pear"     ; element at end of list
SET $LIST(fruit,*-2)="peach"  ; offset from end of list
```

- Remove an element value (this sets the value to the null string; it does not remove the element position):

```
SET $LIST(fruit,2)=""
```

- Append an element to a list. You can append to the end of the list, or to a location past the end of the list, by using `*+n` syntax. **SET $LIST** inserts null value elements as needed to pad to the specified position:

```
SET $LIST(fruit,*+1)="plum"
```

- Replace one element with a sublist of elements:

```
SET $LIST(fruit,3)=$LISTBUILD("orange","banana")
```

Three Parameter Operations

You can perform the following three-parameter (range) operations. Note that range operations specify an element values as a list, even when specifying a single element value.

- Replace one element with several elements:

```
SET $LIST(fruit,3,3)=$LISTBUILD("orange","banana")
```

- Replace a range of element values with the same number of new values:

```
SET $LIST(fruit,2,3)=$LISTBUILD("orange","banana")
```

- Replace a range of element values with a larger or smaller number of new values:

```
SET $LIST(fruit,2,3)=$LISTBUILD("orange","banana","peach")
```

- Remove a range of element values (this sets the element values to the null string; it does not remove the element positions):

```
SET $LIST(fruit,2,3)=$LISTBUILD("","")
```

- Remove a range of element values and their positions:

```
SET $LIST(fruit,2,3)=""
```

- Append a range of element to a list. You can append to the end of the list, or to a location past the end of the list, by using `*+n` syntax. **SET $LIST** inserts null value elements as needed to pad to the specified position:

```
SET $LIST(fruit,*+1,*+2)=$LISTBUILD("plum","pear")
```

  SET $LIST only appends the specified element values. If the *end* position is larger than the specified elements, empty trailing element positions are *not* created.

Examples

Examples of Returning Elements with $LIST

The following examples use the 2-parameter form of **$LIST** to return a list element as a string:

The following two **$LIST** statements return “Red”, the first element in the list. The first returns the first element by default, the second returns the first element because the *position* parameter is set to 1. The value is returned as a string:

```
SET colorlist=$LISTBUILD("Red","Orange","Yellow","Green","Blue","Violet")
WRITE $LIST(colorlist),!
WRITE $LIST(colorlist,1)
```

The following two **$LIST** statements return “Orange”, the second element in the list. The first counts from the beginning of the list, the second counts backwards from the end of the list. The value is returned as a string:

```
SET colorlist=$LISTBUILD("Red","Orange","Yellow","Green","Blue","Violet")
WRITE $LIST(colorlist,2),!
WRITE $LIST(colorlist,*-4)
```

The following examples use the 3-parameter form of **$LIST** to return one or more elements as an encoded list string. Because a list contains non-printing encoding character, you must use **$LISTTOSTRING** to convert the sublist to a printable string.

The following two **$LIST** statements return “Blue”, the fifth element in the list as an encoded list string. The first counts from the beginning of the list, the second counts backwards from the end of the list. Because the element is specified as a range, it is retrieved as a list consisting of one element:

```
SET colorlist=$LISTBUILD("Red","Orange","Yellow","Green","Blue","Violet")
WRITE $LISTTOSTRING($LIST(colorlist,5,5))
WRITE $LISTTOSTRING($LIST(colorlist,*-1,*-1))
```

The following example returns “Red Orange Yellow”, a three-element list string beginning with the first element and ending with the third element in the list:

```
SET colorlist=$LISTBUILD("Red","Orange","Yellow","Green","Blue","Violet")
WRITE $LISTTOSTRING($LIST(colorlist,1,3))
```

The following example returns “Green Blue Violet”, a three-element list string beginning with the fourth element and ending with the last element in the list:

```
SET colorlist=$LISTBUILD("Red","Orange","Yellow","Green","Blue","Violet")
WRITE $LISTTOSTRING($LIST(colorlist,4,*))
```

The following example returns a list element from a property:

```
SET cfg=##class(%iKnow.Configuration).%New("Trilingual",1,$LB("en","fr","es"))
WRITE $LIST(cfg.Languages,2)
```

Examples of Replacing, Removing, or Appending Elements with SET $LIST

The following example shows `SET $LIST` replacing the second element:

```
SET fruit=$LISTBUILD("apple","onion","banana","pear")
WRITE !,$LISTTOSTRING(fruit,"/")
SET $LIST(fruit,2)="orange"
WRITE !,$LISTTOSTRING(fruit,"/")
```

The following example shows `SET $LIST` replacing the second and third elements:

```
SET fruit=$LISTBUILD("apple","potato","onion","pear")
WRITE !,$LISTTOSTRING(fruit,"/")
SET $LIST(fruit,2,3)=$LISTBUILD("orange","banana")
WRITE !,$LISTTOSTRING(fruit,"/")
```

The following example shows `SET $LIST` replacing the second and third elements with four elements:

```
SET fruit=$LISTBUILD("apple","potato","onion","pear")
WRITE !,$LISTTOSTRING(fruit,"/")
SET $LIST(fruit,2,3)=$LISTBUILD("orange","banana","peach","tangerine")
WRITE !,$LISTTOSTRING(fruit,"/")
```

The following example shows `SET $LIST` appending an element to the end of the list:

```
SET fruit=$LISTBUILD("apple","orange","banana","peach")
WRITE $LL(fruit)," ",$LISTTOSTRING(fruit,"/",1),!
SET $LIST(fruit,*+1)="pear"
WRITE $LL(fruit)," ",$LISTTOSTRING(fruit,"/",1)
```

The following example shows `SET $LIST` appending an element three positions past the end of the list:

```
SET fruit=$LISTBUILD("apple","orange","banana","peach")
WRITE $LL(fruit)," ",$LISTTOSTRING(fruit,"/",1),!
SET $LIST(fruit,*+3)="tangerine"
WRITE $LL(fruit)," ",$LISTTOSTRING(fruit,"/",1)
```

The following four examples show `SET $LIST` using *-n syntax to replace elements by offset from the end of the list. Note that `SET $LIST(x,*-n)` and `SET $LIST(x,n,*-n` perform different operations: `SET $LIST(x,*-n)` replaces the *value* of the specified element; `SET $LIST(x,n,*-n)` deletes the specified range of elements, then appends the specified list.

To replace the next-to-last element with a single value, use `SET $LIST(x,*-1)`:

```
SET fruit=$LISTBUILD("apple","banana","orange","potato","pear")
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
SET $LIST(fruit,*-1)="peach"
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
```

To remove a single element by offset from the end of the list, use `SET $LIST(x,*-n,*-n)=""`:

```
SET fruit=$LISTBUILD("apple","banana","orange","potato","pear")
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
SET $LIST(fruit,*-1,*-1)=""
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
```

To replace a single element by offset from the end of the list with a list of elements, use `SET $LIST(x,*-n,*-n)=list`:

```
SET fruit=$LISTBUILD("apple","banana","potato","orange","pear")
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
SET $LIST(fruit,*-2,*-2)=$LISTBUILD("peach","plum","quince")
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
```

To replace a single element by offset from the end of the list with a sublist, use `SET $LIST(x,*-n)=list`:

```
SET fruit=$LISTBUILD("apple","banana","potato","orange","pear")
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
SET $LIST(fruit,*-2)=$LISTBUILD("peach","plum","quince")
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
```

The following example shows `SET $LIST` removing elements from the list, beginning with the third element through the end of the list:

```
SET fruit=$LISTBUILD("apple","orange","onion","peanut","potato")
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
SET $LIST(fruit,3,*)=""
WRITE !,"list length is ",$LISTLENGTH(fruit)," "
WRITE $LISTTOSTRING(fruit,"/")
```

Notes

Unicode

If one Unicode character appears in a list element, that entire list element is represented as Unicode (wide) characters. Other elements in the list are not affected.

The following example shows two lists. The *y* list consists of two elements which contain only ASCII characters. The *z* list consists of two elements: the first element contains a Unicode character ($CHAR(960) = the pi symbol); the second element contains only ASCII characters.

```
SET y=$LISTBUILD("ABC"_$CHAR(68),"XYZ")
SET z=$LISTBUILD("ABC"_$CHAR(960),"XYZ")
WRITE !,"The ASCII list y elements: "
ZZDUMP $LIST(y,1)
ZZDUMP $LIST(y,2)
WRITE !,"The Unicode list z elements: "
ZZDUMP $LIST(z,1)
ZZDUMP $LIST(z,2)
```

Note that InterSystems IRIS encodes the first element of *z* entirely in wide Unicode characters. The second element of *z* contains no Unicode characters, and thus InterSystems IRIS encodes it using narrow ASCII characters.

$LIST Compared with $EXTRACT and $PIECE

$LIST determines an element from an encoded list by counting elements (not characters) from the beginning (or end) of the list.

$EXTRACT determines a substring by counting characters from the beginning (or end) of a string. **$EXTRACT** takes as input an ordinary character string.

$PIECE determines a substring by counting user-defined delimiter characters within the string. **$PIECE** takes as input an ordinary character string containing multiple instances of a character (or string) intended for use as a delimiter.

$LIST cannot be used on ordinary strings. **$PIECE** and **$EXTRACT** cannot be used on encoded lists.

See Also

- $LISTBUILD function
- $LISTDATA function
- $LISTFIND function
- $LISTFROMSTRING function
- $LISTGET function
- $LISTLENGTH function
- $LISTNEXT
- $LISTSAME function
- $LISTTOSTRING function
- $LISTUPDATE function
- $LISTVALID function

$LISTBUILD

Builds a list of elements from the specified expressions.

```
$LISTBUILD(element,...)
$LB(element,...)

SET $LISTBUILD(var1,var2,...)=list
SET $LB(var1,var2,...)=list
```

Parameters

element	An expression that specifies a list element value. Can be a single expression or an expression in a comma-separated list of expressions. A placeholder comma can be specified for an omitted element.
var	A variable, specified as a single variable or as a variable in a comma-separated list of variables. A placeholder comma can be specified for an omitted variable. A *var* may be a variable of any type: local, process-private, or global, unsubscripted or subscripted.
list	An expression that evaluates to a valid list. Because lists contain encoding, *list* must be created using **$LISTBUILD** or $LISTFROMSTRING, or extracted from another list using $LIST.

Description

$LISTBUILD has two syntax forms: **$LISTBUILD** and **SET $LISTBUILD**:

- **$LISTBUILD(element1,element2,...)** takes one or more expressions and returns an encoded list structure with one element for each expression. Elements are placed in the list in the order specified. Elements are counted from 1.
- **SET $LISTBUILD(var1,var2,...)=list** extracts multiple elements from a list into variables. It is similar to **SET $LISTGET(var1,var2,...)=list**. They differ in how they handle variables that are not assigned an explicit value: **SET $LISTGET** defines these variables (thus avoiding an <UNDEFINED> error), and assigns them the empty string (null value, overwriting any prior value. **SET $LISTBUILD** does not define these variables; if the variable had no prior value it generates an <UNDEFINED> error, if the variable had a prior value, this value is preserved.

$LISTBUILD(element1,element2,...)

The following functions can be used to create a list:

- **$LISTBUILD**, which creates a list from multiple data items (strings or numerics), one list element per data item. **$LISTBUILD** can also be used to create list elements containing no data.
- **$LISTFROMSTRING**, which creates a list from a single string containing multiple delimited elements.
- **$LIST**, which extracts a sublist from an existing list.
- The null string ("") is also considered to be a valid list. The null string ("") is used to represent a null list, a list containing no elements. Because it contains no list elements, `$LISTLENGTH("")` returns an element count of 0.
- Certain $CHAR non-printing character combinations, such as `$CHAR(1)`, `$CHAR(2,1)`, and `$CHAR(3,1,asciicode)` can also return an encoded empty or one-element list.

You can use the $LISTVALID function to determine if an expression is a valid list.

$LISTBUILD is used with the other $LIST functions: **$LISTDATA**, **$LISTFIND**, **$LISTGET**, **$LISTNEXT**, **$LISTLENGTH**, **$LISTSAME**, and **$LISTTOSTRING**.

If one or more characters in a list element is a wide (Unicode) character, all characters in that element are represented as wide characters. To ensure compatibility across systems, **$LISTBUILD** always stores these bytes the same way, regardless of the hardware platform. Wide characters are represented as byte strings.

Note: **$LISTBUILD** and the other $LIST functions use an optimized binary representation to store data elements. For this reason, equivalency tests may not work as expected when comparing encoded lists. Data that might, in other contexts, be considered equivalent, may have a different internal representation. For example, **$LISTBUILD(1)** is not equal to **$LISTBUILD("1")** and **$LISTBUILD(1.0)** is not equal to **$LISTBUILD(1)**. However, list display functions, such as **$LIST** and **$LISTTOSTRING** return numeric list element values in canonical form. Therefore `$LIST($LISTBUILD(1),1)=$LIST($LISTBUILD("1"),1)`.

For the same reason, an encoded list value returned by **$LISTBUILD** should not be used in character search and parse functions that use a delimiter character, such as **$PIECE** and the two-argument form of **$LENGTH**. Elements in a list created by **$LISTBUILD** are not marked by a character delimiter, and thus can contain any character.

SET $LISTBUILD

When used on the *left side of the equal sign* in a **SET** command, the **$LISTBUILD** function extracts multiple elements from a list as a single operation. The syntax is as follows:

```
SET $LISTBUILD(var1,var2,...)=list
```

The *var* arguments of **SET $LISTBUILD** are a comma-separated list of variables, each of which is set to the value of the *list* element in the corresponding position. Thus, *var1* is set to the value of the first *list* element, *var2* is set to the value of the second *list* element, and so forth. The *var* arguments do not have to be existing variables; the variable is defined when **SET $LISTBUILD** assigns it a value.

- The number of *var* arguments may be less than or greater than the number of *list* elements. Unspecified *var* values retain their prior value; if previously undefined they remain undefined. Compare this behavior with SET $LISTGET. Excess *list* elements are ignored.
- The *var* arguments and/or the *list* elements may contain omitted values, represented by placeholder commas. An omitted *var* argument is undefined. An omitted *list* element causes the corresponding *var* value to retain its prior value; if previously undefined it remains undefined. Compare this behavior with SET $LISTGET.

SET $LISTBUILD is an atomic operation. The maximum number of *var* arguments is 1024. Attempting to exceed this number results in a <SYNTAX> error.

If a *var* argument is an object property (object.property) the property must be multidimensional. Any property may be referenced as an i%property instance variable within an object method.

In the following examples, **$LISTBUILD** (on the right side of the equal sign) creates a list with four elements.

In the following example, **SET $LISTBUILD** extracts the first two elements from a list into two variables:

```
SET colorlist=$LISTBUILD("red","blue","green","white")
SET $LISTBUILD(a,b)=colorlist
WRITE "a=",a," b=",b   /* a="red" b="blue" */
```

In the following example, **SET $LISTBUILD** extracts elements from a list into five variables. Because the specified *list* does not have a 5th element, the corresponding *var* variable (*e*) contains its prior value:

```
SET (a,b,c,d,e)=0
SET colorlist=$LISTBUILD("red","blue","green","white")
SET $LISTBUILD(a,b,c,d,e)=colorlist
WRITE "a=",a," b=",b," c=",c," d=",d," e=",e
/* a="red" b="blue" c="green" d="white" e=0 */
```

In the following example, **SET $LISTBUILD** extracts elements from a list into four variables. Because the specified *list* does not have a 3rd element, the corresponding *var* variable (*c*) contains its prior value:

```
SET (a,b,c,d)=0
SET colorlist=$LISTBUILD("red","blue",,"white")
SET $LISTBUILD(a,b,c,d)=colorlist
WRITE "a=",a," b=",b," c=",c," d=",d
/* a="red" b="blue" c=0 d="white" */
```

In the following example, **SET $LISTBUILD** extracts elements from a list into four variables. Because the 3rd *list* element value is a nested list, the corresponding *var* variable (*c*) contains a list value:

```
SET (a,b,c,d)=0
SET colorlist=$LISTBUILD("red","blue",$LISTBUILD("green","yellow"),"white")
SET $LISTBUILD(a,b,c,d)=colorlist
WRITE "a=",a," b=",b," c=",c," d=",d
/* a="red" b="blue" c=$LB("green","yellow") d="white" */
```

Examples

Many of the examples shown here use the $LISTTOSTRING function to convert the **$LISTBUILD** return value for display; **$LISTBUILD** returns an encoded string that cannot be displayed directly.

The following example produces the three-element list "Red,Blue,Green":

```
SET colorlist=$LISTBUILD("Red","Blue","Green")
WRITE $LISTTOSTRING(colorlist,"^")
```

The following example creates a list of six numeric elements that display as "3^0^44^5.6^33^400". Note that **$LISTBUILD** encodes numeric element values based on an optimized binary representation, which may not be the same as canonical form. List display functions such as **$LIST** and **$LISTTOSTRING** return numeric element values in canonical form:

```
SET numlist=$LISTBUILD(003,0.00,44.0000000,5.6,+33,4E2)
WRITE $LISTTOSTRING(numlist,"^")
```

Omitting Elements

Omitting an element expression defines an encoded element, but the data value of that element is undefined.

In the following example, the **$LISTBUILD** statements both produce a valid three-element list whose second element has an undefined value. Omitting an element and specifying an undefined variable for an element produces exactly the same result. **$LISTBUILD** can take an undefined variable as a list element without generating an error and the resulting list passes the **$LISTVALID** test. However, referencing an undefined list element with a list function such as **$LIST** or **$LISTTOSTRING** generates a <NULL VALUE> error:

```
KILL a
SET list1=$LISTBUILD("Red",,"Green")
SET list2=$LISTBUILD("Red",a,"Green")
WRITE "List lengths:",$LISTLENGTH(list1)," ",$LISTLENGTH(list2),!
IF $LISTVALID(list1)=1,$LISTVALID(list2)=1 {
   WRITE "These are valid lists",! }
IF list1=list2 {WRITE "and they're identical"}
ELSE {WRITE "They're not identical"}
```

The following example shows that an undefined element can be specified at the end of a list, as well as within a list. A list with trailing undefined elements is a valid list. However, referencing this undefined element with any list function generates a <NULL VALUE> error:

```
KILL z
SET list3=$LISTBUILD("Red",)
SET list4=$LISTBUILD("Red",z)
WRITE "List lengths:",$LISTLENGTH(list3)," ",$LISTLENGTH(list4),!
IF $LISTVALID(list3)=1,$LISTVALID(list4)=1 {
   WRITE "These are valid lists",! }
IF list3=list4 {WRITE "and they're identical"}
ELSE {WRITE "They're not identical"}
```

However, the following example produces a three-element list whose second element has a data value: the empty string. No error condition occurs when referencing the second element:

```
SET list5=$LISTBUILD("Red","","Green")
SET list5len=$LISTLENGTH(list5)
WRITE "List length: ",list5len,!
FOR i=1:1:list5len {
   WRITE "Element ",i," value: ",$LIST(list5,i),! }
```

Lists with No Data or Null String Data

Any list created using **$LISTBUILD** contains at least one encoded list element. That element may or may not contain data. Because **$LISTLENGTH** counts elements, not data, any list created using **$LISTBUILD** has a list length of at least 1.

Referencing a **$LISTBUILD** element whose data value is undefined generates a <NULL VALUE> error. The following are all valid **$LISTBUILD** statements that create “empty” lists. However, attempting to reference an element is such a list results in a <NULL VALUE> error:

```
TRY {
  SET x=$LISTBUILD(UndefinedVar)
  SET y=$LISTBUILD(,)
  SET z=$LISTBUILD()
  IF $LISTVALID(x)=1,$LISTVALID(y)=1,$LISTVALID(z)=1 {
     WRITE "These are valid lists",! }
  WRITE "$LB(UndefinedVar) contains ",$LISTLENGTH(x)," elements",!
  WRITE "$LB(,) contains ",$LISTLENGTH(y)," elements",!
  WRITE "$LB() contains ",$LISTLENGTH(z)," elements",!
  /* Attempt to use null lists */
  WRITE "$LB(UndefinedVar) list value ",$LISTTOSTRING(x,"^"),!
  WRITE "$LB(,) list value ",$LISTTOSTRING(y,"^"),!
  WRITE "$LB() list value ",$LISTTOSTRING(z,"^"),!
}
  CATCH exp { WRITE !!,"In the CATCH block",!
        IF 1=exp.%IsA("%Exception.SystemException") {
           WRITE "System exception",!
           WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
           WRITE "Location: ",exp.Location,!
           WRITE "Code: "
         }
         ELSE { WRITE "Some other type of exception",! RETURN }
           WRITE exp.Code,!
           WRITE "Data: ",exp.Data,!
           RETURN
  }
```

The following are valid **$LISTBUILD** statements that create a list element that contains data, though this data has a null string value:

```
SET x=$LISTBUILD("")
  WRITE "list contains ",$LISTLENGTH(x)," elements",!
  WRITE "list value is ",$LISTTOSTRING(x,"^"),!
SET y=$LISTBUILD($CHAR(0))
  WRITE "list contains ",$LISTLENGTH(y)," elements",!
  WRITE "list value is ",$LISTTOSTRING(y,"^")
```

Nesting Lists

An element of a list may itself be a list. For example, the following statement produces a three-element list whose third element is the two-element list, "Walnut,Pecan":

```
SET nlist=$LISTBUILD("Apple","Pear",$LISTBUILD("Walnut","Pecan"))
  WRITE "Nested list length is ",$LISTLENGTH($LIST(nlist,3)),!
  WRITE "Full list length is ",$LISTLENGTH(nlist),!
  WRITE "List is ",$LISTTOSTRING(nlist,"^"),!
```

Concatenating Lists

The result of concatenating two lists with the Concatenate operator (_) is a list that combines the two lists.

In the following example, concatenating two lists creates a list that is identical to a list with the same elements created using **LISTBUILD**:

```
SET list1=$LISTBUILD("A","B")
SET list2=$LISTBUILD("C","D","E")
SET clist=list1_list2
SET list=$LISTBUILD("A","B","C","D","E")
  IF clist=list {WRITE "they're identical",!}
  ELSE {WRITE "they're not identical",!}
WRITE "concatenated ",$LISTTOSTRING(clist,"^"),!
WRITE "same list as ",$LISTTOSTRING(list,"^")
```

You cannot concatenate a string to a list. Attempting to do so generates a <LIST> error the first time you attempt to access the result:

```
TRY {
SET list=$LISTBUILD("A","B")_"C"
  WRITE "$LISTBUILD completed without error",!
SET listlen=$LISTLENGTH(list)
  WRITE "$LISTLENGTH completed without error",!
SET listval=$LISTTOSTRING(list,"^")
   WRITE "$LISTTOSTRING completed without error",!
}
CATCH exp { WRITE !!,"In the CATCH block",!
     IF 1=exp.%IsA("%Exception.SystemException") {
        WRITE "System exception",!
        WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
        WRITE "Location: ",exp.Location,!
        WRITE "Code: "
     }
     ELSE { WRITE "Some other type of exception",! RETURN }
     WRITE exp.Code,!
     WRITE "Data: ",exp.Data,!
     RETURN
}
```

For further details on concatenation, see Operators in *Using ObjectScript*.

See Also

- SET command
- ZZDUMP command
- $LIST function
- $LISTDATA function
- $LISTFIND function
- $LISTFROMSTRING function
- $LISTGET function
- $LISTLENGTH function
- $LISTNEXT
- $LISTSAME function
- $LISTTOSTRING function
- $LISTUPDATE function
- $LISTVALID function

$LISTDATA

Indicates whether the specified element exists and has a data value.

```
$LISTDATA(list,position,var)
$LD(list,position,var)
```

Parameters

list	An expression that evaluates to a valid list.
position	*Optional* — An expression interpreted as a position in the specified list. Either a positive, non-zero integer or -1.
var	*Optional* — A variable that contains the element value at the specified list position. If **$LISTDATA** returns a value of a 1, *var* is written; if **$LISTDATA** returns a value of a 0, *var* is unchanged.

Description

$LISTDATA checks for data in the requested element in a list and returns a boolean value. **$LISTDATA** returns a value of 1 if the element indicated by the *position* parameter is in the *list* and has a data value. **$LISTDATA** returns a value of a 0 if the element is not in the *list* or does not have a data value.

Optionally, **$LISTDATA** can write the element value to the *var* variable.

Note: **$LISTDATA** should *not* be used in a loop structure to return multiple successive element values. While this will work, it is highly inefficient, because **$LISTDATA** must evaluate the list from the beginning with each iteration. The $LISTNEXT function is a far more efficient way to return multiple successive element values.

Parameters

list

A *list* is an encoded string containing multiple elements. A *list* must have been created using $LISTBUILD or $LISTFROMSTRING, or extracted from another list using **$LIST**.

You can use the $LISTVALID function to determine if an expression is a valid list. If the expression in the *list* parameter does not evaluate to a valid list, a <LIST> error occurs. If a valid list contains no data at the specified position, **$LISTDATA** returns 0.

position

The integer position of the element in the list, counting from 1. If you omit the *position* parameter, **$LISTDATA** evaluates the first element. If the value of the *position* parameter is -1, it is equivalent to specifying the final element of the list.

$LISTDATA returns 0 if *position* refers to a nonexistent list member. A *position* of 0 always returns 0. If the value of *position* is less than -1, invoking the **$LISTDATA** function generates a <RANGE> error.

var

If **$LISTDATA** returns a value of a 1, InterSystems IRIS writes the value of the requested element to *var*. If **$LISTDATA** returns a value of a 0, *var* is unchanged. The *var* parameter can be a local, global, or process-private global variable, with or without subscripts. It does not need to be defined; the first call to **$LISTDATA** that returns 1 defines and sets *var*. If the first call to **$LISTDATA** returns 0, *var* remains undefined.

The *var* parameter cannot be a non-multidimensional object property. Attempting to write a value to a non-multidimensional object property results in an <OBJECT DISPATCH> error.

The *var* parameter cannot be a special variable. Attempting to write a value to a special variable results in a <SYNTAX> error.

Examples

The following two examples show the results of the various values of the *position* parameter.

The following **$LISTDATA** statements return a value of 0:

```
KILL y
SET x=$LISTBUILD("Red",,y,"","Green",)
WRITE !,$LISTDATA(x,2)  ; second element is undefined
WRITE !,$LISTDATA(x,3)  ; third element is a killed variable
WRITE !,$LISTDATA(x,-1) ; the last element is undefined
WRITE !,$LISTDATA(x,0)  ; the 0th position
WRITE !,$LISTDATA(x,6)  ; 6th position in 5-element list
```

The following **$LISTDATA** statements return a value of 1:

```
SET x=$LISTBUILD("Red",,y,"","Green",)
WRITE !,$LISTDATA(x)    ; first element (by default)
WRITE !,$LISTDATA(x,1)  ; first element specified
WRITE !,$LISTDATA(x,4)  ; fourth element, value=null string
WRITE !,$LISTDATA(x,5)  ; fifth element
```

The following 3-parameter **$LISTDATA** statement tests for the presence of an element value and updates the *evalue* variable with that value. Note that when **$LISTDATA** returns 0, *evalue* remains unchanged:

```
SET x=$LISTBUILD("Red",,y,"","Green",)
FOR i=1:1:$LISTLENGTH(x) {
   WRITE "element ",i," data? ",$LISTDATA(x,i,evalue)," value ",evalue,!
}
WRITE i," list elements"
```

All of the following **$LISTDATA** statements return a value of 0:

```
WRITE !,$LISTDATA($LB())             ; null list
WRITE !,$LISTDATA($LB(UndefinedVar)) ; null list
WRITE !,$LISTDATA("")        ; null string is a valid list
                             ; but contain no data
WRITE !,$LISTDATA($LB(,))    ; two-element null list
```

The following **$LISTDATA** statements return a value of 1:

```
WRITE !,$LISTDATA($LB(""))        ; data is null string
WRITE !,$LISTDATA($LB($CHAR(0))) ; data is non-display character
```

See Also

- $LISTfunction
- $LISTBUILD function
- $LISTFIND function
- $LISTFROMSTRING function
- $LISTGET function
- $LISTLENGTH function
- $LISTNEXT
- $LISTSAME function
- $LISTTOSTRING function

- $LISTUPDATE function
- $LISTVALID function

$LISTFIND

Searches a specified list for the requested value.

```
$LISTFIND(list,value,startafter)
$LF(list,value,startafter)
```

Parameters

list	An expression that evaluates to a valid list. A list is an encoded string containing one or more elements. A list must be created using $LISTBUILD or $LISTFROMSTRING, or extracted from another list using **$LIST**.
value	An expression containing the desired element value.
startafter	*Optional* — An integer expression interpreted as a list position. The search starts with the element after this position; thus 0 means to start with position 1, 1 means to start with position 2. *startafter*=-1 is a valid value, but always returns no match. Only the integer portion of the *startafter* value is used.

Description

$LISTFIND searches the specified *list* for the first instance of the requested *value*. A match must be exact and consist of the full element value. Letter comparisons are case-sensitive. Numbers are compared in canonical form. If an exact match is found, **$LISTFIND** returns the position of the matching element. If *value* is not found, **$LISTFIND** returns a 0.

The search begins with the element after the position indicated by the *startafter* parameter. If you omit the *startafter* parameter, **$LISTFIND** assumes a *startafter* value of 0 and starts the search with the first element (element 1).

If no match is found, **$LISTFIND** returns a 0. **$LISTFIND** will also return a 0 if the value of the *startafter* parameter refers to a nonexistent list member.

You can use the $LISTVALID function to determine if *list* is a valid list. If *list* is not a valid list, the system generates a <LIST> error.

If the value of the *startafter* parameter is less than -1, invoking the **$LISTFIND** function generates a <RANGE> error.

Empty Strings and Empty Lists

The **$LISTFIND** function can be used to locate an empty string value, as shown in the following example:

```
  SET x=$LISTBUILD("A","","C","D")
  WRITE $LISTFIND(x,"")   ; returns 2
```

$LISTFIND can be used with lists containing omitted elements, but cannot be used to locate an omitted element. The following example finds a value in a list with omitted elements:

```
  SET x=$LISTBUILD("A",,"C","D")
 WRITE $LISTFIND(x,"C")   ; returns 3
```

The following **$LISTFIND** example returns 1:

```
 WRITE $LISTFIND($LB(""),"")   ; returns 1
```

The following **$LISTFIND** examples returns 0:

```
 WRITE $LISTFIND("",""),!     ; returns 0
 WRITE $LISTFIND($LB(),""),!  ; returns 0
```

The following examples *list* consists of an empty list concatenated to a list containing data. Prepending the empty list changes the list position of elements in the resulting concatenated list:

```
SET x=$LISTBUILD("A","B","C","D")
WRITE $LISTFIND(x,"B"),!          ; returns 2
WRITE $LISTFIND(""_x,"B"),!       ; returns 2
WRITE $LISTFIND($LB()_x,"B"),!    ; returns 3
WRITE $LISTFIND($LB(,,,)_x,"B")   ; returns 6
```

However, concatenating a null string to *value* has no effect on **$LISTFIND**:

```
SET x=$LISTBUILD("A","B","C","D")
WRITE $LISTFIND(x,"B"),!       ; returns 2
WRITE $LISTFIND(x,"B"_""),!    ; returns 2
WRITE $LISTFIND(x,""_"B"),!    ; returns 2
```

Examples

The following example returns 2, the position of the first occurrence of the requested string:

```
SET x=$LISTBUILD("A","B","C","D")
WRITE $LISTFIND(x,"B")
```

The following example returns 0, indicating the requested string was not found:

```
SET x=$LISTBUILD("A","B","C","D")
WRITE $LISTFIND(x,"E")
```

The following examples show the effect of using the *startafter* parameter. The first example does not find the requested string and returns 0 because the string occurs at the *startafter* position:

```
SET x=$LISTBUILD("A","B","C","D")
WRITE $LISTFIND(x,"B",2)
```

The second example finds the second occurrence of the requested string and returns 4, because the first occurs before the *startafter* position:

```
SET y=$LISTBUILD("A","B","C","A")
WRITE $LISTFIND(y,"A",2)
```

The **$LISTFIND** function only matches complete elements. Thus, the following example returns 0 because no element of the list is equal to the string “B”, though all of the elements contain “B”:

```
SET mylist = $LISTBUILD("ABC","BCD","BBB")
WRITE $LISTFIND(mylist,"B")
```

The following numeric examples all return 0, because numbers are converted to canonical form before matching. In these cases, the string numeric value and the canonical form number do not match:

```
SET y=$LISTBUILD("1.0","+2","003","2*2")
WRITE $LISTFIND(y,1.0),!
WRITE $LISTFIND(y,+2),!
WRITE $LISTFIND(y,003),!
WRITE $LISTFIND(y,4)
```

The following numeric examples match because numeric values are compared in their canonical forms:

```
SET y=$LISTBUILD(7.0,+6,005,2*2)
WRITE $LISTFIND(y,++7.000),!   ; returns 1
WRITE $LISTFIND(y,0006),!      ; returns 2
WRITE $LISTFIND(y,8-3),!       ; returns 3
WRITE $LISTFIND(y,--4.0)       ; returns 4
```

The following examples all return 0, because the specified *startafter* value results in no match:

```
SET y=$LISTBUILD("A","B","C","D")
WRITE $LISTFIND(y,"A",1),!
WRITE $LISTFIND(y,"B",2),!
WRITE $LISTFIND(y,"B",99),!
WRITE $LISTFIND(y,"B",-1)
```

The following example shows how **$LISTFIND** can be used to find a nested list. Note that InterSystems IRIS treats a multi-element nested list as a single list element with a list value:

```
SET y=$LISTBUILD("A",$LB("x","y"),"C","D")
WRITE $LISTFIND(y,$LB("x","y"))
```

See Also

- $LIST function
- $LISTBUILD function
- $LISTDATA function
- $LISTFROMSTRING function
- $LISTGET function
- $LISTLENGTH function
- $LISTNEXT
- $LISTSAME function
- $LISTTOSTRING function
- $LISTUPDATE function
- $LISTVALID function

$LISTFROMSTRING

Creates a list from a string.

```
$LISTFROMSTRING(string,delimiter)
$LFS(string,delimiter)
```

Parameters

string	A string to be converted into an InterSystems IRIS list. This string contains one or more elements, separated by a *delimiter*. The *delimiter* does not become part of the resulting InterSystems IRIS list.
delimiter	*Optional* — The delimiter used to separate substrings (elements) in *string*. Specify *delimiter* as a quoted string. If no *delimiter* is specified, the default is the comma (,) character.

Description

$LISTFROMSTRING takes a quoted string containing delimited elements and returns a list. A list represents data in an encoded format which does not use delimiter characters. Thus a list can contain all possible characters, and is ideally suited for bitstring data. Lists are handled using the ObjectScript **$LIST** functions.

You can use the ZWRITE command to display a list in non-encoded format.

Parameters

string

A string literal (enclosed in quotation marks), a numeric, or a variable or expression that evaluates to a string. This string can contain one or more substrings (elements), separated by a *delimiter*. The string data elements must not contain the *delimiter* character (or string), because the *delimiter* character is not included in the output list.

delimiter

A character (or string of characters) used to delimit substrings within the input string. It can be a numeric or string literal (enclosed in quotation marks), the name of a variable, or an expression that evaluates to a string.

Commonly, a delimiter is a designated character which is never used within string data, but is set aside solely for use as a delimiter separating substrings. A delimiter can also be a multi-character string, the individual characters of which can be used within string data.

If you specify no delimiter, the default delimiter is the comma (,) character. You cannot specify a null string ("") as a delimiter; attempting to do so results in a <STRINGSTACK> error.

Example

The following example takes a string of names which are separated by a blank space, and creates a list:

```
SET namestring="Deborah Noah Martha Bowie"
SET namelist=$LISTFROMSTRING(namestring," ")
WRITE !,"1st element: ",$LIST(namelist,1)
WRITE !,"2nd element: ",$LIST(namelist,2)
WRITE !,"3rd element: ",$LIST(namelist,3)
```

See Also

- $LISTTOSTRING function
- $LISTBUILD function

- $LIST function
- $PIECE function
- $LISTDATA function
- $LISTFIND function
- $LISTGET function
- $LISTLENGTH function
- $LISTNEXT function
- $LISTSAME function
- $LISTUPDATE function
- $LISTVALID function

$LISTGET

Returns an element in a list, or a specified default value if the requested element is undefined.

```
$LISTGET(list,position,default)
$LG(list,position,default)

SET $LISTGET(var1,var2,...)=list
SET $LG(var1,var2,...)=list
```

Parameters

list	An expression that evaluates to a valid list.
position	*Optional* — An integer code specifying the starting position in *list*. Permitted values are *n* (count from beginning of *list*), * (last element in *list*), and *-*n* (relative offset count backwards from end of *list*). Thus, the first element in the list is 1, the second element is 2, the last element in the list is *, and the next-to-last element is *-1. If *position* is a fractional number, it is truncated to its integer part. If *position* is omitted, it defaults to 1. -1 may be used in older code to specify the last element in the list. This deprecated use of -1 should not be combined with * or *-*n* relative offset syntax.
default	*Optional* — An expression that provides the value to return if the list element has an undefined value. If *default* is omitted, it defaults to the null string (““). You must specify a *position* parameter value to specify a *default* value.
var	A variable, specified as a single variable or as a variable in a comma-separated list of variables. A placeholder comma can be specified for an omitted variable. A *var* may be a variable of any type: local, process-private, or global, unsubscripted or subscripted.

Description

$LISTGET has two syntax forms: **$LISTGET** and **SET $LISTGET**:

- **$LISTGET(list,position,default)** returns the requested element in the specified list. If the value of *position* refers to a nonexistent element or identifies an element with an undefined value, the *default* value is returned.

  The **$LISTGET** function is identical to the one- and two-argument forms of the **$LIST** function except that, under conditions that would cause **$LIST** to produce a <NULL VALUE> error, **$LISTGET** returns a default value. See the description of the **$LIST** function for more information on conditions that generate <NULL VALUE> errors.

- **SET $LISTGET(var1,var2,...)=list** extracts multiple elements from a list into variables. It is similar to **SET $LISTBUILD(var1,var2,...)=list**. They differ in how they handle variables that are not assigned an explicit value: **SET $LISTGET** defines these variables (thus avoiding an <UNDEFINED> error), and assigns them the null string value, overwriting any prior value. **SET $LISTBUILD** does not define these variables; if the variable had no prior value it generates an <UNDEFINED> error, if the variable had a prior value, this value is preserved.

Parameters

list

A list can be created using **$LISTBUILD** or **$LISTFROMSTRING**, or extracted from another list using **$LIST**. The null string ("") is also treated as a valid list. You can use $LISTVALID to determine if *list* is a valid list. An invalid list causes **$LISTGET** to generate a <LIST> error.

position

The position (element count) of the list element to return. An element is returned as a string. List elements are counted from 1. If *position* is omitted, **$LISTGET** returns the first element.

- If *position* is *n* (a positive integer), **$LISTGET** counts elements from the beginning of *list*. If *position* is greater than the number of elements in *list*, **$LISTGET** returns the *default* value.
- If *position* is `*`, **$LIST** returns the last element in *list*.
- If *position* is `*-n` (an asterisk followed by a negative integer), **$LIST** counts elements by relative offset from the end of *list*. Thus, *-0 is the last element in the list, *-1 is the next-to-last list element (an offset of 1 from the end). If the `*-n` offset specifies the position before the first element of *list* (for example, *-3 for a 3–element list), **$LISTGET** returns the *default* value. If the `*-n` offset specifies a position prior to that (for example, *-4 for a 3–element list), InterSystems IRIS issues a <RANGE> error.
- If *position* is 0 or -0, **$LISTGET** returns the *default* value.

The numeric portion of the *position* parameter evaluates to an integer. InterSystems IRIS truncates a fractional number to its integer portion. Specifying *position* as -1 (indicating last element of the list) is deprecated and should not be used in new code; a *position* negative number less than -1 generates a <RANGE> error.

When using a variable to specify `*-n` you must always specify the asterisk and a sign character in the parameter itself.

The following are valid specifications of `*-n`:

```
SET count=2
SET alph=$LISTBUILD("a","b","c","d")
WRITE $LISTGET(alph,*-count,"blank")

SET count=-2
SET alph=$LISTBUILD("a","b","c","d")
WRITE $LISTGET(alph,*+count,"blank")
```

default

An expression that evaluates to a string or numeric value. **$LISTGET** returns *default* if the element specified by *position* does not exist. This may occur if *position* is beyond the end of the list, if *position* specifies an element that has no value, if *position* is 0, or if *list* contains no elements. However, if a *position* of `*-n` specifies a position before the 0th element of *list*, InterSystems IRIS issues a <RANGE> error.

If you omit the *default* parameter, the null string ("") is returned as the default value.

SET $LISTGET

When used on the *left side of the equal sign* in a **SET** command, the **$LISTGET** function extracts multiple elements from a list as a single operation. The syntax is as follows:

```
SET $LISTGET(var1,var2,...)=list
```

The *var* arguments of **SET $LISTGET** are a comma-separated list of variables, each of which is set to the value of the *list* element in the corresponding position. Thus, *var1* is set to the value of the first *list* element, *var2* is set to the value of the second *list* element, and so forth. The *var* arguments do not have to be existing variables; the variable is defined when **SET $LISTGET** assigns it a value.

- The number of *var* arguments may be less than or greater than the number of *list* elements. Unspecified *var* values are assigned the null string value: if previously defined, the prior value is replaced with the null string; if previously undefined, the variable is defined. Compare this behavior with SET $LISTBUILD. Excess *list* elements are ignored.
- The *var* arguments and/or the *list* elements may contain omitted values, represented by placeholder commas. An omitted *var* argument is undefined. An omitted *list* element causes the corresponding *var* value to be set to the null

string: if previously defined, the prior value is deleted; if previously undefined, the variable is defined. Compare this behavior with SET $LISTBUILD.

SET $LISTGET is an atomic operation. The maximum number of *var* arguments is 1024. Attempting to exceed this number results in a <SYNTAX> error.

If a *var* argument is an object property (object.property) the property must be multidimensional. Any property may be referenced as an i%property instance variable within an object method.

In the following examples, **$LISTBUILD** (on the right side of the equal sign) creates a list with four elements.

In the following example, **SET $LISTGET** extracts the first two elements from a list into two variables:

```
SET colorlist=$LISTBUILD("red","blue","green","white")
SET $LISTGET(a,b)=colorlist
WRITE "a=",a," b=",b   /* a="red" b="blue" */
```

In the following example, **SET $LISTGET** extracts elements from a list into five variables. Because the specified *list* does not have a 5th element, the corresponding *var* variable (*e*) is defined, with a value of the null string (""):

```
SET (a,b,c,d,e)=0
SET colorlist=$LISTBUILD("red","blue","green","white")
SET $LISTGET(a,b,c,d,e)=colorlist
WRITE "a=",a," b=",b," c=",c," d=",d," e=",e
/* a="red" b="blue" c="green" d="white" e= */
```

In the following example, **SET $LISTGET** extracts elements from a list into four variables. Because the specified *list* does not have a 3rd element, the corresponding *var* variable (*c*) is defined with a value of the null string (""):

```
SET (a,b,c,d)=0
SET colorlist=$LISTBUILD("red","blue",,"white")
SET $LISTGET(a,b,c,d)=colorlist
WRITE "a=",a," b=",b," c=",c," d=",d
/* a="red" b="blue" c= d="white" */
```

In the following example, **SET $LISTGET** extracts elements from a list into four variables. Because the 3rd *list* element value is a nested list, the corresponding *var* variable (*c*) contains a list value:

```
SET (a,b,c,d)=0
SET colorlist=$LISTBUILD("red","blue",$LISTBUILD("green","yellow"),"white")
SET $LISTGET(a,b,c,d)=colorlist
WRITE "a=",a," b=",b," c=",c," d=",d
/* a="red" b="blue" c=$LB("green","yellow") d="white" */
```

Examples

The **$LISTGET** functions in the following example return the value of the list element specified by *position* (the *position* default is 1):

```
SET list=$LISTBUILD("A","B","C")
WRITE !,$LISTGET(list)      ; returns "A"
WRITE !,$LISTGET(list,1)    ; returns "A"
WRITE !,$LISTGET(list,3)    ; returns "C"
WRITE !,$LISTGET(list,*)    ; returns "C"
WRITE !,$LISTGET(list,*-1) ; returns "B"
```

The **$LISTGET** functions in the following example return a value upon encountering the undefined 2nd element in the list. The first two returns a question mark (?), which the user has defined as the *default* value. The second two returns a null string because the user has not specified a *default* value:

```
WRITE "returns:",$LISTGET($LISTBUILD("A",,"C"),2,"?"),!
WRITE "returns:",$LISTGET($LISTBUILD("A",,"C"),*-1,"?"),!
WRITE "returns:",$LISTGET($LISTBUILD("A",,"C"),2),!
WRITE "returns:",$LISTGET($LISTBUILD("A",,"C"),*-1)
```

The following example returns all of the element values in the list. It also lists the positions before and after the ends of the list. Where a value is non-existent, it returns the *default* value:

```
SET list=$LISTBUILD("a","b",,"d",,,"g")
SET llen=$LISTLENGTH(list)
   FOR x=0:1:llen+1 {
   WRITE "position ",x,"=",$LISTGET(list,x," no value"),!
   }
   WRITE "end of the list"
```

The following example returns all of the element values in the list in reverse order. Where a value is omitted, it returns the *default* value:

```
SET list=$LISTBUILD("a","b",,"d",,,"g")
SET llen=$LISTLENGTH(list)
   FOR x=0:1:llen {
   WRITE "position *-",x,"=",$LISTGET(list,*-x," no value"),!
   }
   WRITE "beginning of the list"
```

The **$LISTGET** functions in the following example return the *list* element value of the null string; they do not return the *default* value:

```
WRITE "returns:",$LISTGET($LB(""),1,"no value"),!
WRITE "returns:",$LISTGET($LB(""),*,"no value"),!
WRITE "returns:",$LISTGET($LB(""),*-0,"no value")
```

The **$LISTGET** functions in the following example all return the *default* value:

```
WRITE $LISTGET("",1,"no value"),!
WRITE $LISTGET($LB(),1,"no value"),!
WRITE $LISTGET($LB(UndefinedVar),1,"no value"),!
WRITE $LISTGET($LB(,),1,"no value"),!
WRITE $LISTGET($LB(,),*,"no value"),!
WRITE $LISTGET($LB(,),*-1,"no value"),!
WRITE $LISTGET($LB(""),2,"no value"),!
WRITE $LISTGET($LB(""),*-1,"no value")
```

See Also

- $LIST function
- $LISTBUILD function
- $LISTDATA function
- $LISTFIND function
- $LISTFROMSTRING function
- $LISTLENGTH function
- $LISTNEXT
- $LISTSAME function
- $LISTTOSTRING function
- $LISTUPDATE function
- $LISTVALID function

$LISTLENGTH

Returns the number of elements in a specified list.

```
$LISTLENGTH(list)
$LL(list)
```

Parameter

list	Any expression that evaluates to a list. A list can be created using **$LISTBUILD** or **$LISTFROMSTRING**, or extracted from another list using **$LIST**.

Description

$LISTLENGTH returns the number of elements in *list*. **$LISTLENGTH** counts as a list element every designated list position, whether or not that position contains data.

You can use the $LISTVALID function to determine if *list* is a valid list. If *list* is not a valid list, the system generates a <LIST> error.

An “empty” list created by **$LISTBUILD** defines an encoded list element, although that list element contains no data. Because **$LISTLENGTH** counts list elements (not elements containing data), an “empty” list has a **$LISTLENGTH** count of 1.

The null string ("") is used to represent a null list, a list containing no elements. Because it contains no list elements, it has a **$LISTLENGTH** count of 0.

Examples

The following example returns 3, because there are 3 elements in the list:

```
WRITE $LISTLENGTH($LISTBUILD("Red","Blue","Green"))
```

The following example also returns 3, even though the second element in the list contains no data:

```
WRITE $LISTLENGTH($LISTBUILD("Red",,"Green"))
```

The following examples all return 1. **$LISTLENGTH** makes no distinction between an empty list element and a list element containing data:

```
WRITE $LISTLENGTH($LB()),!
WRITE $LISTLENGTH($LB(UndefinedVar)),!
WRITE $LISTLENGTH($LB("")),!
WRITE $LISTLENGTH($LB($CHAR(0))),!
WRITE $LISTLENGTH($LB("John Smith"))
```

The following example returns 0. $LISTVALID considers the null string a valid list, but it contains no list elements:

```
WRITE $LISTLENGTH("")
```

The following example returns 3, because the two placeholder commas represent 3 empty list elements:

```
WRITE $LISTLENGTH($LB(,,))
```

$LISTLENGTH and Concatenation

Concatenating two lists always results in a **$LISTLENGTH** equal to the sum of the lengths of the lists. This is true even when concatenating empty lists, or concatenating a null string to a list.

The following example all return a list length of 3:

```
WRITE $LISTLENGTH($LB()_$LB("a","b")),!
WRITE $LISTLENGTH($LB("a")_$LB(UndefinedVar)_$LB("c")),!
WRITE $LISTLENGTH($LB("")_$LB()_$LB(UndefinedVar)),!
WRITE $LISTLENGTH(""_$LB("a","b","c")),!
WRITE $LISTLENGTH($LB("a","b")_""_$LB("c"))
```

$LISTLENGTH and Nested Lists

The following example returns 3, because **$LISTLENGTH** does not recognize the individual elements in a nested list, and treats it as a single list element:

```
WRITE $LISTLENGTH($LB("Apple","Pear",$LB("Walnut","Pecan")))
```

The following examples all return 1, because **$LISTLENGTH** counts only the outermost nested list:

```
WRITE $LISTLENGTH($LB($LB($LB()))),!
WRITE $LISTLENGTH($LB($LB($LB("Fred")))),!
WRITE $LISTLENGTH($LB($LB("Barney"_$LB("Fred")))),!
WRITE $LISTLENGTH($LB("Fred"_$LB("Barney"_$LB("Wilma"))))
```

See Also

- $LIST function
- $LISTBUILD function
- $LISTDATA function
- $LISTFIND function
- $LISTFROMSTRING function
- $LISTGET function
- $LISTNEXT
- $LISTSAME function
- $LISTTOSTRING function
- $LISTUPDATE function
- $LISTVALID function

$LISTNEXT

Retrieves elements sequentially from a list.

```
$LISTNEXT(list,ptr,value)
```

Parameters

list	Any expression that evaluates to a list.
ptr	A pointer to the next element in the list. You must specify *ptr* as a local variable initialized to 0. This value points to the beginning of *list*. InterSystems IRIS increments *ptr* using an internal address value algorithm (*not* a predictable integer counter). Therefore, the only value you can use to set *ptr* is 0. *ptr* cannot be a global variable or a subscripted variable.
value	A local variable used to hold the data value of a list element. *value* does not have to be initialized before invoking **$LISTNEXT**. *value* cannot be a global variable or a subscripted variable.

Description

$LISTNEXT sequentially returns elements in a *list*. You initialize *ptr* to 0 before the first invocation of **$LISTNEXT**. This causes **$LISTNEXT** to begin returning elements from the beginning of the list. Each successive invocation of **$LISTNEXT** advances *ptr* and returns the next list element value to *value*. The **$LISTNEXT** function returns 1, indicating that a list element has been successfully retrieved.

When **$LISTNEXT** reaches the end of the list, it returns 0, resets *ptr* to 0, and leaves *value* unchanged from the previous invocation. Because *ptr* has been reset to 0, the next invocation of **$LISTNEXT** would start at the beginning of the list.

Note: Because *ptr* is an index into the internal structure of *list*, the list should not be modified while **$LISTNEXT** is being used on it. Modifying *list* may make the *ptr* value invalid and cause the next invocation of **$LISTNEXT** to issue a <FUNCTION> error.

You can use **$LISTVALID** to determine if *list* is a valid list. An invalid list causes **$LISTNEXT** to generate a <LIST> error.

When **$LISTNEXT** encounters an omitted list element (an element with a null value), it returns 1 indicating that a list element has been successfully retrieved, advances *ptr* to the next element, and resets *value* to be an undefined variable. This can happen when encountering an omitted list element, such as the second invocation of **$LISTNEXT** on *list*=$LB("a",,"b"), or with any of the following valid lists: *list*=$LB(), *list*=$LB(UndefinedVar), or *list*=$LB(,).

`$LISTNEXT("",ptr,value)` returns 0, and does not advance the pointer or set *value*.
`$LISTNEXT($LB(""),ptr,value)` returns 1, advances the pointer, and set *value* to the null string ("").

$LISTNEXT and Performance

An InterSystems IRIS list is the most efficient way to process large numbers of data values. You can use lists to hold large numbers of values for processing, rather than using an array or other data structure. For further details, refer to Maximum String Length in the "Data Types and Values" chapter of *Using ObjectScript*.

Using **$LISTNEXT** to return a large number of elements from a list is substantially more efficient than using **$LIST** to perform the same operation.

The following example rapidly accesses the elements in *mylist*:

```
SET ptr=0
WHILE $LISTNEXT(mylist,ptr,value) {
      /* perform some operation on value */
}
```

It is substantially faster than the following equivalent example:

```
FOR i=1:1:$LISTLENGTH(mylist) {
    SET value=$LIST(mylist,i)
    /* perform some operation on value */
}
```

$LISTNEXT and Nested Lists

The following example returns three elements, because **$LISTNEXT** does not recognize the individual elements in nested lists:

```
SET list=$LISTBUILD("Apple","Pear",$LISTBUILD("Walnut","Pecan"))
SET ptr=0,count=0
WHILE $LISTNEXT(list,ptr,value) {
   SET count=count+1
   WRITE !,value
}
WRITE !,"End of list: ",count," elements found"
QUIT
```

Example

The following example sequentially returns all the elements in the list. When it encounters an omitted element, the $SELECT returns the default value “omitted”:

```
SET list=$LISTBUILD("Red","Blue",,"Green")
SET ptr=0,count=0
WHILE $LISTNEXT(list,ptr,value) {
   SET count=count+1
   WRITE !,count,": ",$SELECT($DATA(value):value,1:"omitted")
}
WRITE !,"End of list: ",count," elements found"
QUIT
```

See Also

- $LIST function
- $LISTBUILD function
- $LISTDATA function
- $LISTFIND function
- $LISTFROMSTRING function
- $LISTGET function
- $LISTLENGTH function
- $LISTSAME function
- $LISTTOSTRING function
- $LISTUPDATE function
- $LISTVALID function

$LISTSAME

Compares two lists and returns a boolean value.

```
$LISTSAME(list1,list2)
$LS(list1,list2)
```

Parameters

list1	Any expression that evaluates to a list. A list can be created using **$LISTBUILD** or **$LISTFROMSTRING**, or extracted from another list using **$LIST**. The null string ("") is also treated as a valid list.
list2	Any expression that evaluates to a list. A list can be created using **$LISTBUILD** or **$LISTFROMSTRING**, or extracted from another list using **$LIST**. The null string ("") is also treated as a valid list.

Description

$LISTSAME compares the contents of two lists and returns 1 if the lists are identical. If the lists are not identical, **$LISTSAME** returns 0. **$LISTSAME** compares list elements using their string representations. **$LISTSAME** comparisons are case-sensitive.

$LISTSAME compares the two lists element-by-element in left-to-right order. Therefore **$LISTSAME** returns a value of 0 when it encounters the first non-identical pair of list elements; it does not check subsequent items to determine if they are valid list elements. If a **$LISTSAME** comparison encounters an invalid item, it issues a <LIST> error.

Examples

The following example returns 1, because the two lists are identical:

```
SET x = $LISTBUILD("Red","Blue","Green")
SET y = $LISTBUILD("Red","Blue","Green")
WRITE $LISTSAME(x,y)
```

The following example returns 0, because the two lists are not identical:

```
SET x = $LISTBUILD("Red","Blue","Yellow")
SET y = $LISTBUILD("Red","Yellow","Blue")
WRITE $LISTSAME(x,y)
```

Identical Lists

$LISTSAME considers two lists to be identical if the string representations of the two lists are identical.

When comparing a numeric list element and a string list element, the string list element must represent the numeric in canonical form; this is because InterSystems IRIS always reduces numerics to canonical form before performing a comparison. In the following example, **$LISTSAME** compares a string and a numeric. The first three **$LISTSAME** functions return 1 (identical); the fourth **$LISTSAME** function returns 0 (not identical) because the string representation is not in canonical form:

```
WRITE $LISTSAME($LISTBUILD("365"),$LISTBUILD(365)),!
WRITE $LISTSAME($LISTBUILD("365"),$LISTBUILD(365.0)),!
WRITE $LISTSAME($LISTBUILD("365.5"),$LISTBUILD(365.5)),!
WRITE $LISTSAME($LISTBUILD("365.0"),$LISTBUILD(365.0))
```

$LISTSAME comparison is not the same equivalence test as the one used by other list operations, which test using the internal representation of a list. This distinction is easily seen when comparing a number and a numeric string, as in the following example:

```
SET x = $LISTBUILD("365")
SET y = $LISTBUILD(365)
IF x=y
  { WRITE !,"Equal sign: number/numeric string identical" }
ELSE { WRITE !,"Equal sign: number/numeric string differ" }
IF 1=$LISTSAME(x,y)
  { WRITE !,"$LISTSAME: number/numeric string identical" }
ELSE { WRITE !,"$LISTSAME: number/numeric string differ" }
```

The equality (=) comparison tests the internal representations of these lists (which are not identical). **$LISTSAME** performs a string conversion on both lists, compares them, and finds them identical.

The following example shows two lists with various representations of numeric elements. **$LISTSAME** considers these two lists to be identical:

```
SET x = $LISTBUILD("360","361","362","363","364","365","366")
SET y = $LISTBUILD(00360.000,(19*19),+"362",363,364.0,+365,"3"_"66")
WRITE !,$LISTSAME(x,y)," lists are identical"
```

Numeric Maximum

A number larger than 2**63 (9223372036854775810) or smaller than -2**63 (–9223372036854775808) exceeds the maximum numeric range for **$LISTSAME** list comparison. **$LISTSAME** returns 0 when such extremely large numbers are compared, as shown in the following example:

```
SET bignum=$LISTBUILD(9223372036854775810)
SET bigstr=$LISTBUILD("9223372036854775810")
WRITE $LISTSAME(bignum,bigstr),!
SET bignum=$LISTBUILD(9223372036854775811)
SET bigstr=$LISTBUILD("9223372036854775811")
WRITE $LISTSAME(bignum,bigstr)
```

Null String and Null List

A list containing the null string (an empty string) as its sole element is a valid list. The null string by itself is also considered a valid list. However these two (a null string and a null list) are not considered identical, as shown in the following example:

```
WRITE !,$LISTSAME($LISTBUILD(""),$LISTBUILD(""))," null lists"
WRITE !,$LISTSAME("","")," null strings"
WRITE !,$LISTSAME($LISTBUILD(""),"")," null list and null string"
```

Normally, a string is not a valid **$LISTSAME** argument, and **$LISTSAME** issues a <LIST> error. However, the following **$LISTSAME** comparisons complete successfully and return 0 (values not identical). The null string and the string “abc” are compared and found not to be identical. These null string comparisons do not issue a <LIST> error:

```
WRITE !,$LISTSAME("","abc")
WRITE !,$LISTSAME("abc","")
```

The following **$LISTSAME** comparisons do issue a <LIST> error, because a list (even a null list) cannot be compared with a string:

```
SET x = $LISTBUILD("")
WRITE !,$LISTSAME("abc",x)
WRITE !,$LISTSAME(x,"abc")
```

Comparing “Empty” Lists

$LISTVALID considers all of the following as valid lists:

```
WRITE $LISTVALID(""),!
WRITE $LISTVALID($LB()),!
WRITE $LISTVALID($LB(UndefinedVar)),!
WRITE $LISTVALID($LB("")),!
WRITE $LISTVALID($LB($CHAR(0))),!
WRITE $LISTVALID($LB(,))
```

$LISTSAME considers only the following pairs as identical:

```
WRITE $LISTSAME($LB(),$LB(UndefinedVar)),!
WRITE $LISTSAME($LB(,),$LB(UndefinedVarA,UndefinedVarB)),!
WRITE $LISTSAME($LB(,),$LB()_$LB())
```

Empty Elements

A **$LISTBUILD** can create empty elements by including extra commas between elements or appending one or more commas to either end of the element list. **$LISTSAME** is aware of empty elements, and does not treat them as equivalent to null string elements.

The following **$LISTSAME** examples all return 0 (not identical):

```
WRITE $LISTSAME($LISTBUILD(365,,367),$LISTBUILD(365,367)),!
WRITE $LISTSAME($LISTBUILD(365,366,),$LISTBUILD(365,366)),!
WRITE $LISTSAME($LISTBUILD(365,366,,),$LISTBUILD(365,366,)),!
WRITE $LISTSAME($LISTBUILD(365,,367),$LISTBUILD(365,"",367))
```

$DOUBLE List Elements

$LISTSAME considers all forms of zero to be identical: 0, –0, $DOUBLE(0), and $DOUBLE(-0).

$LISTSAME considers a $DOUBLE("NAN") list element to be identical to another $DOUBLE("NAN") list element. However, because NAN (Not A Number) cannot be meaningfully compared using numerical operators, InterSystems IRIS operations (such as equal to, less than, or greater than) that attempt to compare $DOUBLE("NAN") to another $DOUBLE("NAN") fail, as shown in the following example:

```
SET x = $DOUBLE("NAN")
SET a = $LISTBUILD(1,2,x)
SET b = $LISTBUILD(1,2,x)
WRITE !,$LISTSAME(a,b)    /* 1 (NAN list elements same) */
WRITE !,x=x               /* 0 (NAN values not equal)   */
```

Nested and Concatenated Lists

$LISTSAME does not support nested lists. It cannot compare two lists that contain lists, even if their contents are identical.

```
SET x = $LISTBUILD("365")
SET y = $LISTBUILD(365)
WRITE !,$LISTSAME(x,y)," lists identical"
WRITE !,$LISTSAME($LISTBUILD(x),$LISTBUILD(y))," nested lists not identical"
```

In the following example, both **$LISTSAME** comparisons returns 0, because these lists are not considered identical:

```
SET x=$LISTBUILD("Apple","Pear","Walnut","Pecan")
SET y=$LISTBUILD("Apple","Pear",$LISTBUILD("Walnut","Pecan"))
SET z=$LISTBUILD("Apple","Pear","Walnut","Pecan","")
WRITE !,$LISTSAME(x,y)," nested list"
WRITE !,$LISTSAME(x,z)," null string is list item"
```

$LISTSAME does support concatenated lists. The following example returns 1, because the lists are considered identical:

```
SET x=$LISTBUILD("Apple","Pear","Walnut","Pecan")
SET y=$LISTBUILD("Apple","Pear")_$LISTBUILD("Walnut","Pecan")
WRITE !,$LISTSAME(x,y)," concatenated list"
```

See Also

- $LIST function
- $LISTBUILD function
- $LISTDATA function
- $LISTFIND function
- $LISTFROMSTRING function
- $LISTGET function

- $LISTLENGTH function
- $LISTNEXT function
- $LISTTOSTRING function
- $LISTUPDATE function
- $LISTVALID function
- $DOUBLE function

$LISTTOSTRING

Creates a string from a list.

```
$LISTTOSTRING(list,delimiter,flag)
$LTS(list,delimiter,flag)
```

Parameters

list	An InterSystems IRIS list, created using **$LISTBUILD** or **$LISTFROMSTRING**, or extracted from another list using **$LIST**.
delimiter	*Optional* — A delimiter used to separate substrings. Specify *delimiter* as a quoted string. If no *delimiter* is specified, the default is the comma (,) character.
flag	*Optional* — A boolean value that specifies how to handle an omitted list element. 0 issues a <NULL VALUE> error. 1 inserts an empty string for the element. The default is 0.

Description

$LISTTOSTRING takes an InterSystems IRIS list and converts it to a string. In the resulting string, the elements of the list are separated by the *delimiter*.

A list represents data in an encoded format which does not use delimiter characters. Thus a list can contain all possible characters, and is ideally suited for bitstring data. **$LISTTOSTRING** converts this list to a string with delimited elements. It sets aside a specified character (or character string) to serve as a delimiter. These delimited elements can be handled using the **$PIECE** function.

Note: The *delimiter* specified here must not occur in the source data. InterSystems IRIS makes no distinction between a character serving as a delimiter and the same character as a data character.

You can use the ZWRITE command to display a list in non-encoded format.

Parameters

list

An InterSystems IRIS list, which contains one or more elements. A list is created using **$LISTBUILD** or extracted from another list using **$LIST**.

If the expression in the *list* parameter does not evaluate to a valid list, a <LIST> error occurs.

```
SET x=$CHAR(0,0,0,1,16,27,134,240)
SET a=$LISTTOSTRING(x,",")   // generates a <LIST> error
```

delimiter

A character (or string of characters) used to delimit substrings within the output string. It can be a numeric or string literal (enclosed in quotation marks), the name of a variable, or an expression that evaluates to a string.

Commonly, a delimiter is a designated character which is never used within string data, but is set aside solely for use as a delimiter separating substrings. A delimiter can also be a multi-character string, the individual characters of which can be used within string data.

If you specify no delimiter, the default delimiter is the comma (,) character. You can specify a null string ("") as a delimiter; in this case, substrings are concatenated with no delimiter. To specify a quote character as a delimiter, specify the quote character twice ("""") or use $CHAR(34).

flag

A boolean flag used to specify how to handle omitted elements in *list*. In the following example, the **$LISTBUILD** creates a list with an omitted element, and the *flag*=1 option is specified to handle this list element:

```
SET colorlist=$LISTBUILD("Red",,"Blue")
WRITE $LISTTOSTRING(colorlist,,1)
```

If the *flag* option was omitted or set to 0, the **$LISTTOSTRING** would generate a <NULL VALUE> error.

Note that if *flag*=1, an element with an empty string value is indistinguishable from an omitted element. Thus `$LISTBUILD("Red","","Blue")` and `$LISTBUILD("Red",,"Blue")` would return the same **$LISTTOSTRING** value. This *flag*=1 behavior is compatible with the implementation of $LISTTOSTRING in InterSystems SQL, as described in the *InterSystems SQL Reference*.

Examples

The following example creates a list of four elements, then converts it to a string with the elements delimited by the colon (:) character:

```
SET namelist=$LISTBUILD("Deborah","Noah","Martha","Bowie")
WRITE $LISTTOSTRING(namelist,":")
```

returns `"Deborah:Noah:Martha:Bowie"`

The following example creates a list of four elements, then converts it to a string with the elements delimited by the *sp* string:

```
SET namelist=$LISTBUILD("Deborah","Noah","Martha","Bowie")
WRITE $LISTTOSTRING(namelist,"*sp*")
```

returns `"Deborah*sp*Noah*sp*Martha*sp*Bowie"`

The following example creates a list with one omitted element and one element with an empty string value. **$LISTTOSTRING** converts it to a string with the elements delimited by the colon (:) character. Because of the omitted element, *flag*=1 is required to avoid a <NULL VALUE> error. However, when *flag*=1, the omitted element and the empty string value are indistinguishable:

```
SET namelist=$LISTBUILD("Deborah",,"","Bowie")
WRITE $LISTTOSTRING(namelist,":",1)
```

returns `"Deborah:::Bowie"`

$LISTVALID considers all of the following valid lists. With *flag*=1, **$LISTTOSTRING** returns the null string ("") for all of them:

```
WRITE "1",$LISTTOSTRING("",,1),!
WRITE "2",$LISTTOSTRING($LB(),,1),!
WRITE "3",$LISTTOSTRING($LB(UndefinedVar),,1),!
WRITE "4",$LISTTOSTRING($LB(""),,1)
```

With *flag*=0, **$LISTTOSTRING** returns the null string ("") for only the following:

```
WRITE "1",$LISTTOSTRING("",,0),!
WRITE "4",$LISTTOSTRING($LB(""),,0)
```

The others generate a <NULL VALUE> error.

See Also

- $LISTFROMSTRING function
- $LISTBUILD function

- $LIST function
- $PIECE function
- $LISTDATA function
- $LISTFIND function
- $LISTGET function
- $LISTLENGTH function
- $LISTNEXT function
- $LISTSAME function
- $LISTUPDATE function
- $LISTVALID function

$LISTUPDATE

Updates a list by optionally replacing a specified list element or sequence of elements.

```
$LISTUPDATE(list,position,bool:val...)
$LU(list,position,bool:val...)
```

Parameters

list	Any expression that evaluates to a list. A list can be created using **$LISTBUILD** or **$LISTFROMSTRING**, or extracted from another list using **$LIST**. The null string ("") is also treated as a valid list.
position	A positive integer specifying the position in *list* to update, counting from 1. If *position* is larger than the number of elements in *list*, **$LISTUPDATE** appends the element, padding if necessary.
bool:	*Optional* — A boolean variable specifying whether or not to update the specified *list* element. If omitted, *bool* defaults to 1, causing this element to be updated.
value	The value used to update the *list* at the specified *position*. You can specify a comma-separated list of *value* parameters or *bool*:*value* pair parameters in any combination.

Description

$LISTUPDATE returns a copy of a list updated by replacing or adding one or more list elements by position. The *position* specifies the position in the list at which to begin updating elements. Elements are updated sequentially, starting from this position. The *position* can be larger than the number of elements in the list. If so, additional null elements are added to the list (if necessary) to insert a new element at the specified position. Note that position must be a positive integer; **$LISTUPDATE** cannot insert a new element at the beginning of the list. Setting *position*=0 performs no operation. **$LISTUPDATE** also cannot specify end-of-list, except by position count from the beginning of the list.

$LISTUPDATE can specify or more than one *bool*:*value* pairs. Multiple *bool*:*value* pairs are separated by commas. These *bool*:*value* pairs update sequential elements, beginning with the *position* element. If *bool*=1, InterSystems IRIS updates that element with *value*; if *bool*=0, InterSystems IRIS does not update that element and proceeds to the next element.

Sequential elements that are not to be updated in a sequence of *bool*:*value* pairs do not have to be specified; they can be represented by placeholder commas. The *bool*: parameter is optional for each *value*; if omitted, it defaults to 1. If you omit *bool* also omit the colon (:) separator character. Thus the following are permitted ways to specify a *bool*:*value* pair:

- Element to update: either `1:"newval"`, or `"newval"` (*bool* defaults to 1).
- Element to *not* update: either `0:"newval"`, or a placeholder comma.

$LISTUPDATE is commonly used to return an updated version of an existing list. You can use **$LISTUPDATE** to create a list by specifying *list*="".

You can also use SET $LIST to update one or more elements in an existing list.

Examples

The following example replaces the list element at position 2 with the specified value:

```
SET caps=1
SET mylist = $LISTBUILD("Red","White","Blue")
SET newlist = $LISTUPDATE(mylist,2,caps:"WHITE")
ZWRITE newlist
```

The following example *does not* replace the list element at position 2 with the specified value:

```
SET caps=0
SET mylist = $LISTBUILD("Red","White","Blue")
SET newlist = $LISTUPDATE(mylist,2,caps:"WHITE")
ZWRITE newlist
```

The following example replaces the list element at position 2 with null:

```
SET caps=1
SET mylist = $LISTBUILD("Red","White","Blue")
SET newlist = $LISTUPDATE(mylist,2,caps:"")
ZWRITE newlist
```

The following example appends the list at position 7 with the specified value, padding null elements at positions 5 and 6:

```
SET bool=1
SET mylist = $LISTBUILD("Red","Orange","Yellow","Green")
SET newlist = $LISTUPDATE(mylist,7,bool:"Purple")
ZWRITE newlist
```

The following example does not append the list at position 7 with the specified value. The unchanged list is returned with no null element padding:

```
SET bool=0
SET mylist = $LISTBUILD("Red","Orange","Yellow","Green")
SET newlist = $LISTUPDATE(mylist,7,bool:"Purple")
ZWRITE newlist
```

The following three examples are all functionally identical. Each replaces the elements at positions 2 and 4, and appends a new element at position 7. It does not replace elements 3 and 5. Element 6 is created as a null element:

```
SET mylist = $LISTBUILD("Red","Orange","Yellow","Green","Blue")
SET newlist = $LISTUPDATE(mylist,2,1:"ORANGE",0:"YELLOW",
                                   1:"GREEN",0:"BLUE",
                                   0:"INDIGO",1:"VIOLET")
ZWRITE newlist
```

Here the *bool* parameter is only specified when it is 0:

```
SET mylist = $LISTBUILD("Red","Orange","Yellow","Green","Blue")
SET newlist = $LISTUPDATE(mylist,2,"ORANGE",0:"YELLOW",
                                   "GREEN",0:"BLUE",
                                   0:"INDIGO","VIOLET")
ZWRITE newlist
```

Here placeholder commas are used to skip elements that are not updated:

```
SET mylist = $LISTBUILD("Red","Orange","Yellow","Green","Blue")
SET newlist = $LISTUPDATE(mylist,2,"ORANGE",,"GREEN",,,"VIOLET")
ZWRITE newlist
```

See Also

- $LIST function
- $LISTBUILD function
- $LISTDATA function
- $LISTFIND function
- $LISTFROMSTRING function
- $LISTGET function
- $LISTLENGTH function
- $LISTNEXT function
- $LISTSAME function
- $LISTTOSTRING function

- $LISTVALID function

$LISTVALID

Determines if an expression is a list.

```
$LISTVALID(exp)
$LV(exp)
```

Parameter

exp	Any valid expression.

Description

$LISTVALID determines whether *exp* is a list, and returns a Boolean value: If *exp* is a list, **$LISTVALID** returns 1; if *exp* is not a list, **$LISTVALID** returns 0.

A list can be created using **$LISTBUILD** or **$LISTFROMSTRING**, or extracted from another list using **$LIST**. A list containing the empty string ("") as its sole element is a valid list. The empty string ("") by itself is also considered a valid list. (Certain $CHAR non-printing character combinations, such as `$CHAR(1)`, `$CHAR(2,1)`, and `$CHAR(3,1,asciicode)` can also return a valid empty or one-element list.)

Examples

The following examples all return 1, indicating a valid list:

```
SET w = $LISTBUILD("Red","Blue","Green")
SET x = $LISTBUILD("Red")
SET y = $LISTBUILD(365)
SET z = $LISTBUILD("")
WRITE !,$LISTVALID(w)
WRITE !,$LISTVALID(x)
WRITE !,$LISTVALID(y)
WRITE !,$LISTVALID(z)
```

The following examples all return 0. Numbers and strings (with the exception of the null string) are not valid lists:

```
SET x = "Red"
SET y = 44
WRITE !,$LISTVALID(x)
WRITE !,$LISTVALID(y)
```

The following examples all return 1. Concatenated, nested, and omitted value lists are all valid lists:

```
SET w=$LISTBUILD("Apple","Pear")
SET x=$LISTBUILD("Walnut","Pecan")
SET y=$LISTBUILD("Apple","Pear",$LISTBUILD("Walnut","Pecan"))
SET z=$LISTBUILD("Apple","Pear",,"Pecan")
WRITE !,$LISTVALID(w_x) ; concatenated
WRITE !,$LISTVALID(y)   ; nested
WRITE !,$LISTVALID(z)   ; omitted element
```

The following examples all return 1. **$LISTVALID** considers all of the following “empty” lists as valid lists. **$LISTBUILD** can take an undefined variable as a list element without generating an error.

```
WRITE $LISTVALID(""),!
WRITE $LISTVALID($LB()),!
WRITE $LISTVALID($LB(UndefinedVar)),!
WRITE $LISTVALID($LB("")),!
WRITE $LISTVALID($LB($CHAR(0))),!
WRITE $LISTVALID($LB(,))
```

See Also

- $LIST function

- $LISTBUILD function
- $LISTDATA function
- $LISTFIND function
- $LISTFROMSTRING function
- $LISTGET function
- $LISTLENGTH function
- $LISTNEXT function
- $LISTSAME function
- $LISTTOSTRING function
- $LISTUPDATE function

$LOCATE

Locates the first match of a regular expression in a string.

```
$LOCATE(string,regexp,start,end,val)
```

Parameters

string	The string to be matched.
regexp	A regular expression to match against *string*. A regular expression consists of one or more meta-characters, and may also contain literal characters.
start	*Optional* — An integer specifying the starting position within *string* from which to match the *regexp*. If you omit *start*, matching begins at the beginning of *string*. If you omit *start* and specify *end* and/or *val*, you must specify the place-holder comma.
end	*Optional* — **$LOCATE** assigns an integer value to this variable if the match is successful. This integer is the next character position after the matched string. InterSystems IRIS passes *end* by reference. This parameter must be a local variable. It cannot be an array, a global variable, or a reference to an object property.
val	*Optional* — **$LOCATE** assigns a string value to this variable if the match is successful. This string consists of the matched substring. InterSystems IRIS passes *val* by reference. This parameter must be a local variable. It cannot be an array, a global variable, or a reference to an object property.

Description

$LOCATE matches a regular expression against successive substrings of a specified string. It returns an integer specifying the starting location of the first *regexp* match within *string*. It counts locations from 1. It returns 0 if *regexp* does not match any subset of *string*.

Optionally, it can also assign the matching substring to a variable.

If you omit an optional parameter and specify a later parameter, you must specify the appropriate place-holder comma(s).

ObjectScript support for regular expressions consists of the **$LOCATE** and **$MATCH** functions:

- **$LOCATE** matches a regular expression to successive substrings of *string* and returns the location (and, optionally, the value) of the first match.
- **$MATCH** matches a regular expression to the full *string* and returns a boolean indicating whether a match occurred.

The **Locate()** method of the %Regex.Matcher class provides similar functionality as **$LOCATE**. The %Regex.Matcher class methods provide substantial additional functionality for using regular expressions.

Other ObjectScript matching operations use InterSystems IRIS pattern match operators.

Parameters

string

An expression that evaluates to a string. The expression can be specified as the name of a variable, a numeric value, a string literal, or any valid ObjectScript expression. A *string* can contain control characters.

If *string* is the empty string and *regexp* cannot match the empty string, **$LOCATE** returns 0; *end* and *val* are not set.

If *string* is the empty string and *regexp* can match the empty string, **$LOCATE** returns 1; *end* is set to 1, and *val* is set to the empty string.

regexp

A regular expression used to match against *string* to locate the desired substring. A regular expression is an expression that evaluates to a string consisting of some combination of meta-characters and literals. Meta-characters specify character types and match patterns. Literals specify one or more matching single characters, ranges of characters, or substrings. An extensive regular expression syntax is supported. For details, refer to the "Regular Expressions" chapter of *Using ObjectScript* .

start

An integer specifying the starting position within *string* from which to match the *regexp*. 1 or 0 specify starting at the beginning of *string*. A *start* value equal to the length of string + 1 always returns 0. A *start* value greater than the length of string + 1 generates a <REGULAR EXPRESSION> error with ERROR #8351.

Regardless of the *start* position, **$LOCATE** returns the position of the first match as a count from the beginning of the string.

end

An output variable that **$LOCATE** assigns an integer value if the locate operation found a match. The assigned value is the location of the first character position after the matched substring, counting from the beginning of the string. If the match occurs at the end of the string, this character position can be one more that the total string length. If a match was not found, the *end* value is left unchanged. If *end* has not been previously set, the variable remains undefined.

The *end* variable cannot be a reference to an object property.

By using the same variable for *start* and *end*, you can invoke **$LOCATE** repeatedly to find all of the matches in the string. This is shown in the following example, which locates the positions of the vowels in the alphabet:

```
SET alphabet="abcdefghijklmnopqrstuvwxyz"
SET pos=1
SET val=""
FOR i=1:1:5 {
  WRITE $LOCATE(alphabet,"[aeiou]",pos,pos,val)
  WRITE " is the position of the ",i,"th vowel: ",val,! }
```

val

An output variable that **$LOCATE** assigns a string value if the locate operation found a match. This string value is the matching substring. If a match was not found, the *val* value is left unchanged. If *val* has not been previously set, the variable remains undefined.

The *val* variable cannot be a reference to an object property.

Examples

The following example returns 4, because the *regexp* literal "de" matches at the 4th character of the string:

```
WRITE $LOCATE("abcdef","de")
```

The following example returns 8, because *regexp* specifies a lowercase letter string of three characters, which is first found here as the substring "fga" starting a position 8:

```
WRITE $LOCATE("ABC-de-fgabc123ABC","[[:lower:]]{3}")
```

The following example returns 5, because the specified *regexp* format of spaces (\s) and non-space characters (\S) is found beginning at the 5th character of the string. This example omits the *start* parameter; it sets the *end* variable to 11, which is the character after the matched substring.

```
WRITE $LOCATE("AAAAA# $ 456789","\S\S\s\S\s\S",,end)
```

The following example returns 9, because *regexp* specifies a letter string of three characters, and the *start* parameter states it must begin at or after position 6:

```
SET end="",val=""
WRITE $LOCATE("abc-def-ghi-jkl","[[:alpha:]]{3}",6,end,val),!
WRITE "the position after the matched string is: ",end,!
WRITE "the matched value is: ",val
```

The *end* parameter is set to 12, and the *val* parameter is set to “ghi”.

The following example shows that a numeric is resolved to canonical form before *regexp* is matched to the resulting string. The *end* parameter is set to 5, one character beyond the end of the 4–character string “1.23”:

```
WRITE $LOCATE(123E-2,"\.\d*",1,end,val),!
WRITE "end is: ",end,!
WRITE "value is: ",val,!
```

The following example sets the *start* parameter to a value greater than the length of *string*+1. This results in an error, as shown:

```
 TRY {
 SET str="abcdef"
 SET strlen=$LENGTH(str)
 WRITE "start=string length, match=",$LOCATE(str,"\p{L}",strlen),!
 WRITE "start=string length+1, match=",$LOCATE(str,"\p{L}",strlen+1),!
 WRITE "start=string length+2, match=",$LOCATE(str,"\p{L}",strlen+2),!
 }
CATCH exp {
  WRITE !!,"CATCH block exception handler:",!
  IF 1=exp.%IsA("%Exception.SystemException") {
    WRITE "System exception",!
    WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
    WRITE "Location: ",exp.Location,!
    WRITE "Code: ",exp.Code,!!
    WRITE "%Regex.Matcher status:"
    SET err=##class(%Regex.Matcher).LastStatus()
    DO $SYSTEM.Status.DisplayError(err) }
  ELSE {WRITE "Unexpected exception type",! }
  RETURN
}
```

See Also

- $CHAR function
- $MATCH function
- Regular Expressions in *Using ObjectScript*
- Pattern Matching in *Using ObjectScript*

$MATCH

Matches a regular expression to a string.

```
$MATCH(string,regexp)
```

Parameters

string	The string to be matched.
regexp	A regular expression to match against *string*. A regular expression consists of one or more meta-characters, and may also contain literal characters.

Description

$MATCH is a boolean function that returns 1 if *string* and *regexp* match, and 0 if *string* and *regexp* do not match. By default, matching is case-sensitive.

ObjectScript support for regular expressions consists of the **$LOCATE** and **$MATCH** functions:

- **$MATCH** matches a regular expression to the full *string* and returns a boolean indicating whether a match occurred.
- **$LOCATE** matches a regular expression to successive substrings of *string* and returns the location (and, optionally, the value) of the first match.

The **Match()** method of the %Regex.Matcher class provides the same functionality. The %Regex.Matcher class provides additional functionality for using regular expressions.

Other ObjectScript matching operations use InterSystems IRIS pattern match operators.

Parameters

string

An expression that evaluates to a string. The expression can be specified as the name of a variable, a numeric value, a string literal, or any valid ObjectScript expression. A *string* can contain control characters.

regexp

A regular expression used to match against *string*. A regular expression is an expression that evaluates to a string consisting of some combination of meta-characters and literals. Meta-characters specify character types and match patterns. Literals specify one or more matching single characters, ranges of characters, or substrings. An extensive regular expression syntax is supported. For details, refer to the “Regular Expressions” chapter of *Using ObjectScript* .

Examples

The following example matches a string with a regular expression that specifies that the first character must be an uppercase letter (\p{LU}), followed by at least one additional character (+ quantifier), and that this second character, and all subsequent characters, must be word characters (letters, numbers, or the underscore character) (\w):

```
   SET strng(1)="Assembly_17"
   SET strng(2)="Part5"
   SET strng(3)="SheetMetalScrew"
   SET n=1
  WHILE $DATA(strng(n)) {
    IF $MATCH(strng(n),"\p{LU}\w+")
      { WRITE strng(n)," : successful match",! }
    ELSE { WRITE strng(n)," : invalid string",! }
    SET n=n+1 }
```

The following example returns 1, because the hexadecimal regular expression (hex 41) matches the letter “A”:

```
WRITE $MATCH("A","\x41")
```

The following example returns 1, because the specified string matches the format of spaces (\s) and non-space characters (\S) specified in the regular expression:

```
WRITE $MATCH("A# $ 4","\S\S\s\S\s\S")
```

The following example returns 1, because the specified date matches the format of digits and literals specified in the regular expression:

```
SET today=$ZDATE($HOROLOG)
WRITE $MATCH(today,"^\d\d/\d\d/\d\d\d\d$")
```

Note that this format requires that the day and month each be specified as two digits, so a leading zero is required for values smaller than 10.

The following example returns 1, because each letter in the string is within the corresponding letter range in the regular expression:

```
WRITE $MATCH("HAL","[G-I][A-C][K-Z]")
```

The following example specifies an invalid *regexp* parameter. This results in an error, as shown:

```
  TRY {
  SET str="abcdef"
  WRITE "match=",$MATCH(str,"\p{}"),!
  }
 CATCH exp {
   WRITE !!,"CATCH block exception handler:",!
   IF 1=exp.%IsA("%Exception.SystemException") {
     WRITE "System exception",!
     WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
     WRITE "Location: ",exp.Location,!
     WRITE "Code: ",exp.Code,!!
     WRITE "%Regex.Matcher status:"
     SET err=##class(%Regex.Matcher).LastStatus()
     DO $SYSTEM.Status.DisplayError(err) }
   ELSE {WRITE "Unexpected exception type",! }
   RETURN
 }
```

See Also

- $CHAR function
- $LOCATE function
- $ZSTRIP function
- Regular Expressions in *Using ObjectScript*
- Pattern Matching in *Using ObjectScript*

$METHOD

Supports calls to an instance method.

```
$METHOD(instance, methodname, arg1, arg2, arg3, ... )
```

Parameters

instance	An expression that evaluates to an object reference. The value of the expression must be that of an in-memory instance of a class.
methodname	An expression that evaluates to a string. The value of the string must exactly match the name of an existing method in the instance of the class given as the first argument.
arg1, *arg2*, *arg3*, ...	A series of expressions to be substituted for the arguments to the designated method. The values of the expressions can be of any type. It is the responsibility of the implementer to make sure that the supplied expressions both match in type and have values with the bounds that the method expects. (If the specified method expects no arguments then nothing beyond *classname* and *methodname* need be used in the function invocation. If the method requires arguments, the rules that govern what must be supplied are those of the target method.)

Description

$METHOD executes a named instance method for a specified instance of a designated class.

This function permits an ObjectScript program to call an arbitrary method in an existing instance of some class. Since the first argument must be a reference to an object, it is computed at execution time. The method name may be computed at runtime or supplied as a string literal. If the method takes arguments, they are supplied from the list of arguments that follow the method name. A maximum of 255 argument values may be passed to the method. If the method requires arguments, the rules that govern what must be supplied are those of the target method. To invoke a class method rather than an instance method, use the **$CLASSMETHOD** function.

The invocation of **$METHOD** as a function or a procedure determines the invocation of the target method. You can invoke **$METHOD** using the **DO** command, discarding the return value. Like all **DO** command arguments, **$METHOD** can take a postconditional parameter when called by **DO**.

When used within one method of a class instance to refer to another method of that instance, the **$METHOD** may omit *instance*. The comma that would normally follow *Instance* is still required, however.

If there is an attempt to invoke a method that is nonexistent or that is declared to be a class method, this results in a `<METHOD DOES NOT EXIST>` error.

Example

The following example shows **$METHOD** used as a function:

```
SET ListOfStuff = ##class(%Library.ListOfDataTypes).%New()
FOR i = "First", "Second", "Third", "Fourth"
   {
       DO ListOfStuff.Insert((i _ "-Element"))
   }
SET methodname = "Count"
SET elements = $METHOD(ListOfStuff,methodname)
WRITE "Elements: ",elements,!
SET i = $RANDOM(elements) + 1
WRITE "Element #", i , " = " , $METHOD(ListOfStuff,"GetAt", i), !
```

See Also

- $CLASSMETHOD function
- $CLASSNAME function
- $PARAMETER function
- $PROPERTY function
- $THIS special variable

$NAME

Returns the name value of a variable or a portion of a subscript reference.

```
$NAME(variable,integer)
$NA(variable,integer)
```

Parameters

variable	The variable whose name value is to be returned. It can specify a local or global variable, which can be either subscripted or unsubscripted. It does not need to be a defined variable. However, it may not be a defined private variable. If *variable* is a subscripted global, you can specify a naked global reference.
integer	*Optional* — A numeric value that specifies which portion (level) of a subscript reference to return. It can be a positive integer, the name of a variable, or an expression. When used, *variable* must be a subscripted reference.

Description

$NAME returns a formatted form of the variable name reference supplied as *variable*. It does not check whether this variable is defined or has a data value. The value **$NAME** returns depends on the parameters used.

- **$NAME**(*variable*) returns the name value of the specified variable in *canonical* form; that is, as a fully expanded reference.
- **$NAME**(*variable*,*integer*) returns a portion of a subscript reference. Specifically, *integer* controls the number of subscripts returned by the function.

Execution of this function does not affect the naked indicator.

Parameters

variable

variable can be a local variable, a process-private global variable, or a global variable. It can be unsubscripted or subscripted. If *variable* is a global it can use extended global reference. **$NAME** returns the extended global reference as specified, without checking whether the specified namespace exists or whether the user has access privileges for the namespace. It does not capitalize the namespace name. If *variable* is a naked global reference, **$NAME** returns the full global reference. If *variable* is a private variable, a compile error occurs.

It can be a multidimensional object property; it cannot be a non-multidimensional object property. Attempting to use **$NAME** on a non-multidimensional object property results in an <OBJECT DISPATCH> error.

$NAME cannot return a special variable, even those that can be modified using **SET**. Attempting to return a special variable results in a <SYNTAX> error.

integer

The *integer* parameter is used when *variable* is a subscripted reference. If the value of *integer* is 0, **$NAME** returns only the name of the variable. If the value of *integer* is less than the number of subscripts in *variable*, **$NAME** returns the number of subscripts indicated by the value of *integer*. If *integer* is greater than the number of subscripts in *variable*, **$NAME** returns the full subscripted reference.

If *variable* is an unsubscripted variable, the value of *integer* is ignored; **$NAME** returns the variable name. If *integer* is the null string ("") or a nonnumeric string, **$NAME** returns the variable name with no subscripts.

The value of *integer* receives standard integer parsing. For example, leading zeros and the plus sign are ignored. Fractional digits are truncated and ignored. A negative *integer* value results in a <FUNCTION> error.

Examples

In this example, the *integer* parameter specifies the level to return. If the specified number of subscripts in *integer* matches or exceeds the number of subscript levels (in this case, 3), then **$NAME** returns all defined levels, behaving as if you specified the one-parameter form. If you specify an *integer* level of zero (0), the null string (""), or any nonnumeric string (such as "A"), **$NAME** returns the name of the array (in this case “^client”)

```
SET ^client(4)="Vermont"
SET ^client(4,1)="Brattleboro"
SET ^client(4,1,1)="Yankee Ingenuity"
SET ^client(4,1,2)="Vermonster Systems"
WRITE !,$NAME(^client(4,1,1),1) ; returns 1 level
WRITE !,$NAME(^client(4,1,1),2) ; returns 2 levels
WRITE !,$NAME(^client(4,1,1),3) ; returns 3 levels
WRITE !,$NAME(^client(4,1,1),4) ; returns all (3) levels
WRITE !,$NAME(^client(4,1,1),0) ; returns array name
WRITE !,$NAME(^client(4,1,1),"") ; returns array name
WRITE !,$NAME(^client(4,1,1))    ; returns all (3) levels
```

In the following example, **$NAME** is used with a naked reference in a loop to output the values for all elements in the current (user-supplied) array level.

```
READ !,"Array element: ",ary
SET x=@ary ; dummy operation to set current array and level
SET y=$ORDER(^("")) ; null string to find beginning of level
FOR i=0:0 {
  WRITE !,@$NAME(^(y))
  SET y=$ORDER(^(y))
  QUIT:y=""
}
```

The first **SET** command performs a dummy assignment to establish the user-supplied array and level as the basis for the subsequent naked references. The **$ORDER** function is used with a naked reference to return the number of the first subscript (whether negative or positive) at the current level.

The **WRITE** command in the **FOR** loop uses **$NAME** with a naked global reference and argument indirection to output the value of the current element. The **SET** command uses **$ORDER** with a naked global reference to return the subscript of the next existing element that contains data. Finally, the postconditional **QUIT** checks the value returned by **$ORDER** to detect the end of the current level and terminate the loop processing.

You can use the returned **$NAME** string value for name or subscript indirection or pass it as a parameter to a routine or user-defined function. For more information, refer to Indirection in *Using ObjectScript*. Consider the routine ^DESCEND that lists descendant nodes of the specified node.

```
DESCEND(ROOT)  ;List descendant nodes
   NEW REF
   SET REF=ROOT
   IF ROOT'["(" {
       FOR {
       SET REF=$QUERY(@REF)
       QUIT:REF=""
       WRITE REF,! }
   }
   ELSE {
     SET $EXTRACT(ROOT,$LENGTH(ROOT))=","
     FOR {
       SET REF=$QUERY(@REF)
       QUIT:REF'[ROOT
       WRITE REF,!   }
   }
```

The following example demonstrates how you can use **$NAME** to pass a parameter to the ^DESCEND routine defined in the previous example.

```
FOR var1="ONE","TWO","THREE" {
  DO ^DESCEND($NAME(^X(var1))) }
```

^X("ONE",2,3)

Notes

Uses for $NAME

You typically use **$NAME** to return the name values of array elements for use with the **$DATA** and **$ORDER** functions.

If a reference to an array element contains expressions, **$NAME** evaluates the expressions before returning the canonical form of the name. For example:

```
SET x=1+2
SET y=$NAME(^client(4,1,x))
WRITE y
```

$NAME evaluates the variable *x* and returns the value ^client(4,1,3).

Naked Global References

$NAME also accepts a naked global reference and returns the name value in its canonical form (that is, a full (non-naked) reference). A naked reference is specified without the array name and designates the most recently executed global reference. In the following example, the first **SET** command establishes the global reference and the second **SET** command uses the **$NAME** function with a naked global reference.

```
SET ^client(5,1,2)="Savings/27564/3270.00"
SET y=$NAME(^(3))
WRITE y
```

In this case, **$NAME** returns the value ^client(5,1,3). The supplied subscript value (3) replaces the existing subscript value (2), at the current level.

For more details, see Naked Global Reference in *Using Globals*.

Extended Global References

You can control whether **$NAME** returns name values in extended global reference form on a per-process basis using the **RefInKind()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *RefInKind* property of the Config.Miscellaneous class.

With extended reference mode in effect, the following example returns the defined namespace and name `^["PAYROLL"]MyRoutine` (as shown in the first example), and not just `^MyRoutine` (as shown in the second example):

```
DO ##class(%SYSTEM.Process).RefInKind(0)
WRITE $NAME(^["PAYROLL"]MyRoutine)

DO ##class(%SYSTEM.Process).RefInKind(1)
WRITE $NAME(^["PAYROLL"]MyRoutine)
```

For a description of extended global reference syntax, see the Global Structure chapter in *Using Globals*.

See Also

- $DATA function
- $ORDER function
- $GET function

$NCONVERT

Converts a number to a binary value encoded in a string of 8-bit characters.

```
$NCONVERT(n,format,endian)
$NC(n,format,endian)
```

Parameters

n	Any number, which can be specified as a value, a variable, or an expression. Additional limitations on valid values are imposed by the *format* selected.
format	One of the following format codes, specified as a quoted string: S1, S2, S4, S8, U1, U2, U4, F4, or F8.
endian	*Optional* — A boolean value, where 0 = little-endian and 1 = big-endian. The default is 0.

Description

$NCONVERT uses the specified *format* to convert the number *n* to an encoded string of 8-bit characters. The values of these characters are in the range **$CHAR(0)** through **$CHAR(255)**.

The following are the supported *format* codes:

S1	Signed integer encoded into a string of one 8-bit byte. The value must be in the range -128 through 127, inclusive.
S2	Signed integer encoded into a string of two 8-bit bytes. The value must be in the range -32768 through 32767, inclusive.
S4	Signed integer encoded into a string of four 8-bit bytes. The value must be in the range -2147483648 through 2147483647, inclusive.
S8	Signed integer encoded into a string of eight 8-bit bytes. The value must be in the range -9223372036854775808 through 9223372036854775807, inclusive.
U1	Unsigned integer encoded into a string of one 8-bit byte. The maximum value is 255.
U2	Unsigned integer encoded into a string of two 8-bit bytes. The maximum value is 65535.
U4	Unsigned integer encoded into a string of four 8-bit bytes. The maximum value is 4294967295.
F4	IEEE floating point number encoded into a string of four 8-bit bytes.
F8	IEEE floating point number encoded into a string of eight 8-bit bytes.

Values beyond the range of *format* limits result in a <VALUE OUT OF RANGE> error. Specifying a negative number for an Unsigned *format* results in a <VALUE OUT OF RANGE> error. If *n* is a non-numeric value (contains any non-numeric characters) InterSystems IRIS performs conversion of a string to a numeric value. A string beginning with a non-numeric character is converted to 0.

InterSystems IRIS rounds a fractional number to an integer value for all formats except F4 and F8.

You can use the **IsBigEndian()** class method to determine which bit ordering is used on your operating system platform: 1=big-endian bit order; 0=little-endian bit order.

```
WRITE $SYSTEM.Version.IsBigEndian()
```

$SCONVERT provides the inverse of the **$NCONVERT** operation.

Examples

The following example converts a series of unsigned numbers to two-byte encoded values:

```
FOR x=250:1:260 {
  ZZDUMP $NCONVERT(x,"U2") }
QUIT
```

The following example performs the same operation in big-endian order:

```
FOR x=250:1:260 {
  ZZDUMP $NCONVERT(x,"U2",1) }
QUIT
```

See Also

- $SCONVERT function

$NORMALIZE

Validates and returns a numeric value; rounds to a specified precision.

```
$NORMALIZE(num,scale)
```

Parameters

num	The numeric value to be validated. It can be a numeric or string value, a variable name, or any valid ObjectScript expression.
scale	The number of significant digits to round *num* to as the returned value. This number can be larger or smaller than the actual number of fractional digits in *num*. Permitted values are 0 (round to integer), –1 (truncate to integer), and positive integers (round to specified number of fractional digits). There is no maximum *scale* value. However, the functional maximum cannot exceed the numeric precision. For standard InterSystems IRIS fractional numbers the functional *scale* maximum is 18 (minus the number of integer digits – 1).

Description

The **$NORMALIZE** function validates *num* and returns the normalized form of *num*. It performs rounding (or truncation) of fractional digits using the *scale* parameter. You can use the *scale* parameter to round a real number to a specified number of fractional digits, to round a real number to an integer, or to truncate a real number to an integer.

After rounding, **$NORMALIZE** removes trailing zeros from the return value. For this reason, the number of fractional digits returned may be less than the number specified in *scale*, as shown in the following example:

```
WRITE $NORMALIZE($ZPI,11),!
WRITE $NORMALIZE($ZPI,12),!   /* trailing zero removed */
WRITE $NORMALIZE($ZPI,13),!
WRITE $NORMALIZE($ZPI,14)
```

Parameters

num

The number to be validated may be an integer, a real number, or a scientific notation number (with the letter “E” or “e”). It may be a string, expression, or variable that resolves to a number. It may be signed or unsigned, and may contain leading or trailing zeros. **$NORMALIZE** validates character-by-character. It stops validation and returns the validated portion of the string if:

- *num* contains any characters other than the digits 0–9, + or – signs, a decimal point (.), and a letter “E” or “e”.
- *num* contains more than one decimal point, or letter “E” or “e”.
- If a + or – sign is found after a numeric in *num* it is considered a trailing sign, and no further numerics are parsed.
- The letter “E” or “e” is not followed by an integer.

The *scale* parameter value causes the returned value to be a rounded or truncated version of the *num* value. The actual value of the *num* variable is not changed by **$NORMALIZE** processing.

scale

The mandatory *scale* parameter is used to specify how many fractional digits to round to. Depending on the value specified, *scale* can have no effect on fractional digits, round to a specified number of fractional digits, round to an integer, or truncate to an integer.

A nonnegative *scale* value causes *num* to be rounded to that number of fractional digits. When rounding, a value of 5 or greater is always rounded up. To avoid rounding a number, make *scale* larger than the number of possible fractional digits in *num*. A *scale* value of 0 causes *num* to be rounded to an integer value (3.9 = 4). A *scale* value of –1 causes *num* to be truncated to an integer value (3.9 = 3). A *scale* value which is nonnumeric or the null string is equivalent to a *scale* value of 0.

Specify an integer value for *scale*; decimal digits in the *scale* value are ignored. You can specify a *scale* value larger than the number of decimal digits specified in *num*. You can specify a *scale* value of –1; all other negative *scale* values result in a <FUNCTION> error.

Examples

In the following example, each invocation of **$NORMALIZE** returns the normalized version of *num* with the specified rounding (or integer truncation):

```
WRITE !,$NORMALIZE(0,0)         ; All integers OK
WRITE !,$NORMALIZE("",0)        ; Null string is parsed as 0
WRITE !,$NORMALIZE(4.567,2)     ; Real numbers OK
WRITE !,$NORMALIZE("4.567",2)   ; Numeric strings OK
WRITE !,$NORMALIZE(-+.0,99)     ; Leading/trailing signs OK
WRITE !,$NORMALIZE(+004.500,1)  ; Leading/trailing 0's OK
WRITE !,$NORMALIZE(4E2,-1)      ; Scientific notation OK
```

In the following example, each invocation of **$NORMALIZE** returns a numeric subset of *num*:

```
WRITE !,$NORMALIZE("4,567",0)
  ; NumericGroupSeparators (commas) are not recognized
  ; here validation halts at the comma, and 4 is returned.
WRITE !,$NORMALIZE("4A",0)
  ; Invalid (nonnumeric) character halts validation
  ; here 4 is returned.
```

The following example shows the use of the *scale* parameter to round (or truncate) the return value:

```
WRITE !,$NORMALIZE(4.55,2)
  ; When scale is equal to the fractional digits of num,
  ; all digits of num are returned without rounding.
WRITE !,$NORMALIZE(3.85,1)
  ; num is rounded to 1 fractional digit,
  ; (with values of 5 or greater rounded up)
  ; here 3.9 is returned.
WRITE !,$NORMALIZE(4.01,17)
  ; scale can be larger than number of fractional digits,
  ; and no rounding is peformed; here 4.01 is returned.
WRITE !,$NORMALIZE(3.85,0)
  ; When scale=0, num is rounded to an integer value.
  ; here 4 is returned.
WRITE !,$NORMALIZE(3.85,-1)
  ; When scale=-1, num is truncated to an integer value.
  ; here 3 is returned.
```

Notes

$DOUBLE Numbers

$DOUBLE IEEE floating point numbers are encoded using binary notation. Most decimal fractions cannot be exactly represented in this binary notation. When a **$DOUBLE** value is input to **$NORMALIZE** with a *scale* value, the return value frequently contains more fractional digits than specified in *scale* because the fractional decimal result is not representable in binary, so the return value must be rounded to the nearest representable **$DOUBLE** value, as shown in the following example:

```
SET x=1234.1234
SET y=$DOUBLE(1234.1234)
WRITE "Decimal: ",$NORMALIZE(x,2),!
WRITE "Double: ",$NORMALIZE(y,2),!
WRITE "Dec/Dub: ",$NORMALIZE($DECIMAL(y),2)
```

If you are normalizing a **$DOUBLE** value for decimal formatting, you should convert the $DOUBLE value to decimal representation before normalizing the result, as shown in the above example.

$NORMALIZE handles `$DOUBLE("INF")` and `$DOUBLE("NAN")` values, and returns INF and NAN.

DecimalSeparator Value Ignored

$NORMALIZE is intended to operate on numbers. A *num* string is interpreted as a number. InterSystems IRIS converts a number to a canonical form before supplying it to **$NORMALIZE**. This conversion to a canonical number *does not* use the DecimalSeparator property value for the current locale.

For example, if you specify for *num* the string "00123.4500", **$NORMALIZE** treats this as the canonical number 123.45, regardless of the current DecimalSeparator value. If you specify the string "00123,4500", **$NORMALIZE** treats this as the canonical number 123 (truncating at the first non-numeric character), regardless of the current DecimalSeparator value.

If you want a function that takes a string as input, use $INUMBER. If you want a function that produces a string result use $FNUMBER.

$NORMALIZE, and $NUMBER Compared

The **$NORMALIZE**, and **$NUMBER** functions both validate numbers and return a validated version of the specified number.

These two functions offer different validation criteria. Select the one that best meets your needs.

- Both functions parse signed and unsigned integers (including –0), scientific notation numbers (with “E” or “e”), and real numbers. However, **$NUMBER** can be set (using the “I” format) to reject numbers with a fractional part (including scientific notation with a negative base-10 exponent). Both functions parse both numbers (123.45) and numeric strings (“123.45”).
- Both functions strip out leading and trailing zeroes. The decimal character is stripped out unless followed by a nonzero value.
- Numeric strings containing a NumericGroupSeparator: **$NUMBER** parses NumericGroupSeparator characters (American format: comma (,); European format: period (.) or apostrophe (')) and the decimal character (American format: period (.) or European format: comma (,)) based on its *format* parameter (or the default for the current locale). It accepts and strips out any number of NumericGroupSeparator characters. For example, in American format it validate “123,,4,56.99” as the number 123456.99. **$NORMALIZE** does not recognize NumericGroupSeparator characters. It validates character-by-character until it encounters a nonnumeric character; for example, it validates “123,456.99” as the number 123.
- Multiple leading signs (+ and –) are interpreted by both functions for numbers. Only **$NORMALIZE** accepts multiple leading signs in a quoted numeric string.
- Trailing + and – signs: Both functions reject trailing signs in numbers. In a quoted numeric string **$NUMBER** parses one (and only one) trailing sign. **$NORMALIZE** parses multiple trailing signs.
- Parentheses: **$NUMBER** parses parentheses surrounding an unsigned number in a quoted string as indicating a negative number. **$NORMALIZE** treats parentheses as nonnumeric characters.
- Numeric strings containing multiple decimal characters: **$NORMALIZE** validates character-by-character until it encounters the second decimal character. For example, in American format it validates “123.4.56” as the number 123.4. **$NUMBER** rejects any string containing more than one decimal character as an invalid number.

  Numeric strings containing other nonnumeric characters: $NORMALIZE validates character-by-character until it encounters an alphabetic character. It validates “123A456” as the number 123. **$NUMBER** validates or rejects the entire string; it reject “123A456” as an invalid number.
- The null string: **$NORMALIZE** parses the null string as zero (0). **$NUMBER** rejects the null string.

The **$NUMBER** function provide optional min/max range checking. This is also available using the $ISVALIDNUM function.

$NORMALIZE, **$NUMBER**, and **$ISVALIDNUM** all provide rounding of numbers to a specified number of fractional digits. **$NORMALIZE** can round fractional digits, and round or truncate a real number to return an integer. For example, **$NORMALIZE** can round 488.65 to 488.7 or 489, or truncate it to 488. **$NUMBER** can round real numbers or integers. For example, **$NUMBER** can round 488.65 to 488.7, 489, 490 or 500.

See Also

- $DOUBLE function
- $FNUMBER function
- $INUMBER function
- $ISVALIDNUM function
- $NUMBER function
- More information on locales in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$NOW

Returns the local date and time with fractional seconds for the current process.

```
$NOW(tzmins)
```

Parameter

tzmins	*Optional* — A positive or negative integer value that specifies the desired time zone offset from the Greenwich meridian, in minutes. A value of 0 corresponds to the Greenwich meridian. Positive integers correspond to time zones west of Greenwich; negative integers correspond to time zones east of Greenwich. For example, a value of 300 corresponds to United States Eastern Standard Time, 5 hours (300 minutes) west of Greenwich. The range of permitted values is -1440 through 1440; values beyond this range result in an <ILLEGAL VALUE> error. If you omit *tzmins*, the **$NOW** function returns the local date and time based on the **$ZTIMEZONE** special variable value. The range of **$ZTIMEZONE** values that the **$NOW** function supports is -1440 through 1440; values beyond this range result in an <ILLEGAL VALUE> error.

Description

$NOW can return the following:

- The current local date and time with fractional seconds for the current process.
- The local date and time for a specified time zone, with fractional seconds, for the current process.

The **$NOW** function returns a character string that consists of two numeric values, separated by a comma. The first number is an integer that represents the current local date. The second is a fractional number that represents the current local time. These values are counters, not user-readable dates and times.

$NOW returns the date and time in InterSystems IRIS storage (**$HOROLOG**) format, with the additional feature of fractional seconds. **$NOW** returns the current local date and time in the following format: *ddddd,sssss.ffffff*

The first integer (*ddddd*) is the number of days since December 31, 1840, where day 1 is January 1, 1841. The maximum value for this date integer is 2980013, which corresponds to December 31, 9999.

The second number (*sssss.ffffff*) is the number of seconds (and fractional seconds) since midnight of the current day. InterSystems IRIS increments the *sssss* field from 0 to 86399 seconds. When it reaches 86399 at midnight, InterSystems IRIS resets the *sssss* field to 0 and increments the date field by 1. Note that within the first second after midnight, seconds are represented as 0.*ffffff* (for example, `0.123`); this number is not in ObjectScript canonical form (for example, `.123`), which affects the string sorting order of these values. You can prepend a plus sign (+) to force conversion of a number to canonical form before performing a sort operation. The number of *ffffff* fractional digits is the maximum precision supported by the current operating system. For more on Windows fractional seconds, see below.

The **$NOW** function can be invoked with or without a parameter value. The parentheses are mandatory.

$NOW with no parameter value returns the current local date and time for the current process. It determines the local time zone from the value set in the **$ZTIMEZONE** special variable. Setting **$ZTIMEZONE** changes the time portion of **$NOW**, and this change of time can also change the date portion of **$NOW**.

CAUTION: The **$NOW** local time value may not correspond to local clock time. **$NOW** determines local time using the **$ZTIMEZONE** value. **$ZTIMEZONE** is continuous throughout the year; it does not adjust for Daylight Saving Time (DST) or other local time variants.

Offset from UTC time is calculated using a count of time zones from the Greenwich meridian. It is not a comparison of your local time with local Greenwich time. The term Greenwich Mean Time (GMT) may be confusing; local time at Greenwich is the same as UTC during the winter; during the summer it differs from UTC by one hour. This is because a local time variant, known as British Summer Time, is applied. **$NOW** ignores all local time variants.

Also, because **$NOW** resynchronizes its time value with the system clock, comparisons of time values between **$NOW** and other InterSystems IRIS time functions and special variables may show slight variations. This variation is limited to 0.05 seconds; however, within this range of variation, comparisons may yield misleading results. For example, `WRITE $NOW(),!,$HOROLOG` may yield results such as the following:

```
61438,38794.002085
61438,38793
```

This anomaly is caused both by the 0.05 second resynchronization variation and by **$HOROLOG** truncation of fractional seconds.

$NOW with a parameter value returns the time and date that correspond to the time zone specified in *tzmins*. The value of **$ZTIMEZONE** is ignored.

Time Functions Compared

The various ways to return the current date and time are compared, as follows:

- **$NOW** returns the local date and time for the current process. **$NOW** returns the date and time in InterSystems IRIS storage format. It includes fractional seconds; the number of fractional digits is the maximum precision supported by the current operating system.
  - **$NOW()** determines the local time zone from the value of the **$ZTIMEZONE** special variable. The local time is *not* adjusted for local time variants, such as Daylight Saving Time. It therefore may not correspond to local clock time.
  - **$NOW(tzmins)** returns the time and date that correspond to the specified *tzmins* time zone parameter. The value of **$ZTIMEZONE** is ignored.
- **$HOROLOG** contains the local, variant-adjusted date and time in InterSystems IRIS storage format. The local time zone is determined from the current value of the **$ZTIMEZONE** special variable, and then adjusted for local time variants, such as Daylight Saving Time. It returns whole seconds only; fractions of a second are truncated.
- **$ZTIMESTAMP** contains the UTC (Coordinated Universal Time) date and time, with fractional seconds, in InterSystems IRIS storage format. Fractional seconds are expressed in three digits of precision (on Windows systems), or six digits of precision (on UNIX® systems). For this reason, **$NOW(0)** may return UTC time with greater fractional second precision than **$ZTIMESTAMP**.

Microseconds on Windows

The precision of microseconds on Windows systems is generally less accurate than other platforms. This is due to the limitations of the QueryPerformanceCounter() Windows library routine. InterSystems IRIS determines microseconds by comparing the result computed by QueryPerformanceCounter() with the system clock used for other date/time functions, which has at best 1 millisecond precision (and usually between 1 and 20 milliseconds of accuracy depending on the hardware running Windows.) When the **$NOW** microsecond precision clock differs from the millisecond precision clock by more than 50 milliseconds, InterSystems IRIS adjusts the microsecond precision clock forward or backwards to agree with the more accurate (but less precise) millisecond precision clock.

Because of this, on Windows, the **$NOW** function is suitable for measuring microsecond precision time intervals only over a very short duration, lasting no longer than a small number of seconds. On systems with multiple CPU cores, the InterSystems IRIS Windows process for each core will make microsecond adjustments that are local to the individual process. This means that **$NOW** values returned on different InterSystems IRIS CPU processes can disagree with each other. This discrepancy among CPU processes is more pronounced when Windows is running on a virtual machine that is hosted on a multi-core CPU chip.

Separating Date and Time

To get just the date portion or just the time portion of **$NOW**, you can use the $PIECE function, specifying the comma as the delimiter character:

```
SET dateval=$PIECE($NOW(),",",1)
SET timeval=$PIECE($NOW(),",",2)
WRITE !,"Date and time: ",$NOW()
WRITE !,"Date only: ",dateval
WRITE !,"Time only: ",timeval
```

Setting the Date

The value returned by **$NOW** and **$ZTIMESTAMP** cannot be set using the **FixedDate()** method of the %SYSTEM.Process class.

The value contained in **$HOROLOG** can be set to a user-specified date for the current process using the **FixedDate()** method of the %SYSTEM.Process class.

Examples

The following example shows two ways to return the current local date and time:

```
WRITE $ZDATETIME($NOW(),1,1,3)," $NOW() date & time",!
WRITE $ZDATETIME($HOROLOG,1,1,3)," $HOROLOG date & time"
```

Note that **$HOROLOG** adjusts for local time variants, such as Daylight Saving Time. **$NOW** does not adjust for local time variants.

The following example uses **$ZDATE** to convert the date field in **$NOW** to a date format.

```
WRITE $ZDATE($PIECE($NOW(),",",1))
```

returns a value formatted like this: 04/29/2009

The following example converts the time portion of **$NOW** to a time in the form of hours:minutes:seconds.ffff on a 12-hour (a.m. or p.m.) clock.

```
CLOCKTIME
  NEW
  SET Time=$PIECE($NOW(),",",2)
  SET Sec=Time#60
  SET Totmin=Time\60
  SET Min=Totmin#60
  SET Milhour=Totmin\60
  IF Milhour=12 { SET Hour=12,Meridian=" pm" }
  ELSEIF Milhour>12 { SET Hour=Milhour-12,Meridian=" pm" }
  ELSE { SET Hour=Milhour,Meridian=" am" }
  WRITE !,Hour,":",Min,":",Sec,Meridian
  QUIT
```

See Also

- $ZDATE function

- $ZDATEH function
- $ZDATETIME function
- $ZDATETIMEH function
- $ZTIME function
- $ZTIMEH function
- $HOROLOG special variable
- $ZTIMESTAMP special variable
- $ZTIMEZONE special variable

$NUMBER

Validates and returns a numeric value; optionally provides rounding and range checking.

```
$NUMBER(num,format,min,max)
$NUM(num,format,min,max)
```

Parameters

num	The numeric value to be validated and then converted to InterSystems IRIS canonical form. It can be a numeric or string value, a variable name, or any valid ObjectScript expression.
format	*Optional* — Specifies which processing options to apply to *num*. These processing options dictate primarily how to recognize and handle numbers containing decimal points.
min	*Optional* — The minimum acceptable numeric value.
max	*Optional* — The maximum acceptable numeric value.

Description

The **$NUMBER** function converts and validates the *num* numeric value using the specified *format*. It accepts numbers supplied with a variety of punctuation formats and returns numbers in InterSystems IRIS canonical form. You can use *format* to test whether a number is an integer. If *min* or *max* are specified, the number must fall within that range of values.

$NUMBER can be used for American format numbers, European format numbers, and Russian/Czech format numbers.

Using **$NUMBER** on the $DOUBLE values INF, –INF, or NAN always returns the empty string.

Parameters

format

The possible *format* codes are as follows. These *format* codes may be specified in any order. A nonnumeric *format* must be specified as a quoted string. Any or all of the following *format* codes may be omitted. If *format* is invalid, **$NUMBER** generates a <SYNTAX> error.

- Decimal character: either "." or "," indicating whether to use the American (".") or European (",") convention for validating the decimal point. You can specify either of these characters, or no decimal character. If you omit the decimal character, the number takes the DecimalSeparator of the current locale. Refer to European and American Decimal Separators below
- Rounding factor: an integer indicating how many digits to round to. This integer can be preceded by an optional + or - sign. If the rounding factor is positive (or unsigned) the number is rounded to the specified number of fractional digits. If the rounding factor is 0, the number is rounded to an integer. If the rounding factor is a negative integer, the number is rounded the indicated number of places to the left of the decimal separator. For example, a rounding factor of -2 rounds 234.45 to 200. The number "5" is always rounded up; thus a rounding factor of 1 rounds 123.45 to 123.5. After rounding, trailing zeros are removed; thus rounding 4.0043 to two fractional digits returns 4, not 4.00. For rounding of IEEE floating point numbers refer to $DOUBLE Numbers below.
- Integer indicator: the letter "I" (uppercase or lowercase) which specifies that the number must resolve to an integer. For example, `-07.00` resolves to an integer, but `-07.01` does not. If the number does not resolve to an integer, **$NUMBER** returns the null string. In the following example, only the first three **$NUMBER** functions returns an integer. The other three return the null string:

```
WRITE $NUMBER(-07.00,"I"),"  non-canonical integer numeric",!
WRITE $NUMBER(+"-07.00","I")," string forced as integer numeric",!
WRITE $NUMBER("-7","I")," canonical integer string numeric",!
WRITE $NUMBER("-07.00","I")," non-canonical integer string numeric",!
WRITE $NUMBER(-07.01,"I")," fractional numeric",!
WRITE $NUMBER("-07.01","I")," fractional string numeric",!
```

min and max

You can specify a minimum allowed value, a maximum allowed value, neither, or both. If specified, the *num* value (after rounding) must be greater than or equal to the *min* value, and less than or equal to the *max* value. A null string as a *min* or *max* value is equal to zero. If a value does not meet these criteria, **$NUMBER** returns the null string.

Thus in the following examples, the first is valid because *num* (4.0) equals *max* (4). The second is valid because *num* (4.003) still equals *max* (4) within the format range (two fractional digits). However, the third is not valid because **$NUMBER** rounds *num* up to a value (4.01) greater than *max* within the format range. It returns a null string.

```
WRITE !,$NUMBER(4.0,2,0,4)
WRITE !,$NUMBER(4.003,2,0,4)
WRITE !,$NUMBER(4.006,2,0,4)
```

You can omit parameters, retaining the commas as place holders. The first line of the following example sets a *max* value, but no *format* or *min* value. The second line sets no *format* value, but sets a *min* value of the null string, which is equivalent to zero. Thus the first line returns –7, and the second line fails the *min* criteria and returns the null string.

```
SET max=10
WRITE !,$NUMBER(-7,,,max)
WRITE !,$NUMBER(-7,,"",max)
```

You cannot specify trailing commas. The following results in a <SYNTAX> error:

```
WRITE $NUMBER(mynum,,min,)
```

Notes

Order of Operations

$NUMBER performs the following series of conversions and validations. If the number fails any validation step, **$NUMBER** returns a null string (""). If the number passes all validation steps, **$NUMBER** returns the resulting converted InterSystems IRIS canonical form number.

1. **$NUMBER** uses the decimal character format to determine which character is the group separator and strips out all group separator characters (regardless of their location in the number). It uses the following rule: If the decimal character specified in *format* is a period (.), then the group separator is a comma (,) or blank space. If the decimal character specified in *format* is a comma (,), then the group separator is a period (.) or blank space. If no decimal character is specified in *format*, the group separator is the NumericGroupSeparator property of the current locale. (The Russian (rusw), Ukrainian (ukrw), and Czech (csyw) locales use a blank space as the numeric group separator.)
2. **$NUMBER** validates that the number is well-formed. A well-formed number can contain any of the following:
   - Numbers
   - An optional decimal indicator character, as defined above (one or none, but not more than one).
   - An optional plus (+) or minus (-) sign character (leading or trailing, but not more than one).
   - Optional parentheses enclosing the number to indicate a negative value (debit). The number within the parentheses cannot have a sign character.
   - An optional base-10 exponent, indicated by an "E" (uppercase or lowercase) followed by an integer. If "E" is specified, an exponent integer must be present. The exponent integer may be preceded by a sign character.

3. If the integer indicator is present in *format*, **$NUMBER** checks for integers. An integer cannot contain a decimal indicator character. Numeric strings (“123.45”) and numbers (123.45) are parsed differently. Numeric strings fail this integer test even if there are no digits following the decimal indicator character, or if expansion of scientific notation or rounding would eliminate the fractional digits. Numbers pass these validation tests. If a number fails the integer indicator check, **$NUMBER** returns the null string ("").
4. **$NUMBER** converts the number to an InterSystems IRIS canonical form number. It expands scientific notation, replaces enclosing parentheses with a negative sign character, strips off leading and trailing zeros, and deletes a decimal indicator character if it is not followed by any nonzero digits.
5. **$NUMBER** uses the rounding factor (if present) to round the number the specified number of digits. It then strips off any leading or trailing zeros and the decimal indicator character if it is not followed by any digits.
6. **$NUMBER** validates the number against the minimum value, if specified.
7. **$NUMBER** validates the number against the maximum value, if specified.
8. **$NUMBER** returns the resulting number.

European and American Decimal Separators

$NUMBER returns a number in canonical form, removing all numeric group separators and includes at most one decimal separator character. You can use the *format* values “,” or “.” to identify the decimal separator used in *num*; by specifying the decimal separator, you are also implicitly specifying the numeric group separator.

To determine the DecimalSeparator character for your locale, invoke the following method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DecimalSeparator")
```

To determine the NumericGroupSeparator character and NumericGroupSize number for your locale, invoke the following methods:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("NumericGroupSeparator"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("NumericGroupSize")
```

In following examples, a comma is specified as the decimal separator:

```
SET num="123,456"
WRITE !,$NUMBER(num,",")
   // converts to the fractional number "123.456"
   // (comma is identified as decimal separator)
SET num="123,45,6"
WRITE !,$NUMBER(num,",")
  // returns the null string
  // (invalid number, too many decimal separators)
SET num="123.456"
WRITE !,$NUMBER(num,",")
  // converts to the integer "123456"
  // removing group separator
  // (if comma is decimal, then period is group separator)
SET num="123.4.56"
WRITE !,$NUMBER(num,",")
  // converts to the integer "123456"
  // removing group separators
  // (number and placement of group separators ignored)
```

$DOUBLE Numbers

$DOUBLE IEEE floating point numbers are encoded using binary notation. Most decimal fractions cannot be exactly represented in this binary notation. When a **$DOUBLE** value is input to **$NUMBER** with a rounding factor, the return value frequently contains more fractional digits than specified in the rounding factor. This is because the fractional decimal result is not representable in binary, so the return value must be rounded to the nearest representable **$DOUBLE** value, as shown in the following example:

```
SET x=1234.5678
SET y=$DOUBLE(1234.5678)
WRITE "Decimal: ",x," rounded ",$NUMBER(x,2),!
WRITE "Double: ",y," rounded ",$NUMBER(y,2)
```

When using **$DOUBLE** numbers be aware that IEEE floating point numbers and standard InterSystems IRIS fractional numbers differ in precision. **$DOUBLE** IEEE floating point numbers are encoded using binary notation. They have a precision of 53 binary bits, which corresponds to 15.95 decimal digits of precision. (Note that the binary representation does not correspond exactly to a decimal fraction.) Because most decimal fractions cannot be exactly represented in this binary notation, an IEEE floating point number may differ slightly from the corresponding standard InterSystems IRIS floating point number. Standard InterSystems IRIS fractional numbers have a precision of 18 decimal digits on all supported InterSystems IRIS system platforms. When an IEEE floating point number is displayed as a fractional number, the binary bits are often converted to a fractional number with far more than 18 decimal digits. This *does not* mean that IEEE floating point numbers are more precise than standard InterSystems IRIS fractional numbers.

If you are using **$NUMBER** to round a **$DOUBLE** value and wish to return a specific number of fractional digits, you should convert the $DOUBLE value to decimal representation before rounding the result.

$NUMBER returns `$DOUBLE("INF")` or `$DOUBLE("NAN")` as the empty string.

See Also

- $DOUBLE function
- $FNUMBER function
- $INUMBER function
- $ISVALIDNUM function
- $NORMALIZE function
- More information on locales in the section on “System Classes for National Language Support” in *Specialized System Tools and Utilities*.

$ORDER

Returns the next local variable or the subscript of a local or global variable.

```
$ORDER(variable,direction,target)
$O(variable,direction,target)
```

Parameters

variable	A subscripted local, process-private global, or global variable. If an array, the subscript is required. You cannot specify just the array name. You can specify an unsubscripted local variable using indirection (see example below). You cannot specify a simple object property reference as *variable*; you can specify a multidimensional property reference as *variable* with the syntax obj.property.
direction	*Optional* — The subscript order in which to traverse the target array. Values for subscripted variables can be: 1 = ascending subscript order (the default) or –1 = descending subscript order. For unsubscripted local variables, 1 (the default) is the only permitted value.
target	*Optional* — Returns the current data value of the next or previous node of *variable*. Whether it is the next or previous depends on the setting of *direction*. You must specify a *direction* value to specify a *target*. For unsubscripted local variables, *direction* must be set to 1. If *variable* is undefined, the *target* value remains unchanged. The *target* parameter cannot be used with structured system variables (SSVNs) such as **^$ROUTINE**.

Description

$ORDER is primarily used to loop through subscripted variables at a specified subscript level from a specified starting point. It returns sequential variables in collation sequence. It allows for gaps in the subscript sequence.

The value **$ORDER** returns depends on the parameters used.

- **$ORDER**(*variable*) returns the number of the next defined subscript if *variable* is a subscripted variable. The returned subscript is at the same level as that specified for the variable. For example, `$ORDER(^client(4,1,6))` returns the next third-level subscript. That would be 7, if the variable ^client(4,1,7) exists.

  $ORDER(*variable*) returns the name of the next defined local variable in alphabetic collating sequence, if *variable* is an unsubscripted local variable. For example, **$ORDER** would return the following defined local variables in the following sequence: a, a0a, a1, a1a, aa, b, bb, c. (See example below).

- **$ORDER**(*variable*,*direction*) returns either the next or the previous subscript for the variable. You can specify *direction* as 1 (next, the default) or –1 (previous).

  For unsubscripted local variables, **$ORDER** returns variables in *direction* 1 (next) order only. You cannot specify a *direction* of -1 (previous); attempting to do so results in a <FUNCTION> error.

- **$ORDER**(*variable*,*direction*,*target*) returns the subscript for the variable, and sets *target* to its current data value. This can be either the next or the previous subscript for a subscripted variable, depending on the *direction* setting. For an unsubscripted local variable, *direction* must be set to 1 to return the current data value to *target*. The *target* parameter cannot be used with structured system variables (SSVNs) such as **^$ROUTINE**. The **ZBREAK** command cannot specify the *target* parameter as a watchpoint.

First Subscript Returned

You can either start a **$ORDER** loop with the variable following a specified variable, or with the first variable:

- Start at specified point: `SET key=$ORDER(^mydata(99))` returns the next higher subscript after 99 — subscript 100, if it exists. Note that the node you specify in the argument (here subscript 99) need not exist. To return all positive subscripts you can specify `SET key=$ORDER(^mydata(-1))`. To return all negative subscripts you can specify `SET key=$ORDER(^mydata(0),-1)`.
- Start at beginning: `SET key=$ORDER(^mydata(""))` returns the first subscripted variable in collation sequence. This technique is required if the level may contain negative as well as positive subscripts.

The following example returns both negative and positive first-level subscripts in ascending numeric sequence.

```
 SET mydata(1)="a",mydata(-3)="C",mydata(5)="e",mydata(-5)="E"
// Get first subscript
SET key=$ORDER(mydata(""))
WHILE (key'="") {
  WRITE key,!
  // Get next subscript
  SET key = $ORDER(mydata(key))
}
```

When **$ORDER** reaches the end of the subscripts for the given level, it returns a null string (""). If you use **$ORDER** in a loop, your code should always include a test for this value.

The **$ORDER** start code and failure code values are both the null string (""). Because **$ORDER** starts and finishes on the null string, it correctly returns nodes having both negative and positive subscripts.

You can use **$ORDER** to return a limited subset of the defined local variables. You can use argumentless WRITE to display all defined local variables.

Examples

The examples shown here return local variables. **$ORDER** can also return subscripted global variables and subscripted process-private global variables.

The following example uses **$ORDER** in a **WHILE** loop to return all of the first-level subscripts in the mydata(n) global:

```
 SET mydata(1)="a",mydata(3)="c",mydata(7)="g"
// Get first subscript
SET key=$ORDER(mydata(""))
WHILE (key'="") {
  WRITE key,!
  // Get next subscript
  SET key = $ORDER(mydata(key))
}
```

The following example uses **$ORDER** in a **WHILE** loop to return all of the second-level subscripts in the mydata(1,n) global. Note that the first-level and third-level subscripts are ignored. This example returns both the subscript numbers and the corresponding variable values:

```
SET mydata(1,1)="a",mydata(1,3)="c",mydata(1,3,1)="lcase",mydata(1)="A",mydata(1,7)="g"
SET key=$ORDER(mydata(1,""),1,target)
WHILE (key'="") {
  WRITE key," = ",target,!
  // Get next subscript
  SET key = $ORDER(mydata(1,key),1,target)
}
```

The following example uses **$ORDER** in a **WHILE** loop to return unsubscripted local variables. Local variables are returned in collation sequence. This example returns both the local variable names and their values. Note that the @ indirection operator must be used when looping through unsubscripted local variables. This example starts with the next local variable in collation sequence after *b* (in this case, *bminus*). It then loops through all defined local variables that follow it in collation sequence. To avoid listing the variables *foo* and *target*, these variables are defined as process-private globals, rather than local variables:

```
SET a="great",b="good",bminus="pretty good",c="fair",d="poor",f="failure"
SET ^||foo="b"
SET ^||foo=$ORDER(@^||foo,1,^||target)
WHILE ^||foo '= "" {
WRITE ^||foo," = ",^||target,!
SET ^||foo=$ORDER(@^||foo,1,^||target)
    }
```

Notes

Uses for $ORDER

$ORDER is typically used with loop processing to traverse the nodes in an array that doesn't use consecutive integer subscripts. **$ORDER** simply returns the subscript of the next existing node. For example:

```
SET struct=""
FOR  {
  SET struct=$ORDER(^client(struct))
  QUIT:struct=""
  WRITE !,^client(struct)
}
```

The above routine writes the values for all the top-level nodes in the ^client global array.

$ORDER returns subscripts of existing nodes, but not all nodes contain a value. If you use **$ORDER** in a loop to feed a command (such as **WRITE**) that expects data, you must include a **$DATA** check for valueless nodes. For example, you could specify the **WRITE** command in the previous example with a postconditional test, as follows:

```
WRITE:($DATA(^client(struct))#10) !,^client(struct)
```

This test covers the case of both a valueless pointer node and a valueless terminal node. If your code becomes too cumbersome for a simple **FOR** loop, you can relegate part of it to a block-structured **DO**.

Global References

If a *variable* is global variable, it can include an extended global reference, specifying a global in a different namespace. If you specify a nonexistent namespace, InterSystems IRIS issues a <NAMESPACE> error. If you specify a namespace for which you do not have privileges, InterSystems IRIS issues a <PROTECT> error, followed by the global name and database path, such as the following: `<PROTECT> ^myglobal(1),c:\intersystems\iris\mgr\`. If the global variable has subscript mapping to a namespace for which the user does not have Read permission, the <PROTECT> error information shows the original global reference because you cannot see a subscript in a namespace for which you do not have privileges. However, the <PROTECT> error database path shows the protected database, not the original database.

If *variable* is a subscripted global variable, it can be a naked global reference. A naked global reference is specified without the array name and designates the most recently executed global reference. For example:

```
SET var1=^client(4,5)
SET var2=$ORDER(^(""))
WRITE "var1=",var1,!,"var2=",var2
```

The first **SET** command establishes the current global reference, including the subscript level for the reference. The **$ORDER** function uses a naked global reference to return the first subscript for this level. For example, it would return the value 1, indicating ^client(4,1), if that subscripted global is defined. If ^client(4,1) is not defined, it would return the value 2, indicating ^client(4,2) if that subscripted global is defined, and so forth.

All three parameters of **$ORDER** can take a naked global reference, or specify the global reference. However, if *direction* specifies an explicit global reference, subsequent naked global references do not use the *direction* global reference. They continue to use the prior established global reference, as shown in the following example:

```
SET ^client(4,3)="Jones"
SET ^client(4,5)="Smith"
SET ^dir(1)=-1
SET rtn=$ORDER(^client(4,5),-1)
WRITE $ZREFERENCE,!
   /* naked global ref is ^client(4,5) */
SET rtn=$ORDER(^client(4,5),^dir(1))
```

```
WRITE $ZREFERENCE,!
   /* NOTE: naked global ref is ^client(4,5) */
SET rtn=$ORDER(^client(4,5),^dir(1),^(1))
WRITE $ZREFERENCE
   /* NOTE: naked global ref is ^client(4,1) */
WRITE ^client(4,1),!
SET rtn=$ORDER(^client(4,5),^dir(1),^targ(1))
WRITE $ZREFERENCE
   /* naked global ref is ^targ(1) */
WRITE ^targ(1),!
SET ^rtn(1)=$ORDER(^client(4,5),^dir(1),^targ(2))
WRITE $ZREFERENCE
   /* naked global ref is ^rtn(1) */
WRITE ^targ(2)
```

For more details, see Naked Global Reference in *Using Globals*.

$ORDER and $DOUBLE Subscripts

$DOUBLE floating point numbers can be used as subscript identifiers. However, when used as a subscript identifier, the **$DOUBLE** number is converted to a string. When **$ORDER** returns a subscript of this type, it returns it as a numeric string, not a **$DOUBLE** floating point number.

See Also

- $DATA function
- $GET function
- $QUERY function
- Global Structure chapter in *Using Globals*

$PARAMETER

Returns the value of the specified class parameter.

```
$PARAMETER(class,parameter)
```

Parameters

class	*Optional* — Either a class name or an object reference (OREF) to a class instance. If omitted, uses the object reference of the current class instance. When omitted, you must specify the placeholder comma.
parameter	The name of a parameter. An expression which evaluates to a string. The value of the string must match the name of an existing parameter of the class identified by *class*.

Description

$PARAMETER returns the value of a specified class parameter. **$PARAMETER** can look up this *parameter* in the current class context or in a specified class context. You can specify a *class* name as a quoted string, specify an OREF, or omit the *class* parameter and take as default the current instance (see $THIS). Specifying *class* is optional; specifying the comma separator is mandatory.

For example:

```
WRITE $PARAMETER("%Library.Boolean","XSDTYPE")
```

There are several ways to return the value of a parameter using object syntax, as shown in the following example:

```
WRITE "ObjectScript function:",!
WRITE $PARAMETER("Sample.Person","EXTENTQUERYSPEC")
WRITE !,"class parameter:",!
WRITE ##class(Sample.Person).#EXTENTQUERYSPEC
WRITE !,"instance parameter:",!
SET myinst=##class(Sample.Person).%New()
WRITE myinst.%GetParameter("EXTENTQUERYSPEC")
WRITE !,"instance parameter:",!
WRITE myinst.#EXTENTQUERYSPEC
```

Invalid Values

- $PARAMETER("","XMLTYPE"): attempting to invoke an invalid OREF (such as the empty string, an integer, or a fractional number) results in an <INVALID OREF> error.
- $PARAMETER("bogus","XMLTYPE"): attempting to invoke a nonexistent class results in a <CLASS DOES NOT EXIST> error, followed by the specified class name. If a package name is not specified, InterSystems IRIS assumes the default. For example, attempting to invoke the nonexistent *class* "bogus" results in the error <CLASS DOES NOT EXIST> *User.bogus.
- $PARAMETER(,"XMLTYPE"): attempting to default to the current object instance when none has been established results in a <NO CURRENT OBJECT> error.
- $PARAMETER("%SYSTEM.Task",""): attempting to reference an invalid *parameter* name (for example, an empty string) or to reference a parameter by number generates an <ILLEGAL VALUE> error.
- $PARAMETER("%SYSTEM.Task","MakeCoffee"): attempting to reference a nonexistent *parameter* name returns the empty string ("").

Examples

The following example specifies class names and returns the class default values for the XMLTYPE and XSDTYPE parameters:

```
WRITE $PARAMETER("%SYSTEM.Task","XMLTYPE"),!
WRITE $PARAMETER("%Date","XSDTYPE")
```

The following example specifies an OREF and returns the value of the XMLTYPE parameter for this instance:

```
SET oref=##class(%SYSTEM.Task).%New()
WRITE $PARAMETER(oref,"XMLTYPE")
```

The following example returns a system parameter using **$PARAMETER** syntax and using class syntax:

```
WRITE $PARAMETER("%SYSTEM.SQL","%RandomSig"),!
WRITE ##class(%SYSTEM.SQL).#%RandomSig
```

See Also

- $CLASSMETHOD function
- $CLASSNAME function
- $METHOD function
- $PROPERTY function
- $THIS special variable

$PIECE

Returns or replaces a substring, using a delimiter.

```
$PIECE(string,delimiter,from,to)
$P(string,delimiter,from,to)

SET $PIECE(string,delimiter,from,to)=value
SET $P(string,delimiter,from,to)=value
```

Parameters

string	The target string in which delimited substrings are identified. Specify *string* as an expression that evaluates to a quoted string or a numeric value. In **SET $PIECE** syntax, *string* must be a variable or a multi-dimensional property.
delimiter	A delimiter used to identify substrings within *string*. Specify *delimiter* as an expression that evaluates to a quoted string containing one or more characters.
from	*Optional* — An expression that evaluates to a code specifying the location of a substring, or the beginning of a range of substrings, within *string*. Substrings are separated by a *delimiter*, and counted from 1. Permitted values are *n* (a positive integer specifying the substring count from the beginning of *string*), * (specifying the last substring in *string*), and *-*n* (offset integer count of substrings counting backwards from end of *string*). **SET $PIECE** syntax also supports *+*n* (offset integer count of substrings to append beyond the end of *string*). Thus, the first delimited substring is 1, the second delimited substring is 2, the last delimited substring is *, and the next-to-last delimited substring is *-1. If *from* is omitted, it defaults to the first delimited substring.
to	*Optional* — An expression that evaluates to a code specifying the ending substring for a range of substrings within *string*. Must be used with *from*. Permitted values are *n* (a positive integer specifying the substring count from the beginning of *string*), * (specifying the last substring in *string*), and *-*n* (offset integer count of substrings from end of *string*). **SET $PIECE** syntax also supports *+*n* (offset integer for a range of substrings to append beyond the end of *string*). If *to* is prior to *from* in *string*, no operation is performed and no error is generated.

Description

$PIECE identifies substrings within *string* by the presence of a *delimiter*. If the *delimiter* does not occur in *string*, the entire string is treated as a single substring.

$PIECE can be used in two ways:

- To return a substring from *string*. This uses the `$PIECE(string,delimiter,from,to)` syntax.
- To replace a substring within *string*. It identifiers a substring and replaces it with another substring. The replacement substring may be the same length, longer, or shorter than the original substring. This uses the `SET $PIECE(string,delimiter,from,to)=value` syntax.

Returning a Substring

When returning a specified substring (piece) from *string*, the substring returned depends on the parameters used:

- **$PIECE**(*string*,*delimiter*) returns the first substring in *string*. If *delimiter* occurs in *string*, this is the substring that precedes the first occurrence of *delimiter*. If *delimiter* does not occur in *string*, the returned substring is *string*.

- **$PIECE**(*string*,*delimiter*,*from*) returns a substring whose location is specified by the *from* parameter. Substrings are delimited by delimiters and the beginning and end of *string*. The delimiter itself is not returned.
- **$PIECE**(*string*,*delimiter*,*from*,*to*) returns a range of substrings including the substring specified in *from* through the substring specified in *to* (inclusive). This four-argument form of **$PIECE** returns a substring that includes any intermediate occurrences of *delimiter* that occur between the *from* and *to* substrings. If *to* is greater than the number of substrings, the returned substring includes all substrings to the end of *string*.

Parameters

string

When **$PIECE** is used to return a substring, *string* can be a string literal enclosed in quotation marks, a canonical numeric, a variable, an object property, or any valid ObjectScript expression that evaluates to a string or a numeric. If you specify a null string ("") as the target string, **$PIECE** always returns the null string, regardless of the other parameter values.

A target string usually contains instances of a character (or character string) which are used as delimiters. This character or character string cannot also be used as a data value within *string*.

When **$PIECE** is used with **SET** on the left hand side of the equals sign to replace a substring, *string* can be a variable or a multidimensional property reference; it cannot be a non-multidimensional object property.

delimiter

The search string to be used to delimit substrings within *string*. It can be a string literal enclosed in quotation marks, a canonical numeric, a variable or any valid ObjectScript expression that evaluates to a string or a numeric.

Commonly, a delimiter is a designated character which is never used as data within *string*, but is set aside solely for use as a delimiter separating substrings. For example, if *delimiter* is “^”, the *string* “Red^Orange^Yellow” contains three delimited substrings.

A delimiter can be a multi-character string, the individual characters of which can be used within string data. For example, if *delimiter* is “^#”, the *string* “Red^Orange^#^Yellow#Green#^Blue” contains two delimited substrings: “Red^Orange” and “^Yellow#Green#^Blue”.

Commonly, *string* does not begin or end with a *delimiter*. If *string* begins or ends with a *delimiter*, **$PIECE** treats this delimiter as demarcating a substring with a null string ("") value. For example, if *delimiter* is “^”, the *string* “^Red^Orange^Yellow^” contains five delimited substrings; substrings 1 and 5 have null string values.

If the specified delimiter is not in *string*, **$PIECE** returns the entire *string*. If the specified delimiter is the null string (""), **$PIECE** returns the null string.

from

The location of a substring within *string*. Use *n* (a positive integer) to count delimited substrings from the beginning of *string*. Use * to specify the last delimited substring in *string*. Use *-*n* to count delimited substrings by offset from the last delimited substring in *string*.

- 1 specifies the first substring of *string* (the substring that precedes the first occurrence of *delimiter*). If *string* does not contain the specified delimiter, a *from* value of 1 returns *string*. If *from* is omitted, it defaults to 1.
- 2 specifies the second substring of *string* (the substring that appears between the first and second occurrences of *delimiter*, or between the first occurrence of *delimiter* and the end of *string*).
- * specifies the last substring of *string* (the substring that follows the last occurrence of *delimiter*). If *string* does not contain the specified delimiter, a *from* value of * returns *string*.
- *-1 specifies the next-to-last substring of *string*. *-*n* counts by offset from the last substring of *string*. *-0 is the last substring of *string*; * and *-0 are functionally identical.

- For **SET $PIECE** syntax only — `*+n` (an asterisk followed by a positive number) appends delimited substrings by offset beyond the end of *string*. Thus, `*+1` appends a delimited substring beyond the end of *string*, *+2 appends a delimited substring two positions beyond the end of *string*, padding with delimiters.
- If *from* is the null string (""), zero, a negative number, or specifies a count or offset beyond the number of substrings in *string*, **$PIECE** returns a null string.

$PIECE converts a *from* numeric to canonical form (resolving leading plus and minus signs and removing leading zeros), then truncates it to an integer.

If the *from* parameter is used with the *to* parameter, it identifies the start of a range of substrings to be returned as a string, and should be less than the value of *to*.

to

The number of the substring within *string* that ends the range initiated by the *from* parameter. The returned string includes both the *from* and *to* substrings, as well as any intermediate substrings and the delimiters separating them. The *to* parameter must be used with *from* and should be greater than the value of *from*.

Use *n* (a positive integer) to count delimited substrings from the beginning of *string*. Use * to specify the last delimited substring in *string*. Use *-*n* to count delimited substrings by offset backwards from the last delimited substring in *string*.

For **SET $PIECE** syntax only — `*+n` (an asterisk followed by a positive number) specifies the end of a range of substrings to append beyond the end of *string*.

- If *from* is less than *to*, **$PIECE** returns a string consisting of all of the delimited substrings within this range, including the *from* and *to* substrings. This returned string contains the substrings and the delimiters within this range. If *to* is greater than the number of delimited substrings, the returned string contains all the string data (substrings and delimiters) beginning with the *from* substring and continuing to the end of *string*.
- If *from* is equal to *to*, **$PIECE** returns the *from* substring. This can occur if *from* and *to* are the same value, or are different values that reference the same substring.
- If *from* is greater than *to*, is zero (0), or is the null string (""), **$PIECE** returns a null string.

$PIECE converts a *to* numeric to canonical form (resolving leading plus and minus signs and removing leading zeros), then truncates it to an integer.

*Specifying *-n and *+n Parameter Values*

When using a variable to specify `*-n` or `*+n`, you must always specify the asterisk and a sign character in the parameter itself.

The following are valid specifications of `*-n`:

```
SET count=2
SET alph="a^b^c^d"
WRITE $PIECE(alph,"^",*-count)
```

```
SET count=-2
SET alph="a^b^c^d"
WRITE $PIECE(alph,"^",*+count)
```

The following is a valid specification of `*+n`:

```
SET count=2
SET alph="a^b^c^d"
SET $PIECE(alph,"^",*+count)="F"
WRITE alph
```

Whitespace is permitted within these parameter values.

Examples: Returning a Delimited Substring

In the following example, each **$PIECE** returns the specified substring as identified by the "," delimiter:

```
SET colorlist="Red,Green,Blue,Yellow,Orange,Black"
WRITE $PIECE(colorlist,","),!     ; returns "Red" (substring 1) by default
WRITE $PIECE(colorlist,",",3),!   ; returns "Blue" the third substring
WRITE $PIECE(colorlist,",",*),!   ; returns "Black" the last substring
WRITE $PIECE(colorlist,",",*-1),! ; returns "Orange" the next-to-last substring
```

In the following example, **$PIECE** returns the integer and fractional parts of a number:

```
SET int=$PIECE(123.999,".")
SET frac=$PIECE(123.999,".",*)
WRITE "integer=",int," fraction =.",frac
```

The following example returns "Blue,Yellow,Orange", the third through fifth substrings in colorlist, as delimited by ",":

```
SET colorlist="Red,Green,Blue,Yellow,Orange,Black"
SET extract=$PIECE(colorlist,",",3,5)
WRITE extract
```

The following **WRITE** statements all return the first substring “123”, showing that these formats are equivalent when *from* and *to* have a value of 1:

```
SET numlist="123#456#789"
WRITE !,"2-arg=",$PIECE(numlist,"#")
WRITE !,"3-arg=",$PIECE(numlist,"#",1)
WRITE !,"4-arg=",$PIECE(numlist,"#",1,1)
```

In the following example, both **$PIECE** functions returns the entire *string* string, because there are no occurrences of *delimiter* in *string*:

```
SET colorlist="Red,Green,Blue,Yellow,Orange,Black"
SET extract1=$PIECE(colorlist,"#")
SET extract2=$PIECE(colorlist,"#",1,4)
WRITE "#   =",extract1,!,"#,1,4=",extract2
```

The following example **$PIECE** returns the second substring from an object property:

```
SET tStatement = ##class(%SQL.Statement).%New()
SET tStatement.%SchemaPath="MyTests,Sample,Cinema"
WRITE "whole schema path: ",tStatement.%SchemaPath,!
WRITE "2nd piece of schema path: ",$PIECE(tStatement.%SchemaPath,",",2),!
```

The following two examples use more complex delimiters.

This example uses a delimiter string “#-#” to return three substrings of the string *numlist*. Here, the component characters of the delimiter string, “#” and “-”, can be used as data values; only the specified sequence of characters (#-#) is set aside:

```
SET numlist="1#2-3#-#45##6#-#789"
WRITE !,$PIECE(numlist,"#-#",1)
WRITE !,$PIECE(numlist,"#-#",2)
WRITE !,$PIECE(numlist,"#-#",3)
```

The following example uses a non-ASCII delimiter character (in this case, the Unicode character for pi), specified using the **$CHAR** function, and inserted into *string* by using the concatenate operator (_):

```
SET a = $CHAR(960)
SET colorlist="Red"_a_"Green"_a_"Blue"
SET extract1=$PIECE(colorlist,a)
SET extract2=$PIECE(colorlist,a,2)
SET extract3=$PIECE(colorlist,a,2,3)
WRITE extract1,!,extract2,!,extract3
```

Replacing a Substring Using SET $PIECE

When making assignments with the **SET** command, you can use **$PIECE** to the left, as well as to the right, of the equals sign. When used to the left of the equals sign, **$PIECE** designates a substring to be replaced by the assigned value.

When **$PIECE** is used with **SET** on the left hand side of the equals sign, *string* can be a valid variable name. If the variable does not exist, **SET $PIECE** defines it. The *string* parameter can also be a multidimensional property reference; it cannot be a non-multidimensional object property. Attempting to use **SET $PIECE** on a non-multidimensional object property results in an <OBJECT DISPATCH> error.

The use of **$PIECE** (and **$LIST** and **$EXTRACT**) in this context differs from other standard functions because it modifies an existing value, instead of just returning a value. You cannot use **SET (a,b,c,...)=value** syntax with **$PIECE** (or **$LIST** or **$EXTRACT**) on the left of the equals sign, if the function uses relative offset syntax: `*` representing the end of a string and `*-n` or `*+n` representing relative offset from the end of the string. You must instead use **SET a=value,b=value,c=value,...** syntax.

Examples: Replacing a Delimited Substring

The following example changes the value of *colorlist* to "Magenta,Green,Cyan,Yellow,Orange,Black":

```
SET colorlist="Red,Green,Blue,Yellow,Orange,Black"
WRITE colorlist,!
SET $PIECE(colorlist,",",1)="Magenta"
WRITE colorlist,!
SET $PIECE(colorlist,",",*-3)="Cyan"
WRITE colorlist,!
```

The replacement substring may, of course, be longer or shorter than the original, and may include delimiters:

```
SET colorlist="Red,Green,Blue,Yellow,Orange,Black"
WRITE colorlist,!
SET $PIECE(colorlist,",",3)="Turquoise,Aqua,Teal"
WRITE colorlist,!
```

If you specify a *from* and *to* argument, the included substrings are replaced by the specified value, in this case the 4th through 6th delimited substrings:

```
SET colorlist="Red,Blue,Yellow,Green,Orange,Black"
WRITE !,colorlist
SET $PIECE(colorlist,",",4,6)="Yellow+Blue,Yellow+Red"
WRITE !,colorlist
```

You can append one or more delimited substrings either by delimited substring count (using *n*), or by offset from the end of *string* (using *+*n*). **SET $PIECE** appends additional delimiters as needed to append the delimited substring(s) at the specified location. The following examples both change the value of *colorlist* to "Green^Blue^^Red", padding with an extra empty string delimited substring:

```
SET colorlist="Green^Blue"
SET $PIECE(colorlist,"^",4)="Red"
WRITE colorlist

SET colorlist="Green^Blue"
SET $PIECE(colorlist,"^",*+2)="Red"
WRITE colorlist
```

If *delimiter* doesn't appear in *string*, **$PIECE** treats *string* as a single piece and performs the same substitutions described above. If there is no *from* argument specified, the new value replaces the original *string*:

```
SET colorlist="Red,Green,Blue"
WRITE colorlist,!
SET $PIECE(colorlist,"^")="Purple^Orange"
WRITE colorlist
```

If *delimiter* doesn't appear in *string*, and *from* is specified as an integer greater than 1, **$PIECE** appends *from*-1 delimiters and the supplied value to the end of *string*:

```
SET colorlist="Red,Green,Blue"
WRITE colorlist,!
SET $PIECE(colorlist,"^",3)="Purple"
WRITE colorlist
```

If *from* represents a position prior to the beginning of the string, InterSystems IRIS performs no operation:

```
SET colorlist="Red,Green,Blue"
WRITE colorlist,!
SET $PIECE(colorlist,",",*-7)="Purple"
WRITE colorlist
```

If *from* represents a position prior to the beginning of the string and *to* is provided, InterSystems IRIS treats *from* as position 1:

```
SET colorlist="Red,Green,Blue"
WRITE colorlist,!
SET $PIECE(colorlist,",",*-7,1)="Purple"
WRITE colorlist
```

Initializing a String Variable

The *string* variable does not need to be defined before being assigned a value. The following example initializes *newvar* to the character pattern ">>>>>>TOTAL":

```
SET $PIECE(newvar,">",7)="TOTAL"
WRITE newvar
```

See the "SET with $PIECE and $EXTRACT" section of the **SET** command documentation for more information.

Delimiter is Null String

If the delimiter is the null string, the new value replaces the original *string*, regardless of the values of the *from* and *to* arguments.

The following two examples both set *colorlist* to “Purple”:

```
SET colorlist="Red,Green,Blue"
WRITE !,colorlist
SET $PIECE(colorlist,"")="Purple"
WRITE !,colorlist

SET colorlist="Red,Blue,Yellow,Green,Orange,Black"
WRITE !,colorlist
SET $PIECE(colorlist,"",3,5)="Purple"
WRITE !,colorlist
```

Notes

Using $PIECE to Unpack Data Values

$PIECE is typically used to "unpack" data values that contain multiple fields delimited by a separator character. Typical delimiter characters include the slash (/), the comma (,), the space ( ), and the semicolon (;). The following sample values are good candidates for use with **$PIECE**:

```
"John Jones/29 River St./Boston MA, 02095"
"Mumps;Measles;Chicken Pox;Diptheria"
"45.23,52.76,89.05,48.27"
```

$PIECE and $LENGTH

The two-argument form of **$LENGTH** returns the number of substrings in a string, based on a delimiter. Use **$LENGTH** to determine the number of substrings in a string, and then use **$PIECE** to extract individual substrings, as shown in the following example:

```
SET sentence="The quick brown fox jumped over the lazy dog's back."
SET delim=" "
SET countdown=$LENGTH(sentence,delim)
SET countup=1
FOR reps=countdown:-1:1 {
   SET extract=$PIECE(sentence,delim,countup)
   WRITE !,countup," ",extract
   SET countup=countup+1
}
WRITE !,"All done!"
```

Null Values

$PIECE does not distinguish between a delimited substring with a null string value, and a nonexistent substring. Both return a null string value. For example, the following examples both return the null string for a *from* value of 7:

```
SET colorlist="Red,Green,Blue,Yellow,Orange,Black"
SET extract1=$PIECE(colorlist,",",6)
SET extract2=$PIECE(colorlist,",",7)
WRITE "6=",extract1,!,"7=",extract2
```

```
SET colorlist="Red,Green,Blue,Yellow,Orange,Black,"
SET extract1=$PIECE(colorlist,",",6)
SET extract2=$PIECE(colorlist,",",7)
WRITE "6=",extract1,!,"7=",extract2
```

In the first case, there is no seventh substring; a null string is returned. In the second case there is a seventh substring, as indicted by the delimiter at the end of the *string*; the value of this seventh substring is the null string.

The following example shows null values within a *string*. It extracts substrings 1 and 3. These substrings exists, but both contain a null string. (Substring 1 is defined as the string preceding the first delimiter character):

```
SET colorlist=",Red,,Blue,"
SET extract1=$PIECE(colorlist,",")
SET extract3=$PIECE(colorlist,",",3)
WRITE !,"sub1=",extract1,!,"sub3=",extract3
```

The following examples also returns a null string, because the specified substrings do not exist:

```
SET colorlist="Red,Green,Blue,Yellow,Orange,Black"
SET extract=$PIECE(colorlist,",",0)
WRITE !,"Length=",$LENGTH(extract),!,"Value=",extract
```

```
SET colorlist="Red,Green,Blue,Yellow,Orange,Black"
SET extract=$PIECE(colorlist,",",8,20)
WRITE !,"Length=",$LENGTH(extract),!,"Value=",extract
```

Forcing Numeric Evaluation

Prefacing **$PIECE** (or any ObjectScript function) with a unary + sign forces numeric evaluation of the return value. It returns a numeric substring in canonical form. It returns a non-numeric substring as 0. It returns the leading numeric part of a mixed numeric substring. It returns 0 for a null string value or a nonexistent substring.

This forced numeric evaluation is shown in the following example:

```
SET str="snow white,7dwarves,+007.00,99.90,,-0,"
WRITE "Substrings:",!
FOR i=1:1:7 {WRITE i,"=",$PIECE(str,",",i)," "}
WRITE !,"Forced Numerics:",!
FOR i=1:1:7 {WRITE i,"=",+$PIECE(str,",",i)," "}
```

Nested $PIECE Operations

To perform complex extractions, you can nest **$PIECE** references within each other. The inner **$PIECE** returns a substring that is operated on by the outer **$PIECE**. Each **$PIECE** uses its own delimiter. For example, the following returns the state abbreviation “MA”:

```
SET patient="John Jones/29 River St./Boston MA 02095"
SET patientstateaddress=$PIECE($PIECE(patient,"/",3)," ",2)
WRITE patientstateaddress
```

The following is another example of nested **$PIECE** operations, using a hierarchy of delimiters. First, the inner **$PIECE** uses the caret (^) delimiter to find the second piece of *nestlist*: "A,B,C". Then the outer **$PIECE** uses the comma (,) delimiter to return the first and second pieces ("A,B") of the substring "A,B,C":

```
SET nestlist="1,2,3^A,B,C^@#!"
WRITE $PIECE($PIECE(nestlist,"^",2),",",1,2)
```

$PIECE Compared with $EXTRACT and $LIST

$PIECE determines a substring by counting user-defined delimiter characters within the string. **$PIECE** takes as input an ordinary character string containing multiple instances of a character (or string) intended for use as a delimiter.

$EXTRACT determines a substring by counting characters from the beginning of a string. **$EXTRACT** takes as input an ordinary character string.

$LIST determines an element from an encoded list by counting elements (not characters) from the beginning of the list. The **$LIST** functions specify substrings without using a designated delimiter. If setting aside a delimiter character or character sequence is not appropriate to the type of data (for example, bitstring data), you should use the $LISTBUILD and $LIST functions to store and retrieve substrings. You can convert a delimited string into a list using the $LISTFROMSTRING function. You can convert a list to a delimited string using the $LISTTOSTRING function.

The data storage strategies used by **$PIECE** and the **$LIST** functions are incompatible, and their use should not be combined. For example, attempted to use **$PIECE** on a list created using **$LISTBUILD** yields unpredictable results and should be avoided.

See Also

- SET command
- $EXTRACT function
- $LENGTH function
- $LIST function
- $LISTBUILD function
- $LISTFROMSTRING function
- $LISTTOSTRING function
- $REVERSE function

$PREFETCHOFF

Ends pre-fetching of globals.

```
$PREFETCHOFF(gref,gref2)
```

Parameters

gref	*Optional* — A global reference.
gref2	*Optional* — A global reference used to establish a range.

Description

$PREFETCHOFF turns off the pre-fetching of global nodes established by **$PREFETCHON**.

There are three forms of **$PREFETCHOFF**:

- `$PREFETCHOFF()` turns off all pre-fetching established for the current process.
- `$PREFETCHOFF(gref)` turns off pre-fetching of the *gref* node and all of its descendents. The *gref* value must correspond exactly to the **$PREFETCHON** value.
- `$PREFETCHOFF(gref,gref2)` turns off pre-fetching of the nodes in the range *gref* through *gref2*. *gref* and *gref2* must be nodes of the same global. The *gref* and *gref2* values must correspond exactly to the **$PREFETCHON** values. You cannot turn off part of a range of values.

Upon successful completion, `$PREFETCHOFF()` returns 0. It returns 0 even if there were no pre-fetches to turn off.

Upon successful completion, `$PREFETCHOFF(gref)` and `$PREFETCHOFF(gref,gref2)` return a string of six integers separated by commas. These six values are: number of blocks prefetched, number of I/Os performed, number of prefetch operations, milliseconds of prefetch disk time, background job: number of blocks prefetched, and background job: number of I/Os performed.

Upon failure, all forms of **$PREFETCHOFF** return -1. `$PREFETCHOFF(gref)` and `$PREFETCHOFF(gref,gref2)` return -1 if there is no corresponding **$PREFETCHON** that exactly matches the specified global or range of globals, or if the specified prefetch global or range of globals has already been turned off.

Parameters

gref

A global reference, either a global or a process-private global. The global does not need to be defined at the time that the pre-fetch is turned off.

You can specify this global using @ indirection. Refer to Indirection in *Using ObjectScript*.

You cannot specify a structured system variable name (SSVN) for this parameter.

gref2

A global reference used to establish a range with *gref*. Therefore, *gref2* must be a global node lower in the same global tree as *gref*.

You can specify this global using @ indirection. Refer to Indirection in *Using ObjectScript*.

Examples

The following example establishes two pre-fetches, then turns them off individually:

```
SET ret=$PREFETCHON(^a)
IF ret=1 { WRITE !,"prefetch established" }
ELSE { WRITE !,"prefetch not established" }
SET ret2=$PREFETCHON(^b)
IF ret2=1 { WRITE !,"prefetch established" }
ELSE { WRITE !,"prefetch not established" }
SET retoff=$PREFETCHOFF(^a)
IF retoff'=-1 { WRITE !,"prefetch turned off. Values:",retoff }
ELSE { WRITE !,"prefetch not turned off" }
SET retoff2=$PREFETCHOFF(^b)
IF retoff2'=-1 { WRITE !,"prefetch turned off. Values:",retoff2 }
ELSE { WRITE !,"prefetch not turned off" }
```

The following example establishes two pre-fetches, then turns off all pre-fetches for the current process:

```
SET ret=$PREFETCHON(^a)
IF ret=1 { WRITE !,"prefetch established" }
ELSE { WRITE !,"prefetch not established" }
SET ret2=$PREFETCHON(^b)
IF ret2=1 { WRITE !,"prefetch established" }
ELSE { WRITE !,"prefetch not established" }
SET retoff=$PREFETCHOFF()
IF retoff=0 { WRITE !,"all prefetches turned off" }
ELSE { WRITE !,"prefetch not turned off" }
```

See Also

- $PREFETCHON function
- Globals in *Using ObjectScript*

$PREFETCHON

Establishes pre-fetch for specified globals.

```
$PREFETCHON(gref,gref2)
```

Parameters

gref	A global reference.
gref2	*Optional* — A global reference used to establish a range.

Description

$PREFETCHON improves performance by turning on pre-fetching for a global or a range of globals. **$PREFETCHON** returns 1 indicating successful completion (pre-fetching is enabled). **$PREFETCHON** returns 0 indicating the desired pre-fetch could not be established. A 0 might be returned if the specified range includes two different global names, or if there is some other problem that prevents pre-fetching. A returned 0 is not an error; it does not interrupt program execution, and processing of global references in the specified range is not impaired. It simply means that these global operations do not have the performance boost of pre-fetching.

Note: Pre-fetching of globals is not supported on a remote database.

$PREFETCHOFF turns off pre-fetching.

There are two forms of **$PREFETCHON**:

- `$PREFETCHON(gref)` pre-fetches the *gref* node and all of its descendents. For example, `$PREFETCHON(^abc(4))` pre-fetches all of the descendents of ^abc(4), such as ^abc(4,1), ^abc(4,2,2), and so forth. It does not pre-fetch ^abc(5).
- `$PREFETCHON(gref,gref2)` pre-fetches the nodes in the range *gref* through *gref2*. This does not include the descendents of *gref2*. *gref* and *gref2* must be nodes of the same global. For example, `$PREFETCHON(^abc(4),^abc(7,5))` pre-fetches all of the global nodes in the range of ^abc(4) through ^abc(7,5), including ^abc(4,2,2), ^abc(5), and ^abc(7,1,2). However, it does not pre-fetch ^abc(7,5,1).

Pre-fetching is not restricted to read access; it also works well when a large number of **SET** operations are being performed.

Pre-fetching and Performance

When you invoke **$PREFETCHON**, one or more pre-fetch background processes (daemons) are started as required. These pre-fetch daemons are shared systemwide by all processes. Because each pre-fetch daemon processes only one pre-fetch request at a time, it is usually advantageous to have several pre-fetch daemons running on your system. However, large numbers of concurrent pre-fetch daemons can have a performance impact on interactive system access.

Pre-fetching can improve performance when running an application that reads a large number of disk blocks containing nodes from the same global tree. Pre-fetching is most efficient when:

- Data is accessed in generally ascending order, meaning that data blocks of the global tree are generally accessed in left-to-right order. However, there is no requirement for adhering strictly to ascending order. Pre-fetching works best when either the data blocks of the global tree are generally accessed in left-to-right order, or when at least one data block within the range is likely to be accessed prior to most of its neighbors to the right in the logical tree.
- Most of the data blocks in the specified range are accessed. However, the initial pre-fetch does not fetch as many blocks as subsequent fetches, in case the user decides to cancel the operation after accessing only a small portion of the data.
- Less than 100 pre-fetches are active at any given time.

Parameters

gref

A global reference, either a global or a process-private global. The global does not need to be defined at the time that the pre-fetch is established.

You can specify this global using @ indirection. Refer to Indirection in *Using ObjectScript*.

You cannot specify a structured system variable name (SSVN) for this parameter.

gref2

A global reference used to establish a range with *gref*. Therefore, *gref2* must be a global node lower in the same global tree as *gref*.

You can specify this global using @ indirection. Refer to Indirection in *Using ObjectScript*.

Examples

The following example establishes pre-fetch for the global ^a.

```
SET ^a="myglobal"
SET x=^a
SET ret=$PREFETCHON(^a)
IF ret=1 { WRITE !,"prefetch established" }
ELSE { WRITE !,"prefetch not established" }
SET ret=$PREFETCHOFF()
```

The following example establishes pre-fetch for the range of globals ^||a(1) through ^a||(50).

```
SET ret=$PREFETCHON(^||a(1),^||a(50))
IF ret=1 { WRITE !,"prefetch established" }
ELSE { WRITE !,"prefetch not established" }
```

See Also

- $PREFETCHOFF function
- Globals in *Using ObjectScript*

$PROPERTY

Supports reference to a particular property of an instance.

```
$PROPERTY(instance, propertyname, index1, index2, index3... )
```

Parameters

instance	*Optional* — An expression that evaluates to an object instance reference (OREF). The value of the expression must be that of an in-memory instance of the desired class. If omitted, defaults to the current object.
propertyname	An expression that evaluates to a string. The value of the string must match the name of an existing property defined in the class identified by *instance*.
index1, *index2*, *index3*, ...	*Optional* — If *propertyname* is a multidimensional value, then this series of expressions is treated as indices into the array represented by the property. (If the specified property is not multidimensional, the presence of extra arguments causes an error at runtime.)

Description

$PROPERTY gets or sets the value of a property in an instance of the designated class. This function permits an ObjectScript program to select the value of an arbitrary property in an existing instance of some class. Since the first argument must be an instance of a class, it is computed at execution time. The property name may be computed at runtime or supplied as a string literal. The contents of the string must match exactly the name of a property declared in the class. Property names are case-sensitive.

If the property is declared to be multidimensional, then the arguments after the property name are treated as indices into a multidimensional array. A maximum of 255 argument values may be used for the index.

$PROPERTY may also appear on the left side of an assignment. When **$PROPERTY** appears to the left of an assignment operator, it provides the location to which a value is assigned. When it appears to the right, it is the value being used in the calculation.

If *instance* is not a valid in-memory OREF, an <INVALID OREF> error occurs. If *propertyname* is not a valid property, a <PROPERTY DOES NOT EXIST> error occurs. If you specify an *index1* and *propertyname* is not multidimensional, an <OBJECT DISPATCH> error occurs.

Remarks

The **$PROPERTY** function calls the **Get()** or **Set()** methods of the property passed to it. It is functionally the same as using the "Instance.PropertyName" syntax, where "Instance" and "PropertyName" are equivalent to the arguments as listed in the function's signature. Because of this, **$PROPERTY** should not be called within a property's **Get()** or **Set()** method, if one exists. For more information on **Get()** and **Set()** methods, see the chapter "Using and Overriding Property Methods" in *Defining and Using Classes*.

When used within a method to refer to a property of the current instance, **$PROPERTY** may omit *instance*. The comma that would normally follow *instance* is still required, however.

An attempt to get a multidimensional value from a property which is not declared to be multidimensional results in a `<FUNCTION>` error; likewise for attempting to set a multidimensional value into a property that is not multidimensional.

Examples

The following example returns the current NLS Language property value:

```
SET nlsoref=##class(%SYS.NLS.Locale).%New()
WRITE $PROPERTY(nlsoref,"Language")
```

The following example shows **$PROPERTY** used as a function:

```
SET TestName = "%Library.File"
SET ClassDef = ##class(%Library.ClassDefinition).%OpenId(TestName)
FOR i = "Name", "Super", "Persistent", "Final"
{
   WRITE i, ": ", $PROPERTY(ClassDef, i), !
}
```

The following example shows **$PROPERTY** used on both sides of an assignment operator:

```
SET TestFile = ##class(%Library.File).%New("AFile")
WRITE "Initial file name: ",$PROPERTY(TestFile,"Name"),!
SET $PROPERTY(TestFile,"Name") =
        $PROPERTY(TestFile,"Name") _ "Renamed"
WRITE "File name afterward: ",$PROPERTY(TestFile,"Name"),!
```

The following example returns a property value from the current object, in this case the SQL Shell. **$PROPERTY** is specified with its first parameter omitted:

```
USER>DO $SYSTEM.SQL.Shell()
SQL Command Line Shell
----------------------------------------------------

The command prefix is currently set to: <<nothing>>.
Enter <command>, 'q' to quit, '?' for help.
[SQL]USER>>set path="a,b,c"

path="a,b,c"
[SQL]USER>>! WRITE "The schema search path is ",$PROPERTY(,"Path")
The schema search path is "a,b,c"
[SQL]USER>>
```

See Also

- $CLASSMETHOD function
- $CLASSNAME function
- $METHOD function
- $PARAMETER function
- $THIS special variable

$QLENGTH

Returns the number of subscript levels in a variable.

```
$QLENGTH(var)
$QL(var)
```

Parameter

var	A string, or expression that evaluates to a string, that contains the name of a variable. The variable name can specify no subscripts or one or more subscripts.

Description

$QLENGTH returns the number of subscript levels in *var*. **$QLENGTH** simply counts the number of subscript levels specified in *var*. The *var* variable does not have to be defined for **$QLENGTH** to return the number of subscript levels.

Parameter

var

A quoted string, or expression that evaluates to a string, which specifies a variable. It can be a local variable, a process-private global, or a global variable.

If the string is a global reference, *var* can specify an extended global reference by including a namespace name. Because *var* is a quoted string, the quotes around a namespace reference must be doubled to be parsed correctly as literal quotation marks. For example, `"^|""SAMPLES""|myglobal(1,4,6)"`. The same applies to the quotes in a process-private global with "^" syntax. For example, `"^|""^""|ppgname(3,6)"`. **$QLENGTH** does not check whether the specified namespace exists or whether the user has access privileges for the namespace.

A *var* must specify a variable name in canonical form (a fully expanded reference). To use **$QLENGTH** with a naked global reference, or with indirection, you can use the **$NAME** function to return the corresponding fully expanded reference.

Examples

The following example show the results of **$QLENGTH** when used with subscripted and unsubscripted globals. The first **$QLENGTH** takes a global with no subscripts and returns 0. The second **$QLENGTH** takes a global with two subscript levels and returns 2. Note that quotes found in the variable name are doubled because *var* is specified as a quoted string.

```
WRITE !,$QLENGTH("^|""USER""|test")
   ; returns 0
SET name="^|""USER""|test(1,""customer"")"
WRITE !,$QLENGTH(name)
   ; returns 2
```

The following example returns the **$QLENGTH** value for a process-private global with three subscript levels. The **$ZREFERENCE** special variable contains the name of the most recently referenced variable.

```
SET ^||myppg("food","fruit",1)="apples"
WRITE !,$QLENGTH($ZREFERENCE)   ; returns 3
```

The following example returns the **$QLENGTH** value for a process-private global specified as a naked global reference. The **$NAME** function is used to expand the naked global reference to canonical form:

```
SET ^grocerylist("food","fruit",1)="apples"
SET ^(2)="bananas"
WRITE !,$QLENGTH($NAME(^(2)))   ; returns 3
```

See Also

- $QUERY function
- $QSUBSCRIPT function
- $NAME function
- $ZREFERENCE special variable
- Global Structure in *Using Globals*

$QSUBSCRIPT

Returns a variable name or a subscript name.

```
$QSUBSCRIPT(namevalue,intexpr)
$QS(namevalue,intexpr)
```

Parameters

namevalue	A string, or an expression that evaluates to a string, which is the name of a local variable, process-private global, or global variable, with or without subscripts.
intexpr	An integer code that specifies which name to return: variable name, subscript name, or namespace name.

Description

$QSUBSCRIPT returns the variable name, or the name of a specified subscript of *namevalue*, depending on the value of *intexpr*. If *namevalue* is a global variable, you can also return the namespace name, if it was explicitly specified. **$QSUBSCRIPT** does not return a default namespace name.

Parameters

namevalue

A quoted string, or expression that evaluates to a string, which is a local or global reference. It can have the form: Name(s_1,s_2,...,s_n).

If the string is a global reference, it can contain a namespace reference. Because *namevalue* is a quoted string, the quotes around a namespace reference must be doubled to be parsed correctly as literal quotation marks.

A *namevalue* must reference a variable name in canonical form (a fully expanded reference). To use **$QSUBSCRIPT** with a naked global reference, or with indirection, you can use the **$NAME** function to return the corresponding fully expanded reference.

intexpr

An integer expression code that indicates which value to return. Assume that the *namevalue* parameter has the form NAME(s_1,s_2,...,s_n), where *n* is the ordinal number of the last subscript. The *intexpr* parameter can have any of the following values:

Code	Return Value
< -1	Generates a <FUNCTION> error; these numbers are reserved for future extensions.
-1	Returns the namespace name if a global variable *namevalue* includes one; otherwise, returns the null string ("").
0	Returns the variable name. Returns ^NAME for a global variable, and ^||NAME for a process-private global variable. Does not return a namespace name.
<=*n*	Returns the subscript name for the level of subscription specified by the integer *n*, with 1 being the first subscript level and *n* being the highest defined subscript level.
>*n*	An integer > *n* returns the null string (""), where *n* is the highest defined subscript level.

Examples

The following example returns **$QSUBSCRIPT** values when *namevalue* is a subscripted global with one subscript level and a specified namespace:

```
SET global="^|""account""|%test(""customer"")"
WRITE !,$QSUBSCRIPT(global,-1)  ; account
WRITE !,$QSUBSCRIPT(global,0)   ; ^%test
WRITE !,$QSUBSCRIPT(global,1)   ; customer
WRITE !,$QSUBSCRIPT(global,2)   ; null string
```

The following example returns **$QSUBSCRIPT** values when *namevalue* is a process-private global with two subscript levels. The **$ZREFERENCE** special variable contains the name of the most recently referenced variable.

```
SET ^||myppg(1,3)="apples"
WRITE !,$QSUBSCRIPT($ZREFERENCE,-1)  ; null string
WRITE !,$QSUBSCRIPT($ZREFERENCE,0)   ; ^||myppg
WRITE !,$QSUBSCRIPT($ZREFERENCE,1)   ; 1
WRITE !,$QSUBSCRIPT($ZREFERENCE,2)   ; 3
```

The following example returns the **$QSUBSCRIPT** value for a global variable specified as a naked global reference. The **$NAME** function is used to expand the naked global reference to canonical form:

```
SET ^grocerylist("food","fruit",1)="apples"
SET ^(2)="bananas"
WRITE !,$QSUBSCRIPT($NAME(^(2)),2)   ; returns "fruit"
```

See Also

- $QUERY function
- $QLENGTH function
- $NAME function
- $ZREFERENCE special variable
- Global Structure in *Using Globals*

$QUERY

Performs a physical scan of a local or global array.

```
$QUERY(reference,direction,target)
$Q(reference,direction,target)
```

Parameters

reference	A reference that evaluates to the name (and optionally subscripts) of a public local or global variable. You cannot specify a simple object property as *reference*; you can specify a multidimensional property as *reference* with the syntax obj.property.
direction	*Optional* — The direction to traverse the array. Forward = 1, backwards = -1. The default is forward.
target	*Optional* — Returns the current data value of *reference*.

Description

$QUERY performs a physical scan of a public local or global array; it returns the full reference, name and subscripts, of the defined node next in sequence to the specified array node. If no such node exists, **$QUERY** returns the null string.

Parameters

reference

This parameter must evaluate to a public variable or a global. **$QUERY** cannot scan a private variable.

This parameter can be a multidimensional object property. It cannot be a non-multidimensional object property. Attempting to use **$QUERY** on a non-multidimensional object property results in an <OBJECT DISPATCH> error.

The returned global reference can be at the same level, a lower level, or a higher level as the level specified in the *reference* parameter. If you specify *reference* without specifying subscripts, **$QUERY** returns the first defined node in the array.

direction

If no *direction* is specified, the default direction is forward. If you wish to specify a direction, a parameter value of 1 will traverse the array forward, a value of -1 will traverse the array backward.

target

If you wish to specify a *target*, you must specify a *direction*. If the variable identified in the *reference* parameter is undefined, the *target* value remains unchanged.

The **ZBREAK** command cannot specify the *target* parameter as a watchpoint.

Example

This example presents a generalized routine for outputting the data values for all the nodes in a user-specified array. It can accommodate arrays with any number of levels. The code performs the same operation as the code shown in the example under the **$ORDER** function. Instead of requiring 23 lines, however, it requires only six and is not restricted as to the number of levels it can handle.

```
Start  READ !,"Array name: ",ary QUIT:ary=""
  SET queryary=$QUERY(@ary@(""))
  WRITE !,@queryary
  FOR   {
    SET queryary=$QUERY(@queryary)
        QUIT:queryary=""
        WRITE !,@queryary
  }
  WRITE !,"Finished."
  QUIT
```

The first **SET** command uses **$QUERY** with subscript indirection to initialize the global reference to the first existing node that contains data. For more information, refer to Indirection in *Using ObjectScript*. (Like **$ORDER**, **$QUERY** accepts a null string to designate the first subscript in an array.) The first **WRITE** command outputs the value of the first node found. If it were omitted, the first node would be skipped.

In the **FOR** loop, **$QUERY** is used to retrieve the next node and update the global reference, whose contents are then output by the **WRITE** command. The postconditional **QUIT** terminates the loop when it finds a null string (""), indicating that **$QUERY** has reached the end of the array.

No **$DATA** tests are required, unless you wish to distinguish between pointer nodes ($DATA=11) and terminal nodes ($DATA=1).

Notes

Using $QUERY to Traverse an Array

Used repetitively, **$QUERY** can traverse an entire array in left-to-right, top-to-bottom fashion, returning the entire sequence of defined nodes. **$QUERY** can start at the point determined by the subscript specified for *reference*. It proceeds along both the horizontal and vertical axes. For example:

```
SET exam=$QUERY(^client(4,1,2))
```

Based on this example, **$QUERY** might return any of the following values, assuming a three-level array:

Value	Returned by the $QUERY Function If...
^client(4,1,3)	If ^client(4,1,3) exists and contains data.
^client(4,2)	If ^client(4,1,3) does not exist or does not contain data and if ^client(4,2) does exist and contains data.
^client(5)	If ^client(4,1,3) and ^client(4,2) do not exist or do not contain data and if ^client(5) does exist and contains data.
null string ("")	If none of the previous global references exist or contain data; **$QUERY** has reached the end of the array.

With a direction value of -1, **$QUERY** can traverse an entire array in reverse order in right-to-left, bottom-to-top fashion.

$QUERY Compared to $ORDER

$QUERY differs from the $ORDER function in that **$QUERY** returns a full global reference, while **$ORDER** returns only the subscript of the next node. **$ORDER** proceeds along only the horizontal axis, across nodes at one level.

$QUERY also differs from **$ORDER** in that it selects only those existing nodes that contain data. **$ORDER** selects existing nodes, regardless of whether or not they contain data. Where **$ORDER** performs an implicit test for existence ($DATA'=0), **$QUERY** performs an implicit test for both existence and data ($DATA'=0 and $DATA'=10). Note, however, that **$QUERY** does not distinguish between pointer nodes ($DATA=11) and terminal nodes ($DATA=1) that contain data. To make this distinction, you must include appropriate **$DATA** tests in your code.

Like **$ORDER**, **$QUERY** is typically used with loop processing to traverse the nodes in an array that doesn't use consecutive integer subscripts. **$QUERY** simply returns the global reference of the next node with a value. **$QUERY** provides very compact code for accessing global arrays.

Like the $NAME and **$ORDER** functions, **$QUERY** can be used with a naked global reference, which is specified without the array name and designates the most recently executed global reference. For example:

```
SET a=^client(1)
SET x=2
SET z=$QUERY(^(x))
```

The first **SET** command establishes the current global reference, including the level for the reference. The second **SET** command sets up a variable for use with subscripts. The **$QUERY** function uses a naked global reference to return the full global reference for the next node following ^client(2). For example, the returned value might be ^client(2,1) or ^client(3).

$QUERY and Extended Global References

You can control whether **$QUERY** returns global references in Extended Global Reference form on a per-process basis using the **RefInKind()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *RefInKind* property of the Config.Miscellaneous class.

For further details on extended global references, see the Global Structure chapter in *Using Globals*.

See Also

- $DATA function
- $NAME function
- $ORDER function
- $QLENGTH function
- $QSUBSCRIPT function

$RANDOM

Returns a pseudo-random integer value in the specified range.

```
$RANDOM(range)
$R(range)
```

Parameter

range	A nonzero positive integer used to specify the upper bound of the range of possible random numbers.

Description

$RANDOM returns a pseudo-random integer value between 0 and *range*-1 (inclusive). Thus `$RANDOM(3)` returns 0, 1, 2, but not 3. Returned numbers are uniformly distributed across the specified range.

$RANDOM is sufficiently random for most purposes. Applications that require strictly random values should use the **GenCryptRand()** method of the %SYSTEM.Encryption class.

Parameters

range

This value specifies the upper bound of the range of possible random numbers; the highest random number being *range* minus 1. The *range* value can be a nonzero positive integer value, the name of an integer variable, or any valid ObjectScript expression that evaluates to a nonzero positive integer. The maximum *range* value is 1E17 (100000000000000000); specifying a value beyond this maximum results in a <FUNCTION> error. `$RANDOM(1)` is valid, but always returns 0. `$RANDOM(0)` results in a <FUNCTION> error.

Examples

The following example returns a random number from 0 through 24 (inclusive).

```
WRITE $RANDOM(25)
```

To return a random number with a fractional portion, you can use the concatenation operator (_) or the addition operator (+), as shown in the following example:

```
SET x=$RANDOM(10)_$RANDOM(10)/10
WRITE !,x
SET y=$RANDOM(10)+($RANDOM(10)/10)
WRITE !,y
```

This program returns numbers with one fractional digit, ranging between .0 and 9.9 (inclusive). Using either operator, InterSystems IRIS deletes any leading and trailing zeros (and the decimal point, if the fractional portion is zero). However, if both **$RANDOM** functions return zero (0 and .0), InterSystems IRIS returns a zero (0).

The following example simulates the roll of two dice:

```
Dice
   FOR {
      READ "Roll dice? ",reply#1
      IF "Yy"[reply,reply'="" {
         WRITE !,"Pair of dice: "
         WRITE $RANDOM(6)+1,"+",$RANDOM(6)+1,! }
      ELSE { QUIT }
   }
```

$REPLACE

Returns a new string that consists of a string-for-string substring replacement from an input string.

```
$REPLACE(string,searchstr,replacestr,start,count,case)
```

Parameters

string	The source string. It can be a numeric value, a string literal, the name of a variable, or any valid ObjectScript expression. If *string* is an empty string (""), **$REPLACE** returns an empty string.
searchstr	The substring to search for in *string*. It can be a numeric value, a string literal, the name of a variable, or any valid ObjectScript expression. If *searchstr* is an empty string (""), **$REPLACE** returns *string*.
replacestr	The replacement substring substituted for instances of *searchstr* in *string*. It can be a numeric value, a string literal, the name of a variable, or any valid ObjectScript expression. If *replacestr* is an empty string (""), **$REPLACE** returns *string* with the occurrences of *searchstr* removed.
start	*Optional* — Character count position within *string* where substring search is to begin. String characters are counted from 1. A value of 0, a negative number, a nonnumeric string or an empty string are equivalent to 1. If omitted, 1 is assumed. If *start* > 1, the substring of *string* beginning with that character is returned, with substring substitutions (if any) performed. If *start* > $LENGTH(*string*), **$REPLACE** returns the empty string ("").
count	*Optional* — Number of substring substitutions to perform. If omitted, the default value is -1, which means perform all possible substitutions. A value of 0, a negative number other than -1, a nonnumeric string or an empty string are equivalent to 0 which means perform no substitutions. If *start* is specified, *count* begins substring substitutions from the *start* position.
case	*Optional* — Boolean flag indicating whether matching of *searchstr* in *string* is to be case-sensitive. 0 = case-sensitive (the default). 1 = not case-sensitive. Any nonzero number is equivalent to 1. Any nonnumeric value is equivalent to 0. Placeholder commas can be supplied when *start* or *count* are not specified.

Description

The **$REPLACE** function returns a new string that consists of a string-for-string replacement of the input string. It searches *string* for the *searchstr* substring. If **$REPLACE** finds one or more matches, it replaces the *searchstr* substring with *replacestr* and returns the resulting string. The *replacestr* parameter value may be long or shorter than *searchstr*; *replacestr* may be an empty string.

By default, **$REPLACE** begins at the start of *string* and replaces every instance of *searchstr*. You can use the optional *start* parameter to begin comparisons at a specified character count location within the string. The returned string is a substring of *string* that begins at the *start* location and replaces every instance of *searchstr* from that point.

You can use the optional *count* parameter to replace only a specified number of matching substrings.

By default, **$REPLACE** substring matching is case-sensitive. You can use the optional *case* parameter to specify not case-sensitive matching.

Note: Because **$REPLACE** can change the length of a string, you should not use **$REPLACE** on encoded string values, such as an ObjectScript $List or a %List object property.

$REPLACE and $TRANSLATE

$REPLACE performs string-for-string matching and replacement. **$TRANSLATE** performs character-for-character matching and replacement. **$REPLACE** can replace a single specified substring of one or more characters with another substring. **$TRANSLATE** can replace multiple specified characters with corresponding specified new characters. By default, both functions replace all matching instances in the string.

$REPLACE matching is case-sensitive by default, but can be invoked as not case-sensitive; **$TRANSLATE** matching is always case-sensitive. **$REPLACE** can specify the starting point for matching and/or the number of replacements to perform; **$TRANSLATE** replaces all matches in the source string.

Examples

The following example shows two ways of using **$REPLACE**. The first **$REPLACE** does not change the input string value. The second **$REPLACE** changes the input string value by setting it equal to the function's return value:

```
SET str="The quick brown fox"
    // creates a new string, does not change str value
SET newstr=$REPLACE(str,"brown","red")
WRITE "source string: ",str,!,"new string: ",newstr,!!
    // creates a new string and replaces str with new string value
SET str=$REPLACE(str,"brown","silver")
WRITE "revised string: ",str
```

In the following example, invocations of **$REPLACE** match and substitute for the all instances of a substring, and the first two instances of a substring:

```
SET str="1110/1110/1100/1110"
WRITE !,"before conversion  ",str
SET newall=$REPLACE(str,"111","AAA")
WRITE !,"after replacement  ",newall
SET newsome=$REPLACE(str,"111","AAA",1,2)
WRITE !,"after replacement  ",newsome
```

In the following example, invocations of **$REPLACE** perform case-sensitive and not case-sensitive matching and replacement of all occurrences in the string:

```
SET str="Yes/yes/Y/YES/Yes"
WRITE !,"before conversion  ",str
SET case=$REPLACE(str,"Yes","NO")
WRITE !,"after replacement  ",case
SET nocase=$REPLACE(str,"Yes","NO",1,-1,1)
WRITE !,"after replacement  ",nocase
```

The following example compares the **$REPLACE** and **$TRANSLATE** functions:

```
SET str="A mom, o plom, o comal, Pomama"
WRITE !,"before conversion  ",str
SET s4s=$REPLACE(str,"om","an")
WRITE !,"after replacement  ",s4s
SET c4c=$TRANSLATE(str,"om","an")
WRITE !,"after translation  ",c4c
```

$REPLACE returns "A man, o plan, o canal, Panama"

$TRANSLATE returns "A nan, a plan, a canal, Panana"

In the following example, the four-parameter form of **$REPLACE** returns only the part of the string beginning with the start point, with the string-for-string replacements performed:

```
SET str="A mon, a plon, a conal, Ponama"
WRITE !,"before start replacement ",str
SET newstr=$REPLACE(str,"on","an",8)
WRITE !,"after start replacement  ",newstr
```

$REPLACE returns "a plan, a canal, Panama"

See Also

- $TRANSLATE function
- $EXTRACT function
- $PIECE function
- $REVERSE function
- $ZCONVERT function

$REVERSE

Returns the characters in a string in reverse order.

```
$REVERSE(string)
$RE(string)
```

Parameter

string	A string or expression that evaluates to a string.

Description

$REVERSE returns the characters in *string* in reverse order. The *string* can contain 8-bit characters or 16-bit Unicode characters. For further details on InterSystems IRIS Unicode support, refer to Unicode in *Using ObjectScript*.

Surrogate Pairs

$REVERSE does not recognize surrogate pairs. Surrogate pairs are used to represent some Chinese characters and to support the Japanese JIS2004 standard. You can use the **$WISWIDE** function to determine if a string contains a surrogate pair. The **$WREVERSE** function recognizes and correctly parses surrogate pairs. **$REVERSE** and **$WREVERSE** are otherwise identical. However, because **$REVERSE** is generally faster than **$WREVERSE**, **$REVERSE** is preferable for all cases where a surrogate pair is not likely to be encountered.

Examples

The following **WRITE** commands shows the return value from **$REVERSE**. The first returns “CBA”, the second returns 321.

```
WRITE !,$REVERSE("ABC")
WRITE !,$REVERSE(123)
```

You can use the **$REVERSE** function with other functions to perform search operations from the end of the string. The following example demonstrates how you can use **$REVERSE** with the **$FIND** and **$LENGTH** functions to locate the last example of a string within a line of text. It returns the position of that string as 33:

```
SET line="THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG."
SET position=$LENGTH(line)+2-$FIND($REVERSE(line),$REVERSE("THE"))
WRITE "The last THE in the line begins at ",position
```

See Also

- $FIND function
- $EXTRACT function
- $LENGTH function
- $PIECE function
- $WISWIDE function
- $WLENGTH function
- $WREVERSE function

$SCONVERT

Converts a binary encoded value to a number.

```
$SCONVERT(s,format,endian,position)
$SC(s,format,endian,position)
```

Parameters

s	A string of 8-bit bytes which encode for a number. Limitations on valid values are imposed by the *format* selected.
format	One of the following format codes, specified as a quoted string: S1, S2, S4, S8, U1, U2, U4, F4, or F8.
endian	*Optional* — A boolean value, where 0 = little-endian and 1 = big-endian. The default is 0.
position	*Optional* — The character position in the string of 8-bit bytes at which to begin conversion. Character positions are counted from 1. The default value is 1. If you specify *position*, you must either specify *endian* or a placeholder comma.

Description

$SCONVERT converts *s* from an encoded string of 8-bit bytes to a numeric value, using the specified *format*.

The following are the supported *format* codes:

S1	Signed integer encoded into a string of one 8-bit bytes. The value must be in the range -128 through 127, inclusive.
S2	Signed integer encoded into a string of two 8-bit bytes. The value must be in the range -32768 through 32767, inclusive.
S4	Signed integer encoded into a string of four 8-bit bytes. The value must be in the range -2147483648 through 2147483647, inclusive.
S8	Signed integer encoded into a string of eight 8-bit bytes. The value must be in the range -9223372036854775808 through 9223372036854775807, inclusive.
U1	Unsigned integer encoded into a string of one 8-bit bytes. The maximum value is 256.
U2	Unsigned integer encoded into a string of two 8-bit bytes. The maximum value is 65535.
U4	Unsigned integer encoded into a string of four 8-bit bytes. The maximum value is 4294967295.
F4	IEEE floating point number encoded into a string of four 8-bit bytes.
F8	IEEE floating point number encoded into a string of eight 8-bit bytes.

String *s* must contain sufficient characters starting at and following the specified character *position* to satisfy the number of 8-bit bytes required by the *format* code. For example, `$SCONVERT(s,"S4",0,9)` requires that the length of *s* be at least 12 characters because the decoded result comes from the character positions 9, 10, 11 and 12. Values beyond this range result in a <VALUE OUT OF RANGE> error.

$SCONVERT is intended only for use on 8-bit byte strings.

If argument *s* is a numeric value, it is converted to a string containing its canonical numeric form before it is decoded.

You can use the **IsBigEndian()** class method to determine which bit ordering is used on your operating system platform: 1=big-endian bit order; 0=little-endian bit order.

```
WRITE $SYSTEM.Version.IsBigEndian()
```

$SCONVERT provides the inverse of the **$NCONVERT** operation.

Examples

In the following example, **$SCONVERT** converts a two-byte binary encoded value to a number:

```
SET x=$NCONVERT(258,"U2")
ZZDUMP x
SET y=$SCONVERT(x,"U2")
WRITE !,y
```

The following example, **$SCONVERT** converts a two-byte binary encoded value in big-endian order to a number:

```
SET x=$NCONVERT(258,"U2",1)
ZZDUMP x
SET y=$SCONVERT(x,"U2",1)
WRITE !,y
```

See Also

- $NCONVERT function

$SELECT

Returns the value associated with the first true expression.

```
$SELECT(expression:value,...)
$S(expression:value,...)
```

Parameters

expression	The select test for the associated *value* parameter.
value	The value to be returned if the associated *expression* evaluates to true.

Description

The **$SELECT** function returns the value associated with the first *expression* that evaluates to true (1). Each **$SELECT** argument is a pair of expressions separated by a colon. The left half is a truth-valued expression. The right half can be any expression. In the following example, the truth values of the first three expressions are tested; if none of them evaluate to true, the final expression (which always evaluates to true) returns its value:

```
WRITE $SELECT(x=1:"1st is True",x=2:"2nd is True",x=3:"3rd is True",1:"The Default")
```

The specified list of *expression*:*value* pairs can be of any length. **$SELECT** evaluates the parameters from left to right. When **$SELECT** discovers a truth-valued expression with the value of true (1), it returns the matching expression to the right of the colon. **$SELECT** stops evaluation after it discovers the left-most true truth-valued expression. It never evaluates later pairs on the parameter list.

You can construct complex logic by nesting **$SELECT** functions. Like all evaluated truth conditions, a NOT logical operator (') can be applied to a nested **$SELECT**.

Parameters

expression

The select test for the associated *value* parameter. It can be any valid InterSystems IRIS relational or logical expression. If no *expression* evaluates to true, the system generates a <SELECT> error. To prevent an error from disrupting an executing routine, the final *expression* can be the value 1, which always evaluates to true.

When *expression* is a string or numeric, any non-zero numeric value evaluates to true. A zero numeric value or a non-numeric string evaluates to false.

value

The value to be returned if the associated *expression* evaluates to true. It can be a numeric value, a string literal, a variable name, or any valid ObjectScript expression. If you specify an expression for *value*, it is evaluated only after the associated *expression* evaluates to true. If *value* contains a subscripted global reference, it changes the naked indicator when it is evaluated. For this reason, be careful when using naked global references either within or immediately after a **$SELECT** function. For more details on the naked indicator, see Naked Global Reference in *Using Globals*.

Examples

To ensure that a <SELECT> error never results, you should always include the value 1 as the last expression with an appropriate default value. This is shown in the following example:

```
Start
   READ !,"Which level?: ",a
   QUIT:a=""
   SET x=$SELECT(a=1:"Level1",a=2:"Level2",a=3:"Level3",1:"Start")
   DO @x
Level1()
   WRITE !,"This is Level 1"
Level2()
   WRITE !,"This is Level 2"
Level3()
   WRITE !,"This is Level 3"
```

If the user enters a value other then 1, 2, 3, or the null string, control is passed back to the top of the routine.

You can use **$SELECT** to replace multiple **IF** clauses. The following example uses **IF**, **ELSEIF**, and **ELSE** clauses to determine whether a number is odd or even:

```
OddEven()
   READ !,"Enter an Integer: ",x
   QUIT:x=""
   WRITE !,"The input value is "
   IF 0=$ISVALIDNUM(x) { WRITE "not a number" }
   ELSEIF x=0 { WRITE "zero" }
   ELSEIF ""=$NUMBER(x,"I") { WRITE "not an integer" }
   ELSEIF x#2=1 { WRITE "odd" }
   ELSE  { WRITE "even" }
   DO OddEven
```

The following example also accepts a number and determines if the number is odd or even. It uses **$SELECT** to replace the **IF** command in the previous example:

```
OddEven()
   READ !,"Enter an Integer: ",x
   QUIT:x=""
   WRITE !,"The input value is "
   WRITE $SELECT(0=$ISVALIDNUM(x):"not a number",x=0:"zero",
                 ""=$NUMBER(x,"I"):"not an integer",x#2=1:"odd",1:"even")
   DO OddEven
```

See Also

- $CASE function

$SEQUENCE

Increments a global variable shared by multiple processes.

```
$SEQUENCE(gvar)
$SEQ(gvar)

SET $SEQUENCE(gvar)=value
SET $SEQ(gvar)=value
```

Parameter

gvar	The variable whose value is to be incremented. Commonly, *gvar* is a global variable (^gvar), either subscripted or unsubscripted. The variable need not be defined. If *gvar* is not defined, or is set to the null string (""), **$SEQUENCE** treats it as having an initial value of zero and increments accordingly, returning a value of 1. You cannot specify a literal value for *gvar*. You cannot specify a simple object property reference as *gvar*; you can specify a multidimensional property reference as *gvar* with the syntax obj.property.

Description

$SEQUENCE provides a fast way for multiple processes to obtain unique (non-duplicate) integer indices for the same global variable. For each process, **$SEQUENCE** allocates a sequence (range) of integer values. Subsequent calls to **$SEQUENCE** increment to the next value in the allocated sequence for that process. When a process consumes all of the integer values in its allocated sequence, it is automatically assigned a new sequence of integer values. **$SEQUENCE** automatically determines the size of the sequence of integer values to allocate. It determines the size of the allocated sequence separately for each sequence allocation. In some cases, this sequence may be a single integer.

$SEQUENCE always increments an integer value by 1. By default, **$SEQUENCE** assigns positive integers, beginning with 1. However, **$SEQUENCE** can be set to a negative integer; negative integers are incremented towards zero. If **$SEQUENCE** was set to a negative integer, a subsequent call can assign zero as an increment. Setting *gvar* to a non-integer numeric value generates an <ILLEGAL VALUE> error.

$SEQUENCE is intended to be used when multiple processes concurrently increment the same global. Both **$SEQUENCE** and **$INCREMENT** can perform this operation, but **$SEQUENCE** commonly provides better performance. The order in which **$SEQUENCE** allocates indices is different from the **$INCREMENT** order. **$SEQUENCE** can allocate a sequential range of increments to a process, rather than the **$INCREMENT** behavior of allocating single integer increments to each process. This can substantially improve performance by reducing process collision and synchronization. It can also improve data block performance when inserting records, because sequential record IDs are grouped by process.

When a process calls **$SEQUENCE**, one of the following occurs:

- The ^*gvar* global variable is undefined because no process has defined this variable. The integers returned by **$SEQUENCE** will start with 1.
- The ^*gvar* global variable was last modified by a **$SEQUENCE** call from another process. The integers returned by **$SEQUENCE** will start with the first integer after the sequence allocated to the other process.
- The ^*gvar* global variable was last modified by a **SET $SEQUENCE** called from any process. The integers returned by **$SEQUENCE** will start with the first integer after the value to which **$SEQUENCE** was set.

The size of the sequence that **$SEQUENCE** allocates to a process depends on an internal timestamp. When a process invokes **$SEQUENCE** for the second time, InterSystems IRIS compares the prior timestamp with the current time.

Depending on the duration between these **$SEQUENCE** calls, InterSystems IRIS allocates either a single increment or a calculated sequence of increments to the process:

- Allocated sequence is 1: **$SEQUENCE** behaves like **$INCREMENT**.
- Allocated sequence is > 1: **$SEQUENCE** uses this per-process sequence of increments. Each process uses its allocated sequence, then is assigned a new sequence.

For example, Process A and Process B are both incrementing the same global. The first time each process increments the global it is a single increment. The next time each process increments the global, InterSystems IRIS compares the two **$SEQUENCE** operations and calculates a sequence of increments (this sequence may be one integer). Subsequent **$SEQUENCE** operations use up these per-process sequences before re-allocating increments. This might result in increments such as the following: A1, B2 (single increments setting the clock), A3 (compares A1 & A3, allocates 4, 5, 6, 7 to Process A), B8 (compares B2 and B8, allocates 9, 10, 11 to Process B). The full increment sequence might be as follows: A1, B2, A3, A4, B8, A5, A6, B9, A7, B10, B11.

If a process does not use all of its allocated sequence, the remaining numbers are unused, gaps in the increment sequence.

The following example shows the difference between the increment integer returned by **$SEQUENCE** (the current sequence number) and the value of *gvar* (the highest allocated sequence number):

```
SET $SEQUENCE(^myseq)=""
FOR i=1:1:15 {WRITE "increment:",$SEQ(^myseq)," allocated:",^myseq,! }
```

For further details on using **$SEQUENCE** with global variables, see Using Multidimensional Storage (Globals) in *Using Globals*.

Dedicated Global Variable

Once a sequence has been started by the first call on `$SEQUENCE(^gvar)`, all future changes to the value of `^gvar` during the life of that sequence can only be made by calling `$SEQUENCE(^gvar)`. Using any other function or statement to change the value of `^gvar` causes the sequence to become undefined.

Restrictions on the use of **$SEQUENCE** and **$INCREMENT** on the same global are described below.

SET $SEQUENCE

You can use **SET $SEQUENCE** to kill or reset a **$SEQUENCE** global. **SET $SEQUENCE** resets the global variable and deallocates sequences of integers allocated to other processes.

- `SET $SEQUENCE(^gvar)=""` kills the specified global node and notifies all jobs with cached **$SEQUENCE** numbers to purge their current increment value. The first call to **$SEQUENCE** increments to 1. `SET $SEQUENCE(^gvar)=""` only kills the specified global node; it does not kill that node's descendants (if any).
- `SET $SEQUENCE(^gvar)=n` (where *n* is an integer) resets the specified global node to *n*, and notifies all jobs with cached **$SEQUENCE** numbers to purge their current increment value. Subsequent invocations of **$SEQUENCE** on all jobs will use the new *n* increment starting value.

  If **SET $SEQUENCE** attempts to set *^gvar* to a fractional number, an <ILLEGAL VALUE> error occurs. If **SET $SEQUENCE** attempts to set *^gvar* to a non-numeric string, *^gvar* is set to 0.

You cannot use **KILL ^gvar** or **SET ^gvar** to kill or reset a **$SEQUENCE** global because these commands do not deallocate sequences of integers allocated to processes.

Parameter

gvar

A variable containing an integer value to be incremented. The variable does not need to be defined; the first call to **$SEQUENCE** defines an undefined variable as 0 then increments its value to 1. The *gvar* value must be a positive or negative integer.

Commonly, the *gvar* parameter is a global variable, either subscripted or unsubscripted: ^gvar. It can contain an extended global reference. If a subscripted global variable, it can be specified using a naked global reference.

The *gvar* parameter can be a local variable or process-private global. However, because **$SEQUENCE** is intended for use across processes, this usage is not meaningful, in most cases. Using **$SEQUENCE** on a local variable or process-private global is the same as using **$INCREMENT** with a numeric increment of 1. The **$SEQUENCE** restrictions described below concerning locking, journaling, and transaction rollback do not apply to local variables or process-private globals. Using **$SEQUENCE** on a local variable or process-private global has the same error behavior as **$INCREMENT**; this is different from the error behavior for **$SEQUENCE** on a global variable, as described in the next section.

The *gvar* parameter can be a multidimensional property reference. For example, `$SEQUENCE(..Count)`. It cannot be a non-multidimensional object property. Attempting to increment a non-multidimensional object property results in an <OBJECT DISPATCH> error.

$SEQUENCE cannot increment special variables, even those that can be modified using **SET**. Attempting to increment a special variable results in a <SYNTAX> error.

Incrementing Very Large Numbers

The integers returned by **$SEQUENCE** are in the range -9223372036854775807 to 9223372036854775806 (-2**63+1 to 2**63-2). Attempting a **SET $SEQUENCE** on a global variable with an integer beyond this range generates an <ILLEGAL VALUE> error.

In the following example, **$SEQUENCE** on a global variable can be set to 9.223372036854775800E18, but incrementing this number past the range limit generates a <MAXINCREMENT> error. You can run this example repeatedly to perform "slow increments" and "fast increments". Note that "fast increments" in this example may result in <MAXINCREMENT> before actually incrementing to the range limit, because **$SEQUENCE** is attempting to allocate a sequence of numbers beyond the range limit:

```
TRY {
SET rand=$RANDOM(2)
SET $SEQUENCE(^bignum)=9.223372036854775800E18
  IF rand=0 {  WRITE "slow increments:",!
  FOR x=1:1:10 {WRITE $SEQUENCE(^bignum)," increment #",x,!
              HANG .5 }
  }
  IF rand=1 {WRITE "fast increments:",!
  FOR i=1:1:10 {WRITE $SEQUENCE(^bignum)," increment #",i,!}
  }
}
CATCH exp { WRITE !,"In the CATCH block",!
              IF 1=exp.%IsA("%Exception.SystemException") {
                WRITE "System exception",!
                WRITE "Name: ",$ZCVT(exp.Name,"O","HTML"),!
                WRITE "Location: ",exp.Location,!
              }
              ELSE { WRITE "unknown error",! }
}
```

These types of errors only occur when incrementing a global variable.

$SEQUENCE or $INCREMENT

$SEQUENCE is intended specifically for integer increment operations involving multiple simultaneous processes. **$INCREMENT** is a more general increment/decrement function:

- **$SEQUENCE** increments an integer by 1. **$INCREMENT** increments or decrements any numeric value by any specified numeric value.
- **$SEQUENCE** can allocate a sequence of increments to a process. **$INCREMENT** allocates only a single increment.
- **SET $SEQUENCE** can be used to change or undefine (kill) a global. **$INCREMENT** cannot be used on the left side of the **SET** command.

Note: **$SEQUENCE** and **$INCREMENT** may be used on the same global variable only when performing an operation that simply increments a numeric value, such as Id allocation. Any other use of **$SEQUENCE** and **$INCREMENT** on the same global may produce unpredictable results and is not recommended.

Locking and Simultaneous Global Increments

$SEQUENCE uses special, efficient locking techniques that only synchronize **$SEQUENCE** calls with other **$SEQUENCE** calls. Attempting to use the **LOCK** command on a global used by **$SEQUENCE** will have no effect on **$SEQUENCE**. For example, suppose Process 1 executes a lock on ^COUNTER:

```
LOCK ^COUNTER
```

Then suppose, Process 2 increments ^COUNTER:

```
SET x=$SEQUENCE(^COUNTER)
```

Process 2 is not prevented from incrementing ^COUNTER by the lock held by Process 1.

$SEQUENCE and Transaction Processing

- Locking: The common usage for **$SEQUENCE** is to increment a counter before adding a new entry to a database. **$SEQUENCE** provides a way to do this very quickly, avoiding the use of the **LOCK** command. The trade-off for this is that *gvar* is *not* locked. The *gvar* may be incremented by one process within a transaction and, while that transaction is still processing, be incremented by another process in a parallel transaction.
- Rollback: Calls to **$SEQUENCE** are not journaled. Therefore, rolling back a transaction will not change the value of *gvar*. Any integer values allocated by **$SEQUENCE** during a rolled back transaction will not be available for allocation by any future **$SEQUENCE** call.

For further details on using **$SEQUENCE** in a distributed database environment, refer to Use the $Increment Function for Application Counters in the "Horizontally Scaling Systems for User Volume with InterSystems Distributed Caching" chapter of the *Scalability Guide*.

See Also

- $INCREMENT function
- TROLLBACK command
- $GET function
- Using ObjectScript for Transaction Processing in *Using ObjectScript*

$SORTBEGIN

Initiates a sorting mode to improve performance of multiple sets to a global.

```
$SORTBEGIN(set_global)
```

Parameter

set_global	A global variable name.

Description

$SORTBEGIN initiates a special sorting mode during which **SET** operations to the specified target global are redirected to a process-private temporary area and sorted into subsets. This mode is ended with a call to **$SORTEND** which copies the data into the target global reference. When the special sorting mode is in effect, all sets to the target global reference and any of its descendants are affected.

$SORTBEGIN is designed to help the performance of operations, such as index building, where a large amount of unordered data needs to be written to a global. When the amount of data written approaches or exceeds the amount of available buffer pool memory, performance can suffer drastically. **$SORTBEGIN** solves this problem by guaranteeing that data is written to the target global in sequential order, thus minimizing the number of physical disk accesses needed. It does this by writing and sorting data into one or more temporary buffers (using space in the IRISTEMP database if needed) and then, when **$SORTEND** is called, copying the data sequentially into the target global.

While **$SORTBEGIN** is in effect, data read from the target global will not reflect any **SET** operations. You cannot use **$SORTBEGIN** in cases where you need to read global values from the same global in which you are inserting values.

InterSystems IRIS object and InterSystems SQL applications automatically make use of **$SORTBEGIN** for index and temporary index creation.

The **$SORTBEGIN** sorting mode can be terminated without writing data to the target global by calling **$SORTEND** with it optional second parameter set to 0.

If successful, **$SORTBEGIN** returns a nonzero integer value. If unsuccessful, **$SORTBEGIN** returns zero.

Sorting Mode Errors

Invoking some operations between the **$SORTBEGIN** and **$SORTEND** result in InterSystems IRIS issuing an error code:

- If the mapping of the namespace of *set_global* is changed between **$SORTBEGIN** and **$SORTEND**, a <NAMESPACE> error occurs when you invoke **$SORTEND**. However, if **$SORTBEGIN** specifies *set_global* with an implied namespaces, subsequent namespace mapping changes have no effect on **$SORTEND**. Global references with implied namespace and global references with explicit namespaces should not be mixed in the same sort operation. For information on modifying namespaces, see Configuring Namespaces in the *System Administration Guide*.
- If you establish a **$SORTBEGIN** global, and then issue a **$SORTBEGIN** for an ancestor or descendent of that global, InterSystems IRIS issues a <DUPLICATEARG> error. For example, if you invoke `$SORTBEGIN(^test(1,2,3))`, the following function calls result in a <DUPLICATEARG> error: `$SORTBEGIN(^test(1,2))` or `$SORTBEGIN(^test(1,2,3,4))`.

See Also

- $SORTEND function

$SORTEND

Concludes the sorting mode initiated by $SORTBEGIN.

```
$SORTEND(set_global,dosort)
```

Parameters

set_global	*Optional* — A global variable that was specified in a corresponding **$SORTBEGIN**. If omitted, **$SORTEND** concludes all **$SORTBEGIN** operations for the current process.
dosort	*Optional* — A flag parameter. If 1, InterSystems IRIS performs the sort operation initiated by **$SORTBEGIN** and copies the sorted data into *set_global*. If 0, InterSystems IRIS terminates the sort operation without copying any data. The default is 1.

Description

$SORTEND specifies the end of a special sorting mode initiated by **$SORTBEGIN** on a specific target global. The value of the **$SORTEND** *set_global* must match the corresponding **$SORTBEGIN** *set_global*.

If you omit *set_global*, **$SORTEND** ends all current sorting modes initiated by all active **$SORTBEGIN** functions for the current process. Therefore, `$SORTEND()` or `$SORTEND(,1)` end and commit all current sorting modes for the process; `$SORTEND(,0)` aborts all current sorting modes for the process.

- If successful, **$SORTEND** returns a positive integer count of the total number of global nodes set. When *set_global* is specified, this is the number of sets applied to the specified *set_global* variable. When *set_global* is omitted, this is the number of sets applied to all current **$SORTBEGIN** *set_global* variables. This integer count is returned regardless of the *dosort* flag setting.
- If unsuccessful, **$SORTEND** returns -1. For example, if **$SORTEND** specifies a *set_global* that does not have a corresponding active **$SORTBEGIN**.
- If no-op, **$SORTEND** returns 0. This can occur if you there are no sets applied to the specified *set_global* variable, or if there is no active **$SORTBEGIN** when you issue a **$SORTEND** that does not specify a *set_global*.

If the mapping of the namespace of *set_global* is changed between **$SORTBEGIN** and **$SORTEND**, a <NAMESPACE> error occurs when you invoke **$SORTEND**. However, if **$SORTBEGIN** specifies *set_global* with an implied namespaces, subsequent namespace mapping changes have no effect on **$SORTEND**. Global references with implied namespace and global references with explicit namespaces should not be mixed in the same sort operation. For information on modifying namespaces, see Configuring Namespaces in the *System Administration Guide*.

Examples

The following example applies three sets to the global ^myyestest. **$SORTEND** returns 3. Because *dosort* is 1, these sets are applied, as shown by the **$DATA** function return values:

```
WRITE $SORTBEGIN(^myyestest),!
  SET ^myyestest(1)="apple"
  SET ^myyestest(2)="orange"
  SET ^myyestest(3)="banana"
WRITE $SORTEND(^myyestest,1),!
WRITE $DATA(^myyestest(1)),!
WRITE $DATA(^myyestest(2)),!
WRITE $DATA(^myyestest(3))
KILL ^myyestest
```

The following example applies three sets to the global ^mynotest. **$SORTEND** returns 3. Because *dosort* is 0, these sets are *not* applied, as shown by the **$DATA** function return values:

```
WRITE $SORTBEGIN(^mynotest),!
  SET ^mynotest(1)="apple"
  SET ^mynotest(2)="orange"
  SET ^mynotest(3)="banana"
WRITE $SORTEND(^mynotest,0),!
WRITE $DATA(^mynotest(1)),!
WRITE $DATA(^mynotest(2)),!
WRITE $DATA(^mynotest(3))
KILL ^mynotest
```

The following two examples specify two **$SORTBEGIN** operations, and within them apply three sets to the global ^mytesta and two sets to the global ^mytestb. **$SORTEND** does not specify a *set_global*, and therefore ends all current **$SORTBEGIN** operations and returns 5. Note that in both examples **$SORTEND** returns 5, though the first example commits these sets and the second example aborts these sets.

```
WRITE $SORTBEGIN(^mytesta),!
  SET ^mytesta(1)="apple"
  SET ^mytesta(2)="orange"
  SET ^mytesta(3)="banana"
WRITE $SORTBEGIN(^mytestb),!
  SET ^mytestb(1)="corn"
  SET ^mytestb(2)="carrot"
WRITE "$SORTEND returns: ",$SORTEND(,1),!
  WRITE "global sets committed?: ",$DATA(^mytesta(2))
KILL ^mytesta,^mytestb
```

```
WRITE $SORTBEGIN(^mytesta),!
  SET ^mytesta(1)="apple"
  SET ^mytesta(2)="orange"
  SET ^mytesta(3)="banana"
WRITE $SORTBEGIN(^mytestb),!
  SET ^mytestb(1)="corn"
  SET ^mytestb(2)="carrot"
WRITE "$SORTEND returns: ",$SORTEND(,0),!
  WRITE "global sets committed?: ",$DATA(^mytesta(2))
KILL ^mytesta,^mytestb
```

See Also

- $SORTBEGIN function

$STACK

Returns information about active contexts saved on the process call stack.

```
$STACK(context_level,code_string)
$ST(context_level,code_string)
```

Parameters

context_level	An integer specifying the zero-based context level number of the context for which information is requested. Supported values include 0, positive integers, and -1.
code_string	*Optional* — A keyword string that specifies the kind of context information that is requested. supported values are “PLACE”, “MCODE”, and “ECODE”

Description

The **$STACK** function returns information on either the current execution stack or the current error stack, depending on the value of the **$ECODE** special variable. **$STACK** is most commonly used to return information on the current execution stack (also known as the process call stack).

Each time a routine invokes a **DO** command, an **XECUTE** command, or a user-defined function (but not a **GOTO** command), the context of the currently executing routine is saved on the *call stack* and execution starts in the newly created context of the called routine. The called routine, in turn, can call another routine, and so on, causing more saved contexts to be placed on the call stack.

The **$STACK** function returns information about these active contexts saved on your process call stack. **$STACK** also can return information about the currently executing context. However, during error processing, **$STACK** returns a snapshot of all the context information that is available when an error occurs in your application.

You can use the $STACK special variable to determine the current context level.

$ECODE and $STACK

The values returned by **$STACK** are dependent on the $ECODE special variable. If **$ECODE** is clear (set to the null string), **$STACK** returns the current execution stack. If **$ECODE** contains a non-null value, **$STACK** returns the current error stack.

Error stack context information is only available when the **$ECODE** special variable contains a non-null value. This can occur either when an error has occurred or when **$ECODE** is explicitly set to a non-null value. In this case, **$STACK** returns information about the error stack context rather than an active stack context at the specified context level.

When error stack context information is not available (`$ECODE=""`) and you specify the current context level with the two-argument form of **$STACK**, InterSystems IRIS returns information about the currently executing command. To ensure consistent behavior when accessing the current execution stack, specify `SET $ECODE=""` before calling **$STACK**.

See Error Handling in *Using ObjectScript* for more detailed information about error processing and your error process stack.

The One-Argument Form of $STACK

$STACK(*context_level*) returns a string that indicates how the specified context level was established. The following table describes the string values that can be returned:

DO	Returned when the specified context was established by a **DO** command.
XECUTE	Returned when the specified context was established by an **XECUTE** command or a **BREAK** command.
$$	Returned when the specified context was established by a user-defined function reference.
An ECODE string	The error code value of the error that caused the specified context to be added to the error stack. For example, `,M26,`. When an error occurs at a context level where an error has already occurred, the context information is placed at the next higher error stack level; it is only returned when context information at the specified error stack context level is relocated information.

When the specified context level is zero (0) or is undefined, **$STACK** returns the null string.

You can also specify a -1 for the context level in the one-argument form of the **$STACK** function. In this case, **$STACK** returns the maximum context level for the information that is available that, during normal processing, is the context level number of the currently executing context. However, during error processing, **$STACK(-1)** returns whichever is greater:

- The maximum context level of your process error stack
- The context level number of the currently executing context

The Two-Argument Form of $STACK

$STACK(*context_level*,*code_string*) returns information about the specified context level according to the *code_string* you specify. A *code_string* must be specified as a quoted string; *code_string* values are not case-sensitive. For example, **$STACK(1,"PLACE")** or **$STACK(1,"place")**.

The following describes the code strings and the information returned when you specify each.

- PLACE — Returns the entry reference and command number of the last command executed at a specified context level. The value is returned in the following format for **DO** and user-defined function contexts: "label[+offset][^routine name] +command". For **XECUTE** contexts, the following format is used: "@ +command".
- MCODE — Returns the source routine line, or **XECUTE** string, that contains the last command executed at the specified context level. (Routine lines are returned in the same manner as those returned by the **$TEXT** function.)

  Note: During error processing, if memory is low while the error stack is being built or updated, you may not have enough memory to store the source line. In this case, the return value for the MCODE code string is the null string. However, the return value for the PLACE code string indicates the location.

- ECODE — The error code of any error that occurred at the specified context level (available only in error stack contexts).

When the requested information is not available at the specified context level, the two argument form of **$STACK** returns the null string.

Example

The following example demonstrates some of the information that **$STACK** can return:

```
STAC  ;
      SET $ECODE=""
      XECUTE "DO First"
      QUIT
First SET varSecond=$$Second()
      QUIT
Second()  FOR loop=0:1:$STACK(-1) {
          WRITE !,"Context level:",loop,?25,"Context type: ",$STACK(loop)
          WRITE !,?5,"Current place: ",$STACK(loop,"PLACE")
          WRITE !,?5,"Current source: ",$STACK(loop,"MCODE")
          WRITE ! }
      QUIT 1
```

```
>DO  ^STAC
Context level: 0      Context type:
  Current place: @ +1
  Current source: DO ^STAC
Context level: 1      Context type: DO
  Current place: STAC+2^STAC +1
  Current source: XECUTE "DO First"
Context level: 2      Context type: XECUTE
  Current place: @ +1
  Current source: DO First
Context level: 3      Context type: DO
  Current place: First^STAC +1
  Current source: First SET Second=$$Second
Context level: 4      Context type: $$
  Current place: Second+2^STAC +4
  Current source: WRITE !,?5,"Current source: ",$STACK(loop,"MCODE")
```

Notes

Cross-Namespace Routine Calls

If a routine calls a routine in a different namespace, **$STACK** returns the namespace name as part of the routine name. For example, if a routine in the USER namespace calls a routine in the SAMPLES namespace, **$STACK** returns `^|"SAMPLES"|routinename`.

$STACK uses the caret (^) character as a delimiter. Therefore, if an implied namespace name includes the caret (^) character, InterSystems IRIS displays this namespace name character as the @ character.

$STACK Counts Multiple-Argument Commands

When you specify a multiple-argument command, the command count includes command keywords and all command arguments beyond the first. Consider the following multiple-argument command:

```
TEST
  SET X=1,Y=Z
```

In InterSystems IRIS, the **$STACK** statement, **$STACK(1,"PLACE")** returns "TEST^TEST +2" because the Y=Z argument counts as a separate command.

$STACK with <STORE> Errors or Low Memory Conditions

After a <STORE> error or under low-memory conditions, the information available normally through the application of the two-argument form of **$STACK** may not be available.

See Also

- DO command
- XECUTE command
- $ECODE special variable
- $ESTACK special variable
- $STACK special variable
- Error Handling in *Using ObjectScript*

- Using %STACK to Display the Stack in the "Command-line Routine Debugging" chapter of *Using ObjectScript*

$TEXT

Returns a line of source code found at the specified location.

```
$TEXT(label+offset^routine)
$T(label+offset^routine)

$TEXT(@expr_atom)
$T(@expr_atom)
```

Parameters

label	*Optional* — A line label in a routine. Must be a literal value; a variable cannot be used to specify *label*. Line labels are case-sensitive. If omitted, *+offset* is counted from the beginning of the routine.
+offset	*Optional* — An expression that resolves to a positive integer that identifies the line to be returned as an offset number of lines. If omitted, the line identified by *label* is returned.
^routine	*Optional* — The name of a routine. Must be a literal value; a variable cannot be used to specify *routine*. (Note that the ^ character is a separator character, not part of the routine name.) If the routine is not in the current namespace, you can specify the namespace that contains the routine using an extended routine reference, as follows: `^|"namespace"|routine`. If omitted, defaults to the currently loaded routine.
@expr_atom	An expression atom that uses indirection to supply a location. Resolves to some form of label+offset^routine.

Description

$TEXT returns a line of code found at the specified location. If **$TEXT** does not find source code at the specified location, it returns the null string.

To identify a single line of source code, you must specify either a *label*, an *+offset*, or both. By default, **$TEXT** accesses the currently loaded routine. Either **$TEXT** is coded in the currently executing routine, or accesses the currently loaded routine as the static routine most recently loaded using ZLOAD. You can use *^routine* to specify a routine location other than the currently loaded routine. You can use indirection (*@expr_atom*) to specify a location.

$TEXT returns the specified line from the INT code version of a routine. INT code does not count or include preprocessor statements. INT code includes all labels and most comments, but does not count or include completely blank lines from the MAC version of the routine, whether in the source code or within a multiline comment.

The *+offset* argument counts lines using the INT code version of the routine. After modifying a routine, you must re-compile the routine for **$TEXT** to correctly count lines and line offsets that correspond to the INT version.

In the returned source code, if the first whitespace character in the line is a tab, **$TEXT** replaces it with a single space character. All other tabs and space characters are returned unchanged. Thus `$PIECE($TEXT(line)," ",1)` always returns a label, and `$PIECE($TEXT(line)," ",2,*)` returns all code except a label.

When a routine is distributed as object code only, the ;; comment is the only comment type retained in the object code. Thus only ;; comments are available to **$TEXT** in those routines. For a ;; comment to be returned by **$TEXT**, it must either appear on its own line, or on the same line as a label. It cannot appear on a line containing a command, or a line declaring a function or subroutine. For further details on the different types of InterSystems IRIS comments, refer to Comments in *Using ObjectScript*.

You can use the PRINT or ZPRINT commands to display a single line (or multiple lines) of source code from the currently loaded routine. **ZPRINT** (or **PRINT**) sets the edit pointer to the end of the lines it printed. **$TEXT** does not change the edit pointer.

Parameters

label

The label within the current routine or, if the *routine* parameter is also supplied, a label in the specified routine. Must be specified as a literal, without quotes. Label names are case-sensitive, and may contain Unicode characters. A label may be longer than 31 characters, but must be unique within the first 31 characters. **$TEXT** matches only the first 31 characters of a specified *label*.

If you omit the *offset* option, or specify *label+0*, InterSystems IRIS prints the label line. *label+1* prints the line after the label. If *label* is not found in the routine, **$TEXT** returns the empty string.

offset

A positive integer specifying a line count, or as an expression that evaluates to a positive integer. The leading plus sign (+) is mandatory. If specified alone, the *+offset* specifies a line count from the beginning of the routine, with +1 being the first line of the routine. If specified with the *label* parameter, the line count is calculated from the label location, with +0 being the label line itself, and +1 being the line after the label. If *+offset* is larger than the number of lines in the routine (or the number of lines from *label* to the end of the routine) **$TEXT** returns the empty string.

You can specify an offset of +0. When *label* is specified, `$TEXT(mylabel+0)` is the same as `$TEXT(mylabel)`. If you invoke `$TEXT(+0)`, it returns the name of the currently loaded routine.

InterSystems IRIS resolves an *+offset* value to a canonical positive integer. A negative integer offset value generates a <NOLINE> error.

Note that InterSystems IRIS resolves numbers and numeric strings to canonical form, which involves removal of the leading plus sign (+). For this reason, you must specify the plus sign in the **$TEXT** function to use it as an offset.

To use a variable as the offset it must be preceded by a plus sign as shown in the following example:

```
SET x=7
WRITE $TEXT(x)    /* because there is no plus sign, search for a label named x  */
WRITE $TEXT(+x)   /* locates the offset +7 code line */
```

routine

If specified alone, it indicates the first line of code in the routine. If specified with only the *label* parameter, the line found at that specified label within the routine is returned. If specified with only the *offset* parameter, the line at the specified offset within the routine is returned. If both *label* and *offset* are supplied, the line found at the specified offset within the specified label within the routine is returned.

The *routine* argument must be specified as a literal, without quotes. You cannot use a variable to specify the *routine* name. The leading caret (^) is mandatory.

By default, InterSystems IRIS searches for the routine in the current namespace. If the desired routine resides in another namespace, you can specify that namespace using extended global reference. For example, `$TEXT(mylabel+2^|"SAMPLES"|myroutine)`. Note that only vertical bars can be used here; square brackets cannot be used. You can specify the namespace portion of *^routine* as a variable.

$TEXT returns the empty string if the specified routine or namespace does not exist, or if the user does not have access privileges for the namespace.

expression atom (@expr_atom)

An indirect argument that evaluates to a **$TEXT** argument (label+offset^routine). For more information, refer to Indirection in *Using ObjectScript*.

Examples

The following four examples demonstrate a routine saved with object code only. The first two examples return the referenced line, including the ;; comment. The third and fourth examples return the null string:

```
Start ;; this comment is on a label line
  WRITE $TEXT(Start)
```

```
Start
  ;; this comment is on its own line
  WRITE $TEXT(Start+1)
```

```
Start
  SET x="fred" ;; this comment is on a command line
  WRITE $TEXT(Start+1)
```

```
MyFunc() ;; this comment is on a function declaration line
  WRITE $TEXT(MyFunc)
```

The following example shows that only the first 31 characters of *label* are matched with the specified label:

```
StartabcdefghijklmnopqrstuvwxyzA ;; 32-character label
  WRITE $TEXT(StartabcdefghijklmnopqrstuvwxyzB)
```

The following example shows the **$TEXT**(*label*) form, which returns the line found at the specified label within the current routine. The label is also returned. If the user enters "?", the Info text is written out, along with the line label, and control returns to the initial prompt:

```
Start
  READ !,"Array name or ? for Info: ",ary QUIT:ary=""
  IF ary="?" {
    WRITE !,$TEXT(Info),!
    GOTO Start }
  ELSE { DO ArrayOutput(ary) }
  QUIT
Info  ;; This routine outputs the first-level subscripts of a variable.
  QUIT
ArrayOutput(val)
   SET i=1
   WHILE $DATA(@val@(i)) {
     WRITE !,"subscript ",i," is ",@val@(i)
     SET i=i+1
   }
   QUIT
```

The following example shows the **$TEXT**(*label+offset*) form, which returns the line found at the offset within the specified label, which must be within the current routine. If the offset is 0, the label line, with the label, is returned. This example uses a **FOR** loop to access multiline text, avoiding displaying the label or the multiline comment delimiters:

```
Start
  READ !,"Array name or ? for Info: ",ary QUIT:ary=""
  IF ary="?" {
    DO Info
    GOTO Start }
  ELSE { DO ArrayOutput(ary) }
  QUIT
Info  FOR loop=2:1:6 { WRITE !,$TEXT(Info+loop) }
     /*
    This routine outputs the first-level subscripts of a variable.
    Specifically, it asks you to supply the name of the variable
    and then writes out the current values for each subscript
    node that contains data. It stops when it encounters a node
    that does not contain data.
    */
  QUIT
ArrayOutput(val)
   SET i=1
   WHILE $DATA(@val@(i)) {
```

```
    WRITE !,"subscript ",i," is ",@val@(i)
    SET i=i+1
  }
  QUIT
```

The following example uses extended routine reference to access a line of code from a routine in the SAMPLES namespace. It accesses the first line of code after the ErrorTest label in the routine named myroutine. It can be executed from any namespace:

```
WRITE $TEXT(ErrorTest+1^|"SAMPLES"|myroutine)
```

Notes

Argument Indirection

Indirection of the entire **$TEXT** argument is a convenient way to make an indirect reference to both the line and the routine. For example, if the variable *ENTRYREF* contains both a line label and a routine name, you can reference the variable:

```
$TEXT(@ENTRYREF)
```

rather than referencing the line and the routine separately:

```
$TEXT(@$PIECE(ENTRYREF,"^",1)^@$PIECE(ENTRYREF,"^",2))
```

See Also

- PRINT command
- ZINSERT command
- ZLOAD command
- ZPRINT command
- ZREMOVE command
- ZSAVE command
- ZZPRINT command
- Comments in *Using ObjectScript*
- Labels in *Using ObjectScript*
- Indirection in *Using ObjectScript*

$TRANSLATE

Returns a new string that consists of character-for-character replacement of a source string.

```
$TRANSLATE(string,identifier,associator)
$TR(string,identifier,associator)
```

Parameters

string	The source string. It can be a numeric value, a string literal, the name of a variable, or any valid ObjectScript expression.
identifier	A string consisting of one or more characters to search for in *string*. It can be a numeric value, a string literal, the name of a variable, or any valid ObjectScript expression.
associator	*Optional* — A string consisting of one or more replacement characters that correspond positionally to each character in *identifier*. It can be a numeric value, a string literal, the name of a variable, or any valid ObjectScript expression.

Description

The **$TRANSLATE** function returns a new string that consists of a character-for-character replacement of the source string. A **$TRANSLATE** operation can replace multiple different characters, but it can only replace a single character with (at most) a single character. It processes the *string* parameter one character at a time. It compares each character in the input string with each character in the *identifier* parameter. If **$TRANSLATE** finds a match, it performs one of the following actions on that character:

- The two-parameter form of **$TRANSLATE** removes those characters in the *identifier* parameter from the returned string.
- The three-parameter form of **$TRANSLATE** replaces the *identifier* character(s) found in the *string* with the positionally corresponding character(s) from the *associator* parameter and returns the resulting string. Replacement is performed on a character, not a string, basis. If the *identifier* parameter contains fewer characters than the *associator* parameter, the excess character(s) in the *associator* parameter are ignored. If the *identifier* parameter contains more characters than the *associator* parameter, the excess character(s) in the *identifier* parameter are deleted in the output string.

$TRANSLATE is case-sensitive.

The *string*, *identifier*, and *associator* parameters are normally specified as quoted strings. If the value of one of these parameters is purely numeric, string quotes are not required; however, because InterSystems IRIS will convert the parameter value to a canonical number before supplying the value to **$TRANSLATE**, this usage is not recommended.

$TRANSLATE and $REPLACE

$TRANSLATE performs character-for-character matching and replacement. **$REPLACE** performs string-for-string matching and replacement. **$REPLACE** can replace a single specified substring of one or more characters with another substring, or remove multiple instances of a specified substring. **$TRANSLATE** can replace multiple specified characters with corresponding specified replacement characters.

$TRANSLATE matching is always case-sensitive; **$REPLACE** matching is case-sensitive by default, but can be invoked as not case-sensitive. **$TRANSLATE** always replaces all matches in the source string; **$REPLACE** can specify the starting point for matching and/or the number of replacements to perform.

Examples

The following example shows two ways of using **$TRANSLATE**. The first **$TRANSLATE** does not change the input string value. The second **$TRANSLATE** changes the input string value by setting it equal to the function's return value:

```
  SET str="The quick brown fox"
  SET newstr=$$TRANSLATE(str,"qbf","QBF")
  WRITE "source string: ",str,!,"new string: ",newstr,!!
   // creates a new string, does not change str value
  SET str=$$TRANSLATE(str,"qbf","QBF")
  WRITE "revised string: ",str
   // creates a new string and replaces str with new string value
```

In the following example, a two-parameter **$TRANSLATE** removes Numeric Group Separators based on the setting for the current locale:

```
AppropriateInput
   SET ds=##class(%SYS.NLS.Format).GetFormatItem("DecimalSeparator")
   IF ds="." {SET x="+1,462,543.33"}
   ELSE {SET x="+1.462.543,33"}
TranslateNum
   WRITE !,"before translation ",x
   SET ngs=##class(%SYS.NLS.Format).GetFormatItem("NumericGroupSeparator")
   IF ngs=","     {SET x=$TRANSLATE(x,",") }
   ELSEIF ngs="." {SET x=$TRANSLATE(x,".") }
   ELSEIF ngs=" " {SET x=$TRANSLATE(x," ") }
   ELSE {WRITE "Non-standard NumericGroupSeparator:", ngs
         RETURN }
   WRITE !,"after translation  ",x
```

In the following example, a three-parameter **$TRANSLATE** replaces various Date Separator Characters with slashes. Note that the *associator* must specify "/" as many times as the number of characters in *identifier*:

```
   SET x(1)="06-23-2014"
   SET x(2)="06.24.2014"
   SET x(3)="06/25/2014"
   SET x(4)="06|26|2014"
   SET x(5)="06 27 2014"
   FOR i=1:1:5{
        SET x(i)=$TRANSLATE(x(i),"- .|","////")
        WRITE "x(",i,") :",x(i),!
   }
```

In the following example, a three-parameter **$TRANSLATE** "simplifies" Spanish to basic ASCII by replacing accented letters with non-accented letters and removing the question and exclamation sentence prefix punctuation:

```
  SET esp="¿Sabes lo que ocurrirá en el año 2016?"
  WRITE "Spanish:",!,esp,!
  SET iden=$CHAR(225)_$CHAR(233)_$CHAR(237)_$CHAR(241)_$CHAR(243)_$CHAR(250)_$CHAR(161)_$CHAR(191)
  SET asso="aeinou"
  WRITE "Identifier: ",iden,!
  WRITE "Associator: ",asso,!
  SET spanglish=$TRANSLATE(esp,iden,asso)
  WRITE "Spanglish:",!,spanglish
```

Needless to say, this is not a recommended conversion for use on actual Spanish text.

See Also

- $EXTRACT function
- $PIECE function
- $REPLACE function
- $REVERSE function
- $ZCONVERT function

$VIEW

Returns the contents of memory locations.

```
$VIEW(offset,mode,length)
$V(offset,mode,length)
```

Parameters

offset	Positive Integer: an offset, in bytes, from a base address within the memory region specified by *mode*. Interpretation is mode-dependent (see below.) -1: a flag to return process summary information.
mode	*Optional* — The memory region whose base address will be used to locate the data. Default is -1.
length	*Optional* — The length of the data to be returned, in bytes. May also contain a letter "O" reverse order suffix. Default is 1. When returning process summary information , a returned value format flag: 1=caret–separated string (the default); 2=$list-structured string.

Description

$VIEW returns the contents of memory locations.

The *view buffer* is a special memory area used to store blocks of data read from the InterSystems IRIS database (IRIS.DAT) with the VIEW command. After reading a block into the view buffer, you can use the **$VIEW** function with *mode* 0 to examine the contents of the view buffer. You must open the view buffer as device 63 in order to access it; when finished, you should close device 63.

You can also use **$VIEW** to return process summary information.

The **$VIEW** function is usually used when debugging and repairing InterSystems IRIS databases and system information.

Parameters

offset

The value of this argument depends upon the *mode* argument, as follows:

- When *mode* is 0, -1, or -2, specify a positive integer as the offset from the base address, in bytes, counting from 0.
- When *mode* is -3, or a positive integer, specify an address in the process address space. The value -1 can be used to retrieve a summary of the process state, as described in "Process Summary Information" below.
- When *mode* is -5, specify a positive integer that specifies the number of global nodes in the current block. In this case, odd values return full global references and even values return pointers or data.

mode

The possible values for *mode* are shown in the following table. If *mode* is omitted, the default is -1. Note that some values are implementation specific. Implementation restrictions are noted in the table.

Mode	Memory Management Region	Base Address
0	The view buffer	Beginning of view buffer
-1	The process's partition (default)	Beginning of partition
-2	The system table	Beginning of system table
-3	The address space for the current process.	0
-5	Global reference and data	Special. See "Using Mode -5," later in the Notes section.
-6	Reserved for InterSystems use	
-7	Used only by the integrity checking utility	Special.
n	When *n* is a positive number, the address space for the running process *n*, where *n* is the pid (value of the **$JOB** special variable) for that process. Treats *offset* and *length* the same as *mode* -3.	0

length

A length in bytes, or a flag character. Interpretation depends on the *mode* and *offset* values:

- When *mode* is 0, -1, or -2, -3, or a positive integer (a pid), and *offset* is a positive integer, the *length* parameter can be:
  - A negative integer from -1 to the maximum string length (as a negative integer) to return that length of data as a string. **$VIEW** returns the specified number of characters starting at the address indicated by *offset*.
  - A positive integer in the range 1 through 8 (inclusive) to return the decimal value of the data. **$VIEW** returns from one to four contiguous bytes, or eight contiguous bytes, starting at the address indicated by *offset*.
  - A letter C or P as a quoted string to indicate a four-byte address on 32-bit systems, or an eight-byte address on 64-bit systems. When specifying C or P, you do not specify a *length* integer value.

  To return a byte value in reverse order (low-order byte at lowest address) append a letter O suffix to the *length* value and enclose the resulting string in double quotes.

  If the *length* parameter is omitted, the default is 1.
- When *mode* is -3, or a positive integer (a pid), and *offset* is -1, the *length* parameter is a flag that specifies the format of the summary information. Specify a *length* of 1 to return this summary as a delimited string, or 2 to return this summary as a **$LIST** structure. If the *length* parameter is omitted, the default is 1.
- When *mode* is -5, do not specify a *length* parameter.

Notes

$VIEW Usage Restricted

The **$VIEW** function is a restricted system capability. It is a protected command because the invoked code is located in the IRISSYS database. For further details, refer to the "IRISSYS Special Capabilities" in the Assets and Resources chapter of the *Security Administration Guide*.

Process Summary Information

When *offset* is -1, you can use *mode* -3 to return summary information from the current process address space as a ^ delimited string, as shown in this example:

```
WRITE $VIEW(-1,-3,1)
```

You can also return the same information as a **$LIST** structure, as follows:

```
SET infolist = $VIEW(-1,-3,2)
ZWRITE infolist
```

To return summary information from the address space of a specified process, provide the Process ID (pid) for that process as a positive integer for the *mode* argument, as shown in this example:

```
SET pid=$PIECE($IO,"|",4)
WRITE $VIEW(-1,pid,1)
```

The following Terminal example returns more than one currently open devices in the *dev* field. It first returns just the current process. It then opens a spool device (device 2), and returns the open devices as a comma-separated list:

```
USER>WRITE $VIEW(-1,-3)
8484^*^|TRM|:|8484*,^116^...
USER>OPEN 2:(3:12)

USER>WRITE $VIEW(-1,-3)
8484^*^|TRM|:|8484*,2,^118^...
```

The summary information return value is in the following format:

```
pid^mode^dev^mem^dir^rou^stat^prio^uic^loc^blk^^^defns^lic^jbstat^mempeak^roles^loginroles
```

The fields are defined as follows:

pid	The process ID. See the *Pid* property of the SYS.Process class.
mode	* if in at the Terminal prompt. + or – if the job is part of a callin connection. Omitted for daemons.
dev	Current open device(s), returned as a comma-separated list. The current device (the **$IO** device) is indicated by an asterisk (*) suffix. See the *OpenDevices* property of the SYS.Process class. Note that the *dev* value includes a trailing comma, the OpenDevices value does not.
mem	Memory in use in the process partition (in KBs), if the process is not a daemon. Similar to but not identical to the *MemoryUsed* property of the SYS.Process class.
dir	Default directory.
rou	Routine name.
stat	A comma-separated pair of integer counts, bol,gcnt, where *bol* is the beginning of line token, specifying the number of lines executed, and *gcnt* is the global count, specifying the total number of **FOR** loops and **XECUTE** commands performed.
prio	User's current base priority. See the *Priority* property of the SYS.Process class.
uic	Obsolete, defaults to 0,0.
loc	Location, for daemon processes only.
blk	Number of 2K blocks that can be used for buddy block queues. This is the maximum size of user memory space (also known as partition space). See the *MemoryAllocated* property of the SYS.Process class.
defns	Default namespace. See the *NameSpace* property of the SYS.Process class.
lic	License bits.

jbstat	Job status, specified as high,low representing the high and low order bits. Refer to $ZJOB special variable for details.
mempeak	Peak memory usage for the process, in kilobytes. This value is approximate to the nearest 64K. See the *MemoryPeak* property of the SYS.Process class.
roles	The roles that the process currently has, returned as a comma-separated list. Same as $ROLES value. See the *Roles* property of the SYS.Process class.
loginroles	The roles that the process had when it was initiated, returned as a comma-separated list. See the *LoginRoles* property of the SYS.Process class.

Using Mode -5

If the current block in the view buffer contains part of a global, specifying -5 for *mode* returns the global references and the values contained in the block. The *length* parameter is not valid for a *mode* of -5.

With a *mode* of -5, the *offset* value specifies the number of global nodes in the block, rather than a byte offset from the base address. Odd values return full global references and even values return pointers or data.

For example, to return the full global reference of the *n*th node in the view buffer, specify *n**2-1 for *offset*. To return the value of the *n*th node, specify *n**2. To return the global reference of the last node in the block, specify -1 for the *offset* value.

$VIEW returns the nodes in collating sequence (that is, numeric). This is the same sequence that the **$ORDER** function uses. By writing code that expects this sequence, you can quickly perform a sequential scan through a global in the view buffer. (Several of the ObjectScript utilities use this technique.) **$VIEW** returns a null string ("") if the *offset* specifies a location beyond the last node in the view buffer. Be sure to include a test for this value in your code.

If the current block is a pointer block, the values returned are InterSystems IRIS block numbers, which are pointers. If the block is a data block, the values returned are the data values associated with the nodes.

If **$VIEW** issues a <DATABASE> or <FUNCTION> error, it means that the information in the block is neither a valid global reference nor valid data.

The following example shows generalized code for examining the contents of the view buffer. The code first opens the view buffer and prompts for the number of the block to be read in. The **FOR** loop then cycles through all the offsets in the current block. The **$VIEW** function uses a mode of -5 to return the value at each offset. The **WRITE** commands output the resulting offset-value pairs.

When the end of the block is reached, **$VIEW** returns a null string (""). The **IF** command tests for this value and writes out the “End of block” message. The **QUIT** command then terminates the loop and control returns to the prompt so the user can read in another block.

```
Start OPEN 63
      WRITE !,"Opening view buffer."
      READ !!,"Number of block to read in: ",block QUIT:block=""
      VIEW block
         FOR i=1:1 {
               SET x=$VIEW(i,-5)
               IF x="",i#2 {
                    WRITE !!,"End of block: ",block
                    CLOSE 63
                    QUIT }
               WRITE !,"Offset = ",i
               WRITE !,"Value = ",x
        }
        GOTO Start+2
        CLOSE 63
        QUIT
```

For a global block, typical output produced by this routine might appear as follows:

```
Opening view buffer.
Number of block to read in:3720
Offset = 1
Value = ^client(5)
Offset = 2
Value = John Jones
Offset = 3
Value = ^client(5,1)
Offset = 4
Value = 23 Bay Rd./Boston/MA 02049
 .
 .
 .
Offset = 126
Value = ^client(18,1,1)
Offset = 127
Value = Checking/45673/1248.00
End of block: 3720
Number of block to read in:
```

Reverse Order Byte Values (Big-Endian only)

On big-endian systems, you can return byte values in reverse order by using a letter “O” suffix as part of the *length* parameter. When you specify the letter O in *length*, **$VIEW** returns a byte value in reverse order. (The *length* value must be enclosed in double quotes.) This is shown in the following example:

```
USE IO
FOR Z=0:0 {
   WRITE *-6
   SET NEXTBN=$VIEW(LINKA,0,"3O")
   QUIT:NEXTBN=0 }
```

In the example above, the *length* parameter of **$VIEW** is “3O” (3 and the letter O). When run on a big-endian system, this specifies a length of the next three (3) bytes in reverse order (O). Thus, **$VIEW** starts at a position in memory (the view buffer—as indicated by a *mode* of 0) and returns the highest byte, the second highest byte, and the third highest byte.

On little-endian systems, the letter “O” is a no-op. A *length* value of “3O” is the same as a *length* value of “3”.

You can use the **IsBigEndian()** class method to determine which bit ordering is used on your operating system platform: 1=big-endian bit order; 0=little-endian bit order.

```
WRITE $SYSTEM.Version.IsBigEndian()
```

See Also

- VIEW command
- JOB command

$WASCII

Returns the numeric code corresponding to a character, recognizing surrogate pairs.

```
$WASCII(expression,position)
$WA(expression,position)
```

Parameters

expression	The character to be converted.
position	*Optional* — The position of a character within a character string, counting from 1. The default is 1.

Description

$WASCII returns the character code value for a single character specified in *expression*. **$WASCII** recognizes a surrogate pair as a single character. The returned value is a positive integer.

The *expression* parameter may evaluate to a single character or to a string of characters. If *expression* evaluates to a string of characters, you can include the optional *position* parameter to indicate which character you want to convert. The *position* counts a surrogate pair as a single character. You can use the $WISWIDE function to determine if a string contains a surrogate pair.

A surrogate pair is a pair of 16-bit InterSystems IRIS character elements that together encode a single Unicode character. Surrogate pairs are used to represent certain ideographs which are used in Chinese, Japanese kanji, and Korean hanja. (Most commonly-used Chinese, kanji, and hanja characters *are* represented by standard 16-bit Unicode encodings.) Surrogate pairs provide InterSystems IRIS support for the Japanese JIS X0213:2004 (JIS2004) encoding standard and the Chinese GB18030 encoding standard.

A surrogate pair consists of high-order 16-bit character element in the hexadecimal range D800 through DBFF, and a low-order 16-bit character element in the hexadecimal range DC00 through DFFF.

The **$WASCII** function recognizes a surrogate pair as a single character. The **$ASCII** function treats a surrogate pair as two characters. In all other aspects, **$WASCII** and **$ASCII** are functionally identical. However, because **$ASCII** is generally faster than **$WASCII**, **$ASCII** is preferable for all cases where a surrogate pair is not likely to be encountered. For further details on character to numeric code conversion, refer to the $ASCII function.

Examples

The following example shows **$WASCII** returning the Unicode value for a surrogate pair:

```
SET hipart=$CHAR($ZHEX("D806"))
SET lopart=$CHAR($ZHEX("DC06"))
WRITE !,$ASCII(hipart)," = high-order value"
WRITE !,$ASCII(lopart)," = low-order value"
SET spair=hipart_lopart /* surrogate pair */
SET xpair=hipart_hipart /* NOT a surrogate pair */
WRITE !,$WASCII(spair)," = surrogate pair value"
WRITE !,$WASCII(xpair)," = Not a surrogate pair"
```

The following example compares **$WASCII** and **$ASCII** return values for a surrogate pair:

```
SET hipart=$CHAR($ZHEX("D806"))
SET lopart=$CHAR($ZHEX("DC06"))
WRITE !,$ASCII(hipart)," = high-order value"
WRITE !,$ASCII(lopart)," = low-order value"
SET spair=hipart_lopart /* surrogate pair */
WRITE !,$ASCII(spair)," = $ASCII value for surrogate pair"
WRITE !,$WASCII(spair)," = $WASCII value for surrogate pair"
```

The following example shows the effects on *position* counting of surrogate pairs. It returns both the **$WASCII** and **$ASCII** values for each *position*. **$WASCII** counts a surrogate pair as one position; **$ASCII** counts a surrogate pair as two positions:

```
SET hipart=$CHAR($ZHEX("D806"))
SET lopart=$CHAR($ZHEX("DC06"))
WRITE !,$ASCII(hipart)," = high-order value"
WRITE !,$ASCII(lopart)," = low-order value",!
SET str="AB"_lopart_hipart_lopart_"CD"_hipart_lopart_"EF"
FOR x=1:1:11 {
WRITE !,"position ",x," $WASCII ",$WASCII(str,x)," $ASCII ",$ASCII(str,x) }
```

See Also

- $ASCII function
- $WCHAR function
- $WEXTRACT function
- $WFIND function
- $WISWIDE function
- $WLENGTH function
- $WREVERSE function

$WCHAR

Returns the character corresponding to a numeric code, recognizing surrogate pairs.

```
$WCHAR(expression,...)
$WC(expression,...)
```

Parameter

expression	The integer value to be converted.

Description

$WCHAR returns the character(s) corresponding to a code value(s) specified in *expression*. Decimal values of 65535 (hex FFFF) and smaller are processed identically by **$CHAR** and **$WCHAR**. Values from 65536 (hex 10000) through 1114111 (hex 10FFFF) are used to represent Unicode surrogate pairs; these characters can be returned using **$WCHAR**.

If *expression* contains a comma-separated list of code values, **$WCHAR** returns the corresponding characters as a string. **$WCHAR** recognizes a surrogate pair as a single character. You can use the $WISWIDE function to determine if a string contains a surrogate pair.

A surrogate pair is a pair of 16-bit InterSystems IRIS character elements that together encode a single Unicode character. Surrogate pairs are used to represent certain ideographs which are used in Chinese, Japanese kanji, and Korean hanja. (Most commonly-used Chinese, kanji, and hanja characters *are* represented by standard 16-bit Unicode encodings.) Surrogate pairs provide InterSystems IRIS support for the Japanese JIS X0213:2004 (JIS2004) encoding standard and the Chinese GB18030 encoding standard.

A surrogate pair consists of high-order 16-bit character element in the hexadecimal range D800 through DBFF, and a low-order 16-bit character element in the hexadecimal range DC00 through DFFF.

The **$WCHAR** function treats a surrogate pair as a single character. The **$CHAR** function treats a surrogate pair as two characters. In all other aspects, **$WCHAR** and **$CHAR** are functionally identical. However, because **$CHAR** is generally faster than **$WCHAR**, **$CHAR** is preferable for all cases where a surrogate pair is not likely to be encountered.

For further details on numeric code to character conversion, refer to the $CHAR function.

See Also

- $CHAR function
- $WASCII function
- $WEXTRACT function
- $WFIND function
- $WISWIDE function
- $WLENGTH function
- $WREVERSE function

$WEXTRACT

Extracts a substring from a character string by position, or replaces a substring by position, recognizing surrogate pairs.

```
$WEXTRACT(string,from,to)
$WE(string,from,to)

SET $WEXTRACT(string,from,to)=value
SET $WE(string,from,to)=value
```

Parameters

string	The target string in which substrings are identified. Specify *string* as an expression that evaluates to a quoted string or a numeric value. In **SET $WEXTRACT** syntax, *string* must be a variable or a multi-dimensional property.
from	*Optional* — The starting position within the target string. Characters are counted from 1. A surrogate pair is counted as a single character. Permitted values are *n* (a positive integer specifying the start position as a character count from the beginning of *string*), * (specifying the last character in *string*), and *-*n* (offset integer count of characters backwards from end of *string*). **SET $WEXTRACT** syntax also supports *+*n* (offset integer count of characters to append beyond the end of *string*). If not specified, the default is 1. Different values are used for the two-parameter form `$WEXTRACT(string,from)`, and the three-parameter form `$WEXTRACT(string,from,to)`: Without *to*: Specifies a single character. To count from the beginning of *string*, specify an expression that evaluates to a positive integer (counting from 1); a zero (0) or negative number returns the empty string. To count from the end of *string* specify *, or *-*n*. If *from* is omitted it defaults to 1. With *to*: Specifies the start of a range of characters. To count from the beginning of *string*, specify an expression that evaluates to a positive integer (counting from 1). A zero (0) or negative number evaluates as 1. To count from the end of *string* specify *, or *-*n*.
to	*Optional* — Specifies the end position (inclusive) for a range of characters. Must be used with *from*. Permitted values are *n* (a positive integer equal to or larger than *from* that specifies the end position as a character count from the beginning of *string*), * (specifying the last character in *string*), and *-*n* (offset integer count of characters backwards from end of *string*). A surrogate pair is counted as a single character. You can specify a *to* value that is beyond the end of the string. **SET $WEXTRACT** syntax also supports *+*n* (offset integer count of the end of a range of characters to append beyond the end of *string*).

Description

$WEXTRACT identifies a substring within *string* by position, either counting characters from the beginning of *string* or counting characters by offset from the end of *string*. A substring can be a single character or a range of characters. **$WEXTRACT** recognizes a surrogate pair as a single character.

$WEXTRACT can be used in two ways:

- To return a substring from *string*. This uses the `$WEXTRACT(string,from,to)` syntax.
- To replace a substring within *string*. The replacement substring may be the same length, longer, or shorter than the original substring. This uses the `SET $WEXTRACT(string,from,to)=value` syntax.

$WEXTRACT and **$EXTRACT** are functionally identical, except for the handling of surrogate pairs.

Surrogate Pairs

The **$WEXTRACT** *from* and *to* parameters count a surrogate pair as a single character. You can use the $WISWIDE function to determine if a string contains a surrogate pair.

A surrogate pair is a pair of 16-bit InterSystems IRIS character elements that together encode a single Unicode character. Surrogate pairs are used to represent certain ideographs which are used in Chinese, Japanese kanji, and Korean hanja. (Most commonly-used Chinese, kanji, and hanja characters *are* represented by standard 16-bit Unicode encodings.) Surrogate pairs provide InterSystems IRIS support for the Japanese JIS X0213:2004 (JIS2004) encoding standard and the Chinese GB18030 encoding standard.

A surrogate pair consists of high-order 16-bit character element in the hexadecimal range D800 through DBFF, and a low-order 16-bit character element in the hexadecimal range DC00 through DFFF.

The **$WEXTRACT** function treats a surrogate pair as a single character. The **$EXTRACT** function treats a surrogate pair as two characters. If a string contains no surrogate pairs, either **$WEXTRACT** and **$EXTRACT** can be used and return the same value. However, because **$EXTRACT** is generally faster than **$WEXTRACT**, **$EXTRACT** is preferable for all cases where a surrogate pair is not likely to be encountered. For further details on extracting a substring, refer to the $EXTRACT function.

Returning a Substring

$WEXTRACT returns a substring by character position from *string*. The nature of this substring extraction depends on the parameters used:

- **$WEXTRACT**(*string*) extracts the first character in the string.
- **$WEXTRACT**(*string*,*from*) extracts a single character in the position specified by *from*. The *from* value can be an integer count of characters from the beginning of the string, an asterisk specifying the last character of the string, or an asterisk with a negative integer specifying a character count backwards from the end of the string.

  The following example extracts single letters from a string containing a surrogate pair. Note that **$LENGTH** counts a surrogate pair as two characters, but **$WEXTRACT** counts a surrogate pair as a single character:

  ```
  SET hipart=$CHAR($ZHEX("D806"))
  SET lopart=$CHAR($ZHEX("DC06"))
  SET spair=hipart_lopart /* surrogate pair */
  WRITE "length of surrogate pair ",$LENGTH(spair),!
  SET mystr="AB"_spair_"DEFG"
  WRITE !,$WEXTRACT(mystr,4)    // "D" the 4th character
  WRITE !,$WEXTRACT(mystr,*)    // "G" the last character
  WRITE !,$WEXTRACT(mystr,*-5)  // "B" the offset 5 character from end
  WRITE !,$WEXTRACT(mystr,*-0)  // "G" the last character by 0 offset
  ```

- **$WEXTRACT**(*string*,*from*,*to*) extracts the range of characters starting with the *from* position and ending with the *to* position (inclusive). The following **$WEXTRACT** functions both return the string “Alabama”, counting surrogate pairs as single characters:

  ```
  SET hipart=$CHAR($ZHEX("D806"))
  SET lopart=$CHAR($ZHEX("DC06"))
  SET spair=hipart_lopart /* surrogate pair */
  SET var2=spair_"XXX"_spair_"Alabama"_spair
   WRITE !,$WEXTRACT(var2,6,12)
   WRITE !,$WEXTRACT(var2,*-7,*-1)
  ```

  If the *from* and *to* positions are the same,**$WEXTRACT** returns a single character. If the *to* position is closer to the beginning of the string than the *from* position, **$WEXTRACT** returns the null string.

Replacing a Substring

You can use **$WEXTRACT** with the **SET** command to replace a specified character or range of characters with another value. You can also use it to append characters to the end of a string. **SET $WEXTRACT** counts a surrogate pair as a single character.

When **$WEXTRACT** is used with **SET** on the left hand side of the equals sign, *string* can be a valid variable name. If the variable does not exist, **SET $WEXTRACT** defines it. The *string* parameter can also be a multidimensional property reference; it cannot be a non-multidimensional object property. Attempting to use **SET $WEXTRACT** on a non-multidimensional object property results in an <OBJECT DISPATCH> error.

You cannot use **SET (a,b,c,...)=value** syntax with **$WEXTRACT** (or **$EXTRACT**, **$PIECE**, or **$LIST**) on the left of the equals sign, if the function uses relative offset syntax: `*` representing the end of a string and `*-n` or `*+n` representing relative offset from the end of the string. You must instead use **SET a=value,b=value,c=value,...** syntax.

For further details on replacing a substring, refer to the $EXTRACT function.

Examples

The following example shows the two-parameter form of **$WEXTRACT** returning the Unicode value for a surrogate pair:

```
SET hipart=$CHAR($ZHEX("D806"))
SET lopart=$CHAR($ZHEX("DC06"))
SET spair=hipart_lopart /* surrogate pair */
SET x="ABC"_spair_"DEFGHIJK"
WRITE !,"$EXTRACT character "
ZZDUMP $EXTRACT(x,4)
WRITE !,"$WEXTRACT character "
ZZDUMP $WEXTRACT(x,4)
```

The following example shows the three-parameter form of **$WEXTRACT** including a surrogate pair in a substring range:

```
SET hipart=$CHAR($ZHEX("D806"))
SET lopart=$CHAR($ZHEX("DC06"))
SET spair=hipart_lopart /* surrogate pair */
SET x="ABC"_spair_"DEFGHIJK"
 WRITE !,"$EXTRACT two characters "
 ZZDUMP $EXTRACT(x,3,4)
 WRITE !,"$WEXTRACT two characters "
 ZZDUMP $WEXTRACT(x,3,4)
```

See Also

- $EXTRACT function
- $WASCII function
- $WCHAR function
- $WFIND function
- $WISWIDE function
- $WLENGTH function
- $WREVERSE function

$WFIND

Finds a substring by value and returns an integer specifying its end position in the string, recognizing surrogate pairs.

```
$WFIND(string,substring,position)
$WF(string,substring,position)
```

Parameters

string	The target string that is to be searched. It can be a variable name, a numeric value, a string literal, or any valid ObjectScript expression that resolves to a string.
substring	The substring that is to be searched for. It can be a variable name, a numeric value, a string literal, or any valid ObjectScript expression that resolves to a string.
position	*Optional* — A position within the target string at which to start the search. It must be a positive integer.

Description

$WFIND returns an integer specifying the end position of a substring within a string. In calculating position, it counts each surrogate pair as a single character. **$WFIND** is functionally identical to **$FIND**, except that **$WFIND** recognizes surrogate pairs. It counts a surrogate pair as a single character. You can use the $WISWIDE function to determine if a string contains a surrogate pair.

A surrogate pair is a pair of 16-bit InterSystems IRIS character elements that together encode a single Unicode character. Surrogate pairs are used to represent certain ideographs which are used in Chinese, Japanese kanji, and Korean hanja. (Most commonly-used Chinese, kanji, and hanja characters *are* represented by standard 16-bit Unicode encodings.) Surrogate pairs provide InterSystems IRIS support for the Japanese JIS X0213:2004 (JIS2004) encoding standard and the Chinese GB18030 encoding standard.

A surrogate pair consists of high-order 16-bit character element in the hexadecimal range D800 through DBFF, and a low-order 16-bit character element in the hexadecimal range DC00 through DFFF.

The **$WFIND** function counts a surrogate pair as a single character. The **$FIND** function counts a surrogate pair as two characters. In all other aspects, **$WFIND** and **$FIND** are functionally identical. However, because **$FIND** is generally faster than **$WFIND**, **$FIND** is preferable for all cases where a surrogate pair is not likely to be encountered.

For further details on finding a substring, refer to the $FIND function.

Examples

The following example shows how **$WFIND** counts a surrogate pair as a single character in the return value:

```
SET spair=$CHAR($ZHEX("D806"),$ZHEX("DC06"))
SET str="ABC"_spair_"DEF"
WRITE !,$FIND(str,"DE")," $FIND location in string"
WRITE !,$WFIND(str,"DE")," $WFIND location in string"
```

The following example shows how **$WFIND** counts a surrogate pair as a single character in the *position* parameter:

```
SET spair=$CHAR($ZHEX("D806"),$ZHEX("DC06"))
SET str="ABC"_spair_"DEF"
WRITE !,$FIND(str,"DE",6)," $FIND location in string"
WRITE !,$WFIND(str,"DE",6)," $WFIND location in string"
```

See Also

- $FIND function

- $WASCII function
- $WCHAR function
- $WEXTRACT function
- $WISWIDE function
- $WLENGTH function
- $WREVERSE function

$WISWIDE

Returns a flag indicating whether a string contains surrogate pairs.

```
$WISWIDE(string)
```

Parameter

string	A string or expression that evaluates to a string.

Description

$WISWIDE returns a boolean value indicating whether *string* contains surrogate pairs. 0=*string* does not contain any surrogate pairs. 1=*string* contains one or more surrogate pairs.

A surrogate pair is a pair of 16-bit InterSystems IRIS character elements that together encode a single Unicode character. Surrogate pairs are used to represent certain ideographs which are used in Chinese, Japanese kanji, and Korean hanja. (Most commonly-used Chinese, kanji, and hanja characters *are* represented by standard 16-bit Unicode encodings.) Surrogate pairs provide InterSystems IRIS support for the Japanese JIS X0213:2004 (JIS2004) encoding standard and the Chinese GB18030 encoding standard.

A surrogate pair consists of high-order 16-bit character element in the hexadecimal range D800 through DBFF, and a low-order 16-bit character element in the hexadecimal range DC00 through DFFF.

Example

The following example shows **$WISWIDE** returning a boolean for a surrogate pair:

```
SET spair=$CHAR($ZHEX("D806"),$ZHEX("DC06")) /* surrogate pair */
SET xpair=$CHAR($ZHEX("DC06"),$ZHEX("D806")) /* NOT a surrogate pair */
SET str="AB"_spair_"CD"
WRITE !,$WISWIDE(str)," = surrogate pair(s) in string?"
SET xstr="AB"_xpair_"CD"
WRITE !,$WISWIDE(xstr)," = surrogate pair(s) in string?"
```

See Also

- $WASCII function
- $WCHAR function
- $WEXTRACT function
- $WFIND function
- $WLENGTH function
- $WREVERSE function

$WLENGTH

Returns the number of characters in a string, recognizing surrogate pairs.

```
$WLENGTH(string)
$WL(string)
```

Parameter

string	A string or expression that evaluates to a string.

Description

$WLENGTH returns the number of characters in *string*. **$WLENGTH** is functionally identical to **$LENGTH**, except that **$WLENGTH** recognizes surrogate pairs. It counts a surrogate pair as a single character. You can use the $WISWIDE function to determine if a string contains a surrogate pair.

A surrogate pair is a pair of 16-bit InterSystems IRIS character elements that together encode a single Unicode character. Surrogate pairs are used to represent certain ideographs which are used in Chinese, Japanese kanji, and Korean hanja. (Most commonly-used Chinese, kanji, and hanja characters *are* represented by standard 16-bit Unicode encodings.) Surrogate pairs provide InterSystems IRIS support for the Japanese JIS X0213:2004 (JIS2004) encoding standard and the Chinese GB18030 encoding standard.

A surrogate pair consists of high-order 16-bit character element in the hexadecimal range D800 through DBFF, and a low-order 16-bit character element in the hexadecimal range DC00 through DFFF.

The **$WLENGTH** function counts a surrogate pair as a single character. The **$LENGTH** function counts a surrogate pair as two characters. In all other aspects, **$WLENGTH** and **$LENGTH** are functionally identical. However, because **$LENGTH** is generally faster than **$WLENGTH**, **$LENGTH** is preferable for all cases where a surrogate pair is not likely to be encountered.

For further details on string length, refer to the $LENGTH function.

Example

The following example shows how **$WLENGTH** counts a surrogate pair as a single character:

```
SET spair=$CHAR($ZHEX("D806"),$ZHEX("DC06"))
SET str="AB"_spair_"CD"
WRITE !,$LENGTH(str)," $LENGTH characters in string"
WRITE !,$WLENGTH(str)," $WLENGTH characters in string"
```

See Also

- $LENGTH function
- $WASCII function
- $WCHAR function
- $WEXTRACT function
- $WFIND function
- $WISWIDE function
- $WREVERSE function

$WREVERSE

Returns the characters in a string in reverse order, recognizing surrogate pairs.

```
$WREVERSE(string)
$WRE(string)
```

Parameter

string	A string or expression that evaluates to a string.

Description

$WREVERSE returns the characters in *string* in reverse order. **$WREVERSE** is functionally identical to **$REVERSE**, except that **$WREVERSE** recognizes surrogate pairs. You can use the $WISWIDE function to determine if a string contains a surrogate pair.

A surrogate pair is a pair of 16-bit InterSystems IRIS character elements that together encode a single Unicode character. Surrogate pairs are used to represent certain ideographs which are used in Chinese, Japanese kanji, and Korean hanja. (Most commonly-used Chinese, kanji, and hanja characters *are* represented by standard 16-bit Unicode encodings.) Surrogate pairs provide InterSystems IRIS support for the Japanese JIS X0213:2004 (JIS2004) encoding standard and the Chinese GB18030 encoding standard.

A surrogate pair consists of high-order 16-bit character element in the hexadecimal range D800 through DBFF, and a low-order 16-bit character element in the hexadecimal range DC00 through DFFF.

The **$WREVERSE** function counts a surrogate pair as a single character. The **$REVERSE** function treats a surrogate pair as two characters. In all other aspects, **$WREVERSE** and **$REVERSE** are functionally identical. However, because **$REVERSE** is generally faster than **$WREVERSE**, **$REVERSE** is preferable for all cases where a surrogate pair is not likely to be encountered.

For further details on reversing strings, refer to the $REVERSE function.

Example

The following example shows how **$WREVERSE** treats a surrogate pair as a single character:

```
SET spair=$CHAR($ZHEX("D806"),$ZHEX("DC06"))
SET str="AB"_spair_"CD"
  WRITE !,"String before reversing:"
  ZZDUMP str
SET wrev=$WREVERSE(str)
  WRITE !,"$WREVERSE did not reverse surrogate pair:"
  ZZDUMP wrev
SET rev=$REVERSE(str)
  WRITE !,"$REVERSE reversed surrogate pair:"
  ZZDUMP rev
```

See Also

- $REVERSE function
- $WASCII function
- $WCHAR function
- $WEXTRACT function
- $WFIND function
- $WISWIDE function

- $WLENGTH function

$XECUTE

Executes a specified command line.

```
$XECUTE(code,paramlist)
```

Parameters

code	An expression that resolves to a valid ObjectScript command line, specified as a quoted string. A command line can contain one or more ObjectScript commands. The final command must be an argumented **QUIT**.
paramlist	*Optional* — A list of parameters to be passed to *code*. Multiple parameters are separated by commas.

Description

The **$XECUTE** function allows you to execute user-written *code* as a function, supplying passed parameters and returning a value. The *code* parameter must evaluate to a quoted string containing one or more ObjectScript commands. The *code* execution must conclude with a **QUIT** command that returns an argument. InterSystems IRIS then returns this **QUIT** argument as the **$XECUTE** return code value.

You can use the *paramlist* argument to pass parameters to *code*. If you are passing parameters, there must be a formal parameter list at the beginning of *code*. Parameters are specified positionally. There must be at least as many formal parameters listed in *code* as there are actual parameters specified in *paramlist*.

You can use the **CheckSyntax()** method of the %Library.Routine class to perform syntax checking on *code*.

Each invocation of **$XECUTE** places a new context frame on the call stack for your process. The **$STACK** special variable contains the current number of context frames on the call stack.

The **$XECUTE** function performs substantially the same operation as the **XECUTE** command, with the following differences: The **$XECUTE** function does not support postconditionals or the use of multiple command line arguments. The **$XECUTE** function requires every execution path to end with an argumented **QUIT**; the **XECUTE** command neither requires a **QUIT** nor permits an argumented **QUIT**.

Parameters

code

An expression that evaluates to a valid ObjectScript command line, specified as a quoted string. The *code* string must not contain a tab character at the beginning or a <Return> at the end. The string can be no longer than a valid ObjectScript program line. The *code* string must contain a **QUIT** command that returns an argument at the conclusion of each possible execution path.

If **$XECUTE** passes parameters to *code*, the *code* string must begin with a formal parameter list. A formal parameter list is enclosed in parentheses; within the parentheses, parameters are separated by commas.

paramlist

A list of parameters to pass to *code*, specified as a comma-separated list. Each parameter in *paramlist* must correspond to a formal parameter within the *code* string. The number of parameters in *paramlist* may be less than or equal to the number of formal parameters listed in *code*.

You can use a dot prefix to pass a parameter by reference. This is useful for passing a value out from *code*. An example is provided below. For further details, refer to Passing by Reference in the "User-defined Code" chapter of *Using ObjectScript*.

Examples

In the following example, the **$XECUTE** function executes the command line specified in *cmdline*. It passes two parameters, *num1* and *num2* to this command line.

```
   SET cmd="(dvnd,dvsr) IF dvsr=0 {QUIT 99} ELSE {SET ^testnum=dvnd/dvsr QUIT 0}"
   SET rtn=$XECUTE(cmd,num1,num2)
   IF rtn=99
     {WRITE !,"Division by zero. ^testnum not set"}
   ELSE
     {WRITE !,"global ^testnum set to",^testnum}
```

The following example uses passing by reference (`.y`) to pass a local variable value from the *code* to the invoking context.

```
CubeIt
  SET x=7
  SET rtn=$XECUTE("(in,out) SET out=in*in*in QUIT 0",x,.y)
  IF rtn=0 {WRITE !,x," cubed is ",y}
  ELSE {WRITE !,"Error code=",SQLCODE}
```

The following example shows how **$XECUTE** increments the **$STACK** special variable. This example either writes the **$STACK** value from within **$XECUTE**, or has **$XECUTE** invoke the **XECUTE** command, which writes the **$STACK** value:

```
StackIt
  SET stackit=$RANDOM(3)
  IF stackit=0 {GOTO StackIt}
  WRITE "initial stack level ",$STACK,!
  SET cmd="(stackit) IF stackit=1 {WRITE ""stack is "",$STACK,!  QUIT 1} "_
           "ELSEIF stackit=2 {WRITE ""stack is "",$STACK  XECUTE ""WRITE """" stack is """",$STACK,!""
  QUIT 1} "_
             "ELSE { QUIT 0}"
  SET rtn=$XECUTE(cmd,stackit)
  IF rtn=1 { WRITE "return stack level ",$STACK }
  ELSE {WRITE "unexpected value: rtn=",rtn}
```

See Also

- DO command
- XECUTE command
- QUIT command
- $STACK special variable

$ZABS

Absolute value function.

```
$ZABS(n)
```

Parameter

n	Any number.

Description

$ZABS returns the absolute value of *n*.

Parameter

n

Any number. Can be specified as a value, a variable, or an expression. The expression is evaluated, and the result converted to a positive value. Multiple plus and minus signs are permitted. Leading and trailing zeros are deleted.

For evaluation of mixed numeric strings and non-numeric strings, refer to Strings As Numbers in *Using ObjectScript*.

Example

The following example returns the absolute value of the number you supply:

```
READ "Input a number: ",num
SET abs=$ZABS(num)
WRITE "The absolute value of ",num," is ",abs
```

See Also

- Operators in *Using ObjectScript*

$ZARCCOS

Inverse (arc) cosine function.

```
$ZARCCOS(n)
```

Parameter

n	A signed decimal number.

Description

$ZARCCOS returns the trigonometric inverse (arc) cosine of *n*. The result is given in radians (to 18 decimal places).

Parameter

n

Signed decimal number ranging from 1 to -1 (inclusive). It can be specified as a value, a variable, or an expression. Numbers outside the range generate an <ILLEGAL VALUE> error. A non-numeric string is evaluated as 0.

The following are arc cosine values returned by **$ZARCCOS**:

1	returns 0
0	returns 1.570796326794896619
-1	returns pi (3.141592653589793238)

Examples

The following example permits you to compare the arc cosine and the arc sine of a number:

```
READ "Input a number: ",num
IF num>1 { WRITE !,"ILLEGAL VALUE: number too big" }
ELSEIF num<-1 { WRITE !,"ILLEGAL VALUE: number too small" }
ELSE {
      WRITE !,"the arc cosine is: ",$ZARCCOS(num)
      WRITE !,"the arc sine is: ",$ZARCSIN(num)
     }
QUIT
```

The following example compares the results from InterSystems IRIS fractional numbers (**$DECIMAL** numbers) and **$DOUBLE** numbers. In both cases, the arc cosine of 1 is exactly 0:

```
WRITE !,"the arc cosine is: ",$ZARCCOS(0.0)
WRITE !,"the arc cosine is: ",$ZARCCOS($DOUBLE(0.0))
WRITE !,"the arc cosine is: ",$ZARCCOS(1.0)
WRITE !,"the arc cosine is: ",$ZARCCOS($DOUBLE(1.0))
WRITE !,"the arc cosine is: ",$ZARCCOS(-1.0)
WRITE !,"the arc cosine is: ",$ZARCCOS($DOUBLE(-1.0))
```

See Also

- $ZCOS function
- $ZPI special variable

$ZARCSIN

Inverse (arc) sine function.

```
$ZARCSIN(n)
```

Parameter

n	A signed decimal number.

Description

$ZARCSIN returns the trigonometric inverse (arc) sine of *n*. The result is given in *radians*.

Parameter

n

Signed decimal number ranging from 1 to -1 (inclusive). It can be specified as a value, a variable, or an expression. Numbers outside the range generate an <ILLEGAL VALUE> error. A non-numeric string is evaluated as 0.

The following are arc sine values returned by **$ZARCSIN**:

1	returns 1.570796326794896619
0	returns 0
-1	returns -1.570796326794896619

Examples

The following example permits you to compare the arc sine and the arc cosine of a number:

```
READ "Input a number: ",num
IF num>1 { WRITE !,"ILLEGAL VALUE: number too big" }
ELSEIF num<-1 { WRITE !,"ILLEGAL VALUE: number too small" }
ELSE {
      WRITE !,"the arc sine is: ",$ZARCSIN(num)
      WRITE !,"the arc cosine is: ",$ZARCCOS(num)
     }
QUIT
```

The following example compares the results from InterSystems IRIS fractional numbers (**$DECIMAL** numbers) and **$DOUBLE** numbers. In both cases, the arc sine of 0 is exactly 0:

```
WRITE !,"the arc sine is: ",$ZARCSIN(0.0)
WRITE !,"the arc sine is: ",$ZARCSIN($DOUBLE(0.0))
WRITE !,"the arc sine is: ",$ZARCSIN(1.0)
WRITE !,"the arc sine is: ",$ZARCSIN($DOUBLE(1.0))
WRITE !,"the arc sine is: ",$ZARCSIN(-1.0)
WRITE !,"the arc sine is: ",$ZARCSIN($DOUBLE(-1.0))
```

See Also

- $ZSIN function
- $ZPI special variable

$ZARCTAN

Inverse (arc) tangent function.

```
$ZARCTAN(n)
```

Parameter

n	Any positive or negative number.

Description

$ZARCTAN returns the trigonometric inverse (arc) tangent of *n*. Possible results range from 1.57079 (half of pi) through zero to –1.57079. The result is given in *radians*.

Parameter

n

Any positive or negative number. It can be specified as a value, a variable, or an expression. You can use the **$ZPI** special variable to specify pi. A non-numeric string is evaluated as 0.

The following are arc tangent values returned by **$ZARCTAN**:

2	returns 1.107148717794090502
1	returns .7853981633974483098
0	returns 0
-1	returns -.7853981633974483098

Examples

The following example permits you to calculate the arc tangent of a number:

```
 READ "Input a number: ",num
 WRITE !,"the arc tangent is: ",$ZARCTAN(num)
 QUIT
```

The following example compares the results from InterSystems IRIS fractional numbers (**$DECIMAL** numbers) and **$DOUBLE** numbers. In both cases, the arc tangent of pi/2 is a fractional number (not 1), but the arc tangent of 0 is 0:

```
WRITE !,"the arc tangent is: ",$ZARCTAN(0.0)
WRITE !,"the arc tangent is: ",$ZARCTAN($DOUBLE(0.0))
WRITE !,"the arc tangent is: ",$ZARCTAN($ZPI)
WRITE !,"the arc tangent is: ",$ZARCTAN($DOUBLE($ZPI))
WRITE !,"the arc tangent is: ",$ZARCTAN($ZPI/2)
WRITE !,"the arc tangent is: ",$ZARCTAN($DOUBLE($ZPI)/2)
```

See Also

- $ZTAN function
- $ZPI special variable

$ZBOOLEAN

Bitwise logical operation function.

```
$ZBOOLEAN(arg1,arg2,bit_op)
$ZB(arg1,arg2,bit_op)
```

Parameters

arg1	The first argument. An integer or a string, or a variable or expression that resolve to an integer or string. All characters must have an ASCII value between 0 and 255. Cannot be a floating point number.
arg2	The second argument. An integer or a string, or a variable or expression that resolve to an integer or string. All characters must have an ASCII value between 0 and 255. Cannot be a floating point number.
bit_op	An integer indicating the operation to be performed (see table below.) Permitted values are 0 through 15, inclusive.

Description

$ZBOOLEAN performs the bitwise logical operation specified by *bit_op* on two arguments, *arg1* and *arg2*. **$ZBOOLEAN** returns the results of the bitwise combination of *arg1* and *arg2*, as specified by the *bit_op* value. You can view the results using the **ZZDUMP** command.

$ZBOOLEAN performs its operations on either character strings or numbers. For character strings, it performs logical AND and OR operations on each character in the string. For numbers, it performs a logical AND and OR operation on the entire number as a unit. To force the evaluation of a numeric string as a number, preface the string with a plus sign (+).

Note: **$ZBOOLEAN** does not support Unicode characters with a value larger than ASCII 255. To apply **$ZBOOLEAN** to a string of 16-bit Unicode characters, you must first use $ZWUNPACK, followed by **$ZBOOLEAN**, followed by $ZWPACK.

$ZBOOLEAN and **$BITLOGIC** use different data formats. The results of one cannot be used as input to the other.

The bitwise operations includes 16 possible Boolean combinations of *arg1* and *arg2*. The following table lists these combinations.

Bit Mask in *bit_op*	Operation Performed
0	0
1	*arg1* & *arg2* (logical AND)
2	*arg1* & ~*arg2*
3	*arg1*
4	~*arg1* & *arg2*
5	*arg2*
6	*arg1* ^ *arg2* (logical XOR (exclusive or))
7	*arg1* ! *arg2* (logical OR (inclusive or))
8	~(*arg1* ! *arg2*)

Bit Mask in *bit_op*	Operation Performed
9	~(*arg1* ^ *arg2*)
10	~*arg2* (logical NOT)
11	*arg1* ! ~*arg2*
12	~*arg1* (logical NOT)
13	~*arg1* ! *arg2*
14	~(*arg1* & *arg2*)
15	-1 (one's complement of 0)

Where:

& is logical AND

! is logical OR

~ is logical NOT

^ is exclusive OR

For further details, see Operators in *Using ObjectScript*.

All **$ZBOOLEAN** operations parse both *arg1* and *arg2*, including *bit_op* values 0, 3, 5, 10, 12, and 15.

The **$ZBOOLEAN** *arg1* and *arg2* parameters can resolve to one of the following types:

- An integer. A positive or negative whole decimal number of up to 18 digits. No characters other than the numbers 0–9 and, optionally, one or more leading plus and minus signs are permitted. Leading zeros are ignored.
- A string. Enclosed in quotation marks, a string of any length with any contents is permitted. Note that the string "123" and the integer 123 are not the same. A null string is permitted, but if *arg2* is the null string, **$ZBOOLEAN** always returns the value of *arg1*, regardless of the *bit_op* value.
- A signed string. A string preceded by a plus or minus sign is parsed as an integer, regardless of the string's contents. Signed strings are subject to the same length restriction as integers. A signed null string is equivalent to zero.

It is strongly recommended that *arg1* and *arg2* either both resolve to an integer or both resolve to a string. Generally, *arg1* and *arg2* should be the same data type; combining an integer and a string in a **$ZBOOLEAN** operation does not give a useful result in most cases.

Parameters

arg1

The first argument in the bitwise logical expression. For strings, the length of the returned value is always the same as the length of this argument.

arg2

The second argument in the bitwise logical expression.

bit_op

The bitwise logical operation to be performed, specified as a numeric code from 0 to 15, inclusive. Because this code is handled as a bit mask, a value of 16=0, 17=1, 18=2, etc.

The *bit_op* values 0 and 15 return a constant value, but they also evaluate the arguments. If *arg1* is an integer (or signed string), *bit_op* 0 returns 0, and *bit_op* 15 returns –1 (the one's complement of 0.) If *arg1* is a string, *bit_op* 0 returns a low value (hex 00) for each character in *arg1*, and *bit_op* 15 returns a high value (hex FF) for each character in *arg1*. If *arg2* is the null string (""), both operations return the literal value of *arg1*.

The *bit_op* values 3, 5, 10 and 12 perform a logical operation on only one of the arguments, but they evaluate both arguments.

- *bit_op*=3 always returns the value of *arg1*, regardless of the value of *arg2*.
- *bit_op*=5 returns the value of *arg2* when the two arguments have the same data type. However if one argument is a string and the other argument is an integer (or signed string) results are unpredictable. If *arg2* is the null string **$ZBOOLEAN** always returns the literal value of *arg1*.
- *bit_op*=10 returns the one's complement value of *arg2* if both arguments are integers. If *arg1* is a string, the operation returns a high order character for each character in *arg1*.. If *arg2* is a string, and *arg1* is an integer, the bitwise operation is performed on the *arg2* string. If *arg2* is the null string **$ZBOOLEAN** always returns the literal value of *arg1*.
- *bit_op*=12 returns the one's complement value of *arg1* if it is an integer (or signed string), for any value of *arg2* except the null string. If *arg1* is a string, the operation returns the one's complement (as a hex value) of each character in *arg1*. If *arg2* is the null string **$ZBOOLEAN** always returns the literal value of *arg1*.

Examples

The following three examples all illustrate the same AND operation. These examples AND the ASCII values of lowercase letters with the ASCII value of the underscore character, resulting in the ASCII values of the corresponding uppercase letters.

```
WRITE $ZBOOLEAN("abcd","_",1)
```

displays ABCD.

The lowercase "a" = [01100001] (ASCII decimal 97)

The underscore character "_" = [01011111] (ASCII decimal 95)

The uppercase "A" = [01000001] (ASCII decimal 65)

The following example performs the same AND operation as the previous example, but uses the ASCII decimal values of the arguments. The function $ASCII("a") returns the decimal value 97 for the first argument:

```
WRITE $ZBOOLEAN($ASCII("a"),95,1)
```

displays 65.

The following example performs the same AND operation, using a $CHAR value as the second argument:

```
WRITE $ZBOOLEAN("a",$CHAR(95),1)
```

displays A.

The following examples illustrate logical OR:

```
WRITE $ZBOOLEAN(1,0,7)
```

displays 1.

```
WRITE $ZBOOLEAN(1,1,7)
```

displays 1.

```
WRITE $ZBOOLEAN(2,1,7)
```

displays 3.

```
WRITE $ZBOOLEAN(2,2,7)
```

displays 2.

```
WRITE $ZBOOLEAN(3,2,7)
```

displays 3.

The following logical OR examples demonstrate the difference between string comparisons and number comparisons:

```
WRITE $ZBOOLEAN(64,255,7)
```

compares the two values as numbers and displays 255.

```
WRITE $ZBOOLEAN("64","255",7)
```

compares the two values as strings and displays 65.

```
WRITE $ZBOOLEAN(+"64",+"255",7)
```

the plus signs force the comparison of the two values as numbers, and displays 255.

The following examples illustrate exclusive OR:

```
WRITE $ZBOOLEAN(1,0,6)
```

displays 1.

```
WRITE $ZBOOLEAN(1,1,6)
```

displays 0.

```
WRITE $ZBOOLEAN(2,1,6)
```

displays 3.

```
WRITE $ZBOOLEAN(2,2,6)
```

displays 0.

```
WRITE $ZBOOLEAN(3,2,6)
```

displays 1.

```
WRITE $ZBOOLEAN(64,255,6)
```

displays 191.

The following example shows a 4-byte entity with all bytes set to 1:

```
WRITE $ZBOOLEAN(5,1,15)
```

displays -1.

The following example will set x to 3 bytes with all bits set to 1:

```
SET x=$ZBOOLEAN("abc",0,15)
WRITE !,$LENGTH(x)
WRITE !,$ASCII(x,1)," ",$ASCII(x,2)," ",$ASCII(x,3)
```

The first WRITE displays 3; the second WRITE displays 255 255 255.

Notes

Integer Processing

Before **$ZBOOLEAN** performs the bitwise operation, it interprets each numeric value as either an 8-byte or a 4-byte signed binary value, depending on size. **$ZBOOLEAN** always interprets a numeric value as a series of bytes. The boolean operation uses these bytes as a string argument. The result type is the same as the type of *arg1*.

If either *arg1* or *arg2* is numeric and cannot be represented as an 8-byte signed integer (larger than 18 decimal digits), a <FUNCTION> error results. If both *arg1* and *arg2* are numeric and one of them requires 8 bytes to be represented, then both values are interpreted as 8-byte binary values.

After the previous transformations are complete, the given Boolean combination is applied bit by bit to *arg1* and *arg2* to yield the result. The result returned is always the same length as *arg1* (after the above transformations of numeric data). If the length of *arg2* is less than the length of *arg1*, then *arg2* is repeatedly combined with successive substrings of *arg1* in left to right fashion.

$ZBOOLEAN always interprets the numeric value as a series of bytes in little-endian order, with the low-order byte first, no matter what the native byte order of your machine is.

Internal Structure of $ZBOOLEAN Values

The following table lists the internal rules for **$ZBOOLEAN**. You do not need to understand these rules to use **$ZBOOLEAN**; they are presented here for reference purposes only.

There are four possible states of any two bits being compared from within arg1 and arg2. The Boolean operation generates a true result (=1) if and only if bit_op has the bit mask shown in the table.

Bit in arg1	Bit in arg2	Bit Mask in bit_op Decimal	Bit Mask in bit_op Binary
0	0	8	1000
0	1	4	0100
1	0	2	0010
1	1	1	0001

EQV and IMP Logical Operators

$ZBOOLEAN indirectly supports EQV and IMP logical operators. These logical operators are defined as follows:

- EQV is a logical equivalence between two expressions. It is represented by `$ZBOOLEAN(arg1,arg2,9)`. This is logically ~(*arg1* ^ *arg2*) which is logically identical to ((~*arg1*) & (~*arg2*)) ! (*arg1* & *arg2*).
- IMP is a logical implication between two expressions. It is represented by `$ZBOOLEAN(arg1,arg2,13)`. This is logically (~*arg1*) ! *arg2*.

See Also

- ZZDUMP command
- Operators in *Using ObjectScript*

$ZCONVERT

String conversion function.

```
$ZCONVERT(string,mode,trantable,handle)
$ZCVT(string,mode,trantable,handle)
```

Parameters

string	The string to convert, specified as a quoted string. This string can be specified as a value, a variable, or an expression.
mode	A letter code specifying the conversion mode, either the type of case conversion or input/output encoding. Specify *mode* as a quoted string.
trantable	*Optional* — The translation table to use, specified as either an integer or a quoted string,
handle	*Optional* — An unsubscripted local variable that holds a string value. Used for multiple invocations of **$ZCONVERT**. The handle parameter contains the remaining portion of *string* that could not be converted at the end of **$ZCONVERT**, and supplies this remaining portion to the next invocation of **$ZCONVERT**.

Description

$ZCONVERT converts a string from one form to another. The nature of the conversion depends on the parameters you use.

$ZCONVERT Returns a Converted String

$ZCONVERT(*string*, *mode*) returns *string* with the characters converted as specified by *mode*. The conversions are of two types:

- Case conversion
- Encoding translation

Case conversion changes the case of each letter character in the string. You can change all letter characters in a string to their lowercase, uppercase, or titlecase form. Characters that are already in the specified case, and characters with no case (usually any nonalphabetic character) in the string are passed through unchanged. To output a literal quote character (“) within a string, input two quote characters (““). For further case conversion options, including non-ASCII and customized case conversion, refer to the section on “System Classes for National Language Support” in *Specialized System Tools and Utilities*.

Encoding translation translates *string* between the internal encoding style used on your system and another encoding style. You can perform input translation; that is, translate *string* from an external encoding style to the encoding style of your system. You can also perform output translation; that is, translate *string* from the encoding style of your system to an external encoding style. For further I/O translation options, including non-ASCII and customized translation, refer to the section on “System Classes for National Language Support” in *Specialized System Tools and Utilities*.

The values you can use for *mode* are as follows:

Mode Code	Meaning
U or u	Uppercase translation: Convert all characters in *string* to uppercase.
L or l	Lowercase translation: Convert all characters in *string* to lowercase.
T or t	Titlecase translation: Convert all characters in *string* to titlecase. Titlecase is only meaningful for those alphabets (principally Eastern European) that have three forms for a letter: uppercase, lowercase, and titlecase. For all other letters, titlecase translation is the same as uppercase translation.
W or w	Word translation: Convert the first character of each word in *string* to uppercase. Any character preceded by a blank space, a quotation mark ("), an apostrophe ('), or an open parenthesis (() is considered the first character of a word. Word translation converts all other characters to lowercase. Word translation is locale specific; the above syntax rules for English may differ for other language locales.
S or s	Sentence translation: Convert the first character of each sentence in *string* to uppercase. The first non-blank character of *string*, and any character preceded by a period (.), question mark (?), or exclamation mark (!) is considered the first character of a sentence. (Blank spaces between the preceding punctuation character and the letter are ignored.) If this character is a letter, it is converted to uppercase. Sentence translation converts all other letter characters to lowercase. Sentence translation is locale specific; the above syntax rules for English may differ for other language locales.
I or i	Perform input encoding translation on a specified string. For the two-argument form, the translation is performed using the current process I/O *translation handle*. If a current process I/O translation handle has not been defined, InterSystems IRIS performs translation based on the default process I/O translation table name.
O or o	Perform output encoding translation on a specified string. For the two-argument form, the translation is performed using the current process I/O *translation handle*. If a current process I/O translation handle has not been defined, InterSystems IRIS performs translation based on the default process I/O translation table name.

If *mode* is a null string or any value other than the valid characters, you receive a <FUNCTION> error.

Letter Case Translation

You can convert letters in strings to all uppercase letters or all lowercase letters. Conversion works on Unicode letters as well as ASCII letters. The following example converts the Greek alphabet from lowercase to uppercase:

```
FOR i=945:1:969 {WRITE $ZCONVERT($CHAR(i),"U")}
```

However, a small number of letters only have a lowercase letter form. For example, the German eszett ($CHAR(223)) is only defined as a lowercase letter. Attempting to convert it to an uppercase letter results in the same lowercase letter:

```
IF $ZCONVERT($CHAR(223),"U")=$ZCONVERT($CHAR(223),"L") {
    WRITE "uppercase and lowercase letter are the same" }
ELSE {WRITE "uppercase and lowercase are different" }
```

For this reason, when converting alphanumeric strings to a single letter case it is always preferable to convert to lowercase.

You can perform similar letter case translations using the **$TRANSLATE** function, as shown in the following example:

```
WRITE $TRANSLATE(text,"ABCDEFGHIJKLMNOPQRSTUVWXYZ","abcdefghijklmnopqrstuvwxyz")
```

Word and Sentence Translation

“W” and “S” modes determine whether a non-blank character is the first character of a word or the first character of a sentence, and if that character is a letter, translate it to uppercase. All other letters are translated to lowercase. Case translation works on letters in any alphabet, as shown in the following example which converts Greek letters ($CHAR(945) is lowercase alpha; $CHAR(913) is uppercase alpha):

```
SET greek=$CHAR(945,946,947,913,914,915)
WRITE $ZCONVERT(greek,"W")
```

However the rules determining what constitutes a word or sentence are locale dependent. For example, the following example uses the Spanish inverted exclamation point $CHAR(161). The default (English) locale *does not* recognize this character as beginning a sentence or word. In this example, all letters in *spanish* are translated to lowercase:

```
SET spanish=$CHAR(161)_"ola MuNdO! "_$CHAR(161)_"olA!"
SET english="hElLo wOrLd! heLLo!"
WRITE !,$ZCONVERT(english,"S")
WRITE !,$ZCONVERT(spanish,"S")
```

Titlecase Translation

Titlecase (“T”) mode converts *every* letter in the string to its titlecase form. Titlecase *does not* selectively uppercase letters based on their position in a word or string. Titlecase is the case that a letter is represented in when it is the first character of a word in a title. For standard Latin letters, the titlecase form is the same as the uppercase form.

Some languages (for example, Croatian) represent particular letters by two letter glyphs. For example, “lj” is a single letter in the Croatian alphabet. This letter has three forms: lowercase “lj”, uppercase “LJ”, and titlecase “Lj”. **$ZCONVERT** titlecase translation is used for this type of letter conversion.

Three-Parameter Form: Encoding Translation

$ZCONVERT(*string*, *mode*, *trantable*) performs either an input encoding translation or an output encoding translation on *string*. In the three-argument form, the *mode* values you can use are either "I" or "O". You must define the *mode* value. For “I” translations, the *string* may be a hexadecimal string, such as `%4B` (the letter “K”); hexadecimal strings are not case-sensitive.

You can use ZZDUMP to display the hexadecimal encoding for a string of characters. You can use $CHAR to specify a character (or string of characters) by its decimal (base 10) encoding; you can use $ZHEX to converts a hexadecimal number to a decimal number, or a decimal number to a hexadecimal number. If the translated value is a non-printing character, InterSystems IRIS displays it as a null string. If the target device cannot represent a translated character, InterSystems IRIS substitutes a question mark (?) character for the non-displayable character.

The *trantable* value can be a numeric character or a string that specifies the *translation table* or *translation handle* to use. The *trantable* value can be:

- An integer value specifying a process I/O translation object. Available values are 0 through 3 (0 represents the current process I/O translation object).
- An uppercase string value identifying an I/O translation table. Available translation tables include:
  - “RAW” which performs no translation for 8-bit characters or 16-bit Latin-1 characters (Unicode characters in which the high-order byte has the value 00). RAW translation should not be used for InterSystems IRIS systems using non-Latin-1 locales, such as rusw.
  - “SAME” which translates 8-bit characters to the corresponding Unicode characters.
  - “HTML” which adds (output mode) or removes (input mode) HTML escape characters to a string.
  - “JS” (or “JSML”) which uses a supplied JavaScript translation table to escape characters in the string for use within JavaScript. For output translations see the table below. For comparison of JS and JSML, see JS and JSML,

JSON and JSONML Conversions. For input translations, “\0”, “\000”, “\x00”, and “\u0000” are all valid escape sequences for NULL.

- “JSON” (or “JSONML”) which uses a supplied translation table to convert to JSON format. For output translations see the table below. For comparison of JSON and JSONML, see JS and JSML, JSON and JSONML Conversions. For input translations, “\0”, “\000”, “\x00”, and “\u0000” are all valid escape sequences for NULL.
- “URI” which adds (output mode) or removes (input mode) URI parameter escape characters to a string. URI encodes the characters `:/?#[]@!$&'()*+,;=` as follows: %3A%2F%3F%23%5B%5D%40%21%24%26%27%28%29%2A%2B%2C%3B%3D; it does not encode the tilde (~) character. URI encodes characters higher than $CHAR(255) (Unicode characters) as UTF-8 and then % encodes the UTF-8 values in hexadecimal notation.
- “URL” which adds (output mode) or removes (input mode) URL parameter escape characters to a string. URL encodes the characters `:?#[]@+,;=~` as follows: %3A%3F%23%5B%5D%40%2B%2C%3B%3D%7E. Characters higher than $CHAR(255) are represented in Unicode hexadecimal notation: $CHAR(256) = %u0100.
- “UTF8” (UTF-8 encoding) which converts (output mode) 16-bit Unicode characters to a series of 8-bit characters. An ASCII 16–bit Unicode character translates to a single 8–bit character; for example, hex 0041 (the letter “A”) translates to the 8-bit character hex 41. A non-ASCII Unicode character is converted to two or three 8–bit characters. Unicode hex 0080 through 07FF convert to two 8–bit characters; these include the Latin-1 Supplement and Latin Extended characters and the Greek, Cyrillic, Hebrew, and Arabic alphabets. Unicode hex 0800 through FFFF convert to three 8–bit characters; these comprise the rest of the Unicode Basic Multilingual Plane. Thus, the ASCII characters $CHAR(0) through $CHAR(127) are the same in RAW and UTF8 mode; characters $CHAR(128) and above are converted. Input mode reverse this conversion. Refer to Unicode in *Using ObjectScript* for further details.
- “XML” which adds (output mode) or removes (input mode) XML escape characters to a string.

• A string value specifying an I/O translation table defined by an NLS locale. For example, Latin2 or CP1252. For a list of locale translation tables, refer to the *XLTTables* property of %SYS.NLS.Locale, as shown in the following example:

```
SET nlsoref=##class(%SYS.NLS.Locale).%New()
WRITE $LISTTOSTRING($PROPERTY(nlsoref,"XLTTables"),"^")
```

• A string value specifying a user-defined I/O translation table. A named table can be defined in a locale and points to one or two translation tables. Use a named table to define a specific system-to/from-device encoding.

• An empty string ("") specifying the use of the default process I/O translation table. (For equivalent functionality, see the $$GetPDefIO^%NLS() function of the %NLS utility.)

The following is a table of Output mode escape characters:

	HTML	JS	JSON	URL	XML
null $CHAR(0)		\x00	\u0000	%00	
$CHAR(1) through $CHAR(7)		\x01 through \x07	\u0001 through \u0007	%01 through %07	
backspace $CHAR(8)		\b	\b	%08	
horizontal tab $CHAR(9)		\t	\t	%09	
line feed $CHAR(10)		\n	\n	%0A	

	HTML	JS	JSON	URL	XML
vertical tab $CHAR(11)		\v	\u000B	%0B	
form feed $CHAR(12)		\f	\f	%0C	
carriage return $CHAR(13)		\r	\r	%0D	
$CHAR(14) through $CHAR(31)			\u000E through \u001F	%0E through %1F	
$CHAR(32)				%20	
" (doubled)	"	\"	\”	%22	"
#				%23	
%				%25	
&	&			%26	&
‘ (apostrophe) $CHAR(39)	'	\'			'
+				%2B	
,				%2C	
/ (slash) $CHAR(47)		\/			
:				%3A	
;				%3B	
<	<			%3C	<
=				%3D	
>	>			%3E	>
?				%3F	
@				%40	
[				%5B	
\		\\	\\	%5C	
]				%5D	
^				%5E	
‘				%60	
{				%7B	
|				%7C	
}				%7D	
~				%7E	

	HTML	JS	JSON	URL	XML
$CHAR(127) through $CHAR(159)				%7F through %9F	
$CHAR(160)				%A0	
$CHAR(161) through $CHAR(255)				%A1 through %FF	

URL and URI Conversions

A URL or URI can only contain certain 8-bit ASCII characters. All other characters must be represented by an escape sequence beginning with %. If you wish to convert a string containing Unicode characters to a URL or URI, you must first convert your local representation to an 8-bit intermediate representation, using UTF-8 encoding. You then convert the UTF-8 results to URL encoding. To convert a URL back to its original Unicode string, you perform the reverse operation. This is shown in the following example:

```
  SET ustring="US$ to "_$CHAR(8364)_" échange"
  WRITE "initial string is: ",ustring,!
ConvertUnicodeToURL
  SET utfo = $ZCONVERT(ustring,"O","UTF8")
  SET urlo = $ZCONVERT(utfo,"O","URL")
  WRITE "Unicode to URL conversion: ",urlo,!
ConvertURLtoUnicode
  SET urli = $ZCONVERT(urlo,"I","URL")
  SET utfi = $ZCONVERT(urli,"I","UTF8")
  WRITE "URL to Unicode conversion: ",utfi
```

JS and JSML, JSON and JSONML Conversions

The JS and JSON translations use UTF-8 encoding for Unicode characters. The JSML and JSONML translations render Unicode characters without encoding. For ASCII characters ($CHAR(0) through $CHAR(127)), JS and JSML encodings are identical. For ASCII characters ($CHAR(0) through $CHAR(127)), JSON and JSONML encodings are identical.

The following example compares the translation of JS and JSML characters:

```
  FOR i=1:1:256 {SET x=$ZCVT($C(i),"O","JS") SET y=$ZCVT($C(i),"O","JSML")
                 IF x=y {WRITE "."}
                 ELSE {WRITE !!,$ZHEX(i),!,"JS: " ZZDUMP x WRITE !,"JSML: " ZZDUMP y }
                }
```

Four-Parameter Form: Input/Output String

The *handle* parameter is a local variable that **$ZCONVERT** reads at the beginning of execution and writes when it completes execution. It is used to hold information between consecutive invocations of the **$ZCONVERT** function. It can be used for two purposes: concatenating a string to the beginning of *string*, and converting extremely long strings.

To concatenate a string to the beginning of *string*, set *handle* before invoking **$ZCONVERT**:

```
   SET handle="the "
   WRITE $ZCVT("quick brown fox","O","URL",handle),!
   /*  the%20quick%20brown%20fox  */
   WRITE $ZCVT("quick brown fox","O","URL",handle),!
   /*  quick%20brown%20fox  */
```

Note that **$ZCONVERT** resets *handle* when it completes execution. In the previous example, it resets *handle* to the empty string.

This *handle* parameter may be used for input conversions. Specifying a *handle* is useful when dealing with multibyte character sequences when working with partial sets of characters, such as a stream read. In these cases, **$ZCONVERT** uses the *handle* parameter to hold a partial character sequence that may be the leading bytes of a multibyte sequence. If there are input characters left in the buffer at the end of a **$ZCONVERT** which do not make a complete translation unit, these leftover characters are returned in the *handle*. At the beginning of next **$ZCONVERT**, if the *handle* contains data, these leftover characters are prepended to the normal input data. This is particularly valuable for use in UTF8 conversions, as shown in the following example:

```
SET handle=""
WHILE 'stream.AtEnd() {
   WRITE $ZCONVERT(stream.Read(20000),"I","UTF8",handle)
}
```

To convert an extremely long string, it may be necessary to perform more than one string conversions by invoking **$ZCONVERT** multiple times. **$ZCONVERT** provides the optional *handle* parameter to hold the remaining unconverted portion of *string*. If you specify a *handle* parameter, it is updated by each invocation of **$ZCONVERT**. When the string conversion completes, **$ZCONVERT** sets *handle* to the empty string.

```
SET handle=""
SET out = $ZCVT(hugestring,"O","HTML",handle)
IF handle '= "" {
  SET out2 = $ZCVT(handle,"O","HTML",handle)
  WRITE "Converted string is: ",out,out2  }
ELSE {
  WRITE "Converted string is: ",out }
```

Examples

The following example returns "HELLO":

```
WRITE $ZCONVERT("Hello","U")
```

The following example returns "hello":

```
WRITE $ZCVT("Hello","L")
```

The following example returns "HELLO":

```
WRITE $ZCVT("Hello","T")
```

The following example uses the concatenate operator (_) to append and case-convert an accented character:

```
WRITE "TOUCH"_$CHAR(201),!, $ZCVT("TOUCH"_$CHAR(201),"L")
```

returns:

TOUCHÉ

touché

The following example converts the angle brackets in the string to HTML escape characters for output, returning “<TAG>”

```
WRITE $ZCVT("<TAG>","O","HTML")
```

Note that how these angle brackets display depends on the output device; try running this program here and then running it from the Terminal prompt.

The following example shows how **$ZCONVERT** substitutes a ? character for a translated character it cannot display. Both the UTF8 and the current process I/O translation object (*trantable* 0) conversions in this example display $CHAR(63), which is the actual ? character. UTF8 cannot display translated characters above $CHAR(127). Translation table 0 cannot display translated characters above $CHAR(255):

```
FOR i=1:1:300 {IF $ZCONVERT($CHAR(i),"I","UTF8") '= "?"
                 { CONTINUE }
                ELSE {WRITE "UTF8 ",i,"=",$ZCONVERT($CHAR(i),"I","UTF8")}
                IF $ZCONVERT($CHAR(i),"I",0)="?"
                 {WRITE " trantable 0 ",i,"=",$ZCONVERT($CHAR(i),"I",0),!}
               ELSE {WRITE !}
               }
```

See Also

- $ASCII function
- $CHAR function
- $ZSTRIP function
- Pattern Matching operators in *Using ObjectScript*
- More information on locales in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$ZCOS

Cosine function.

```
$ZCOS(n)
```

Parameter

n	An angle in radians ranging from Pi to 2 Pi (inclusive). Other supplied numeric values are converted to a value within this range.

Description

$ZCOS returns the trigonometric cosine of *n*. The result is a signed decimal number ranging from -1 to +1. **$ZCOS(0)** returns 1. **$ZCOS($ZPI)** returns -1.

Parameter

n

An angle in radians ranging from Pi to 2 Pi (inclusive). It can be specified as a value, a variable, or an expression. You can specify the value Pi by using the **$ZPI** special variable. You can specify positive or negative values smaller than Pi or larger than 2 Pi; InterSystems IRIS resolve these values to the corresponding multiple of Pi. For example, 3 Pi is equivalent to Pi, negative Pi is equivalent to Pi, and zero is equivalent to 2 Pi.

A non-numeric string is evaluated as 0.

Examples

The following example permits you to compute the cosine of a number:

```
   READ "Input a number: ",num
   IF $ZABS(num)>(2*$ZPI) { WRITE !,"number is a larger than 2 pi" }
   ELSE {
         WRITE !,"the cosine is: ",$ZCOS(num)
        }
   QUIT
```

The following example compares the results from InterSystems IRIS fractional numbers (**$DECIMAL** numbers) and **$DOUBLE** numbers. In both cases, the cosine of 0 is exactly 1, the cosine of pi is exactly -1:

```
  WRITE !,"the cosine is: ",$ZCOS(0.0)
  WRITE !,"the cosine is: ",$ZCOS($DOUBLE(0.0))
  WRITE !,"the cosine is: ",$ZCOS(1.0)
  WRITE !,"the cosine is: ",$ZCOS($DOUBLE(1.0))
  WRITE !,"the cosine is: ",$ZCOS($ZPI)
  WRITE !,"the cosine is: ",$ZCOS($DOUBLE($ZPI))
```

See Also

- $ZSIN function
- $ZARCCOS function
- $ZPI special variable

$ZCOT

Cotangent function.

```
$ZCOT(n)
```

Parameter

n	An angle in radians.

Description

$ZCOT returns the trigonometric cotangent of *n*. The result is a signed decimal number.

Parameter

n

An angle in radians, specified as a nonzero value. It can be specified as a value, a variable, or an expression. A value of 0 generates an <ILLEGAL VALUE> error. A non-numeric string is evaluated as 0.

Examples

The following example permits you to compute the cotangent of a number:

```
 READ "Input a number: ",num
 IF num=0 { WRITE !,"zero is an illegal value" }
 ELSE {
       WRITE !,"the cotangent is: ",$ZCOT(num)
      }
 QUIT
```

The following example compares the results from InterSystems IRIS fractional numbers (**$DECIMAL** numbers) and **$DOUBLE** numbers:

```
WRITE !,"the cotangent is: ",$ZCOT(1.0)
WRITE !,"the cotangent is: ",$ZCOT($DOUBLE(1.0))
WRITE !,"the cotangent is: ",$ZCOT(-1.0)
WRITE !,"the cotangent is: ",$ZCOT($DOUBLE(-1.0))
WRITE !,"the cotangent is: ",$ZCOT($ZPI/2)
WRITE !,"the cotangent is: ",$ZCOT($DOUBLE($ZPI)/2)
```

Note that the cotangent of pi/2 is a fractional number, not 0.

See Also

- $ZTAN function
- $ZPI special variable

$ZCRC

Checksum function.

```
$ZCRC(string,mode,expression)
```

Parameters

string	A string on which a checksum operation is performed.
mode	An integer code specifying the checksum mode to use.
expression	*Optional* — The initial "seed" value, specified as an integer. If omitted, defaults to zero (0).

Description

$ZCRC performs a cyclic redundancy check on *string* and returns an integer checksum value. The value returned by **$ZCRC** depends on the parameters you use.

- **$ZCRC**(*string*,*mode*) computes and returns a checksum on string. The value of *mode* determines the type of checksum **$ZCRC** computes.
- **$ZCRC**(*string*,*mode*,*expression*) computes and returns a checksum on *string* using the mode specified by *mode*. *expression* supplies an initial "seed" value when checking multiple strings. It allows you to run **$ZCRC** calculations sequentially on multiple strings and obtain the same checksum values as if you had concatenated those strings and then run **$ZCRC** on the resulting string.

Parameters

string

A byte string. Can be specified as a value, a variable, or an expression. Only use a byte string or you will receive a <FUNCTION> error.

mode

The checksum algorithm to use. All checksum modes can be used with 8-bit (ASCII) or 16-bit Unicode (wide) characters. Legal values for *mode* are:

Mode	Computes
0	An 8-bit byte sum. Simply sums the ASCII values of the characters in the string. Thus $ZCRC(2,0)=50, $ZCRC(22,0)=100, $ZCRC(23,0)=101, and $ZCRC(32,0)=101.
1	An 8-bit XOR of the bytes
2	A 16-bit DataTree CRC-CCITT
3	A 16-bit DataTree CRC-16
4	A 16-bit CRC for XMODEM protocols
5	A correct 16-bit CRC-CCITT
6	A correct 16-bit CRC-16
7	A correct 32-bit CRC-32. This corresponds to the cksum utility algorithm 3 on OS X, and the CRC32 class in the Java utilities package.

expression

An argument that is an initial "seed" value. **$ZCRC** adds *expression* to the checksum generated for *string*. This allows you to run **$ZCRC** calculations on multiple strings sequentially and obtain the save checksum value as if you had concatenated those strings and run **$ZCRC** on the resulting string.

Examples

The following example uses *mode*=0 on strings containing the letters A, B, and C and in each case returns the checksum 198:

```
WRITE $ZCRC("ABC",0),!
WRITE $ZCRC("CAB",0),!
WRITE $ZCRC("BCA",0),!
```

The checksum is derived as follows:

```
WRITE $ASCII("A")+$ASCII("B")+$ASCII("C")  /* 65+66+67 = 198 */
```

The following example shows the values returned by each *mode* for the string “ABC”:

```
FOR i=0:1:7 {
   WRITE !,"mode ",i,"=",$ZCRC("ABC",i)
}
```

See Also

- $ZCYC function

$ZCSC

Cosecant function.

```
$ZCSC(n)
```

Parameter

n	An angle in radians.

Description

$ZCSC returns the trigonometric cosecant of *n*. The result is a signed decimal number.

Parameter

n

An angle in radians, specified as a nonzero number. It can be specified as a value, a variable, or an expression. Specifying 0 generates an <ILLEGAL VALUE> error; specifying $DOUBLE(0) generates a <DIVIDE> error. A non-numeric string is evaluated as 0.

Examples

The following example permits you to compute the cosecant of a number:

```
  READ "Input a number: ",num
  IF num=0 { WRITE !,"ILLEGAL VALUE: zero not permitted" }
  ELSE {
        WRITE !,"the cosecant is: ",$ZCSC(num)
       }
  QUIT
```

The following example compares the results from InterSystems IRIS fractional numbers (**$DECIMAL** numbers) and **$DOUBLE** numbers. In both cases, the cosecant of pi/2 is exactly 1:

```
 WRITE !,"the cosecant is: ",$ZCSC($ZPI)
 WRITE !,"the cosecant is: ",$ZCSC($DOUBLE($ZPI))
 WRITE !,"the cosecant is: ",$ZCSC($ZPI/2)
 WRITE !,"the cosecant is: ",$ZCSC($DOUBLE($ZPI)/2)
 WRITE !,"the cosecant is: ",$ZCSC($DOUBLE($ZPI/2))
```

See Also

- $ZSEC function
- $ZCOT function
- $ZPI special variable

$ZCYC

Cyclical-redundancy check for data integrity.

```
$ZCYC(string)
$ZC(string)
```

Parameter

string	A string.

Description

$ZCYC(*string*) computes and returns the cyclical-redundancy check value for the string. It allows two intercommunicating programs to check for data integrity.

The sending program transmits a piece of data along with a matching check value that it calculates using **$ZCYC**. The receiving program verifies the transmitted data by using **$ZCYC** to calculate its check value. If the two check values match, the received data is the same as the sent data.

$ZCYC calculates the check value by performing an exclusive **OR** (XOR) on the binary representations of all the characters in the string.

Note that the $ZCYC value of an 8-bit string is identical to the $ZCRC mode 1 value.

Parameter

string

A string. Can be specified as a value, a variable, or an expression. String values are enclosed in quotation marks.

Example

In this example, the first **$ZCYC** returns 65; the second returns 3; and the third returns 64.

```
SET x= $ZCYC("A")
   ; 1000001 (only one character; no XOR )
SET y= $ZCYC("AB")
   ; 1000001 XOR 1000010 -> 0000011
SET z= $ZCYC("ABC")
   ; 1000001 XOR 1000010 -> 0000011 | 1000011 -> 100000
WRITE !,"x=",x," y=",y," z=",z
```

See Also

- $ZCRC function

$ZDASCII

Converts an eight-byte string to a $DOUBLE floating point number.

```
$ZDASCII(string,position)
$ZDA(string,position)
```

Parameters

string	A string or number. It can be a value, a variable, or an expression. It must be a minimum of eight bytes in length. A number is converted to canonical form by removing a leading plus sign, and leading and trailing zeros before it is supplied to **$ZDASCII**; the resulting canonical number must be a minimum of eight bytes in length.
position	*Optional* — A starting position in the string, expressed as a positive, non-zero integer. The default is 1. Position is counted in single bytes, *not* eight-byte strings. There must exist at least eight bytes of *string* from the specified *position* (inclusive). A numeric *position* value is parsed as an integer by truncating decimal digits, removing leading zeros and plus signs, etc.

Description

The value that **$ZDASCII** returns depends on the parameters you use.

- **$ZDASCII**(*string*) returns a $DOUBLE (IEEE floating point) numeric interpretation of an eight-byte string starting at the first character position of *string*.
- **$ZDASCII**(*string*,*position*) returns a $DOUBLE (IEEE floating point) numeric interpretation of an eight-byte string beginning at the starting byte position specified by *position*.

$ZDASCII can return either a positive or a negative number.

$ZDASCII issues a <FUNCTION> error if *string* is less than eight bytes in length, if the specified *position* results in a remaining *string* of less than eight bytes, or if *position* is an invalid value.

Examples

The following example determines the numeric interpretation of the numeric 12345678:

```
WRITE $ZDASCII(12345678)
```

It returns: .0000000000000000000000000000000000000068213200517013251261

The following examples also return the same value:

```
WRITE !,$ZDASCII("12345678",1)
WRITE !,$ZDASCII(++001234567899,1)
WRITE !,$ZDASCII("++001234567899",5)
```

The following example determines the numeric interpretation of the negative numeric –1234567. Note that the minus sign is counted as a byte:

```
WRITE $ZDASCII(-1234567)
```

It returns: .0000000000000000000000000000000000000000099583343788967399388

The following example determines the numeric interpretation of the character string “abcdefgh”:

```
WRITE $ZDASCII("abcdefgh")
```

It returns: 854088322303612443560000000000000000000000000000000000000000000000

Notes

$ZDASCII and Other $ASCII Functions

$ZDASCII converts a eight byte (64-bit) character string to an IEEE floating point number. **$ZQASCII** converts a eight byte (64-bit) character string to an integer. To convert an 8-bit byte string to an integer use **$ASCII**. To convert a 16-bit (wide) character string to an integer use **$ZWASCII**. To convert a 32-bit (long) character string to an integer use **$ZLASCII**.

See Also

- $ASCII function
- $DOUBLE function
- $ZDCHAR function
- $ZLCHAR function
- $ZWASCII function
- $ZQASCII function

$ZDATE

Validates a date and converts it from internal format to the specified display format.

```
$ZDATE(hdate,dformat,monthlist,yearopt,startwin,endwin,mindate,maxdate,erropt,localeopt)
$ZD(hdate,dformat,monthlist,yearopt,startwin,endwin,mindate,maxdate,erropt,localeopt)
```

Parameters

hdate	An integer specifying an internal date format value. This integer represents the number of days elapsed since December 31, 1840. If **$HOROLOG** is specified for *hdate*, only the date portion of **$HOROLOG** is used. See hdate below.
dformat	*Optional* — An integer code specifying the format for the returned date. See dformat below.
monthlist	*Optional* — A string or the name of a variable that specifies a set of month names. This string must begin with a delimiter character, and its 12 entries must be separated by this delimiter character. See monthlist below.
yearopt	*Optional* — An integer code that specifies whether to represent years as two- or four-digit values. See yearopt below.
startwin	*Optional* — The start of the sliding window during which dates must be represented with two-digit years. See startwin below.
endwin	*Optional* — The end of the sliding window during which dates are represented with two-digit years. See endwin below.
mindate	*Optional* — The lower limit of the range of valid dates. Specified as a **$HOROLOG** integer date count, with 0 representing December 31, 1840. Can be specified as a positive or negative integer. See mindate below.
maxdate	*Optional* — The upper limit of the range of valid dates. Specified as a **$HOROLOG** integer date count. See maxdate below.
erropt	*Optional* — An expression to return when *hdate* is invalid. Specifying a value for this parameter suppresses error codes associated with invalid or out of range *hdate* values. Instead of issuing an error message, **$ZDATE** returns *erropt*. See erropt below.
localeopt	*Optional* — A boolean flag that specifies which locale to use for the *dformat*, *monthlist*, *yearopt*, *mindate* and *maxdate* default values, and other date characteristics, such as the date separator character: *localeopt*=0: the current locale property settings determine these parameter defaults. *localeopt*=1: the ODBC standard locale determines these parameter defaults. *localeopt* not specified: the *dformat* value determines these parameter defaults. If *dformat*=3, ODBC defaults are used. Japanese and Islamic date *dformat*values use their own defaults. For all other *dformat* values, current locale property settings are used as defaults. See localeopt below.

Omitted parameters between specified parameter values are indicated by placeholder commas. Trailing placeholder commas are not required, but are permitted. Blank spaces are permitted between the commas that indicate an omitted parameter.

Description

The **$ZDATE** function converts a specified date in internal storage format (**$HOROLOG** format) to one of several alternate date display formats. The value returned by **$ZDATE** depends on the parameters you use.

Simple $ZDATE format

$ZDATE**(*hdate*), the most basic form of **$ZDATE, returns the date in a display format that corresponds to the specified *hdate*. *hdate* is an integer count of the number of days elapsed since December 31, 1840. It can range from 0 to 2980013 (12/31/1840 to 12/31/9999).

By default, **$ZDATE**(*hdate*) represents years between 1900 and 1999 with two digits. It represents years that fall before 1900 or after 1999 with four digits. For example:

```
WRITE $ZDATE(21400),!  ; returns 08/04/1899
WRITE $ZDATE(50000),!  ; returns 11/23/77
WRITE $ZDATE(60000),!  ; returns 04/10/2005
WRITE $ZDATE(0),!      ; returns 12/31/1840
```

When you supply a **$HOROLOG** date to **$ZDATE**, only the date portion is used. In **$HOROLOG** format, date and time are presented as two integers separated by a comma. Upon encountering the comma (a non-numeric character) **$ZDATE** ignores the rest of the string. In the following example, **$ZDATE** returns 04/10/2005 and the current date using **$HOROLOG** format values:

```
WRITE !,$ZDATE("60000,12345")
WRITE !,$ZDATE($HOROLOG)
```

Customizable Date Default

Upon InterSystems IRIS startup, the default date format is initialized to *dformat*=1, which is the American date format with a slash date separator (MM/DD/[YY]YY). To set this and other default formats to the values for your current locale, set the following global variable: `SET ^SYS("NLS","Config","LocaleFormat")=1`. This sets all format defaults for all processes to your current locale values. These defaults persist until this global is changed.

Note: This section describes the user locale definitions applied when *localeopt* is undefined or set to 0. When *localeopt*=1, **$ZDATE** uses a predefined ODBC locale.

You can use NLS (National Language Support) to override format defaults for the current process. You can either change the all format defaults to the values for a specified locale, or change individual format values.

- To set all of the format defaults (including the date format default) to the properties of a specified locale, invoke the following method call: `SET fmt=##class(%SYS.NLS.Format).%New("lname")`, where *lname* is the NLS name of the desired locale. (For example, deuw=German, espw=Spanish, fraw=French, ptbw=Brazilian Portuguese, rusw=Russian, jpnw=Japanese. A complete list of locales is found in the Management Portal: **System Administration**, **Configuration**, **National Language Settings**, **Locale Definitions**. To set these defaults to the properties of the current locale, specify a *lname* of `"current"`, or the empty string ("").
- To set the default date format to a specified *dformat* format, invoke the **SetFormatItem()** method: `SET rtn=##class(%SYS.NLS.Format).SetFormatItem("DateFormat",n)`, where *n* is the number of the *dformat* value you wish to make the default.

The following example demonstrates setting all format defaults to the Russian locale, returning a date from **$ZDATE** in the default format (Russian), then resetting the format defaults to the current locale defaults. Note that the Russian locale uses a period, rather than a slash as the date part separator:

```
WRITE !,$ZDATE($HOROLOG)
SET fmt=##class(%SYS.NLS.Format).%New("rusw")
WRITE !,$ZDATE($HOROLOG)
SET fmt=##class(%SYS.NLS.Format).%New("current")
WRITE !,$ZDATE($HOROLOG)
```

The following example demonstrates setting individual format defaults. The first **$ZDATE** returns a date in the default format. The first **SetFormatItem()** method changes the default to *dformat*=4, or the European date format (DD/MM/[YY]YY), as is shown by the second **$ZDATE**. The second **SetFormatItem()** method changes the default for the date separator character (which affects the *dformat* -1, 1, 4, and 15). In this example, the date separator character is set to a dot ("."), as is shown by the third **$ZDATE**. Finally, this program restores the original date format values:

```
InitialVals
   SET fmt=##class(%SYS.NLS.Format).GetFormatItem("DateFormat")
   SET sep=##class(%SYS.NLS.Format).GetFormatItem("DateSeparator")
   WRITE !,$ZDATE($HOROLOG)
ChangeVals
   SET x=##class(%SYS.NLS.Format).SetFormatItem("DateFormat",4)
   WRITE !,$ZDATE($HOROLOG)
   SET y=##class(%SYS.NLS.Format).SetFormatItem("DateSeparator",".")
   WRITE !,$ZDATE($HOROLOG)
RestoreVals
   SET x=##class(%SYS.NLS.Format).SetFormatItem("DateFormat",fmt)
   SET y=##class(%SYS.NLS.Format).SetFormatItem("DateSeparator",sep)
   WRITE !,$ZDATE($HOROLOG)
```

For further details on default date formats for supported locales, refer to Dates in *Using ObjectScript*.

Parameters

hdate

The internal date format value representing the number of days elapsed since December 31, 1840. By default, it must be an integer in the range 0 through 2980013. You can specify *hdate* as a numeric, a string literal, or an expression. InterSystems IRIS converts *hdate* to canonical form. It truncates a numeric string (such as a $HOROLOG value) at its first non-numeric character. It evaluates a non-numeric string as the integer 0. A floating-point number that does not resolve to an integer generates an <ILLEGAL VALUE> error.

By default, the earliest valid *hdate* is 0 (December 31, 1840). Dates are limited to positive integers by default because the DateMinimum property defaults to 0. You can specify earlier dates as negative integers, provided the DateMinimum property of the current locale is set to a greater or equal negative integer. The lowest valid DateMinimum value is -672045, which corresponds to January 1, 0001. InterSystems IRIS uses the proleptic Gregorian calendar, which projects the Gregorian calendar back to "Year 1", in conformance with the ISO 8601 standard. This is, in part, because the Gregorian calendar was adopted at different times in different countries. For example, much of continental Europe adopted it in 1582; Great Britain and the United States adopted it in 1752. Thus InterSystems IRIS dates prior to your local adoption of the Gregorian calendar may not correspond to historical dates that were recorded based on the local calendar then in effect. For further details on dates prior to 1840, refer to the mindate parameter.

Invalid and out-of-range *hdate* values and resulting errors are described in the erropt parameter.

dformat

Format for the returned date. Valid values are:

Value	Meaning
1	MM/DD/[YY]YY (07/01/97 or 03/27/2002) — American numeric format. The dateseparator character (/ or .) is taken from the current locale setting.
2	DD Mmm [YY]YY (01 Jul 97 or 27 Mar 2002)
3	YYYY-MM-DD (1997-07-01 or 2002-03-27) — ODBC format. By default this format is independent of your current locale settings (*localeopt*=1), thus specifying dates in an ODBC standard interchange format. To use your current date locale settings with this format, set *localeopt*=0.
4	DD/MM/[YY]YY (01/07/97 or 27/03/2002) — European numeric format. The dateseparator character (/ or .) is taken from the current locale setting.
5	Mmm [D]D, YYYY (Jul 1, 1997 or Mar 27, 2002)

Value	Meaning
6	Mmm [D]D YYYY (Jul 1 1997 or Mar 27 2002)
7	Mmm DD [YY]YY (Jul 01 97 or Mar 27 2002)
8	YYYYMMDD (19970701 or 20020327) — Numeric format
9	Mmmmm [D]D, YYYY (July 1, 1997 or March 27, 2002)
10	W (2) — Day number for the week, numbered from 0 (Sunday) through 6 (Saturday). Compare with the **$SYSTEM.SQL.DAYOFWEEK()** method.
11	Www (Tue) — Abbreviated day name
12	Wwwwww (Tuesday) — Full day name
13	[D]D/[M]M/YYYY (1/7/2549 or 27/11/2549) — Thai date format. Day and month are identical to European usage, except no leading zeros. The year is the Buddhist Era (BE) year, calculated by adding 543 years to the Gregorian year.
14	nnn (354) — Day number for the year
15	DD/MM/[YY]YY (01/07/97 or 27/03/2002) — European format (same as *dformat*=4). The dateseparator character (/ or .) is taken from the current locale setting.
16	YYYYc[M]Mc[D]Dc — Japanese date format. Year, month, and day numbers are the same as other date formats; leading zeros are omitted. The Japanese characters for “year”, “month”, and “day” (shown here as *c*) are inserted after the year, month, and day numbers. These characters are Year=$CHAR(24180), Month=$CHAR(26376), and Day=$CHAR(26085).
17	YYYYc [M]Mc [D]Dc — Japanese date format. Same as *dformat* 16, except that a blank space is inserted after the “year” and “month” Japanese characters.
18	[D]D Mmmmm YYYY — Tabular Hijri (Islamic) date format with full month name. Day leading zeros are omitted; year leading zeros are included. InterSystems IRIS date -445031 (07/19/0622 C.E.) = 1 Muharram 0001.
19	[D]D [M]M YYYY — Tabular Hijri (Islamic) date format with month number. Day and month leading zeros are omitted; year leading zeros are included. InterSystems IRIS date -445031 (07/19/0622 C.E.) = 1 1 0001.
20	[D]D Mmmmm YYYY — Observed Hijri (Islamic) date format with full month name. Defaults to Tabular Hijri (*dformat* 18). To override tabular calculation, use the class %Calendar.Hijri to add observations of new moon crescents.
21	[D]D [M]M YYYY — Observed Hijri (Islamic) date format with month number. Defaults to Tabular Hijri (*dformat* 19). To override tabular calculation, use the class %Calendar.Hijri to add observations of new moon crescents.
-1	Get effective *dformat* value either from the user’s locale (if *localeopt*=0 or undefined), or from the ODBC locale (which defaults *dformat*=3). If *dformat* is taken from the user’s locale, it is the value of fmt.DateFormat, where fmt is an instance of ##class(%SYS.NLS.Format) associated with the current process. This is the default behavior if you do not specify *dformat*. See “Customizable Date Default” for further details.

where:

Syntax	Meaning
YYYY	*YYYY* is a four-digit year. *[YY]YY* is a two-digit year if *hdate* falls within the active window for two-digit years; otherwise it is a four-digit year.
MM	Two-digit month: 01 through 12. *[M]M* indicates that the leading zero is omitted for months 1 through 9.
DD	Two-digit day: 01 through 31. *[D]D* indicates that the leading zero is omitted for days 1 through 9.
Mmm	Month abbreviation extracted from the MonthAbbr property of the current locale. An alternate month abbreviation (or name of any length) can be extracted from an optional list specified as the *monthlist* parameter to **$ZDATE**. The default MonthAbbr values are: “Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec”
Mmmmm	Full name of the month as specified by the MonthName property of the current locale. The default values are: “January February March ... November December”
W	Number 0-6 indicating the day of the week: Sunday=0, Monday=1, Tuesday=2, etc.
Www	Weekday name abbreviation as specified by the WeekdayAbbr property of the current locale. The default values are: “Sun Mon Tue Wed Thu Fri Sat”
Wwwwww	Weekday full name as specified by the WeekdayName property of the current locale. The default values are: “Sunday Monday Tuesday ... Friday Saturday”
nnn	Day number for the specified year, always three digits, with leading zeros if necessary. Values are 001 through 365 (or 366 on leap years).

dformat Default

If you omit *dformat* or set it to -1, the *dformat* default depends on the *localeopt* parameter and the NLS DateFormat property:

- If *localeopt*=1 the *dformat* default is ODBC format. The *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults are also set to ODBC format. This is the same as setting *dformat*=3.
- If *localeopt*=0 or is unspecified, the *dformat* default is taken from the NLS DateFormat property. If DateFormat=3, the *dformat* default is ODBC format. However, DateFormat=3 does not affect the *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults, which are as specified in the current NLS locale definition.

To determine the default date format for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DateFormat")
```

European date format (*dformat*=4, DD/MM/YYYY order) is the default for many (but not all) European languages, including British English, French, German, Italian, Spanish, and Portuguese (which use a “/” DateSeparator character), as well as Czech (csyw), Russian (rusw), Slovak (skyw), Slovenian (svnw), and Ukrainian (ukrw) (which use a “.” DateSeparator character). For further details on default date formats for supported locales, refer to Dates in *Using ObjectScript*.

dformat Settings

If *dformat* is 3 (ODBC date format), ODBC format defaults are also used for the *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults. Current locale defaults are ignored.

If *dformat* is -1, 1, 4, 13, or 15 (numeric date formats), **$ZDATE** uses the value of the DateSeparator property of the current locale as the delimiter between months, days, and the year. When *dformat* is 3 the ODBC date separator (“-”) is used. For all other *dformat* values, a space is used as the date separator. The default value of DateSeparator in English is “/” and all documentation uses this delimiter.

If *dformat* is 11 or 12 (day names) and *localeopt*=0 or is unspecified the day name values come from the current locale properties. If *localeopt*=1, day names come from the ODBC locale. To determine the default weekday names and weekday abbreviations for your locale, invoke the following NLS class methods:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("WeekdayName"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("WeekdayAbbr"),!
```

If *dformat* is 16 or 17 (Japanese date formats), the returned date format is independent of the locale setting. Japanese-format dates can be returned from any InterSystems IRIS instance.

If *dformat* is 18, 19, 20, or 21 (Islamic date formats) and *localeopt* is unspecified, parameters default to Islamic defaults, rather than current locale defaults. The *monthlist* parameter defaults to Arabic month names transliterated with Latin characters. The *tformat*, *yearopt*, *mindate* and *maxdate* parameters default to ODBC defaults. The date separator defaults to the Islamic default (a space), not the ODBC default or the current locale DateSeparator property value. If *localeopt*=0 current locale property defaults are used for these parameters. If *localeopt*=1 ODBC defaults are used for these parameters.

monthlist

An expression that resolves to a string of month names or month name abbreviations, separated by a delimiter character. The names in *monthlist* replace the default month abbreviation values from the MonthAbbr property or the month name values from the MonthName property of the current locale.

monthlist is valid only if *dformat* is 2, 5, 6, 7, 9, 18, or 20. If *dformat* is any other value **$ZDATE** ignores *monthlist*.

The *monthlist* string has the following format:

- The first character of the string is a delimiter character (usually a space). The same delimiter must appear before the first month name and between each month name in *monthlist*. You can specify any single-character delimiter; this delimiter appears between the month, day, and year portions of the returned date value, which is why a space is usually the preferred character.
- The month names string should contain twelve delimited values, corresponding to January through December. It is possible to specify more or less than twelve month names, but if there is no month name corresponding to the month in *hdate* an <ILLEGAL VALUE> error is generated.

If you omit *monthlist* or specify a *monthlist* value of -1, **$ZDATE** uses the list of month names defined in the MonthAbbr or MonthName property of the current locale, unless one of the following is true: If *localeopt*=1, the *monthlist* default is the ODBC month list (in English). If *localeopt* is unspecified and *dformat* is 18 or 20 (Islamic date formats) the *monthlist* default is the Islamic month list (Arabic names expressed using Latin letters), ignoring the MonthAbbr or MonthName property value.

To determine the default month names and month abbreviations for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MonthName"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MonthAbbr"),!
```

The following example lists the month names the default locale, changes the locale for this process to the Russian locale, then lists the Russian month names and displays the current date with a Russian month name. It then reverts the locale defaults to current locale and again displays the current date, this time with the default month name.

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MonthName"),!
SET fmt=##class(%SYS.NLS.Format).%New("rusw")
WRITE fmt.MonthName,!
WRITE $ZDATE($HOROLOG,9),!
SET fmt=##class(%SYS.NLS.Format).%New()
WRITE $ZDATE($HOROLOG,9)
```

yearopt

With *dformat* values 1, 2, 4, 7, or 15, an integer code that specifies the temporal window in which to display the year as a two-digit value. For all other *dformat* values, the *yearopt* is ignored. Valid *yearopt* values are:

Value	Meaning
-1	Get effective *yearopt* value from YearOption property of current locale which defaults to a value of 0. This is the default behavior if you do not specify *yearopt*.
0	Represent 20th century dates (1900 through 1999) with two-digit years and all other dates with four-digit years, unless a process-specific sliding window (established via the **%DATE** utility) is in effect. If such a window is in effect, represent only those dates falling within the sliding window by two-digit years, and all other dates with four-digit years.
1	Represent 20th century dates with two-digit years and all other dates with four-digit years.
2	Represent all dates with two-digit years.
3	Represent with two-digit years those dates falling within the sliding temporal window defined by *startwin* and (optionally) *endwin*. Represent all other dates with four-digit years. When *yearopt* =3, *startwin* and *endwin* are absolute dates in **$HOROLOG** format.
4	Represent all dates with four-digit years. ODBC year option.
5	Represent with two-digit years all dates falling within the sliding temporal window defined by *startwin* and (optionally) *endwin*. Represent all other dates with four-digit years. When yearopt=5, startwin and endwin are relative years.
6	Represent all dates in the current century with two-digit years and all other dates with four-digit years.

To determine the default year option for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("YearOption")
```

If you omit *yearopt* or specify a *yearopt* value of -1, **$ZDATE** uses the YearOption property of the current locale, unless one of the following is true: If *localeopt*=1, the *yearopt* default is the ODBC year option. If *localeopt*=0 or is unspecified and *dformat* is 18, 19, 20, or 21 (Islamic date formats) the *yearopt* default is the ODBC year option (4-digit years); the YearOption property value is ignored for Islamic dates.

startwin

A numeric value that specifies the start of the sliding window during which dates must be represented with two-digit years. See parameter section. You must supply *startwin* when *yearopt* is 3 or 5. *startwin* is not valid with any other *yearopt* values.

When *yearopt* = 3, *startwin* is an absolute date in **$HOROLOG** date format that indicates the start date of the sliding window.

When *yearopt* = 5, *startwin* is a numeric value that indicates the start year of the sliding window expressed as the number of years before the current year. The sliding window always begins on January 1st of the year specified in *startwin*.

endwin

A numeric value that specifies the end of the sliding window during which dates are represented with two-digit years. You may optionally supply *endwin* when *yearopt* is 3 or 5. *endwin* is not valid with any other *yearopt* values.

When *yearopt* = 3, *endwin* is an absolute date in **$HOROLOG** date format that indicates the end date of the sliding window.

When *yearopt* = 5, *endwin* is a numeric value that indicates the end year of the sliding window expressed as the number of years past the current year. The sliding window always ends on December 31st of the year specified in *endwin*. If *endwin* is not specified, it defaults to December 31st of the year 100 years after *startwin*.

If *endwin* is omitted (or specified as -1) the effective sliding window will be 100 years long. The *endwin* value of -1 is a special case that always returns a date value, even when higher and lower *endwin* values return *erropt*. For this reason, it is preferable to omit *endwin* when specifying a 100-year window, and to avoid the use of negative *endwin* values.

If you supply both *startwin* and *endwin*, the sliding window they specify must not have a duration of more than 100 years.

mindate

An expression that specifies the lower limit of the range of valid dates (inclusive). Can be specified as a **$HOROLOG** integer date count (for example, 1/1/2013 is represented as 62823) or a **$HOROLOG** string value. You can include or omit the time portion of a **$HOROLOG** date string (for example “62823,43200”), but only the date portion of *mindate* is parsed. Specifying an *hdate* value earlier than *mindate* generates a <VALUE OUT OF RANGE> error.

The following are supported *mindate* values:

- Positive integer: Most commonly *mindate* is specified as a positive integer to establish the earliest allowed date as some date after December 31, 1840. For example, a *mindate* of 21550 would establish the earliest allowed date as January 1, 1900. The highest valid value is 2980013 (December 31, 9999).
- 0: specifies the minimum date as December 31, 1840. This is the DateMinimum property default.
- Negative integer -2 or larger: specifies a minimum date counting backwards from December 31, 1840. For example, a *mindate* of -14974 would establish the earliest allowed date as January 1, 1800. Negative *mindate* values are only meaningful if the DateMinimum property of the current locale has been set to an equal or greater negative number. The lowest valid value is -672045.
- If omitted (or specified as -1), *mindate* defaults to the DateMinimum property value for the current locale, unless one of the following is true: If *localeopt*=1, the *mindate* default is 0. If *localeopt* is unspecified and *dformat*=3, the *mindate* default is 0. If *localeopt* is unspecified and *dformat* is 18, 19, 20, or 21 (Islamic date formats) the *mindate* default is 0.

You can get and set the DateMinimum property as follows:

```
  SET min=##class(%SYS.NLS.Format).GetFormatItem("DateMinimum")
  WRITE "initial DateMinimum value is ",min,!
Permit18thCenturyDates
  SET x=##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",-51498)
  SET newmin=##class(%SYS.NLS.Format).GetFormatItem("DateMinimum")
  WRITE "set DateMinimum value is ",newmin,!!
RestrictTo19thCenturyDates
  WRITE $ZDATE(-13000,1,,,,,-14974),!!
ResetDateMinimumToDefault
  SET oldmin=##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",min)
  WRITE "reset DateMinimum value from ",oldmin," to ",min
```

You may specify *mindate* with or without *maxdate*. Specifying a *mindate* larger than *maxdate* generates an <ILLEGAL VALUE> error.

ODBC Date Format (dformat 3)

The application of the DateMinimum property is governed by the *localeopt* setting. When *localeopt*=1 (which is the default for *dformat*=3) the date minimum is 0, regardless of the current locale setting. Therefore, in ODBC format (*dformat*=3) the following can be used to specify a date prior to December 31, 1840:

- Specify a *mindate* earlier than the specified date:

  ```
  WRITE $ZDATE(-30,3,,,,,-365)
  ```

- Specify a DateMinimum property value earlier than the specified date and set *localeopt*=0:

```
DO ##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",-365)
WRITE $ZDATE(-30,3,,,,,,,,0)
```

maxdate

An expression that specifies the upper limit of the range of valid dates (inclusive). Can be specified as a **$HOROLOG** integer date count (for example, 1/1/2100 is represented as 94599) or a **$HOROLOG** string value. You can include or omit the time portion of the **$HOROLOG** date (for example "94599,43200"), but only the date portion of *maxdate* is parsed.

If *maxdate* is omitted or if specified as -1, the maximum date limit is obtained from the DateMaximum property of the current locale, which defaults to the maximum permissible value for the date portion of **$HOROLOG**: 2980013 (corresponding to December 31, 9999 CE). However, the application of the DateMaximum property is governed by the *localeopt* setting. When *localeopt*=1 (which is the default for *dformat*=3) the date maximum default is the ODBC value (2980013), regardless of the current locale setting. Islamic date formats also take the ODBC default. The maximum date for Thai date format (*dformat*=13) is **$HOROLOG** 2781687 which corresponds to 31/12/9999 BE.

Specifying a *hdate* larger than *maxdate* generates a <VALUE OUT OF RANGE> error.

Specifying a *maxdate* larger than 2980013 generates an <ILLEGAL VALUE> error.

You may specify *maxdate* with or without *mindate*. Specifying a *maxdate* smaller than *mindate* generates an <ILLEGAL VALUE> error.

erropt

Specifying a value for this parameter suppresses errors associated with invalid or out of range *hdate* values. Instead of generating <ILLEGAL VALUE> or <VALUE OUT OF RANGE> errors, the **$ZDATE** function returns the *erropt* value.

- Validation: InterSystems IRIS performs canonical numeric conversion on *hdate*. Parsing of an *hdate* string halts at the first non-numeric character. Therefore, an *hdate* string such as `64687AD` is the same as `64687`. A non-numeric date (including the null string) evaluates to 0. Thus an empty string *hdate* returns the **$HOROLOG** initial date: December 31, 1840. However, if *hdate* does not evaluate to an integer (contains a non-zero fractional number) it generates an <ILLEGAL VALUE> error.
- Range: *hdate* must evaluate to an integer within the *mindate*/*maxdate* range. By default, date values greater than 2980013 or less than 0 generate a <VALUE OUT OF RANGE> error. By setting *mindate* to a negative number, you can extend the range of valid dates before December 31, 1840. However, for *dformat* 18, 19, 20, or 21 (Hijri Islamic calendar) dates, any date prior to -445031 generates an <ILLEGAL VALUE> error, even if *mindate* is set to an earlier date.

The *erropt* parameter only suppresses errors generated due to invalid or out of range values of *hdate*. Errors generated due to invalid or out of range values of other parameters will always generate errors whether or not *erropt* has been supplied. For example, an <ILLEGAL VALUE> error is always generated when **$ZDATE** specifies a sliding window where *endwin* is earlier than *startwin*. Similarly, an <ILLEGAL VALUE> error is generated when *maxdate* is less than *mindate*.

Invalid Date Handling with ZDateNull

The behavior of **$ZDATE** when given an invalid value for *hdate* can be set using ZDateNull. To set this behavior for the current process, use the **ZDateNull()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *ZDateNull* property of the Config.Miscellaneous class. **$ZDATE** can either issue an error, or return a null value.

The system-wide default behavior is configurable. Go to the Management Portal, select **System Administration**, **Configuration**, **Additional Settings**, **Compatibility**. View and edit the current setting of **ZDateNull**. The default is "false", meaning that **$ZDATE** returns an error.

localeopt

This Boolean parameter specifies either the user's current locale definition or the ODBC locale definition as the source for defaults for the locale-specified parameters *dformat*, *monthlist*, *yearopt*, *mindate* and *maxdate*:

- If *localeopt*=0, all of these parameters take the current locale definition defaults.
- If *localeopt*=1, all of these parameters take the ODBC defaults.
- If *localeopt* is not specified, the *dformat* parameter determine the default for these parameters. If *dformat*=3, the ODBC defaults are used. If *dformat* is 18, 19, 20, or 21 the Islamic date format defaults are used, regardless of the current locale definition. For all other *dformat* values, the current locale definition defaults are used. Refer to the dformat description for further details.

The ODBC locale cannot be changed; it is used to format date strings that are portable between InterSystems IRIS processes that have made different National Language Support (NLS) choices. If *localeopt*=1, the ODBC locale date definitions are as follows:

- Date format defaults to 3. Therefore, if *dformat* is undefined or -1, date format 3 is used.
- Date separator defaults to "/". However, date format defaults to 3, which always uses "-" as the date separator.
- Year option defaults to 4 digits.
- Date minimum and maximum: 0 and 2980013 ($HOROLOG date count).
- English month names, month abbreviations, weekday names, and weekday abbreviations are used.

Examples

Date Format Examples

The following example illustrates how **$ZDATE** returns the various *dformat* formats for the current date. The *yearopt* takes the default values. The date separator, and the names and abbreviations of months and days of the week are, of course, locale-dependent. This example uses the current user locale definition:

```
WRITE $ZDATE($HOROLOG),  "   default date format",!
WRITE $ZDATE($HOROLOG,1),"   1=American numeric format",!
WRITE $ZDATE($HOROLOG,2),"   2=Month abbreviation format",!
WRITE $ZDATE($HOROLOG,3),"   3=ODBC numeric format",!
WRITE $ZDATE($HOROLOG,4),"   4=European numeric format",!
WRITE $ZDATE($HOROLOG,5),"   5=Month abbreviation format",!
WRITE $ZDATE($HOROLOG,6),"   6=Month abbreviation format",!
WRITE $ZDATE($HOROLOG,7),"   7=Month abbreviation format",!
WRITE $ZDATE($HOROLOG,8),"   8=Numeric format no spaces",!
WRITE $ZDATE($HOROLOG,9),"   9=Month name format",!
WRITE $ZDATE($HOROLOG,10),"  10=Day-of-week format",!
WRITE $ZDATE($HOROLOG,11),"  11=Day abbreviation format",!
WRITE $ZDATE($HOROLOG,12),"  12=Day name format",!
WRITE $ZDATE($HOROLOG,13),"  13=Thai numeric format",!
WRITE $ZDATE($HOROLOG,14),"  14=Day-of-year format",!
WRITE $ZDATE($HOROLOG,15),"  15=European numeric format",!
WRITE $ZDATE($HOROLOG,16),"  16=Japanese date format",!
WRITE $ZDATE($HOROLOG,17),"  17=Japanese date format with spaces"
```

The following example compares dates with the locale defaulting to the current user locale with dates when *localeopt*=1 activates the ODBC locale definition. To make this example more interesting, the current user locale is set to French:

```
SET fmt=##class(%SYS.NLS.Format).%New("fraw")
WRITE "default: local=",$ZDATE($HOROLOG),"   ODBC=",$ZDATE($HOROLOG,,,,,,,,,1),!
WRITE "-1:      local=",$ZDATE($HOROLOG,-1),"   ODBC=",$ZDATE($HOROLOG,-1,,,,,,,,1),!!
FOR x=1:1:17 {
  WRITE x,": local=",$ZDATE($HOROLOG,x),"   ODBC=",$ZDATE($HOROLOG,x,,,,,,,,1),! }
```

Two-digit Year Sliding Window Example

To illustrate how to use an explicit sliding window, suppose you enter the following function call in 1997. The *hdate* of 59461 represents October 19, 2003; the *dformat* of 1 allows it to return two-digit or four-digit years, and the *yearopt* of 5 specifies a sliding window for four-digit years. Because of the *yearopt* setting, the *startwin* and *endwin* are calculated relative to the current year (in this case 1997) by addition and subtraction.

```
   WRITE $ZDATE(59461,1,,5,90,10)
```

The sliding window for displaying the year as two digits extends from 1/1/1907 to 12/31/2006. Thus InterSystems IRIS displays the date as 10/19/03.

Date Range Example

The following example uses *mindate* and *maxdate* to test for plausible birth dates. The *maxdate* assumes that a birth date cannot be in the future; the *mindate* assumes that no person listed will be more that 124 years old. The dates are specified in **$HOROLOG** format:

```
PlausibleBirthdate
   SET bdateh(1)=62142
   SET bdateh(2)=16800
   SET bdateh(3)=70000
   DO $SYSTEM.Process.ZDateNull(1)
   SET maxdate=$PIECE($HOROLOG,",",1)+1
   SET mindate=maxdate-(365.25*124)
   FOR x=1:1:3 {
      SET bdate=$ZDATE(bdateh(x),,,,,,mindate,maxdate)
      IF bdate="" {WRITE "Birth date ",bdateh(x)," is out of range",!}
      ELSE {WRITE "Birth date ",bdateh(x)," is ",bdate,!}
   }
```

Two of the above **$ZDATE** input values fall outside of the date range for a birth date test: 16800 (12/30/1886) is more than 124 years ago and 70000 (08/26/2032) is in the future. By default, these invocations of **$ZDATE** would generate a <VALUE OUT OF RANGE> error, but because **ZDateNull(1)** is set, they return the empty string ("").

Notes

Invalid Values with $ZDATE

You receive a <FUNCTION> error in the following conditions:

- If you specify an invalid *dformat* code (an integer value less than -1 or greater than 17, or a non-integer value).
- If you do not specify a *startwin* value when *yearopt* is 3 or 5.

You receive an <ILLEGAL VALUE> error under the following conditions:

- If you specify an invalid value for *hdate* and do not either supply an *erropt* value or set ZDateNull (as described below).
- If the given month number is greater than the number of month values in *monthlist*.
- If *maxdate* is less than *mindate*.
- If *endwin* is less than *startwin*.
- If *startwin* and *endwin* specify a sliding temporal window whose duration is greater than 100 years.

You receive a <VALUE OUT OF RANGE> error under the following conditions:

- If you specify an *hdate* value that is out of the range of valid dates. For InterSystems IRIS this is 0 through 298013. You can use the **ZDateNull()** method of the %SYSTEM.Process class to set the date range and invalid date behavior for the current process.
- If you specify an otherwise valid date which is outside the range defined by the values assumed for *maxdate* and *mindate*, and do not supply an *erropt* value.

Using $ZDATE Instead of Utilities

Keep the following points in mind when you need to choose between the **$ZDATE** function and a date utility:

- You can use the **$ZDATE** function in place of most existing entry points of the **%DO** or **%D** utilities.
- You can invoke **$ZDATE($HOROLOG,7)** directly instead of calling **INT ^%D**. This provides the current date in "Mmm DD [YY]YY" format.
- **$ZDATEH** and **$ZDATE** are much faster than calling entry points of **%DATE**, **%DI** or **%DO**.

See Also

- JOB command
- $ZDATEH function
- $ZDATETIME function
- $ZDATETIMEH function
- $ZTIME function
- $HOROLOG special variable
- $ZTIMESTAMP special variable
- **%DATE** utility, which is documented in the legacy documentation available at http://docs.intersystems.com/priordocexcerpts
- More information on locales in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$ZDATEH

Validates a date and converts it from display format to InterSystems IRIS internal format.

```
$ZDATEH(date,dformat,monthlist,yearopt,startwin,endwin,mindate,maxdate,erropt,localeopt)
$ZDH(date,dformat,monthlist,yearopt,startwin,endwin,mindate,maxdate,erropt,localeopt)
```

Parameters

date	An expression that evaluates to a date string in display format. **$ZDATEH** converts this date string to **$HOROLOG** format. This can be either an explicit date (specified in various formats) or the string “T” or “t”, representing the current date. The “T” or “t” string can optionally include a signed integer offset. For example “T-7” meaning seven days before the current date. See date below.
dformat	*Optional* — An integer code that specifies a date format option for *date*. If *date* is “T”, *dformat* must be 5, 6, 7, 8, 9, or 15. See dformat below.
monthlist	*Optional* — A string or the name of a variable that specifies a set of month names. This string must begin with a delimiter character, and its 12 entries must be separated by this delimiter character. See monthlist below.
yearopt	*Optional* — An integer code that specifies whether to represent years as two- or four-digit values. See yearopt below.
startwin	*Optional* — The start of the sliding window during which dates must be represented with two-digit years. See startwin below.
endwin	*Optional* — The end of the sliding window during which dates are represented with two-digit years. See endwin below.
mindate	*Optional* — The lower limit of the range of valid *date* dates. Specified as a **$HOROLOG** integer date count, with 0 representing December 31, 1840. Can be specified as a positive or negative integer. See mindate below.
maxdate	*Optional* — The upper limit of the range of valid dates. Specified as a **$HOROLOG** integer date count. See maxdate below.
erropt	*Optional* — An expression to return when *date* is invalid. Specifying a value for this parameter suppresses error codes associated with invalid or out of range *date* values. Instead of issuing an error message, **$ZDATEH** returns *erropt*. See erropt below.
localeopt	*Optional* — A boolean flag that specifies which locale to use for the *dformat*, *monthlist*, *yearopt*, *mindate* and *maxdate* default values, and other date characteristics, such as the date separator character: *localeopt*=0: the current locale property settings determine these parameter defaults. *localeopt*=1: the ODBC standard locale determines these parameter defaults. *localeopt* not specified: the *dformat* value determines these parameter defaults. If *dformat*=3, ODBC defaults are used. Japanese and Islamic date *dformat*values use their own defaults. For all other *dformat* values, current locale property settings are used as defaults. See localeopt below.

Omitted parameters between specified parameter values are indicated by placeholder commas. Trailing placeholder commas are not required, but are permitted. Blank spaces are permitted between the commas that indicate an omitted parameter.

Description

The **$ZDATEH** function validates a specified date and converts it from any of the formats supported by the **$ZDATE** function to **$HOROLOG** format. The exact action **$ZDATEH** performs depends on the parameters you use.

Simple $ZDATEH Format

$ZDATEH**(*date*) converts a date in the form MM/DD/[YY]YY to the first integer in the **$HOROLOG format. (The **$HOROLOG** format consists of two integers: the first integer is a date, the second integer is a time.) Two or four digits may be specified for years in the range 1900 to 1999. Four digits must be specified for years before 1900 or after 1999.

Customizable $ZDATEH Format

$ZDATEH(*date*,*dformat*,*monthlist*,*yearopt*,*startwin*,*endwin*,*mindate*,*maxdate*,*erropt*) converts a date in the specified *dformat* to **$HOROLOG** format. The *dformat*, *monthlist*, *yearopt*, *startwin*, *endwin*, *mindate*, *maxdate* and *erropt* values are identical to the values used by **$ZDATE**. However, when you use a *dformat* of 5, 6, 7, 8, or 9, **$ZDATEH** recognizes and converts a date in any of the external date formats defined for *dformat* codes 1, 2, 3, 5, 6, 7, 8, and 9. (But not *dformat* code 4.) It also recognizes a special relative *date* format that consists of a string beginning with the letter T or t (indicating “today”,) optionally followed by a plus (+) or a minus (-) sign, and an integer number of days after or before the current date.

Parameters

date

The date you want converted to **$HOROLOG** format, specified as a quoted string. This can be an explicit date, or the implicit current date, represented by the string “T” or “t”.

An explicit date must be specified in one of the formats supported by *dformat*. The permitted format(s) depends on the *dformat* parameter. If *dformat* is not specified or is 1, 2, 3, or 4, only one date format is permitted. If *dformat* is 5, 6, 7, 8, 9 or 15, multiple date formats are permitted.

If *dformat* is 5, 6, 7, 8, or 9, **$ZDATEH** accepts all unambiguous American date formats. If *dformat* is 15, **$ZDATEH** accepts all unambiguous European date formats. A list of valid date formats is provided below. Note that *dformat*=4 is not a valid American date format because **$ZDATEH** cannot differentiate between 02/03/02 (meaning February 3, 2002) and the European 02/03/02 (meaning March 2, 2002). If you specify a date in a non-permitted format, or a nonexistent date (such as February 31, 2002), **$ZDATEH** generates an <ILLEGAL VALUE> error code. (**$ZDATEH** does check for leap year dates, permitting Feb. 29, 2004 but not Feb. 29, 2003.)

In the Russian, Ukrainian, and Czech locales, a *date* must be specified with periods, rather than slashes, as date part separators: `DD.MM.YYYY`.

An implicit date is specified as a string consisting of the letter “T” or “t”, indicating the current date (today). This string can optionally include a plus or minus sign and an integer, which specify the number of days offset from the current date. For example, “t+9” (nine days after the current date) or “t-12” (twelve days before the current date). Implicit dates are only permitted if *dformat* is 5, 6, 7, 8, 9, or 15. The only permitted implicit date forms are “T” (or “t”), and “T” (or “t”) followed by a sign and integer. InterSystems IRIS generates an <ILLEGAL VALUE> error if you specify a noninteger number, an arithmetic expression, an integer without a sign, or a sign without an integer. “T+0” and “T-0” are permitted, and return the current date. InterSystems IRIS generates a <VALUE OUT OF RANGE> error if you specify an offset that would result in a **$HOROLOG** date beyond the range of valid dates.

By default, the earliest valid *date* is December 31, 1840 (0 in internal **$HOROLOG** representation). Dates are limited to positive integers by default because the DateMinimum property defaults to 0. You can specify earlier dates as negative integers, provided the DateMinimum property of the current locale is set to a greater or equal negative integer. The lowest valid DateMinimum value is -672045, which corresponds to January 1, 0001. InterSystems IRIS uses the proleptic Gregorian calendar, which projects the Gregorian calendar back to “Year 1”, in conformance with the ISO 8601 standard. This is, in part, because the Gregorian calendar was adopted at different times in different countries. For example, much of continental

Europe adopted it in 1582; Great Britain and the United States adopted it in 1752. Thus InterSystems IRIS dates prior to your local adoption of the Gregorian calendar may not correspond to historical dates that were recorded based on the local calendar then in effect. For further details on dates prior to 1840, refer to the *mindate* parameter.

dformat

Format for the date. Valid values are:

Value	Meaning
-1	Get effective *dformat* value from the DateFormat property of the current locale. This is the default behavior if you do not specify *dformat*.
1	*MM/DD/[YY]YY* (07/01/97 or 03/27/2002) — American numeric format. You must specify the correct dateseparator character (/ or .) for the current locale.
2	*DD Mmm [YY]YY* (01 Jul 97)
3	*[YY]YY-MM-DD* (1997-07-01) - ODBC format
4	*DD/MM/[YY]YY* (01/07/97 or 27/03/2002) — European numeric format. You must specify the correct dateseparator character (/ or .) for the current locale.
5	*Mmm D, YYYY* (Jul 1, 1997) or any unambiguous American date format.
6	*Mmm D YYYY* (Jul 1 1997) or any unambiguous American date format.
7	*Mmm DD [YY]YY* (Jul 01 1997) or any unambiguous American date format.
8	*[YY]YYMMDD* (19970701) - Numeric format, or any unambiguous American date format.
9	*Mmmmm D, YYYY* (July 1, 1997), or any unambiguous American date format.
13	*[D]D/[M]M/YYYY* (1/7/2549 or 27/11/2549) — Thai date format. Day and month are identical to European usage, except no leading zeros. The year is the Buddhist Era (BE) year, calculated by adding 543 years to the Gregorian year.
15	*DD/MM/[YY]YY* or *YYYY-MM-DD* or any unambiguous European date format with any dateseparator character, or *YYYYMMDD* with no date separators. The dateseparator character may be any non-alphanumeric character, including blank spaces, regardless of the dateseparator character specified in the current locale. Also accepts *monthlist* names and “T”.
16	YYYYc[M]Mc[D]Dc — Japanese date format. Year, month, and day numbers are the same as other date formats; leading zeros are omitted. The Japanese characters for “year”, “month”, and “day” (shown here as *c*) are inserted after the year, month, and day numbers. These characters are Year=$CHAR(24180), Month=$CHAR(26376), and Day=$CHAR(26085).
17	YYYYc [M]Mc [D]Dc — Japanese date format. Same as *dformat* 16, except that a blank space is inserted after the “year” and “month” Japanese characters.
18	[D]D Mmmmm YYYY — Tabular Hijri (Islamic) date format with full month name. Day leading zeros are omitted; year leading zeros are included. InterSystems IRIS date -445031 (07/19/0622 C.E.) = 1 Muharram 0001.
19	[D]D [M]M YYYY — Tabular Hijri (Islamic) date format with month number. Day and month leading zeros are omitted; year leading zeros are included. InterSystems IRIS date -445031 (07/19/0622 C.E.) = 1 1 0001.
20	[D]D Mmmmm YYYY — Observed Hijri (Islamic) date format with full month name. Defaults to Tabular Hijri (*dformat* 18). To override tabular calculation, use the class %Calendar.Hijri to add observations of new moon crescents.

Value	Meaning
21	[D]D [M]M YYYY — Observed Hijri (Islamic) date format with month number. Defaults to Tabular Hijri (*dformat* 19). To override tabular calculation, use the class %Calendar.Hijri to add observations of new moon crescents.

Where:

Syntax	Meaning
YYYY	*YYYY* is a four-digit year. *[YY]YY* is a two-digit year if the date falls within the active window for two-digit years; otherwise it is a four-digit years. You must supply the year value when using date formats (*dformat*) 1 through 4; these date formats do not supply a missing year value. Date formats 5 through 9 assume the current year if the date you specify does not include a year.
MM	Two-digit month.
D	One-digit day if the day number <10. Otherwise, two digits.
DD	Two-digit day.
Mmm	Month abbreviation extracted from the MonthAbbr property of the current locale. The default values in English are: "Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec". Or an alternate month abbreviation (or name of any length) extracted from an optional list specified as the *monthlist* parameter to **$ZDATEH**.
Mmmmm	Full name of the month as specified by the MonthName property of the current locale. The default values in English are: "January February March ... November December".

dformat Default

If you omit *dformat* or set it to -1, the *dformat* default depends on the *localeopt* parameter and the NLS DateFormat property:

- If *localeopt*=1 the *dformat* default is ODBC format. The *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults are also set to ODBC format. This is the same as setting *dformat*=3.
- If *localeopt*=0 or is unspecified, the *dformat* default is taken from the NLS DateFormat property. If DateFormat=3, the *dformat* default is ODBC format. However, DateFormat=3 does not affect the *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults, which are as specified in the current NLS locale definition.

To determine the default date properties for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DateFormat"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DateSeparator")
```

$ZDATEH will use the value of the DateSeparator property of the current locale (either / or .) as the delimiter between months, days, and the year when *dformat*=1 or 4.

European date format (*dformat*=4, DD/MM/YYYY order) is the default for many (but not all) European languages, including British English, French, German, Italian, Spanish, and Portuguese (which use a "/" DateSeparator character), as well as Czech (csyw), Russian (rusw), Slovak (skyw), Slovenian (svnw), and Ukrainian (ukrw) (which use a "." DateSeparator character). For further details on default date formats for supported locales, refer to Dates in *Using ObjectScript*.

dformat Settings

If *dformat* is 3 (ODBC format date), ODBC format defaults are also used for the *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults. The date separator will always be a "-". Current locale defaults are ignored.

If *dformat* is 16 or 17 (Japanese date formats), the date format is independent of the locale setting. You can use Japanese-format dates on any InterSystems IRIS instance.

If *dformat* is 18, 19, 20, or 21 (Islamic date formats) and *localeopt* is unspecified, parameters default to Islamic defaults, rather than current locale defaults. The *monthlist* parameter defaults to Arabic month names transliterated with Latin characters. The *yearopt*, *mindate* and *maxdate* parameters default to ODBC defaults. The date separator defaults to the Islamic default (a space), not the ODBC default or the current locale DateSeparator property value. If *localeopt*=0 current locale property defaults are used for these parameters. If *localeopt*=1 ODBC defaults are used for these parameters.

monthlist

An expression that resolves to a string of month names or month name abbreviations, separated by a delimiter character. The names in *monthlist* replace the default month abbreviation values from the MonthAbbr property or the month name values from the MonthName property of the current locale.

monthlist is valid only if *dformat* is 2, 5, 6, 7, 8, 9, 15, 18, or 20. If *dformat* is any other value **$ZDATEH** ignores *monthlist*.

The *monthlist* string has the following format:

- The first character of the string is a delimiter character (usually a space). The same delimiter must appear before the first month name and between each month name in *monthlist*. You can specify any single-character delimiter; this delimiter must be specified between the month, day, and year portions of the specified *date* value, which is why a space is usually the preferred character.
- The month names string should contain twelve delimited values, corresponding to January through December. It is possible to specify more or less than twelve month names, but if there is no month name corresponding to the month in *date* an <ILLEGAL VALUE> error is generated.

If you omit *monthlist* or specify a *monthlist* value of -1, **$ZDATEH** uses the list of month names defined in the MonthAbbr or MonthName property of the current locale, unless one of the following is true: If *localeopt*=1, the *monthlist* default is the ODBC month list (in English). If *localeopt* is unspecified and *dformat* is 18 or 20 (Islamic date formats) the *monthlist* default is the Islamic month list (Arabic names expressed using Latin letters), ignoring the MonthAbbr or MonthName property value.

To determine the default month names and month abbreviations for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MonthName"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MonthAbbr"),!
```

yearopt

A numeric code that specifies whether to represent years as either two-digit values or four-digit values. Valid values are:

Value	Meaning
-1	Get effective *yearopt* value from YearOption property of current locale which defaults to a value of 0. This is the default behavior if you do not specify *yearopt* .
0	Represent 20th century dates (1900 through 1999) with two-digit years, unless a process-specific sliding window (established via the %DATE utility) is in effect. If such a window is in effect, represent only those dates falling within the sliding window by two-digit years. Represent all dates falling outside the 20th century or outside the process-specific sliding window by four-digit years.
1	Represent 20th century dates with two-digit years and all other dates with four-digit years, regardless of any sliding temporal window in effect.
2	Represent all dates with two-digit years, regardless of any sliding temporal window in effect. All dates are assumed to be in the 20th century. Because this option deletes two digits from four-digit years, its use results in a nonreversible loss of century information. (This loss may be trivial if all dates are in the same century).

Value	Meaning
3	Represent with two-digit years those dates falling within the sliding temporal window defined by *startwin* and (optionally) *endwin*. Represent all other dates with four-digit years. When *yearopt*=3, *startwin* and *endwin* are absolute dates in **$HOROLOG** format.
4	Represent all dates with four-digit years. Dates input with two- digit years are rejected as invalid.
5	Represent with two-digit years all dates falling within the sliding temporal window defined by *startwin* and (optionally) *endwin*. Represent all other dates with four-digit years. When yearopt=5, *startwin* and *endwin* are relative years.
6	Represent all dates in the current century with two-digit years and all other dates with four-digit years.

If you omit *yearopt* or specify a *yearopt* value of -1, **$ZDATEH** uses the YearOption property of the current locale, unless one of the following is true: If *localeopt*=1, the *yearopt* default is the ODBC year option. If *localeopt*=0 or is unspecified and *dformat* is 18, 19, 20, or 21 (Islamic date formats) the *yearopt* default is the ODBC year option (4-digit years); the YearOption property value is ignored for Islamic dates.

startwin

A numeric value that specifies the start of the sliding window during which dates must be represented with two-digit years. You must supply *startwin* when you use a *yearopt* of 3 or 5.*startwin* is not valid with any other *yearopt* values.

When *yearopt*=3, *startwin* is an absolute date in **$HOROLOG** date format that indicates the start date of the sliding window.

When *yearopt*= 5, *startwin* is a numeric value that indicates the start year of the sliding window expressed in the number of years before the current year. The sliding window always begins on the first day of the year (January 1) specified in *startwin*.

endwin

A numeric value that specifies the end of the sliding window during which dates are represented with two-digit years. You may optionally supply *endwin* when *yearopt* is 3 or 5. *endwin* is not valid with any other *yearopt* values.

When *yearopt*=3, *endwin* is an absolute date in **$HOROLOG** date format that indicates the end date of the sliding window.

When *yearopt*=5, *endwin* is a numeric value that indicates the end year of the sliding window expressed as the number of years past the current year. The sliding window always ends on the last day of the year (December 31) of the year specified in *endwin* or of the implied end year (if you omit *endwin*).

If *endwin* is omitted (or specified as -1) the effective sliding window will be 100 years long. The *endwin* value of -1 is a special case that always returns a date value, even when higher and lower *endwin* values return *erropt*. For this reason, it is preferable to omit *endwin* when specifying a 100-year window, and to avoid the use of negative *endwin* values.

If you supply both *startwin* and *endwin*, the sliding window they specify must not have a duration of more than 100 years.

mindate

An expression that specifies the lower limit of the range of valid dates (inclusive). Can be specified as a **$HOROLOG** integer date count (for example, 1/1/2013 is represented as 62823) or a **$HOROLOG** string value. You can include or omit the time portion of the **$HOROLOG** date (for example “62823,43200”), but only the date portion of *mindate* is parsed. Specifying a *date* value earlier than *mindate* generates a <VALUE OUT OF RANGE> error.

The following are supported *mindate* values:

- Positive integer: Most commonly *mindate* is specified as a positive integer to establish the earliest allowed date as some date after December 31, 1840. For example, a *mindate* of 21550 would establish the earliest allowed date as January 1, 1900. The highest valid value is 2980013 (December 31, 9999).

- 0: specifies the minimum date as December 31, 1840. This is the DateMinimum property default.
- Negative integer -2 or larger: specifies a minimum date counting backwards from December 31, 1840. For example, a *mindate* of -14974 would establish the earliest allowed date as January 1, 1800. Negative *mindate* values are only meaningful if the DateMinimum property of the current locale has been set to an equal or greater negative number. The lowest valid value is -672045.
- If omitted (or specified as -1), *mindate* defaults to the DateMinimum property value for the current locale, unless one of the following is true: If *localeopt*=1, the *mindate* default is 0. If *localeopt* is unspecified and *dformat*=3, the *mindate* default is 0. If *localeopt* is unspecified and *dformat* is 18, 19, 20, or 21 (Islamic date formats) the *mindate* default is 0.

You can get and set the DateMinimum property as follows:

```
  SET min=##class(%SYS.NLS.Format).GetFormatItem("DateMinimum")
  WRITE "initial DateMinimum value is ",min,!
Permit18thCenturyDates
  SET x=##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",-51498)
  SET newmin=##class(%SYS.NLS.Format).GetFormatItem("DateMinimum")
  WRITE "set DateMinimum value is ",newmin,!!
RestrictTo19thCenturyDates
  WRITE $ZDATEH("05/29/1805",1,,,,,-14974),!!
ResetDateMinimumToDefault
  SET oldmin=##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",min)
  WRITE "reset DateMinimum value from ",oldmin," to ",min
```

You may specify *mindate* with or without *maxdate*. Specifying a *mindate* larger than *maxdate* generates an <ILLEGAL VALUE> error.

maxdate

An expression that specifies the upper limit of the range of valid dates (inclusive). Can be specified as a **$HOROLOG** integer date count (for example, 1/1/2100 is represented as 94599) or a **$HOROLOG** string value. You can include or omit the time portion of the **$HOROLOG** date (for example “94599,43200”), but only the date portion of *maxdate* is parsed.

If *maxdate* is omitted or if specified as -1, the maximum date limit is obtained from the DateMaximum property of the current locale, which defaults to the maximum permissible value for the date portion of **$HOROLOG**: 2980013 (corresponding to December 31, 9999 CE). However, the application of the DateMaximum property is governed by the *localeopt* setting. When *localeopt*=1 (which is the default for *dformat*=3) the date maximum default is the ODBC value (2980013), regardless of the current locale setting. Islamic date formats also take the ODBC default. The maximum date for Thai date format (*dformat*=13) is 31/12/9999 BE, which corresponds to **$HOROLOG** 2781687.

Specifying a *date* larger than *maxdate* generates a <VALUE OUT OF RANGE> error.

Specifying a *maxdate* larger than 2980013 generates an <ILLEGAL VALUE> error.

You may specify *maxdate* with or without *mindate*. Specifying a *maxdate* smaller than *mindate* generates an <ILLEGAL VALUE> error.

erropt

Specifying a value for this parameter suppresses errors associated with invalid or out of range *date* values. Instead of generating <ILLEGAL VALUE> or <VALUE OUT OF RANGE> errors, the **$ZDATEH** function returns the *erropt* value.

InterSystems IRIS performs standard numeric evaluation on *date*, which must evaluate to an integer within the *mindate*/*maxdate* range. Thus, 7, "7", +7, 0007, 7.0, "7 dwarves", and --7 all evaluate to the same date value: 01/07/1841. By default, values greater than 2980013 or less than 0 generate a <VALUE OUT OF RANGE> error. Fractional values generate an <ILLEGAL VALUE> error. Non-numeric strings (including the null string) evaluate to 0, and thus return the **$HOROLOG** initial date: 12/31/1840.

The *erropt* parameter only suppresses errors generated due to invalid or out of range values of *date*. Errors generated due to invalid or out of range values of other parameters will always generate errors whether or not *erropt* has been supplied.

For example, an <ILLEGAL VALUE> error is always generated when **$ZDATEH** specifies a sliding window where *endwin* is earlier than *startwin*. Similarly, an <ILLEGAL VALUE> error is generated when *maxdate* is less than *mindate*.

localeopt

This Boolean parameter specifies either the user's current locale definition or the ODBC locale definition as the source for defaults for the locale-specified parameters *dformat, monthlist*, *yearopt*, *mindate* and *maxdate*:

- If *localeopt*=0, all of these parameters take the current locale definition defaults.
- If *localeopt*=1, all of these parameters take the ODBC defaults.
- If *localeopt* is not specified, the *dformat* parameter determine the default for these parameters. If *dformat*=3, the ODBC defaults are used. If *dformat* is 18, 19, 20, or 21 the Islamic date format defaults are used, regardless of the current locale definition. For all other *dformat* values, the current locale definition defaults are used. Refer to the dformat description for further details.

The ODBC locale cannot be changed; it is used to format date strings that are portable between InterSystems IRIS processes that have made different National Language Support (NLS) choices. If *localeopt*=1, the ODBC locale date definitions are as follows:

- Date format defaults to 3. Therefore, if *dformat* is undefined or -1, date format 3 is used.
- Date separator defaults to "/". However, date format defaults to 3, which always uses "-" as the date separator.
- Year option defaults to 4 digits.
- Date minimum and maximum: 0 and 2980013 ($HOROLOG date count).
- English month names, month abbreviations, weekday names, and weekday abbreviations are used.

Examples

The following example returns the **$HOROLOG** date for June 12, 1983:

```
WRITE $ZDATEH("06/12/83")
```

returns 52027.

The following example returns the **$HOROLOG** date for June 12, 1902 (which may not have been your intent):

```
WRITE $ZDATEH("06/12/02")
```

returns 22442.

Note: Two-digit years, by default, are considered 20th Century dates; for 21st Century dates, specify a four-digit year, or change the two-digit sliding window by specifying the *yearopt*, *startwin* and *endwin* parameters. This sliding window can also be set for your locale.

The following example shows how the *dformat* parameter is used to permit multiple date entry formats:

```
WRITE !,$ZDATEH("November 2, 1954",5)
WRITE !,$ZDATEH("Nov 2, 1954",5)
WRITE !,$ZDATEH("Nov. 2 1954",5)
WRITE !,$ZDATEH("11/2/1954",5)
WRITE !,$ZDATEH("11.02.54",5)
WRITE !,$ZDATEH("11 02 1954",5)
```

all return 41578.

In the following examples, suppose the current date is January 16, 2007:

```
WRITE $HOROLOG
```

returns 60646,37854, the first integer of which is the current date (the second integer is the current time, in elapsed seconds).

The next example uses the “T” *date* to return today’s date (here, January 16, 2007):

```
WRITE $ZDATEH("T",5)
```

returns 60646.

The next examples returns the current date with an offset of plus 2 days and minus 2 days:

```
WRITE !,$ZDATEH("T+2",5)
WRITE !,$ZDATEH("T-2",5)
```

returns 60648 and 60644.

The final example illustrates that when no year is specified, **$ZDATEH** assumes the current year (in this case, 2007):

```
WRITE $ZDATEH("25 Nov",5)
```

returns 60959.

Notes

Invalid Values with $ZDATEH

You receive a <FUNCTION> error in the following conditions:

- If you specify an invalid *dformat* code (an integer other than -1, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 15, a zero, or a noninteger value)
- If you specify an invalid *yearopt* code (an integer less than -1 or greater than 6, a value of zero, or a noninteger value)
- If you do not specify a *startwin* value when *yearopt* is 3 or 5

You receive a <ILLEGAL VALUE> error under the following conditions:

- If you specify an invalid value for any date unit (day, month, or year). If specified, the *erropt* value is returned rather than issuing an <ILLEGAL VALUE>.
- If you specify excess leading zeros for any date unit (day, month, or year) in an ODBC date. For example, you can represent the February 3, 2007 as “2007–2–3” or “2007–02–03”, but will receive an <ILLEGAL VALUE> for “2007–002–03”. If specified, the *erropt* value is returned rather than issuing an <ILLEGAL VALUE>.
- If the given month number is greater than the number of month values in *monthlist*.
- If *maxdate* is less than *mindate*.
- If *endwin* is less than *startwin*.
- If *startwin* and *endwin* specify a sliding temporal window whose duration is greater than 100 years.

You receive a <VALUE OUT OF RANGE> error under the following conditions:

- If you specify a date (or an offset to “T”) which is earlier than Dec. 31, 1840 or later than Dec. 31, 9999, and do not supply an *erropt* value
- If you specify an otherwise valid date (or an offset to “T”) which is outside the range of *mindate* and *maxdate* and do not supply an *erropt* value.

Acceptable Date Formats with dformat 5 through 9 and 15

The **$ZDATEH** *dformat* date formats 5 through 9 accept any American format date value that is unambiguous. **$ZDATEH** *dformat* date format 15 accepts any European format date value that is unambiguous. These date formats assume the current year if the date you specify does not include a year.

The following formats are supported:

American Formats: *dformat* 5, 6, 7, 8, or 9	European Formats: *dformat* 15
MM/DD	*DD/MM*
MM-DD	*DD-MM*
MM DD	*DD MM*
MM/DD/YY	*DD/MM/YY*
MM-DD-YY	*DD-MM-YY*
MM DD YY	*DD MM YY*
MM/DD/YYYY	*DD/MM/YYYY*
MM-DD-YYYY	*DD-MM-YYYY*
MM DD YYYY	*DD MM YYYY*
YYYYMMDD	*YYYYMMDD*
YYMMDD	*YYMMDD*
YYYY-MM-DD	*YYYY-MM-DD*
YYYY MM DD	*YYYY MM DD*
Mmm D	*Mmm D*
Mmm D, YY	*Mmm D, YY*
Mmm D, YYYY	*Mmm D, YYYY*
Mmm D YY	*Mmm D YY*
Mmm D YYYY	*Mmm D YYYY*
Mmm DD	*Mmm DD*
Mmm DD YY	*Mmm DD YY*
Mmm DD YYYY	*Mmm DD YYYY*
DD Mmm	*DD Mmm*
DD Mmm YY	*DD Mmm YY*
DD Mmm YYYY	*DD Mmm YYYY*
DD-Mmm	*DD-Mmm*
DD-Mmm-YY	*DD-Mmm-YY*
DD-Mmm-YYYY	*DD-Mmm-YYYY*
YYYY Mmm DD	*YYYY Mmm DD*

MMDD is not an implemented format.

Using $ZDATEH Instead of Utilities

Keep the following points in mind when you need to choose between the **$ZDATEH** function and a date utility:

- You can use the **$ZDATEH** function in place of the existing entry points of the **%DATE** and **%DI** utility.
- **$ZDATEH** and **$ZDATE** are much faster than calling entry points of **%DATE**, **%DI** or **%DO**.

See Also

- JOB command
- $ZDATE function
- $ZDATETIME function
- $ZDATETIMEH function
- $ZTIME function
- $HOROLOG special variable
- $ZTIMESTAMP special variable
- **%DATE** utility, which is documented in the legacy documentation available at http://docs.intersystems.com/priordocexcerpts
- More information on locales in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$ZDATETIME

Validates a date and time and converts it from internal format to the specified display format.

```
$ZDATETIME(hdatetime,dformat,tformat,precision,monthlist,yearopt,startwin,endwin,mindate,maxdate,erropt,localeopt)
$ZDT(hdatetime,dformat,tformat,precision,monthlist,yearopt,startwin,endwin,mindate,maxdate,erropt,localeopt)
```

Parameters

hdatetime	The date and time value, specified in internal date and time format. See hdatetime below.
dformat	*Optional* — An integer code specifying the format for the returned date value. See dformat below.
tformat	*Optional* — An integer code specifying the format for the returned time value. See tformat below.
precision	*Optional* — An integer specifying the number of decimal places of precision (fractional seconds) for the returned time value. See precision below.
monthlist	*Optional* — A string or the name of a variable that specifies a set of month names. This string must begin with a delimiter character, and its 12 entries must be separated by this delimiter character. See monthlist below.
yearopt	*Optional* — An integer code that specifies whether to represent years as two- or four-digit values. See yearopt below.
startwin	*Optional* — The start of the sliding window during which dates are represented with two-digit years. See startwin below.
endwin	*Optional* — The end of the sliding window during which dates are represented with two-digit years. See endwin below.
mindate	*Optional* — The lower limit of the range of valid dates. Specified as a **$HOROLOG** integer date count, with 0 representing December 31, 1840. Can be specified as a positive or negative integer. See mindate below.
maxdate	*Optional* — The upper limit of the range of valid dates, specified as an integer **$HOROLOG** date count. See maxdate below.
erropt	*Optional* — An expression to return when *hdatetime* is invalid. Specifying a value for this parameter suppresses error codes associated with invalid or out of range *hdatetime* values. Instead of issuing an error message, **$ZDATETIME** returns *erropt*. See erropt below.
localeopt	*Optional* — A boolean flag that specifies which locale to use for the *dformat*, *tformat*, *monthlist*, *yearopt*, *mindate* and *maxdate* default values, and other date and time characteristics: *localeopt*=0: the current locale property settings determine these parameter defaults. *localeopt*=1: the ODBC standard locale determines these parameter defaults. *localeopt* not specified: the *dformat* value determines these parameter defaults. If *dformat*=3, ODBC defaults are used; otherwise current locale property settings are used. See localeopt below.

Omitted parameters between specified parameter values are indicated by placeholder commas. Trailing placeholder commas are not required, but are permitted. Blank spaces are permitted between the commas that indicate an omitted parameter.

Description

$ZDATETIME validates a specified date and time and converts them from **$HOROLOG** or **$ZTIMESTAMP** internal format to one of several alternative date and time display formats. The exact value returned depends on the parameters you specify.

- **$ZDATETIME**(*hdatetime*) returns the date and time in the default display format for the current locale.
- **$ZDATETIME**(*hdatetime*,*dformat*,*tformat*,*precision*,*monthlist*,*yearopt*,*startwin*,*endwin*,*mindate*,*maxdate*) returns the date and time in the display format specified by *dformat* and *tformat*, further defined by the other parameters you specify. The range of valid dates may be restricted by the *mindate* and *maxdate* parameters.

Parameters

hdatetime

The date and time, specified as an internal format value. InterSystems IRIS internal format represents dates as a count of days from an arbitrary starting point (Dec. 31, 1840), and represents times as a count of seconds in the current day. The *hdatetime* value must be a string in one of the following formats:

- $HOROLOG: two unsigned integers separated by comma. The first is an integer specifying the date (in days), the second is an integer specifying the time (in seconds).
- $ZTIMESTAMP: two unsigned numbers separated by comma: the first is an integer specifying the date (in days), the second is a number specifying the time (in seconds and fractions of a second). The time value can have up to nine digits of precision (fractional seconds) to the right of the decimal point.

You can specify *hdatetime* as a string value, a variable, or an expression.

If *hdatetime* specifies only the date portion value and no comma, only the date is returned. If *hdatetime* specifies the date portion value followed by a comma, but no time value, the system supplies a time value of 00:00:00.

By default, the earliest valid *hdatetime* date is 0 (December 31, 1840). Dates are limited to positive integers by default because the DateMinimum property defaults to 0. You can specify earlier dates as negative integers, provided the DateMinimum property of the current locale is set to a greater or equal negative integer. The lowest valid DateMinimum value is -672045, which corresponds to January 1, 0001. InterSystems IRIS uses the proleptic Gregorian calendar, which projects the Gregorian calendar back to “Year 1”, in conformance with the ISO 8601 standard. This is, in part, because the Gregorian calendar was adopted at different times in different countries. For example, much of continental Europe adopted it in 1582; Great Britain and the United States adopted it in 1752. Thus InterSystems IRIS dates prior to your local adoption of the Gregorian calendar may not correspond to historical dates that were recorded based on the local calendar then in effect. For further details on dates prior to 1840, refer to the mindate parameter.

Invalid and out-of-range *hdatetime* values and resulting errors are described in the erropt parameter.

dformat

Format for the returned date. Valid values are:

Value	Meaning
1	*MM/DD/[YY]YY* (07/01/97 or 02/22/2018) — American numeric format. The dateseparator character (/ or .) is taken from the current locale setting.
2	*DD Mmm* [YY]YY (01 Jul 97)

Value	Meaning
3	*YYYY-MM-DD* (2018-02-22) — ODBC format. By default this format is independent of your current locale settings, thus specifying dates and times in an ODBC standard interchange format. (The ODBC time format default is described in the *tformat* section, below.) To use your current date and time locale settings with this format, set *localeopt* to 0.
4	*DD/MM/[YY]YY* (01/07/97 or 22/02/2018) — European numeric format. The dateseparator character (/ or .) is taken from the current locale setting.
5	*Mmm [D]D, YYYY* (Jul 1, 1997)
6	*Mmm [D]D YYYY* (Jul 1 1997)
7	*Mmm DD [YY]YY* (Jul 01 1997)
8	*YYYYMMDD* (19970701) — Numeric format
9	*Mmmmm [D]D, YYYY* (July 1, 1997)
10	*W* (2) — Day number for the week, numbered from 0 (Sunday) through 6 (Saturday). Compare with the **$SYSTEM.SQL.DAYOFWEEK()** method.
11	*Www* (Tue) — Abbreviated day name
12	*Wwwwww* (Tuesday) — Full day name
13	*[D]D/[M]M/YYYY* (1/7/2549 or 27/11/2549) — Thai date format. Day and month are identical to European usage, except no leading zeros. The year is the Buddhist Era (BE) year, calculated by adding 543 years to the Gregorian year.
14	*nnn* (354) — Day number for the year
15	DD/MM/[YY]YY (01/07/97 or 22/02/2018) — European format (same as *dformat*=4). The dateseparator character (/ or .) is taken from the current locale setting.
16	YYYYc[M]Mc[D]Dc — Japanese date format. Year, month, and day numbers are the same as other date formats; leading zeros are omitted. The Japanese characters for “year”, “month”, and “day” (shown here as *c*) are inserted after the year, month, and day numbers. These characters are Year=$CHAR(24180), Month=$CHAR(26376), and Day=$CHAR(26085).
17	YYYYc [M]Mc [D]Dc — Japanese date format. Same as *dformat* 16, except that a blank space is inserted after the “year” and “month” Japanese characters.
18	[D]D Mmmmm YYYY — Tabular Hijri (Islamic) date format with full month name. Day leading zeros are omitted; year leading zeros are included. InterSystems IRIS date -445031 (07/19/0622 C.E.) = 1 Muharram 0001 AH.
19	[D]D [M]M YYYY — Tabular Hijri (Islamic) date format with month number. Day and month leading zeros are omitted; year leading zeros are included. InterSystems IRIS date -445031 (07/19/0622 C.E.) = 1 1 0001 AH.
20	[D]D Mmmmm YYYY — Observed Hijri (Islamic) date format with full month name. Defaults to Tabular Hijri (*dformat* 18). To override tabular calculation, use the class %Calendar.Hijri to add observations of new moon crescents.
21	[D]D [M]M YYYY — Observed Hijri (Islamic) date format with month number. Defaults to Tabular Hijri (*dformat* 19). To override tabular calculation, use the class %Calendar.Hijri to add observations of new moon crescents.

Value	Meaning
-1	Get effective *dformat* value from the user's locale, fmt.DateFormat, where fmt is an instance of ##class(%SYS.NLS.Format) associated with the current process. This is the default behavior if you do not specify *dformat*. See "Customizable Date and Time Defaults" for further details.
-2	**$ZDATETIME** returns an integer specifying the count of seconds from a platform-specific origin date/time. This is the value returned by the time() library function, as defined in the ISO C Programming Language Standard. For example, on POSIX-compliant systems this value is the count of seconds from January 1, 1970 00:00:00 UTC. Fractional seconds in the input value are permitted, but ignored. (Currently, this date conversion potentially has the "local time variant boundary day" time conversion anomaly described for *tformat* values 5, 6, 7, and 8.) To convert this integer count of seconds to a PosixTime value, you can use the **UnixTimeToLogical()** method, as shown below. The following platform-specific formats are supported: 32-bit Linux: signed 32-bit integer; 64-bit Linux: signed 64-bit integer; Windows: unsigned 64-bit integer. The *tformat*, *precision*, *monthlist*, *yearopt*, *startwin*, and *endwin* parameters are ignored.
-3	**$ZDATETIME** takes a *datetime* value specified in $HOROLOG internal format, converts that value from local time to UTC Universal time, and returns the resulting value in the same internal format. The *tformat*, *monthlist*, *yearopt*, *startwin*, and *endwin* parameters are ignored. **$ZDATETIMEH** performs the inverse operation. (Currently, this date conversion has the time conversion anomalies described for *tformat* values 5, 6, 7, and 8. These potentially affect dates prior to 1970, dates after 2038, and local time variant boundary days, such as the beginning date or end date for Daylight Saving Time.)

Where:

Syntax	Meaning
YYYY	*YYYY* is a four-digit year. *[YY]YY* is a two-digit year if *hdatetime* falls within the active window for two-digit years; otherwise it is a four-digit year.
MM	Two-digit month: 01 through 12. *[M]M* indicates that the leading zero is omitted for months 1 through 9.
DD	Two-digit day: 01 through 31. *[D]D* indicates that the leading zero is omitted for days 1 through 9.
Mmm	Month abbreviation extracted from the MonthAbbr property of the current locale. An alternate month abbreviation (or name of any length) can be extracted from an optional list specified as the *monthlist* parameter to **$ZDATETIME**. The MonthAbbr default values are: "Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec"
Mmmmm	Full name of the month as specified by the MonthName property of the current locale. The default values are: "January February March ... November December"
W	Number 0-6 indicating the day of the week: Sunday=0, Monday=1, Tuesday=2, etc.
Www	Weekday name abbreviation as specified by the WeekdayAbbr property of the current locale. The default values are: "Sun Mon Tue Wed Thu Fri Sat"
Wwwwww	Weekday full name as specified by the WeekdayName property of the current locale. The default values are: "Sunday Monday Tuesday Wednesday Thursday Friday Saturday"

Syntax	Meaning
nnn	Day number for the specified year, always three digits, with leading zeros if necessary. Values are 001 through 365 (or 366 on leap years).

dformat Default

If you omit *dformat* or set it to -1, the *dformat* default depends on the *localeopt* parameter and the NLS DateFormat property:

- If *localeopt*=1 the *dformat* default is ODBC format. The *tformat*, *monthlist*, *yearopt*, *mindate* and *maxdate* parameters are also set to ODBC format. This is the same as setting *dformat*=3.
- If *localeopt*=0 or is unspecified, the *dformat* default is taken from NLS DateFormat property. If DateFormat=3, the *dformat* default is ODBC format. However, DateFormat=3 does not affect the *tformat*, *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults, which are as specified in the current NLS locale definition.

To determine the default date format for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DateFormat")
```

European date format (*dformat*=4, DD/MM/YYYY order) is the default for many (but not all) European languages, including British English, French, German, Italian, Spanish, and Portuguese (which use a “/” DateSeparator character), as well as Czech (csyw), Russian (rusw), Slovak (skyw), Slovenian (svnw), and Ukrainian (ukrw) (which use a “.” DateSeparator character). For further details on default date formats for supported locales, refer to Dates in *Using ObjectScript*.

dformat Settings

If *dformat* is 3 (ODBC date format), ODBC format defaults are also used for the *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults. Current locale defaults are ignored.

If *dformat* is -1, 1, 4, 13, or 15 (numeric date formats), **$ZDATETIME** uses the value of the DateSeparator property of the current locale as the delimiter between months, days, and the year. When *dformat* is 3 the ODBC date separator (“-”) is used. For all other *dformat* values, a space is used as the date separator. The default value of DateSeparator in English is “/” and all documentation uses this delimiter.

If *dformat* is 11 or 12 (day names) and *localeopt*=0 or is unspecified the day name values come from the current locale properties. If *localeopt*=1, day names come from the ODBC locale. To determine the default weekday names and weekday abbreviations for your locale, invoke the following NLS class methods:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("WeekdayName"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("WeekdayAbbr"),!
```

If *dformat* is -2 (Unix® time: UTC elapsed seconds since 1970-01-01 00:00:00), you can convert this value to an encoded PosixTime value using the **UnixTimeToLogical()** method. The following example uses *dformat* -2 to convert local time to elapsed seconds in UTC (Greenwich) time. It then converts this count of seconds to an encoded %PosixTime value using **UnixTimeToLogical()**. It converts this PosixTime value back to a ODBC-format datetime in UTC time using **LogicalToOdbc()**. It also converts PosixTime back to elapsed seconds using **LogicalToUnixTime()**, then uses $ZDATETIMEH with *dformat* -2 to convert this UTC elapsed seconds count to local datetime:

```
WRITE "local datetime: ",$ZDATETIME($HOROLOG,3),!
SET secs=$ZDATETIME($HOROLOG,-2)
WRITE "UTC seconds since 1970: ",secs,!
SET posix=##class(%PosixTime).UnixTimeToLogical(secs)
WRITE "PosixTime encoded value: ",posix,!
SET datetime=##class(%PosixTime).LogicalToOdbc(posix)
WRITE "UTC datetime: ",datetime,!
SET secs2=##class(%PosixTime).LogicalToUnixTime(posix)
WRITE "UTC seconds since 1970: ",secs2,!
SET htime=$ZDATETIMEH(secs2,-2)
WRITE "local datetime: ",$ZDATETIME(htime,3)
```

Note that Unix® time is a count of whole seconds, whereas Posix time counts fractional seconds with six decimal digits of precision.

If *dformat* is 16 or 17 (Japanese date formats), the returned date format is independent of the locale setting. Japanese-format dates can be returned from any InterSystems IRIS instance.

If *dformat* is 18, 19, 20, or 21 (Islamic date formats) and *localeopt* is unspecified, parameters default to Islamic defaults, rather than current locale defaults. The *monthlist* parameter defaults to Arabic month names transliterated with Latin characters. The *tformat*, *yearopt*, *mindate* and *maxdate* parameters default to ODBC defaults. The date separator defaults to the Islamic default (a space), not the ODBC default or the current locale DateSeparator property value. If *localeopt*=0 current locale property defaults are used for these parameters. If *localeopt*=1 ODBC defaults are used for these parameters.

tformat

A numeric value that specifies the format in which you want to express the time value. Supported values are:

Value	Meaning
-1	Get the effective *tformat* value from the TimeFormat property of the current locale, which defaults to a value of 1. This is the default behavior if you do not specify *tformat* for all *dformat* values except 3.
1	Express time in the form "*hh:mm:ss*" (24-hour clock).
2	Express time in the form “*hh:mm*” (24-hour clock)
3	Express time in the form “*hh:mm:ss*[AM/PM]” (12-hour clock)
4	Express time in the form “*hh:mm*[AM/PM]” (12-hour clock)
5	Express time in the form "*hh:mm:ss+/-hh:mm*" (24-hour clock). The time is expressed as local time. The plus (+) or minus (–) suffix shows the system-defined offset of local time from Coordinated Universal Time (UTC). A minus sign (-hh:mm) indicates that the local time is earlier (westward) of the Greenwich meridian by the returned offset number of hours and minutes. A plus sign (+hh:mm) indicates that the local time is later (eastward) of the Greenwich meridian by the returned offset number of hours and minutes. Further details are described below.
6	Express time in the form “*hh:mm+/-hh:mm*” (24-hour clock). The time is expressed as local time. The plus (+) or minus (–) suffix shows the system-defined offset of local time from Coordinated Universal Time (UTC). A minus sign (-hh:mm) indicates that the local time is earlier (westward) of the Greenwich meridian by the returned offset number of hours and minutes. A plus sign (+hh:mm) indicates that the local time is later (eastward) of the Greenwich meridian by the returned offset number of hours and minutes. Further details are described below.
7	Express time in the form "*hh:mm:ss*Z" (24-hour clock). The “Z” suffix indicates that the time is expressed as Coordinated Universal Time (UTC), rather than as local time.
8	Express time in the form “*hh:mm*Z” (24-hour clock). The “Z” suffix indicates that the time is expressed as Coordinated Universal Time (UTC), rather than as local time.

If you omit *tformat* or set it to -1, the *tformat* default depends on the *localeopt* parameter and the NLS TimeFormat property:

For all *dformat* values except 3, 18, 19, 20, and 21 all time formats default to the current locale definition TimeSeparator and DecimalSeparator property values. For *dformat*=3 (ODBC date format) and *dformat*=18, 19, 20, or 21 (Islamic date formats) the time separator is a colon (:) and the DecimalSeparator is a period (.) regardless of the current locale property values. These defaults can be overridden by setting *localeopt*.

To determine the default time properties for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("TimeFormat"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("TimeSeparator"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DecimalSeparator")
```

For *tformat* values 1 through 4 (which return local time), the date is separated from the time by a space. For *tformat* values 5 through 8 the date is separated from the time by the letter “T”.

12–hour Clock (tformat 3 and 4)

In 12-hour clock formats, morning and evening are represented by time suffixes, here shown as AM and PM. To determine the default time suffixes for your locale, invoke the **GetFormatItem()** NLS class method, as follows:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("AM"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("PM"),!
```

For all *dformat* values except 3, 18, 19, 20, and 21 the `AM` and `PM` properties default to the current locale definition. For *dformat*=3 (ODBC date format) and *dformat*=18, 19, 20, or 21 (Islamic date formats) the time suffixes are always “AM” and “PM”, regardless of the current locale property values. The `AM` and `PM` property defaults are “AM” and “PM” for all locales except the Japanese locale jpww.

By default, Midnight and Noon are represented as “MIDNIGHT” and “NOON” for all locales except Japanese locales (jpnw, jpuw, jpww, zdsw, zdtw, zduw), Portuguese (ptbw), Russian (rusw), and Ukrainian (ukrw).

However, when *dformat*=3, **$ZDATETIME** always uses the ODBC standard values, regardless of the default settings for your locale.

Local Time (tformat 5, 6, 7, and 8)

When *tformat* is set to 5 or 6, the *hdatetime* input value is assumed to be local date and time, and is displayed as local date and time. If *hdatetime* is the current local date and time (**$HOROLOG**), changing $ZTIMEZONE will change this current date and time for the current process.

The offset suffix specifies the local time variant setting as a positive or negative offset in hours and minutes from the Greenwich meridian. Note that this local time variant is not necessarily the time zone offset. For example, the Eastern United States time zone is 5 hours west of Greenwich (`-5:00`), but the local time variant (Daylight Saving Time) offsets the time zone time by one hour to `-04:00`. Setting **$ZTIMEZONE** changes the current process date and time returned by `$ZDATETIME($HOROLOG,1,5)`, but does not change the system local time variation setting.

Note: *tformat* 5 or 6 return the local time variation offset from UTC time. This is neither the local time zone offset, nor is it a comparison of your local time with local time at Greenwich England. The term Greenwich Mean Time (GMT) may be confusing; local time at Greenwich England is the same as UTC during the winter; during the summer it differs from UTC by one hour. This is because a local time variant, known as British Summer Time, is applied.

The following example shows how the *tformat* 5 value is affected by the operating system’s local time variation setting and by changing the time zone for the current process. (Note that this example checks whether a local time variation boundary occurs during program execution):

```
LocalDatetimeOffset
  SET dst=$SYSTEM.Util.IsDST()
  SET local=$ZDATETIME($HOROLOG,1,5)
  WRITE local," is the local date/time and offset",!!
  SET off=$PIECE(local,"+",2)
  IF off="" {SET off=$PIECE(local,"-",2)
             WRITE "-",off," is local offset",!}
  ELSE {WRITE "+",off," is local offset",!}
  SET tz=$ZTIMEZONE
  WRITE tz/60," is the local timezone offset, in hours",!!
  IF dst=1 {WRITE " DST in effect, ",off," offset is not ",tz/60," time zone offset",!}
    ELSEIF dst=0 {WRITE " DST not in effect, offset ",off,"=timezone ",tz/60,!}
    ELSE {WRITE " DST setting cannot be determined",!}
ChangeTimezoneForCurrentProcess
  SET $ZTIMEZONE=tz+180
  WRITE !,"changed the process time zone westward 3 hours",!
  WRITE $ZDATETIME($HOROLOG,1,5)," is new local date/time and offset",!
  WRITE "note that time has changed, but offset has not changed"
  SET $ZTIMEZONE=tz
ConfirmNoDSTBoundary
  SET dst2=$SYSTEM.Util.IsDST()
  GOTO:dst'=dst2 LocalDatetimeOffset
```

When *tformat* is set to 7 or 8, the *hdatetime* input value is assumed to be local date and time. The time is changed to correspond to UTC time (calculated using the local timezone setting). The date returned may also be changed (if necessary) to correspond to this UTC time value. Thus the returned date may differ from the local date.

Note: Conversions involving *dformat* values -2 and -3 and *tformat* values 7 and 8 and the UTC offsets generated by *tformat* values 5 and 6 have the following platform-dependent anomalies:

- Conversions from local time to UTC time depend on local time variant boundary behavior, which may differ on different operating system platforms:

  When the local clock shifts forwards ("Spring ahead" at the start of Daylight Saving Time) the local time loses an hour. This "lost" hour is an illegal local time value. InterSystems IRIS **$HOROLOG** should never return an illegal local time value. However, if a user manually enters this illegal local time value (for example, by setting $HOROLOG), **$ZDATETIME** conversion results are undefined and highly platform-dependent.

  When the local clock shifts backwards ("Fall back" at the end of Daylight Saving Time) the local time hour is repeated. Within this two-hour period, an InterSystems IRIS time conversion operation cannot determine whether it is being applied to the first occurrence of that local time hour, or the second occurrence of the same hour. **$ZDATETIME** uses whichever assumption is used by the platform-specific runtime library. Therefore, within this temporal window, different operating system platforms may give different time conversion results.

- Conversions between local time and UTC time must use the local time variant rules in force for the specified year and location. Because these rules are established by local laws, may have changed in the past, and are subject to change in the future, **$ZDATETIME** conversions depend upon the completeness and accuracy of the rules as encoded by the operating system platform. Predictions for future years must necessarily use the current rules, and these rules may change.

- Conversions between local time and UTC time depend on the date range supported by the operating system platform:

  If a date is earlier than the earliest date supported by the platform, InterSystems IRIS uses the standard time offset for 1902–01–01 (if this date is supported by the platform). If the date 1902–01–01 is not supported by the platform, InterSystems IRIS uses the standard time offset for 1970–01–01. Any local time variant offset (such as Daylight Saving Time) is ignored.

  If a date is later than the latest date supported by the platform, InterSystems IRIS calculates a corresponding date within the range 2010–01–01 to 2037–12–31 and uses the standard time offset for that corresponding date. This algorithm should provide accurate time offsets for dates up to 2100–02–28, provided there are no future changes to the laws governing date/time observances.

Note: **$ZDATETIME** has no way to determine if an *hdatetime* input value is in UTC time or local time. Therefore, do not use *tformat* values 5, 6, 7, or 8 with an *hdatetime* that is *already* in UTC, such as a **$ZTIMESTAMP** value. If you use the output from a *tformat* 7 or 8 conversion in an operation that converts the time back to local time be aware that the date may have been changed in the local-to-UTC conversion.

precision

An integer value that specifies the number of decimal places of fractional seconds precision used to express the time. That is, if you enter a value of 3 as *precision*, **$ZDATETIME** displays the seconds carried out to three decimal places. If you enter a value of 9 as *precision*, **$ZDATETIME** displays the seconds carried out to nine decimal places. This argument specifies the number of fractional digits to return; the actual number of meaningful digits of precision is determined by the *hdatetime* source. For example, **$HOROLOG** does not return fractional seconds; **$ZTIMESTAMP** and **$NOW()** return fractional seconds.

Supported values are as follows:

-1: Get the *precision* value from the TimePrecision property of the current locale, which defaults to a value of 0. This is the default behavior if you do not specify *precision*.

A value of *n* that is greater than or equal to zero (0) results in the expression of time to *n* decimal places.

Precision is only applicable if the *hdatetime* format can include a fractional time value (**$ZTIMESTAMP** format), and if the *tformat* option selected includes seconds. Trailing zeros are not suppressed. If the precision specified exceeds the precision available on your system, the excess digits of precision are returned as trailing zeros. You can use the **Normalize()** method to suppress excess trailing zeros, as shown in the following example, which specifies a *precision* of 9:

```
WRITE $ZDATETIME($ZTIMESTAMP,3,,9),!
WRITE ##class(%TimeStamp).Normalize($ZDATETIME($ZTIMESTAMP,3,,9))
```

To determine the default time precision for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("TimePrecision")
```

You can set the locale's TimePrecision to the desired number of digits, to a maximum of 15.

monthlist

An expression that resolves to a string of month names or month name abbreviations, separated by a delimiter character. The names in *monthlist* replace the default month abbreviation values from the MonthAbbr property or the month name values from the MonthName property of the current locale.

monthlist is valid only if *dformat* is 2, 5, 6, 7, 9, 18, or 20. If *dformat* is any other value **$ZDATETIME** ignores *monthlist*.

The *monthlist* string has the following format:

- The first character of the string is a delimiter character (usually a space). The same delimiter must appear before the first month name and between each month name in *monthlist*. You can specify any single-character delimiter; this delimiter appears between the month, day, and year portions of the returned date value, which is why a space is usually the preferred character.
- The month names string should contain twelve delimited values, corresponding to January through December. It is possible to specify more or less than twelve month names, but if there is no month name corresponding to the month in *hdatetime* an <ILLEGAL VALUE> error is generated.

If you omit *monthlist* or specify a *monthlist* value of -1, **$ZDATETIME** uses the list of month names defined in the MonthAbbr or MonthName property of the current locale, unless one of the following is true: If *localeopt*=1, the *monthlist* default is the ODBC month list (in English). If *localeopt* is unspecified and *dformat* is 18 or 20 (Islamic date formats) the *monthlist* default is the Islamic month list (Arabic names expressed using Latin letters), ignoring the MonthAbbr or MonthName property value.

To determine the default month names and month abbreviations for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MonthName"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MonthAbbr"),!
```

yearopt

With *dformat* values 0, 1, 2, 4, 7, or 15, a numeric code that specifies the temporal window in which to display the year as a two-digit value. *yearopt* can be:

Value	Meaning
-1	Get effective *yearopt* value from YearOption property of current locale which defaults to a value of 0. This is the default behavior if you do not specify *yearopt*.

Value	Meaning
0	Represent 20th century dates (1900 through 1999) with two-digit years, unless a process-specific sliding window (established via the **%DATE** utility) is in effect. If such a window is in effect, represent only those dates falling within the sliding window by two-digit years. Represent all dates falling outside the 20th century or outside the process-specific sliding window by four-digit years.
1	Represent 20th century dates with two-digit years and all other dates with four-digit years.
2	Represent all dates with two-digit years.
3	Represent with two-digit years those dates falling within the sliding temporal window defined by *startwin* and (optionally) *endwin*. Represent all other dates with four-digit years. When *yearopt*=3, *startwin* and *endwin* are absolute dates in **$HOROLOG** format.
4	Represent all dates with four-digit years.
5	Represent with two-digit years all dates falling within the sliding window defined by *startwin* and (optionally) *endwin*. Represent all other dates with four-digit years. When yearopt=5, *startwin* and *endwin* are relative years.
6	Represent all dates in the current century with two-digit years and all other dates with four-digit years.

To determine the default year option for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("YearOption")
```

If you omit *yearopt* or specify a *yearopt* value of -1, **$ZDATETIME** uses the YearOption property of the current locale, unless one of the following is true: If *localeopt*=1, the *yearopt* default is the ODBC year option. If *localeopt*=0 or is unspecified and *dformat* is 18, 19, 20, or 21 (Islamic date formats) the *yearopt* default is the ODBC year option (4-digit years); the YearOption property value is ignored for Islamic dates.

startwin

A numeric value that specifies the start of the sliding window during which dates must be represented with two-digit years. You must supply *startwin* when you use a *yearopt* of 3 or 5. *startwin* is not valid with any other *yearopt* values.

When *yearopt*=3, *startwin* is an absolute date in **$HOROLOG** date format that indicates the start date of the sliding window.

When *yearopt*=5, *startwin* is a numeric value that indicates the start year of the sliding window expressed in the number of years before the current year.

endwin

A numeric value that specifies the end of the sliding window during which dates are represented with two-digit years. You may optionally supply *endwin* when *yearopt* is 3 or 5. *endwin* is not valid with any other *yearopt* values.

When *yearopt*=3, *endwin* is an absolute date in **$HOROLOG** date format that indicates the end date of the sliding window.

When *yearopt*=5, *endwin* is a numeric value that indicates the end year of the sliding window expressed as the number of years past the current year.

When *yearopt*=5, the sliding window always begins on January 1st of the year specified in *startwin* and ends on December 31st of the year specified in *endwin*, or of the implied end year (if you omit *endwin*).

If *endwin* is omitted (or specified as -1) the effective sliding window will be 100 years long. The *endwin* value of -1 is a special case that always returns a date value, even when higher and lower *endwin* values return *erropt*. For this reason, it is preferable to omit *endwin* when specifying a 100-year window, and to avoid the use of negative *endwin* values.

If you supply both *startwin* and *endwin* , the sliding window they specify must not have a duration of more than 100 years.

mindate

An expression that specifies the lower limit of the range of valid dates (inclusive). Can be specified as a **$HOROLOG** integer date count (for example, 2/22/2018 is represented as 64701) or a **$HOROLOG** string value. You can include or omit the time portion of the **$HOROLOG** date (for example “64701,43200”), but only the date portion of *mindate* is parsed. Specifying an *hdatetime* value earlier than *mindate* generates a <VALUE OUT OF RANGE> error.

The following are supported *mindate* values:

- Positive integer: Most commonly *mindate* is specified as a positive integer to establish the earliest allowed date as some date after December 31, 1840. For example, a *mindate* of 21550 would establish the earliest allowed date as January 1, 1900. The highest valid value is 2980013 (December 31, 9999).
- 0: specifies the minimum date as December 31, 1840. This is the DateMinimum property default.
- Negative integer -2 or larger: specifies a minimum date counting backwards from December 31, 1840. For example, a *mindate* of -14974 would establish the earliest allowed date as January 1, 1800. Negative *mindate* values are only meaningful if the DateMinimum property of the current locale has been set to an equal or greater negative number. The lowest valid value is -672045; a *mindate* earlier than -672045 generates an <ILLEGAL VALUE> error.
- If omitted (or specified as -1), *mindate* defaults to the DateMinimum property value for the current locale, unless one of the following is true: If *localeopt*=1, the *mindate* default is 0. If *localeopt* is unspecified and *dformat*=3, the *mindate* default is 0. If *localeopt* is unspecified and *dformat* is 18, 19, 20, or 21 (Islamic date formats) the *mindate* default is 0.

You can get and set the DateMinimum property as follows:

```
  SET min=##class(%SYS.NLS.Format).GetFormatItem("DateMinimum")
  WRITE "initial DateMinimum value is ",min,!
Permit18thCenturyDates
  SET x=##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",-51498)
  SET newmin=##class(%SYS.NLS.Format).GetFormatItem("DateMinimum")
  WRITE "set DateMinimum value is ",newmin,!!
RestrictTo19thCenturyDates
  WRITE $ZDATETIME(-13000,1,,,,,,,-14974),!!
ResetDateMinimumToDefault
  SET oldmin=##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",min)
  WRITE "reset DateMinimum value from ",oldmin," to ",min
```

You may specify *mindate* with or without *maxdate*. Specifying a *mindate* larger than *maxdate* generates an <ILLEGAL VALUE> error.

ODBC Date Format (dformat 3)

The application of the DateMinimum property is governed by the *localeopt* setting. When *localeopt*=1 (which is the default for *dformat*=3) the date minimum is 0, regardless of the current locale setting. Therefore, in ODBC format (*dformat*=3) the following can be used to specify a date prior to December 31, 1840:

- Specify a *mindate* earlier than the specified date:

  ```
  WRITE $ZDATETIME(-30,3,,,,,,,-365)
  ```

- Specify a DateMinimum property value earlier than the specified date and set *localeopt*=0:

  ```
  DO ##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",-365)
  WRITE $ZDATETIME(-30,3,,,,,,,,,,0)
  ```

maxdate

An expression that specifies the upper limit of the range of valid dates (inclusive). Can be specified as a **$HOROLOG** integer date count (for example, 1/1/2100 is represented as 94599) or a **$HOROLOG** string value. You can include or omit the time portion of the **$HOROLOG** date (for example “94599,43200”), but only the date portion of *maxdate* is parsed.

If *maxdate* is omitted or if specified as -1, the maximum date limit is obtained from the DateMaximum property of the current locale, which defaults to the maximum permissible value for the date portion of **$HOROLOG**: 2980013 (corresponding to December 31, 9999 CE). However, the application of the DateMaximum property is governed by the *localeopt* setting. When *localeopt*=1 (which is the default for *dformat*=3) the date maximum default is the ODBC value (2980013), regardless of the current locale setting. Islamic date formats also take the ODBC default. The maximum date for Thai date format (*dformat*=13) is **$HOROLOG** 2781687 which corresponds to 31/12/9999 BE.

Specifying a *hdatetime* date larger than *maxdate* generates a <VALUE OUT OF RANGE> error.

Specifying a *maxdate* larger than 2980013 generates an <ILLEGAL VALUE> error.

You may specify *maxdate* with or without *mindate*. Specifying a *maxdate* smaller than *mindate* generates an <ILLEGAL VALUE> error.

erropt

Specifying a value for this parameter suppresses errors associated with invalid or out of range *hdatetime* values. Instead of generating <ILLEGAL VALUE> or <VALUE OUT OF RANGE> errors, the **$ZDATETIME** function returns the *erropt* value.

- Validation: InterSystems IRIS performs canonical numeric conversion on *hdatetime*. The date and time portions of *hdatetime* are parsed separately. It parses the first comma encountered as the date/time separator. Additional commas are treated as non-numeric characters.

  Parsing of each portion of an *hdatetime* string halts at the first non-numeric character. Therefore, an *hdatetime* such as `64687AD,1234SECS` is the same as `64687,1234`. A non-numeric date or time portion (including the null string) evaluates to 0. Thus an empty string *hdatetime* returns the **$HOROLOG** initial date: December 31, 1840.

  However, if the date portion value does not evaluate to an integer (contains a non-zero fractional number) it generates an <ILLEGAL VALUE> error.

- Range: The date portion of *hdatetime* must evaluate to an integer within the *mindate*/*maxdate* range. By default, date values greater than 2980013 or less than 0 generate a <VALUE OUT OF RANGE> error. By setting *mindate* to a negative number, you can extend the range of valid dates before December 31, 1840. However, for *dformat* 18, 19, 20, or 21 (Hijri Islamic calendar) dates, any date prior to -445031 generates an <ILLEGAL VALUE> error, even if *mindate* is set to an earlier date.

  A time portion of *hdatetime* with a value greater than 86399 generates an <ILLEGAL VALUE> error. A negative *hdatetime* time value generates an <ILLEGAL VALUE> error.

The *erropt* parameter only suppresses errors generated due to invalid or out of range values of *hdatetime*. Errors generated due to invalid or out of range values of other parameters will always generate errors whether or not *erropt* has been supplied. For example, an <ILLEGAL VALUE> error is always generated when **$ZDATETIME** specifies a sliding window where *endwin* is earlier than *startwin*. Similarly, an <ILLEGAL VALUE> error is generated when *maxdate* is less than *mindate*.

localeopt

This Boolean parameter specifies either the user's current locale definition or the ODBC locale definition as the source for defaults for the locale-specified parameters *dformat*, *tformat*, *monthlist*, *yearopt*, *mindate* and *maxdate*:

- If *localeopt*=0, all of these parameters take the current locale definition defaults.
- If *localeopt*=1, all of these parameters take the ODBC defaults.
- If *localeopt* is not specified, the *dformat* parameter determine the default for these parameters. If *dformat*=3, the ODBC defaults are used. If *dformat* is 18, 19, 20, or 21 the Islamic date and time format defaults are used, regardless of the current locale definition. For all other *dformat* values, the current locale definition defaults are used. Refer to the dformat description for further details.

The ODBC standard locale cannot be changed; it is used to format date and time strings that are portable between InterSystems IRIS processes that have made different National Language Support (NLS) choices. The ODBC locale date and time definitions are as follows:

- Date format defaults to 3. Therefore, if *dformat* is undefined or -1, date format 3 is used.
- Date separator defaults to "/". However, date format defaults to 3, which always uses "-" as the date separator.
- Year option defaults to 4 digits.
- Date minimum and maximum are 0 and 2980013 (**$HOROLOG** date count).
- English month names, month abbreviations, weekday names, weekday abbreviations, and the words "Noon" and "Midnight" are used.
- Time format defaults to 1. Time separator is ":". Time precision is 0 (no fractional seconds). AM and PM indicators are "AM" and "PM".

Examples

The following example displays the current local date and time. It takes the default date and time format for the locale:

```
WRITE $ZDATETIME($HOROLOG)
```

The following example displays the current date and time. **$ZTIMESTAMP** contains the current date and time value as Coordinated Universal Time (UTC) date and time. The *dformat* parameter specifies ODBC date format, the *tformat* parameter specifies a 24-hour clock, and the *precision* parameter specifies 6 digits of fractional second precision:

```
WRITE $ZDATETIME($ZTIMESTAMP,3,1,6)
```

This returns the current time stamp date and time, formatted like: `2018-11-25 18:45:16.960000`.

The following example shows how a local time can be converted to UTC time, and how the date may also change as a result of this conversion. In most time zones, the time conversion in one of the following **$ZDATETIME** operations also changes the date:

```
SET local = $ZDATETIME("60219,82824",3,1)
SET utcwest = $ZDATETIME("60219,82824",3,7)
SET utceast = $ZDATETIME("60219,00024",3,7)
WRITE !,local,!,utcwest,!,utceast
```

Notes

Invalid Values with $ZDATETIME

You receive a <FUNCTION> error in the following conditions:

- If you specify an invalid *dformat* code (an integer value less than -3 or greater than 17, a zero, or a noninteger value)
- If you specify a invalid value for *tformat* (an integer value less than -1 or greater than 10, a zero, or a noninteger value)
- If you do not specify a *startwin* value when *yearopt* is 3 or 5

You receive a <ILLEGAL VALUE> error under the following conditions:

- If you specify an invalid value for a date or time and do not supply an *erropt* value
- If the given month number is greater than the number of month values in *monthlist*
- If *maxdate* is less than *mindate*
- If *endwin* is less than *startwin*
- If *startwin* and *endwin* specify a sliding temporal window whose duration is greater than 100 years

You receive a <VALUE OUT OF RANGE> error under the following conditions:

- If you specify an otherwise valid date which is outside the range defined by the values assumed for *maxdate* and *mindate* and do not supply an *erropt* value

Customizable Date and Time Defaults

Upon InterSystems IRIS startup, the default date and time formats are initialized to the American date and time formats (for example, MM/DD/[YY]YY). To set this and other default formats to the values for your current locale, set the following global variable: `SET ^SYS("NLS","Config","LocaleFormat")=1`. This sets all format defaults for all processes to your current locale values. These defaults persist until this global is changed.

Note: This section describes the user locale definitions applied when *localeopt* is undefined or set to 0. When *localeopt*=1, **$ZDATETIME** uses a predefined ODBC locale.

In the following example, the first **$ZDATETIME** returns a date and time in the default format for the locale. The input parameters are the **$ZTIMESTAMP** special variable, with the *dformat* and *tformat* taking defaults, and *precision* set to 2 decimal digits. In most locales, the first **$ZDATETIME** will return *dformat*=1 or the American date and time format with a slash date separator and a dot decimal separator for fractional seconds.

In the ChangeVals section, the first **SetFormatItem()** method changes the locale date format default to *dformat*=4, or the European date format (DD/MM/[YY]YY), as is shown by the second **$ZDATETIME**. The second **SetFormatItem()** method changes the locale default for the date separator character (which affects the *dformat* –1, 1, 4, and 15). In this example, the date separator character is set to a dot ("."), as shown by the third **$ZDATETIME**. The third **SetFormatItem()** method changes the decimal separator character for this locale to the European standard (","), as shown by the final **$ZDATETIME**. This program then restores the initial date format values:

```
InitalizeLocaleFormat
   SET ^SYS("NLS","Config","LocaleFormat")=1
InitialVals
   SET fmt=##class(%SYS.NLS.Format).GetFormatItem("DateFormat")
   SET sep=##class(%SYS.NLS.Format).GetFormatItem("DateSeparator")
   SET dml=##class(%SYS.NLS.Format).GetFormatItem("DecimalSeparator")
   WRITE !,$ZDATETIME($ZTIMESTAMP,,,2)
ChangeVals
  SET x=##class(%SYS.NLS.Format).SetFormatItem("DateFormat",4)
  WRITE !,$ZDATETIME($ZTIMESTAMP,,,2)
  SET y=##class(%SYS.NLS.Format).SetFormatItem("DateSeparator",".")
  WRITE !,$ZDATETIME($ZTIMESTAMP,,,2)
  SET z=##class(%SYS.NLS.Format).SetFormatItem("DecimalSeparator",",")
  WRITE !,$ZDATETIME($ZTIMESTAMP,,,2)
RestoreVals
   SET x=##class(%SYS.NLS.Format).SetFormatItem("DateFormat",fmt)
   SET y=##class(%SYS.NLS.Format).SetFormatItem("DateSeparator",sep)
   SET z=##class(%SYS.NLS.Format).SetFormatItem("DecimalSeparator",dml)
   WRITE !,$ZDATETIME($ZTIMESTAMP,,,2)
```

$ZDATETIME Compared to $ZDATE

$ZDATETIME is similar to **$ZDATE** except it converts a combined date and time value. **$ZDATE** only converts a date value. For example:

```
  WRITE $ZDATE($HOROLOG)
```

returns the current date, formatted like: `02/22/2018`.

```
  WRITE $ZDATETIME($HOROLOG)
```

returns the current date and time, formatted like: `02/22/2018 13:53:57`.

$ZDATE does not support *tformat* values 5 through 8.

See Also

- JOB command
- $ZDATE function
- $ZDATEH function
- $ZDATETIMEH function
- $ZTIME function
- $HOROLOG special variable
- $ZTIMESTAMP special variable
- **%DATE** utility, which is documented in the legacy documentation available at http://docs.intersystems.com/priordocexcerpts
- More information on locales in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$ZDATETIMEH

Validates a date and time and converts from display format to InterSystems IRIS internal format.

```
$ZDATETIMEH(datetime,dformat,tformat,monthlist,yearopt,startwin,endwin,mindate,maxdate,erropt,localeopt)
$ZDTH(datetime,dformat,tformat,monthlist,yearopt,startwin,endwin,mindate,maxdate,erropt,localeopt)
```

Parameters

datetime	The date and time input value. A date/time string specified in display format. **$ZDATETIMEH** converts this date/time string to **$HOROLOG** format. The *datetime* value can be either an explicit date and time (specified in various formats), an explicit date (specified in various formats) with the time value defaulting to 0, or the string “T” or “t”, representing the current date, with the time value either specified or defaulting to 0. The “T” or “t” string can optionally include a signed integer offset. See datetime below.
dformat	*Optional* — An integer code specifying the date format for the date portion of *datetime*. If *datetime* is “T”, *dformat* must be 5, 6, 7, 8, 9, or 15. See dformat below.
tformat	*Optional* — An integer code specifying the time format for the time portion of *datetime*. See tformat below.
monthlist	*Optional* — A string or the name of a variable that specifies a set of month names. This string must begin with a delimiter character, and its 12 entries must be separated by this delimiter character. See monthlist below.
yearopt	*Optional* — An integer code that specifies whether to represent years as two- or four-digit values. See yearopt below.
startwin	*Optional* — The start of the sliding window during which dates must be represented with two-digit years. See startwin below.
endwin	*Optional* — The end of the sliding window during which dates are represented with two-digit years. See endwin below.
mindate	*Optional* — The lower limit of the range of valid dates. Specified as a **$HOROLOG** integer date count, with 0 representing December 31, 1840. Can be specified as a positive or negative integer. See mindate below.
maxdate	*Optional* — The upper limit of the range of valid dates. Specified as a **$HOROLOG** integer date count. See maxdate below.
erropt	*Optional* — An expression to return when *datetime* is invalid. Specifying a value for this parameter suppresses error codes associated with invalid or out of range *datetime* values. Instead of issuing an error message, **$ZDATETIMEH** returns *erropt*. See erropt below.

localeopt	*Optional* — A boolean flag that specifies which locale to use for the *dformat*, *tformat*, *monthlist*, *yearopt*, *mindate* and *maxdate* default values, and other date and time characteristics, such as the DateSeparator character: *localeopt*=0: the current locale property settings determine these parameter defaults. *localeopt*=1: the ODBC standard locale determines these parameter defaults. *localeopt* not specified: the *dformat* value determines these parameter defaults. If *dformat*=3, ODBC defaults are used. Japanese and Islamic date *dformat*values use their own defaults. For all other *dformat* values, current locale property settings are used as defaults. See localeopt below. *Optional* — A boolean flag that specifies which locale to use. When 0, the current locale determines the date separator, time separator, and the other characters, strings, and options used to format dates and times. When 1, the ODBC locale determines these characters, strings, and options. The default is 0, unless *dformat*=3, in which case the default is 1. See below.

Omitted parameters between specified parameter values are indicated by placeholder commas. Trailing placeholder commas are not required, but are permitted. Blank spaces are permitted between the commas that indicate an omitted parameter.

Description

$ZDATETIMEH validates a specified date and time value and converts it from display format to internal format. The corresponding **$ZDATETIME** function converts a date and time from internal format to display format. Internal format is the format used by the **$HOROLOG** or **$ZTIMESTAMP**. It represents a date and time value as a string of two numeric values separated by a comma.

The exact value returned depends on the parameters you use.

$ZDATETIMEH(*datetime*) converts a date and time value in the format "*MM*/*DD*/[*YY*]*YY hh*:*mm*:*ss*[.*ffff*]” to **$HOROLOG** format.

Syntax	Meaning
MM	A two-digit month.
DD	A two-digit day.
[*YY*]*YY*	Two or four digits for years from 1900 to 1999. Four digits for years before 1900 or after 1999.
hh	The hour in a 24-hour clock format.
mm	Minutes.
ss	Seconds.
ffff	Fractional seconds (zero to nine digits).

$ZDATETIMEH(*datetime*,*dformat*,*tformat*,*monthlist*,*yearopt*,*startwin*,*endwin*,*mindate*,*maxdate*,*erropt*) converts a date and time value that was originally specified (through **$ZDATETIME**) in date and time to **$HOROLOG** or **$ZTIMESTAMP** format. The *dformat*, *tformat*, *yearopt*, *startwin* and *endwin* values are identical to the values used by **$ZDATETIME**.

When you use a *dformat* of 5, 6, 7, 8, or 9 **$ZDATETIMEH** recognizes and converts a date in any of the external American date formats corresponding to *dformat* codes 1, 2, 3, 5, 6, 7, 8, 9. For a complete list of valid American date formats, refer to $ZDATEH. When you use a *dformat* of 15 **$ZDATETIMEH** recognizes and converts a date in any unambiguous European date format. For a complete list of valid European date formats, refer to $ZDATEH.

The *dformat* values of 5, 6, 7, 8, 9, or 15 also accept the current date specified by the letter “T” or “t”, optionally followed by a plus (+) or a minus (-), and the number of days after or before the current date.

$ZDATETIMEH recognizes and converts a time in any of eight time formats, regardless of which time format you specify in the function call. In addition, **$ZDATETIMEH** recognizes the suffixes “AM, PM, NOON, and MIDNIGHT.” You can express these suffixes in uppercase, lowercase, or mixed case. You can also abbreviate these suffixes to any number of letters.

The recognized forms include:

- The default date format, *MM*/*DD*/[*YY*]*YY*
- The format *DDMmm*[*YY*]*YY*
- The ODBC format [*YY*]*YY-MM-DD*
- The format *DD*/*MM*/[*YY*]*YY*
- The format *Mmm D, YYYY*
- The format *Mmm D YYYY*
- The format *Mmm DD YY*
- The format *YYYYMMDD* (numeric format)

Parameter Values

datetime

The date and time string that you want to convert to **$HOROLOG** format. You can specify any of the following:

- An expression that evaluates to a single string with the date first, followed by a single blank space, followed by the time.
- An expression that evaluates to a string specifying the date only. The time value defaults to midnight (0), unless *tformat* is 7 or 8, in which case the time defaults to the local time zone offset from midnight (0).
- The letter code “T” or “t”, which specifies the current date. This letter can optionally be followed by a plus (+) or a minus (-) sign and an integer specifying an offset, in days, from the current date. You can either follow this date expression by a single blank space and a time expression, or allow the time to default to midnight (0). (If *tformat* is 7 or 8, the time defaults to the local time zone offset from midnight (0).) If you use this current date option, you must specify a *dformat* of 5, 6, 7, 8, 9, or 15.

Valid date and time values depend on the DateFormat and TimeFormat properties of the current locale and the values specified for the *dformat* and *tformat* parameters. For details on specifying dates, refer to $ZDATEH.

By default, the earliest valid *datetime* date is December 31, 1840 (0 in internal **$HOROLOG** representation). Dates are limited to positive integers by default because the DateMinimum property defaults to 0. You can specify earlier dates as negative integers, provided the DateMinimum property of the current locale is set to a greater or equal negative integer. The lowest valid DateMinimum value is -672045, which corresponds to January 1, 0001. InterSystems IRIS uses the proleptic Gregorian calendar, which projects the Gregorian calendar back to “Year 1”, in conformance with the ISO 8601 standard. This is, in part, because the Gregorian calendar was adopted at different times in different countries. For example, much of continental Europe adopted it in 1582; Great Britain and the United States adopted it in 1752. Thus InterSystems IRIS dates prior to your local adoption of the Gregorian calendar may not correspond to historical dates that were recorded based on the local calendar then in effect. For further details on dates prior to 1840, refer to the *mindate* parameter.

dformat

Format for the date. Valid values are:

Value	Meaning
1	*MM/DD/[YY]YY* (07/01/97 or 03/27/2002) — American numeric format. You must specify the correct DateSeparator character (/ or .) for the current locale.
2	*DD Mmm [YY]YY* (01 Jul 97 or 27 Mar 2002)
3	*[YY]YY-MM-DD* (1997-07-01 or 2002-03-27) - ODBC format
4	*DD/MM/[YY]YY* (01/07/97 or 27/03/2002) — European numeric format. You must specify the correct DateSeparator character (/ or .) for the current locale.
5	*Mmm D, YYYY* (Jul 1, 1997 or Mar 27, 2002)
6	*Mmm D YYYY* (Jul 1 1997 or Mar 27 2002)
7	*Mmm DD [YY]YY* (Jul 01 1997 or Mar 27 2002)
8	*YYYYMMDD* (19930701 or 20020327) - Numeric format
9	*Mmmmm D, YYYY* (July 1, 1997 or March 27, 2002)
13	*[D]D/[M]M/YYYY* (1/7/2549 or 27/11/2549) — Thai date format. Day and month are identical to European usage, except no leading zeros. The year is the Buddhist Era (BE) year, calculated by adding 543 years to the Gregorian year.
15	*DD/MM/[YY]YY* or *YYYY-MM-DD* or any unambiguous European date format with any DateSeparator character, or *YYYYMMDD* with no date separators. The DateSeparator character may be any non-alphanumeric character, including blank spaces, regardless of the DateSeparator character specified in the current locale. Also accepts *monthlist* names and "T". For a complete list of valid European date formats, refer to $ZDATEH.
16	YYYYc[M]Mc[D]Dc — Japanese date format. Year, month, and day numbers are the same as other date formats; leading zeros are omitted. The Japanese characters for "year", "month", and "day" (shown here as *c*) are inserted after the year, month, and day numbers. These characters are Year=$CHAR(24180), Month=$CHAR(26376), and Day=$CHAR(26085).
17	YYYYc [M]Mc [D]Dc — Japanese date format. Same as *dformat* 16, except that a blank space is inserted after the "year" and "month" Japanese characters.
18	[D]D Mmmmm YYYY — Tabular Hijri (Islamic) date format with full month name. Day leading zeros are omitted; year leading zeros are included. InterSystems IRIS date -445031 (07/19/0622 C.E.) = 1 Muharram 0001.
19	[D]D [M]M YYYY — Tabular Hijri (Islamic) date format with month number. Day and month leading zeros are omitted; year leading zeros are included. InterSystems IRIS date -445031 (07/19/0622 C.E.) = 1 1 0001.
20	[D]D Mmmmm YYYY — Observed Hijri (Islamic) date format with full month name. Defaults to Tabular Hijri (*dformat* 18). To override tabular calculation, use the class %Calendar.Hijri to add observations of new moon crescents.
21	[D]D [M]M YYYY — Observed Hijri (Islamic) date format with month number. Defaults to Tabular Hijri (*dformat* 19). To override tabular calculation, use the class %Calendar.Hijri to add observations of new moon crescents.
-1	Get effective *dformat* value from the DateFormat property of the current locale. This is the default behavior if you do not specify *dformat*.

Value	Meaning
-2	**$ZDATETIMEH** takes an integer count of UTC seconds and returns the corresponding local $HOROLOG datetime value. This is the inverse of **$ZDATETIME** *dformat* –2. Refer to $ZDATETIME *dformat* –2 for further details. The input *datetime* value is the value returned by the time() library function, as defined in the ISO C Programming Language Standard. For example, on POSIX-compliant systems this value is the count of seconds from January 1, 1970 00:00:00 UTC. The *tformat*, *monthlist*, *yearopt*, *startwin*, and *endwin* parameters are ignored.
-3	**$ZDATETIMEH** takes a *datetime* value specified in $ZTIMESTAMP internal format, converts that value from UTC Universal time to local time, and returns the resulting value in the same internal format. The *tformat*, *monthlist*, *yearopt*, *startwin*, and *endwin* parameters are ignored. **$ZDATETIME** performs the inverse operation. (Currently, this date conversion has the time conversion anomalies described for *tformat* values 7 and 8. These potentially affect dates prior to 1970, dates after 2038, and local time variant boundary days, such as the beginning date or end date for Daylight Saving Time.)

Where:

Syntax	Meaning
YYYY	*YYYY* is a four-digit year. *[YY]YY* is a two-digit year if *datetime* falls within the active window for two-digit dates; otherwise it is a four-digit number.
MM	Two-digit month.
D	One-digit day if the day number <10. Otherwise, two digits.
DD	Two-digit day.
Mmm	*Mmm* is a month abbreviation extracted from the MonthAbbr property of the current locale. The default values are: “Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec” Or an alternate month abbreviation (or name of any length) extracted from an optional list specified as the *monthlist* parameter to **$ZDATETIMEH**.
Mmmmm	Full name of the month as specified by the MonthName property of the current locale. The default values are: “January February March ... November December” Or an alternate month name extracted from an optional list specified as the *monthlist* parameter to **$ZDATETIMEH**.

dformat Default

If you omit *dformat* or set it to -1, the *dformat* default depends on the *localeopt* parameter and the NLS DateFormat property:

- If *localeopt*=1 the *dformat* default is ODBC format. The *tformat*, *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults are also set to ODBC format. This is the same as setting *dformat*=3.
- If *localeopt*=0 or is unspecified, the *dformat* default is taken from the NLS DateFormat property. If DateFormat=3, the *dformat* default is ODBC format. However, DateFormat=3 does not affect the *tformat*, *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults, which are as specified in the current NLS locale definition.

To determine the default date properties for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DateFormat"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DateSeparator")
```

$ZDATETIMEH will use the value of the DateSeparator property of the current locale (either / or .) as the delimiter between months, days, and the year when *dformat*=1 or 4.

European date format (*dformat*=4, DD/MM/YYYY order) is the default for many (but not all) European languages, including British English, French, German, Italian, Spanish, and Portuguese (which use a "/" DateSeparator character), as well as Czech (csyw), Russian (rusw), Slovak (skyw), Slovenian (svnw), and Ukrainian (ukrw) (which use a "." DateSeparator character). For further details on default date formats for supported locales, refer to Dates in *Using ObjectScript*.

dformat Settings

If *dformat* is 3 (ODBC format date), ODBC format defaults are also used for the *tformat*, *monthlist*, *yearopt*, *mindate* and *maxdate* parameter defaults. Current locale defaults are ignored.

If *dformat* is 16 or 17 (Japanese date formats), the date format is independent of the locale setting. You can use Japanese-format dates from any InterSystems IRIS instance.

If *dformat* is 18, 19, 20, or 21 (Islamic date formats) and *localeopt* is unspecified, parameters default to Islamic defaults, rather than current locale defaults. The *monthlist* parameter defaults to Arabic month names transliterated with Latin characters. The *tformat*, *yearopt*, *mindate* and *maxdate* parameters default to ODBC defaults. The date separator defaults to the Islamic default (a space), not the ODBC default or the current locale DateSeparator property value. If *localeopt*=0 current locale property defaults are used for these parameters. If *localeopt*=1 ODBC defaults are used for these parameters.

tformat

A numeric value that specifies the format in which the time value is input. Supported values are as follows:

Value	Meaning
-1	Get the effective *tformat* value from the TimeFormat property of the current locale, which defaults to a value of 1. This is the default behavior if you do not specify *tformat* for all *dformat* values except 3.
1	Specify time in the form "*hh:mm:ss*" (24-hour clock). This is the default when *dformat*=3.
2	Specify time in the form "*hh:mm*" (24-hour clock)
3	Specify time in the form "*hh:mm:ss[AM/PM]* (12-hour clock)
4	Specify time in the form "*hh:mm[AM/PM]* (12-hour clock)
5	Specify time in the form "*hh:mm:ss+/-hh:mm*" (24-hour clock). The time is specified as local time. The following optional suffix may be supplied, but is ignored: a plus (+) or minus (–) suffix followed by the offset of local time from Coordinated Universal Time (UTC). A minus sign (-hh:mm) indicates that the local time is earlier (westward) of the Greenwich meridian by the returned offset number of hours and minutes. A plus sign (+hh:mm) indicates that the local time is later (eastward) of the Greenwich meridian by the returned offset number of hours and minutes.
6	Specify time in the form "*hh:mm+/-hh:mm*" (24-hour clock). The time is specified as local time. The following optional suffix may be supplied, but is ignored: a plus (+) or minus (–) suffix followed by the offset of local time from Coordinated Universal Time (UTC). A minus sign (-hh:mm) indicates that the local time is earlier (westward) of the Greenwich meridian by the returned offset number of hours and minutes. A plus sign (+hh:mm) indicates that the local time is later (eastward) of the Greenwich meridian by the returned offset number of hours and minutes.

Value	Meaning
7	Specify time in the form "*hh:mm:ssZ*" (24-hour clock). The time must be specified as Coordinated Universal Time (UTC). The optional “Z” suffix may be supplied or omitted, but is ignored. This suffix merely indicates that the time is assumed to be Coordinated Universal Time (UTC), rather than local time.
8	Specify time in the form “*hh:mmZ*” (24-hour clock). The time must be specified as Coordinated Universal Time (UTC). The optional “Z” suffix may be supplied or omitted, but is ignored. This suffix merely indicates that the time is assumed to be Coordinated Universal Time (UTC), rather than local time.

If the *datetime* string contains both a date part and a time part, the time part is separated from the date part by either a single space or the capital letter "T". If a time part is present:

- Time formats 1 through 6 assume *datetime* specifies local time using the same time zone as the result.
- Time formats 7 and 8 assume *datetime* specifies UTC time; these formats convert both the date and time to system local time.

For time formats 5 through 8 the *datetime* time value may be followed by a suffix consisting of either the capital letter "Z" or a UTC offset that starts with a "+" or "-". The presence of a suffix does not affect time zone conversion.

Note: Conversions involving *dformat* values -2 and -3 and *tformat* values 7 and 8 and the UTC offsets generated by *tformat* values 5 and 6 have the following platform-dependent anomalies:

- Local time variant boundary behavior may differ on different operating system platforms. When a local time variant change occurs and the local clock shifts backwards (“Fall back” at the end of Daylight Saving Time) the local time hour is repeated. Within this two-hour period, an InterSystems IRIS time conversion operation cannot determine whether it is being applied to the first occurrence of that local time hour, or the second occurrence of the same hour. **$ZDATETIME** uses whichever assumption is used by the platform-specific runtime library. Therefore, within this temporal window, different operating system platforms may give different time conversion results.
- InterSystems IRIS performs conversions between local time and UTC time using the standard time offset for all dates that are supported by the operating system platform.

  If a specified date is earlier than the earliest date supported by the platform, InterSystems IRIS uses the standard time offset for 1902–01–01 (if this date is supported by the platform). If the date 1902–01–01 is not supported by the platform, InterSystems IRIS uses the standard time offset for 1970–01–01. Any local time variant offset (such as Daylight Saving Time) is ignored.

  If a specified date is later than the latest date supported by the platform, InterSystems IRIS calculates a corresponding date within the range 2010–01–01 to 2037–12–31 and uses the standard time offset for that corresponding date. This algorithm should provide accurate time offsets for dates up to 2100–02–28, provided there are no future changes to the laws governing date/time observances.

To determine the default time format for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("TimeFormat")
```

12–hour Clock (tformat 3 and 4)

In 12-hour clock formats, morning and evening are specified with time suffixes, here shown as AM and PM. To determine the default time suffixes for your locale, invoke the **GetFormatItem()** NLS class method, as follows:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("AM"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("PM"),!
```

For all *dformat* values except 3, 18, 19, 20, and 21 the AM and PM properties default to the current locale definition. For *dformat*=3 (ODBC date format) and *dformat*=18, 19, 20, or 21 (Islamic date formats) the time suffixes are always "AM" and "PM", regardless of the current locale property values. The AM and PM property defaults are "AM" and "PM" for all locales except the Japanese locale jpww.

By default, Midnight and Noon are represented as "MIDNIGHT" and "NOON" for all locales except Japanese locales (jpnw, jpuw, jpww, zdsw, zdtw, zduw), Portuguese (ptbw), Russian (rusw), and Ukrainian (ukrw). However, when *dformat*=3, **$ZDATETIMEH** always uses the ODBC standard values, regardless of the default settings for your locale.

monthlist

An expression that resolves to a string of month names or month name abbreviations, separated by a delimiter character. The names in *monthlist* replace the default month abbreviation values from the MonthAbbr property or the month name values from the MonthName property of the current locale.

monthlist is valid only if *dformat* is 2, 5, 6, 7, 9, 15, 18, or 20. If *dformat* is any other value **$ZDATETIMEH** ignores *monthlist*.

The *monthlist* string has the following format:

- The first character of the string is a delimiter character (usually a space). The same delimiter must appear before the first month name and between each month name in *monthlist*. You can specify any single-character delimiter; this delimiter must be specified between the month, day, and year portions of the specified *datetime* value, which is why a space is usually the preferred character.
- The month names string should contain twelve delimited values, corresponding to January through December. It is possible to specify more or less than twelve month names, but if there is no month name corresponding to the month in *datetime* an <ILLEGAL VALUE> error is generated.

If you omit *monthlist* or specify a *monthlist* value of -1, **$ZDATETIMEH** uses the list of month names defined in the MonthAbbr or MonthName property of the current locale, unless one of the following is true: If *localeopt*=1, the *monthlist* default is the ODBC month list (in English). If *localeopt* is unspecified and *dformat* is 18 or 20 (Islamic date formats) the *monthlist* default is the Islamic month list (Arabic names expressed using Latin letters), ignoring the MonthAbbr or MonthName property value.

To determine the default month names and month abbreviations for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MonthName"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("MonthAbbr"),!
```

yearopt

With *dformat* values 0, 1, 2, 4, or 7, a numeric code that specifies the time window in which to display the year as a two-digit value. *yearopt* can be:

Value	Meaning
-1	Get effective *yearopt* value from YearOption property of current locale which defaults to 0. This is the default behavior if you do not specify *yearopt* .
0	Represent 20th century dates (1900 through 1999) with two-digit years, unless a process-specific sliding window (established via the **%DATE** utility) is in effect. If such a window is in effect, represent only those dates falling within the sliding window by two-digit years. Represent all dates falling outside the 20th century or outside the process-specific sliding window by four-digit years.
1	Represent 20th century dates with two-digit years and all other dates with four-digit years.
2	Represent all dates with two-digit years.
3	Represent with two-digit years those dates falling within the sliding temporal window defined by *startwin* and (optionally) *endwin*. Represent all other dates with four-digit years. When *yearopt* =3, *startwin* and *endwin* are absolute dates in **$HOROLOG** format.
4	Represent all dates with four-digit years.
5	Represent with two-digit years all dates falling within the sliding window defined by *startwin* and (optionally) *endwin.* Represent all other dates with four-digit years. When yearopt=5, *startwin* and *endwin* are relative years.
6	Represent all dates in the current century with two-digit years and all other dates with four-digit years.

If you omit *yearopt* or specify a *yearopt* value of -1, **$ZDATETIMEH** uses the YearOption property of the current locale, unless one of the following is true: If *localeopt*=1, the *yearopt* default is the ODBC year option. If *localeopt*=0 or is unspecified and *dformat* is 18, 19, 20, or 21 (Islamic date formats) the *yearopt* default is the ODBC year option (4-digit years); the YearOption property value is ignored for Islamic dates.

startwin

A numeric value that specifies the start of the sliding window during which dates must be represented with two-digit years. You must supply *startwin* when you use a *yearopt* of 3 or 5. *startwin* is not valid with any other *yearopt* values.

When *yearopt* = 3, *startwin* is an absolute date in **$HOROLOG** date format that indicates the start date of the sliding window.

When *yearopt* = 5, *startwin* is a numeric value that indicates the start year of the sliding window expressed in the number of years before the current year. The sliding window always begins on the first day of the year (January 1) specified in *startwin*.

endwin

A numeric value that specifies the end of the sliding window during which dates are represented with two-digit years. You may optionally supply *endwin* when *yearopt* is 3 or 5. *endwin* is not valid with any other *yearopt* values.

When *yearopt* =3, *endwin* is an absolute date in **$HOROLOG** date format that indicates the end date of the sliding window.

When *yearopt* =5, *endwin* is a numeric value that indicates the end year of the sliding window expressed as the number of years past the current year. The sliding window always ends on December 31st of the year specified in *endwin.* If *endwin* is not specified, it defaults to December 31st of the year 100 years after *startwin*.

If *endwin* is omitted (or specified as -1) the effective sliding window will be 100 years long. The *endwin* value of -1 is a special case that always returns a date value, even when higher and lower *endwin* values return *erropt*. For this reason, it is preferable to omit *endwin* when specifying a 100-year window, and to avoid the use of negative *endwin* values.

If you supply both *startwin* and *endwin* , the sliding window they specify must not have a duration of more than 100 years.

mindate

An expression that specifies the lower limit of the range of valid dates (inclusive). Can be specified as a **$HOROLOG** integer date count (for example, 1/1/2013 is represented as 62823) or a **$HOROLOG** string value. You can include or omit the time portion of a **$HOROLOG** date string (for example “62823,43200”), but only the date portion of *mindate* is parsed. Specifying an *datetime* value earlier than *mindate* generates a <VALUE OUT OF RANGE> error.

The following are supported *mindate* values:

- Positive integer: Most commonly *mindate* is specified as a positive integer to establish the earliest allowed date as some date after December 31, 1840. For example, a *mindate* of 21550 would establish the earliest allowed date as January 1, 1900. The highest valid value is 2980013 (December 31, 9999).
- 0: specifies the minimum date as December 31, 1840. This is the DateMinimum property default.
- Negative integer -2 or larger: specifies a minimum date counting backwards from December 31, 1840. For example, a *mindate* of -14974 would establish the earliest allowed date as January 1, 1800. Negative *mindate* values are only meaningful if the DateMinimum property of the current locale has been set to an equal or greater negative number. The lowest valid value is -672045.
- If omitted (or specified as -1), *mindate* defaults to the DateMinimum property value for the current locale, unless one of the following is true: If *localeopt*=1, the *mindate* default is 0. If *localeopt* is unspecified and *dformat*=3, the *mindate* default is 0. If *localeopt* is unspecified and *dformat* is 18, 19, 20, or 21 (Islamic date formats) the *mindate* default is 0.

You can get and set the DateMinimum property as follows:

```
  SET min=##class(%SYS.NLS.Format).GetFormatItem("DateMinimum")
  WRITE "initial DateMinimum value is ",min,!
Permit18thCenturyDates
  SET x=##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",-51498)
  SET newmin=##class(%SYS.NLS.Format).GetFormatItem("DateMinimum")
  WRITE "set DateMinimum value is ",newmin,!!
RestrictTo19thCenturyDates
  WRITE $ZDATETIMEH("05/29/1805 12:00:00",1,,,,,,-14974),!!
ResetDateMinimumToDefault
  SET oldmin=##class(%SYS.NLS.Format).SetFormatItem("DateMinimum",min)
  WRITE "reset DateMinimum value from ",oldmin," to ",min
```

You may specify *mindate* with or without *maxdate*. Specifying a *mindate* larger than *maxdate* generates an <ILLEGAL VALUE> error.

maxdate

An expression that specifies the upper limit of the range of valid dates (inclusive). Can be specified as a **$HOROLOG** integer date count (for example, 1/1/2100 is represented as 94599) or a **$HOROLOG** string value. You can include or omit the time portion of the **$HOROLOG** date (for example “94599,43200”), but only the date portion of *maxdate* is parsed.

If *maxdate* is omitted or if specified as -1, the maximum date limit is obtained from the DateMaximum property of the current locale, which defaults to the maximum permissible value for the date portion of **$HOROLOG**: 2980013 (corresponding to December 31, 9999). However, the application of the DateMaximum property is governed by the *localeopt* setting. When *localeopt*=1 (which is the default for *dformat*=3) the date maximum default is the ODBC value (2980013), regardless of the current locale setting. Islamic date formats also take the ODBC default. The maximum date for Thai date format (*dformat*=13) is 31/12/9999 BE, which corresponds to **$HOROLOG** 2781687.

Specifying a *datetime* larger than *maxdate* generates a <VALUE OUT OF RANGE> error.

Specifying a *maxdate* larger than 2980013 generates an <ILLEGAL VALUE> error.

You may specify *maxdate* with or without *mindate*. Specifying a *maxdate* smaller than *mindate* generates an <ILLEGAL VALUE> error.

erropt

Specifying a value for this parameter suppresses errors associated with invalid or out of range *datetime* values. Instead of generating <ILLEGAL VALUE> or <VALUE OUT OF RANGE> errors, the **$ZDATETIMEH** function returns the *erropt* value.

InterSystems IRIS performs standard numeric evaluation on *datetime*, which must evaluate to an integer date within the *mindate*/*maxdate* range. Thus, 7, "7", +7, 0007, 7.0, "7 dwarves", and --7 all evaluate to the same date value: 01/07/1841. By default, values greater than 2980013 or less than 0 generate a <VALUE OUT OF RANGE> error. Fractional values generate an <ILLEGAL VALUE> error. Non-numeric strings (including the null string) evaluate to 0, and thus return the **$HOROLOG** initial date: 12/31/1840.

The *erropt* parameter only suppresses errors generated due to invalid or out of range values of *datetime*. Errors generated due to invalid or out of range values of other parameters will always generate errors whether or not *erropt* has been supplied. For example, an <ILLEGAL VALUE> error is always generated when **$ZDATETIMEH** specifies a sliding window where *endwin* is earlier than *startwin*. Similarly, an <ILLEGAL VALUE> error is generated when *maxdate* is less than *mindate*.

localeopt

This Boolean parameter specifies either the user's current locale definition or the ODBC locale definition as the source for defaults for the locale-specified parameters *dformat*, *tformat*, *monthlist*, *yearopt*, *mindate* and *maxdate*:

- If *localeopt*=0, all of these parameters take the current locale definition defaults.
- If *localeopt*=1, all of these parameters take the ODBC defaults.
- If *localeopt* is not specified, the *dformat* parameter determine the default for these parameters. If *dformat*=3, the ODBC defaults are used. If *dformat* is 18, 19, 20, or 21 the Islamic date and time format defaults are used, regardless of the current locale definition. For all other *dformat* values, the current locale definition defaults are used. Refer to the dformat description for further details.

The ODBC standard locale cannot be changed; it is used to format date and time strings that are portable between InterSystems IRIS processes that have made different National Language Support (NLS) choices. The ODBC locale date and time definitions are as follows:

- Date format defaults to 3. Therefore, if *dformat* is undefined or -1, date format 3 is used.
- Date separator defaults to "/". However, date format defaults to 3, which always uses "-" as the date separator.
- Year option defaults to 4 digits.
- Date minimum and maximum are 0 and 2980013 (**$HOROLOG** date count).
- English month names, month abbreviations, weekday names, weekday abbreviations, and the words "Noon" and "Midnight" are used.
- Time format defaults to 1. Time separator is ":". Time precision is 0 (no fractional seconds). AM and PM indicators are "AM" and "PM".

Notes

$ZDATETIMEH and Fractional Seconds

Unlike **$ZDATETIME**, **$ZDATETIMEH** does not allow you to specify a precision for the time. Any fractional seconds in the original **$ZDATETIME**-formatted time are retained in the value **$ZDATETIMEH** returns.

Note that **$HOROLOG** does not return fractional seconds.

Invalid Values with $ZDATETIMEH

You receive a <FUNCTION> error in the following conditions:

- If you specify an invalid *dformat* code (an invalid integer value, or a non-integer value.)
- If you specify an invalid value for *tformat* (an integer value less than -1 or greater than 8, a zero, or a non-integer value.)
- If you do not specify a *startwin* value when *yearopt* is 3 or 5.

You receive an <ILLEGAL VALUE> error under the following conditions:

- If you specify an invalid value for any date/time unit. If specified, the *erropt* value is returned rather than issuing an <ILLEGAL VALUE>.
- If you specify excess leading zeros for any date/time unit in an ODBC date. For example, you can represent the February 3, 2007 as "2007–2–3" or "2007–02–03", but will receive an <ILLEGAL VALUE> for "2007–002–03". If specified, the *erropt* value is returned rather than issuing an <ILLEGAL VALUE>.
- If the given month number is greater than the number of month values in *monthlist.*
- If *maxdate* is less than *mindate.*
- If *endwin* is less than *startwin.*
- If *startwin* and *endwin* specify a sliding temporal window whose duration is greater than 100 years.

You receive a <VALUE OUT OF RANGE> error under the following conditions:

- If you specify a date (or an offset to "T") which is earlier than Dec. 31, 1840 or later than Dec. 31, 9999, and do not supply an *erropt* value.
- If you specify an otherwise valid date (or an offset to "T") which is outside the range of *mindate* and *maxdate* and do not supply an *erropt* value.

The Current Date

The following examples shows how you can use the "T" or "t" letter code to specify the current date. Note that *dformat* must be 5, 6, 7, 8, 9, or 15.

The current date with the time defaulting to 0:

```
WRITE $ZDATETIMEH("T",5)
```

Three days before the current date, with the time defaulting to 0:

```
WRITE $ZDATETIMEH("T-3",5)
```

Two days after the current date, with a specified time:

```
WRITE $ZDATETIMEH("T+2 11:45:00",5)
```

$ZDATETIMEH Compared to $ZDATEH

$ZDATETIMEH is similar to **$ZDATEH** except it converts both a date and a time value to the internal **$HOROLOG** format (even if no time value is specified.) **$ZDATEH** only converts a date value to **$HOROLOG** format. For example:

```
WRITE $ZDATEH("Nov 25, 2002",5)
```

returns 59133.

```
WRITE $ZDATETIMEH("Nov 25, 2002 10:08:09.539",5)
```

returns 59133,36489.539.

Specifying **$ZDATETIMEH** with no time value:

```
WRITE $ZDATETIMEH("Nov 25, 2002",5)
```

returns 59133,0.

Specifying **$ZDATETIMEH** with no time value, and a *tformat* of 7 or 8:

```
WRITE $ZDATETIMEH("Nov 25, 2002",5,7)
```

returns a value such as: 59133,68400, where the time value is the local time zone offset from midnight. In this case, U.S. Eastern Standard Time is 5 hours offset from UTC, so the time value here represents 19:00 (5 hours offset from midnight).

See Also

- JOB command
- $ZDATE function
- $ZDATEH function
- $ZDATETIME function
- $ZTIME function
- $ZTIMEH function
- $HOROLOG special variable
- $ZTIMESTAMP special variable
- **%DATE** utility, which is documented in the legacy documentation available at http://docs.intersystems.com/priordocexcerpts
- More information on locales in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$ZDCHAR

Converts a $DOUBLE floating point number to an eight-byte string.

```
$ZDCHAR(n)
$ZDC(n)
```

Parameter

n	An IEEE-format floating point number. It can be specified as a value, a variable, or an expression.

Description

$ZDCHAR returns an eight-byte (quad) character string corresponding to *n*. The bytes of the character string are presented in little-endian byte order, with the least significant byte first.

The number *n* can be a positive or negative IEEE floating point number. If *n* is not numeric, **$ZDCHAR** returns the empty string. For further details on IEEE floating point numbers, refer to the $DOUBLE function.

Example

The following examples return an eight-byte string corresponding to the IEEE floating point number:

```
WRITE $ZDCHAR($DOUBLE(1.4)),!
WRITE $ZDCHAR($DOUBLE(1.400000000000001))
```

These two functions return: "ffffffö?" and "kfffffö?"

Notes

$ZDCHAR and Other $CHAR Functions

$ZDCHAR converts an IEEE floating point number to a eight byte (64-bit) character string. **$ZQCHAR** converts an integer to an eight byte (64-bit) character string. To convert an integer to an 8-bit character string use **$CHAR**. To convert an integer to a 16-bit (wide) character string use **$ZWCHAR**. To convert an integer to a 32-bit (long) character string use **$ZLCHAR**.

See Also

- $DOUBLE function
- $ZDASCII function
- $CHAR function
- $ZWCHAR function
- $ZLCHAR function
- $ZQCHAR function

$ZEXP

Exponential function (inverse of natural logarithm).

```
$ZEXP(n)
```

Parameter

n	A number of any type. A number larger than 335.6 results in a <MAXNUMBER> error. A number smaller than -295.4 returns 0.

Description

$ZEXP is the exponential function e^n, where e is the constant 2.718281828. Therefore, to return the value of e, you can specify `$ZEXP(1)`. **$ZEXP** is the inverse of the natural logarithm function $ZLN.

Parameter

n

Any number. It can be specified as a value, a variable, or an expression. A positive value larger than 335.6 or smaller than -4944763837 results in a <MAXNUMBER> error. A negative value smaller than -295.4 returns 0. A value of zero (0) returns 1. A non-numeric string is evaluated as 0 and therefore returns 1.

Examples

The following example demonstrates that **$ZEXP** is the inverse of **$ZLN**:

```
SET x=7
WRITE $ZEXP(x),!
WRITE $ZLN(x),!
WRITE $ZEXP($ZLN(x))
```

The following example returns **$ZEXP** for negative and positive integers and for zero. This example returns the constant e as `$ZEXP(1)`:

```
FOR x=-3:1:3 {
  WRITE !,"The exponential of ",x," = ",$ZEXP(x)
  }
QUIT
```

returns:

```
The exponential of -3 = .04978706836786394297
The exponential of -2 = .1353352832366126919
The exponential of -1 = .3678794411714423216
The exponential of 0 = 1
The exponential of 1 = 2.718281828459045236
The exponential of 2 = 7.389056098930650228
The exponential of 3 = 20.08553692318766774
```

The following example uses IEEE floating point numbers ($DOUBLE numbers). The first **$ZEXP** returns a numeric value, the second **$ZEXP** returns “INF” (or <MAXNUMBER> depending on the **IEEEError()** method setting):

```
SET rtn=##class(%SYSTEM.Process).IEEEError(0)
WRITE $ZEXP($DOUBLE(1.0E2)),!
WRITE $ZEXP($DOUBLE(1.0E3))
```

The following example demonstrates that the empty string or a nonnumeric value is treated as 0:

```
WRITE $ZEXP(""),!
WRITE $ZEXP("INF")
```

both return 1.

See Also

- $ZLN function

$ZF

Invokes non-ObjectScript programs or functions from ObjectScript routines.

```
$ZF("function_name",args)
```

Parameters

function_name	The name of the function you want to call.
args	*Optional* — A set of argument values passed to the function.

Description

The various forms of the **$ZF** function allow you to invoke non-ObjectScript programs (such as shell or operating system commands) or functions from ObjectScript routines. You can define interfaces or links to functions written in other languages into InterSystems IRIS and call them from ObjectScript routines using **$ZF**.

$ZF can also be used to:

- Spawn a child process to execute a program or command: $ZF(-100).
- Load a Dynamic Link Library (DLL) then execute functions from that library: $ZF(–3), $ZF(–4), $ZF(–5), and $ZF(–6).

These implementations of **$ZF** take a negative number as the first parameter. They are described in their own reference pages.

Parameters

function_name

The name of the function you want to call enclosed in quotation marks, or a negative number.

args

The *args* parameters are in the form: arg1, arg2, arg3, ...argn. The arguments can consist of such items as descriptions of how arguments are passed and the entry point to the C function you are calling.

Notes

Calling UNIX® System Services with $ZF

InterSystems IRIS supports error checking functions for use with UNIX® system calls from **$ZF**. These calls allow you to check for asynchronous events and to set an alarm handler in **$ZF**. By using these UNIX® functions you can distinguish between real errors, <CTRL-C> interrupts, and calls that should be restarted.

The function declarations are included in iris-cdzf.h and are described in the following table:

Declaration	Purpose	Notes
int sigrtclr();	Clears retry flag.	Should be called once before using sigrtchk()
int dzfalarm();	Establishes new SIGALRM handler.	On entry to **$ZF**, the previous handler is automatically saved. On exit, it is restored automatically. A user program should not alter the handling of any other signal.

Declaration	Purpose	Notes
int sigrtchk();	Checks for asynchronous events.	Should be called whenever one of the following system calls fails: open(), close(), read(), write(), ioctl(), pause(), any call that fails when the process receives a signal. It returns a code indicating the action the user should take: -1 = Not a signal. Check for I/O error. See contents of errno variable. 0 = Other signal. Restart operation from point at which it was interrupted. 1 = SIGINT/. Exit from $ZF with a SIGTERM "return 0." The System traps these signals appropriately.

In a typical **$ZF** function used to control some device, you would code something like this:

```
  IF ((fd = open(DEV_NAME, DEV_MODE)) < 0) {
     ; Set some flags
     ; Call zferror
     ; return 0;
  }
```

The **open** system call can fail if the process receives a signal. Usually this situation is not an error and the operation should be restarted. Depending on the signal, however, you might take other actions. So, to take account of all the possibilities, consider using the following C code:

```
sigrtclr();
   WHILE (TRUE) {
      IF (sigrtchk() == 1) { return 1 or 0; }
      IF ((fd = open(DEV_NAME, DEV_MODE)) < 0) {
         switch (sigrtchk()) {
         case -1:
           /* This is probably a real device error */
           ; Set some flags
           Call zferror
           return 0;
         case 0:
           /* A innocuous signal was received. Restart. */
           ; continue;
         case 1:
           /* Someone is trying to terminate your job. */
           Do cleanup work
           return 1 or 0;
         }
      }
      ELSE { break; }
   /* Code to handle the normal situation: */
   /* open() system call succeeded         */
```

Remember you must not set any signal handler except through dzfalarm().

Translating Strings between Encoding Systems

InterSystems IRIS supports input-output translation via a **$ZF** argument type, t (or T), which can be specified in the following formats:

Argument	Purpose
t	Specifies the current process I/O translation object.
t//	Specifies the default process I/O translation table name.
t/name/	Specifies a particular I/O translation table name.

$ZF conveys the translated string to the external procedure via a counted-byte string placed in the following C structure:

```
typedef struct zarray {
  unsigned short len;
  unsigned char data[1]; /* 1 is a dummy value */
  } *ZARRAYP;
```

This is also the structure used for the b (or B) argument type.

The following **$ZF** sample function performs a round trip conversion:

```
#include iris-cdzf.h
extern    int trantest();
ZFBEGIN
ZFENTRY("TRANTEST","t/SJIS/ T/SJIS/",trantest)

ZFEND

int trantest(inbuf,outbuf);

ZARRAYP inbuf;         /* Buffer containing string that was converted from
        internal InterSystems IRIS encoding to SJIS encoding before it
        was passed to this function */
ZARRAYP outbuf;        /* Buffer containing string in SJIS encoding that will
        be converted back to internal InterSystems IRIS encoding before
        it is passed back into the InterSystems IRIS environment */
{
  int  i;
  /* Copy data one byte at a time from the input argument buffer
     to the output argument buffer */

  for (i = 0; i < inbuf->len; i++)
     outbuf->data[i] = inbuf->data[i];

  /* Set number of bytes of data in the output argument buffer */
       outbuf->len = inbuf->len;

  return 0;  /* Return success */
}
```

Note: Conceptually speaking, data flows to and from a **$ZF** external procedure, as if the external procedure were a device. The output component of an I/O translation is used for data that is passed to an external procedure because the data is “leaving” the InterSystems IRIS environment. The input component of an I/O translation is used for data that is received from an external procedure because the data is “entering” the InterSystems IRIS environment.

If the output component of an I/O translation is undefined and your application attempts to pass anything but the null string using that I/O translation, InterSystems IRIS returns an error, because it does not know how to translate the data.

If the input component of an I/O translation is undefined and an argument of type string associates that I/O translation with a **$ZF** output argument, InterSystems IRIS returns an error, because an output argument with an undefined translation is purposeless.

Zero-Terminated and Counted Unicode Strings

The **$ZF** function supports argument types for zero-terminated Unicode strings and counted Unicode strings.

The argument types for zero-terminated Unicode strings and counted Unicode strings have the following codes:

Argument	Purpose
w	Pointer to a zero-terminated Unicode character string.
s	Pointer to a counted Unicode character string.

For both argument types, the C data type of the Unicode character is an unsigned short. A pointer to a zero-terminated Unicode string is declared as follows:

```
unsigned short *p;
```

A pointer to a counted Unicode string is declared as a pointer to the following C structure:

```
typedef struct zwarray {
  unsigned short len;
  unsigned short data[1]; /* 1 is a dummy value */
  } *ZWARRAYP;
```

For example:

```
ZWARRAYP *p;
```

The *len* field contains the length of the Unicode character array.

The *data* field contains the characters in the counted Unicode string. The maximum size of a Unicode string is the maximum **$ZF** string size, which is an updateable configuration parameter that defaults to 32767.

Each Unicode character is two bytes long. This is important to consider when declaring Unicode strings as output arguments, because InterSystems IRIS reserves space for the longest string that may be passed back. When using the default string size, the total memory consumption for a single Unicode string argument is calculated as follows:

32767 maximum characters * 2 bytes per character = 65534 total bytes.

This is close to the default maximum memory area allocated for all **$ZF** arguments, which is 67584. This maximum **$ZF** heap area is also an updateable configuration parameter.

Error Messages

When the **$ZF** heap area is exhausted, **$ZF** issues an <OUT OF $ZF HEAP SPACE> error. When the **$ZF** String Stack is exhausted, **$ZF** issues a <STRINGSTACK> error. When **$ZF** is unable to allocate a buddyblock, it issues a <STORE> error.

Execution from Child Processes and DLLs

The **$ZF** function can take a negative number as its first parameter. These negative numbers specify functions that support spawned child processes and Dynamic-Link Libraries (DLLs). Each of these $ZF functions is described in a separate reference page.

See Also

- $ZF(-100) function
- $ZF(-1) function (deprecated)
- $ZF(-2) function (deprecated)
- $ZF(-3) function
- $ZF(-4) function
- $ZF(-5) function
- $ZF(-6) function
- *Using the Callout Gateway*

$ZF(-1)

Executes an operating system command or program as a child process, synchronously. (Deprecated)

```
$ZF(-1,program)
```

Parameters

program	*Optional* — The operating system command or program to be executed as a child process, specified as a quoted string. If you omit *program*, **$ZF(-1)** launches the operating system shell.

Description

Note: **$ZF(-1)** is a deprecated function. It is described here for compatibility with existing code only. All new code development should use $ZF(-100).

$ZF(-1) permits an InterSystems IRIS process to invoke a program or a command of the host operating system. It executes the program or command specified in *program* as a spawned child process from the current console. It executes synchronously; it waits for the process to return. **$ZF(-1)** returns the child process exit status.

$ZF(-1) returns the following status codes:

- It returns 0 if the child process executed successfully.
- It returns a positive integer based on the exit status error code issued by the operating system shell. This integer exit status code value is determined by the host operating system. For example, for most Windows command syntax errors, **$ZF(-1)** returns 1.
- It returns -1 if the child process could not be forked.

Because **$ZF(-1)** waits for a response from the spawned child process, you cannot successfully shut down InterSystems IRIS while the child process is executing.

$ZF(-1) with no specified parameters launches the default operating system shell. For further details, see "Issuing Operating System Commands" in *Using the Callout Gateway*.

If a pathname supplied in *program* contains a space character, pathname handling is platform-dependent. Windows and UNIX® permit space characters in pathnames, but the entire pathname containing spaces must be enclosed in an additional set of double quote (") characters. This is in accordance with the Windows `cmd /c` statement. For further details, specify `cmd /?` at the Windows command prompt.

You can use the **NormalizeFilenameWithSpaces()** method of the %Library.File class to handle spaces in pathnames as appropriate for the host platform.

$ZF(-1) requires the **`%System_Callout:U`** privilege. See "Adding the %System_Callout:USE Privilege" in *Using the Callout Gateway* for details.

If **$ZF(-1)** is unable to spawn a process, it generates a <FUNCTION> error.

At the Terminal in the Terminal, you can perform operations similar to **$ZF(-1)** by using an exclamation point (!) or a dollar sign ($) as the first character, followed by the operating system command you wish to execute. The ! or $ command line prefix executes the operating system command, returns results from the invoked process and displays those results at the Terminal. **$ZF(-1)** does not return operating system command results; it executes the operating system command, then returns the exit status code for the invoked process. For further details, see "Issuing Operating System Commands" in *Using the Callout Gateway*.

Auditing

An OS command audit record is added to the audit log for each **$ZF(-1)** call. This record includes information such as the following:

```
Execute O/S command Directory: c:\182u5\mgr\
Command: ls -lt 4002
```

$ZF(-1), $ZF(-2), and $ZF(-100)

These three functions are in most respects identical. $ZF(-100) is the preferred function for all purposes, replacing both **$ZF(-1)** and **$ZF(-2)**.

- **$ZF(-1)** executes using the OS shell. It is synchronous; it suspends execution of the current process while awaiting completion of the spawned child process. It receives status information from the spawned process, which it returns as an exit status code (an integer value) when the spawned process completes. **$ZF(-1)** does not set **$ZCHILD**.
- $ZF(-2) executes using the OS shell. It is asynchronous; it does not suspend execution of the current process. It immediately returns a status value upon spawning the child process. Because it does not await completion of the spawned child process it cannot receive status information from that process. **$ZF(-2)** sets **$ZCHILD** if its fifth argument is true.
- $ZF(-100) can be synchronous or asynchronous. It can execute using the operating system shell or not using the shell. It always sets **$ZCHILD**. Both **$ZF(-1)** and **$ZF(-2)** with no specified parameters launch the operating system shell; **$ZF(-100)** requires a *program* parameter (and the `/SHELL` flag) to launch the operating system shell.

Examples

The following Windows example executes a user-written program, in this case displaying the contents of a .txt file. It uses **NormalizeFilenameWithSpaces()** to handle a pathname for **$ZF(-1)**. A pathname containing spaces is handled as appropriate for the host platform. A pathname that does not contain spaces is passed through unchanged. **$ZF(-1)** returns the Windows shell exit status of 0 if the specified file could be accessed, or 1 if the file access failed:

```
SET fname="C:\My Test.txt"
WRITE fname,!
SET x=##class(%Library.File).NormalizeFilenameWithSpaces(fname)
WRITE x,!
WRITE $ZF(-1,x)
```

The following Windows example invokes the Windows operating system SOL command. SOL opens a window that displays the Solitaire game provided with the Windows operating system. Upon closing of the Solitaire interactive window, **$ZF(-1)** returns the Windows shell exit status of 0, indicating success:

```
SET x=$ZF(-1,"SOL")
WRITE x
```

The following Windows example invokes a non-existent Windows operating system command. **$ZF(-1)** returns the Windows shell exit status of 1, indicating a syntax error:

```
WRITE $ZF(-1,"SOX")
```

The following Windows example invokes a Windows operating system command, specifying a non-existent network name. **$ZF(-1)** returns the Windows shell exit error status of 2:

```
WRITE $ZF(-1,"NET USE :k \\bogusname")
```

See Also

- $ZF(-2) function (deprecated)
- $ZF(-100) function

- Issuing Operating System Commands in *Using the Callout Gateway*

$ZF(-2)

Executes an operating system command or program as a child process, asynchronously. (Deprecated)

```
$ZF(-2,program)
```

Parameter

program	*Optional* — The operating system command or program to be executed as a child process, specified as a quoted string. If you omit *program*, **$ZF(-2)** launches the operating system shell.

Description

Note: **$ZF(-2)** is a deprecated function. It is described here for compatibility with existing code only. All new code development should use $ZF(-100).

$ZF(-2) permits an InterSystems IRIS process to invoke a program or a command of the host operating system. **$ZF(-2)** executes the operating system command specified in *program* as a spawned child process from the current console. It executes asynchronously; it returns immediately after spawning the child process and does not wait for the process to terminate. Input and output devices default to the null device.

$ZF(-2) does not return the child process exit status. Instead, if the child process was created successfully,**$ZF(-2)** returns 0. **$ZF(-2)** returns -1 if a child process could not be forked.

Because **$ZF(-2)** does not wait for a response from the spawned child process, you can shut down InterSystems IRIS while the child process is executing.

$ZF(-2) closes the parent process principal device (specified in **$PRINCIPAL**) before executing the operating system command. This is done because the child process executes concurrently with the parent. If **$ZF(-2)** did not close **$PRINCIPAL**, output from the parent and the child would become intermingled. When using **$ZF(-2)** you should redirect I/O in the command if you wish to recover output from the child process. For example:

```
SET x=$ZF(-2,"ls -l > mydir.txt")
```

$ZF(-2) with no specified parameters launches the default operating system shell. For further details, see "Issuing Operating System Commands" in *Using the Callout Gateway*.

If a pathname supplied in *program* contains a space character, pathname handling is platform-dependent. Windows and UNIX® permit space characters in pathnames, but the entire pathname containing spaces must be enclosed in an additional set of double quote (") characters. This is in accordance with the Windows `cmd /c` statement. For further details, specify `cmd /?` at the Windows command prompt.

You can use the **NormalizeFilenameWithSpaces()** method of the %Library.File class to handle spaces in pathnames as appropriate for the host platform.

$ZF(-2) is a privileged operation, which requires the **`%System_Callout:U`** privilege. See "Adding the %System_Callout:USE Privilege" in *Using the Callout Gateway* for details.

Auditing

An OS command audit record is added to the audit log for each **$ZF(-2)** call. This record includes information such as the following:

```
Execute O/S command Directory: c:\182u5\mgr\
Command: ls -lt 4002 - Detached
```

The Detached keyword indicates the call is **$ZF(-2)**; a **$ZF(-1)** call does not have this keyword.

$ZF(-2), $ZF(-1), and $ZF(-100)

These three functions are in most respects identical. $ZF(-100) is the preferred function for all purposes, replacing both **$ZF(-1)** and **$ZF(-2)**.

- **$ZF(-2)** executes using the OS shell. It is asynchronous; it does not suspend execution of the current process. It immediately returns a status value upon spawning the child process. Because it does not await completion of the spawned child process it cannot receive status information from that process. **$ZF(-2)** sets **$ZCHILD** if its fifth argument is true.
- $ZF(-1) executes using the OS shell. It is synchronous; it suspends execution of the current process while awaiting completion of the spawned child process. It receives status information from the spawned process, which it returns as an exit status code (an integer value) when the spawned process completes. **$ZF(-1)** does not set **$ZCHILD**.
- $ZF(-100) can be synchronous or asynchronous. It can execute using the operating system shell or not using the shell. It always sets **$ZCHILD**. Both **$ZF(-1)** and **$ZF(-2)** with no specified parameters launch the operating system shell; **$ZF(-100)** requires a *program* parameter (and the `/SHELL` flag) to launch the operating system shell.

See Also

- $ZF(-1) function (deprecated)
- $ZF(-100) function
- $PRINCIPAL special variable
- Issuing Operating System Commands in *Using the Callout Gateway*
- Adding the %System_Callout:USE Privilege in *Using the Callout Gateway*

$ZF(-3)

Loads a Dynamic-Link Library (DLL) and executes a library function.

```
$ZF(-3,dll_name,func_name,args)
```

Parameters

dll_name	The name of the dynamic-link library (DLL) to load, specified as a quoted string. When a DLL is already loaded, *dll_name* can be specified as a null string ("").
func_name	*Optional* — The name of the function to execute within the DLL, specified as a quoted string.
args	*Optional* — A comma-separated list of arguments to pass to the function.

Description

Use **$ZF(-3)** to load a Dynamic-Link Library (DLL) and execute the specified function from that DLL. **$ZF(-3)** returns the function's return value.

$ZF(-3) can be invoked in any of the following ways:

To just load a DLL:

```
SET x=$ZF(-3,"mydll")
```

To load a DLL and execute a function located in that DLL:

```
SET x=$ZF(-3,"mydll","$$myfunc",1)
```

Loading a DLL using **$ZF(-3)** makes it the current DLL, and automatically unloads the DLL loaded by a previous invocation of **$ZF(-3)**.

To execute a function located in a DLL loaded by a previous **$ZF(-3)**, you can speed execution by specifying the current DLL using the null string, as follows:

```
SET x=$ZF(-3,"","$$myfunc2",1)
```

To explicitly unload the current DLL (loaded by a previous **$ZF(-3)** call):

```
SET x=$ZF(-3,"")
```

$ZF(-3) can load only one DLL. Loading a DLL unloads the previous DLL. You can also explicitly unload the currently loaded DLL, which would result in no currently loaded DLL. (However, note that **$ZF(-3)** loads and unloads do not affect loads and unloads for use with **$ZF(-5)** or **$ZF(-6)**, as described below.)

The DLL name specified can be a full pathname, or a partial pathname. If you specify a partial pathname, InterSystems IRIS canonicalizes it to the current directory. Generally, DLLs are stored in the binary directory ("bin"). To locate the binary directory, call the **BinaryDirectory()** method of the %SYSTEM.Util class. For further details, refer to the *InterSystems Class Reference*.

Notes

Dynamic-Link Libraries

A DLL is a binary library that contains routines that can be loaded and called at runtime. When a DLL is loaded, InterSystems IRIS finds a function named **GetZFTable()** within it. If **GetZFTable()** is present, it returns a pointer to a table of the functions located in the DLL. Using this table, **$ZF(-3)** calls the specified function from the DLL.

Loading Multiple DLLs

Calls to **$ZF(-3)** can only load one DLL at a time; loading a DLL unloads the previous DLL. To load multiple DLLs concurrently, execute DLL functions with **$ZF(-5)** or **$ZF(-6)**. Loading or unloading a DLL using **$ZF(-3)** has no effect on DLLs loaded for use with **$ZF(-5)** or **$ZF(-6)**.

Loading a DLL Dependent on Another DLL

On Windows, some IRIS system DLLs that are installed in the bin directory are dependent on other DLLs in the bin directory. Windows search rules do not find the dependencies in the bin directory unless bin is added to the process's PATH. From **$ZF(-3)** if a DLL dependency cannot be resolved using the process's PATH, IRIS issues a <DYNAMIC LIBRARY LOAD> error.

However, if a dependent DLL is loaded using $ZF(-4), IRIS first searches the directory from which the DLL is being loaded for dependent DLLs. The IRIS system does this by using a Windows load operation that temporarily adds the originating directory to the PATH while the DLL is loaded. After being loaded by **$ZF(-4)**, this dependent DLL can be used by **$ZF(-3)** without changing the PATH.

See Also

- $ZF(-5) function
- $ZF(-6) function
- Using $ZF(-3) for Simple Library Function Calls in *Using the Callout Gateway*.

$ZF(-4)

Provides utility functions used with **$ZF(-5)** and **$ZF(-6)**.

```
$ZF(-4,1,dll_name)

$ZF(-4,n,dll_id,func_name)

$ZF(-4,n,dll_id,decr_flag)

$ZF(-4,n,dll_index,dll_name)

$ZF(-4,n,dll_index,decr_flag)
```

Parameters

n	A code for the type of operation to perform: 1=load DLL by name. 2=unload DLL by id. 3=look up function in DLL by id. 4=unload DLL by index. 5=create an entry in the system DLL index table. 6=delete an entry in the system DLL index table. 7=create an entry in the process DLL index table. 8=delete an entry in the process DLL index table.
dll_name	The name of the dynamic-link library (DLL). Used with *n*=1, 5, or 7.
dll_id	The id value of a loaded dynamic-link library (DLL). Used with *n*=2, or 3.
dll_index	A user-defined index to a dynamic-link library (DLL) in a DLL index table. Must be a unique, positive, nonzero integer. The numbers 1024 through 2047 are reserved for system use. Used with *n*=4, 5, 6, 7, or 8.
func_name	The name of the function to look up within the DLL. Used only when *n*=3.
decr_flag	*Optional* — A flag for decrementing the DLL reference count. Used with *n*=2 or 4.

Description

$ZF(-4) can be used to establish an ID value for a DLL or for a function within a DLL. These ID values are used by **$ZF(-5)** to execute a function.

$ZF(-4) can be used to establish an index to a DLL index table. These index values are used by **$ZF(-6)** to execute a function.

- You can explicitly load shared libraries using **$ZF(-4,1)**, which loads a library and returns a handle that can be used to access library functions with **$ZF(-5)**.
- You can explicitly load a single shared library using **$ZF(-3)**, which loads a single active library and invokes its methods.
- You can implicitly load shared libraries using **$ZF(-6)**, after indexing a library with **$ZF(-4,5)** or **$ZF(-4,7)**.

Establishing ID Values

To load a DLL and return its ID, use the following syntax:

```
dll_id=$ZF(-4,1,dll_name)
```

To look up a function from a DLL loaded by **$ZF(-4,1)**, and return an ID for that function, use the following syntax:

```
func_id=$ZF(-4,3,dll_id,func_name)
```

To execute a function located by **$ZF(-4,3)**, use **$ZF(-5)**.

To unload a specific DLL loaded by **$ZF(-4,1)**, use the following syntax:

```
$ZF(-4,2,dll_id)
```

To unload all DLLs loaded by **$ZF(-4,1)**, use the following syntax:

```
$ZF(-4,2)
```

Increment and Decrement DLL Loads

When two classes have loaded the same library, the library will be unloaded by the first call to **$ZF(-4,2,dll_id)** or **$ZF(-4,4,dll_index)**. This can leave the other class stranded without access to the library. For this reason, InterSystems IRIS supports a reference count on each DLL. InterSystems IRIS maintains a reference count of the number of times a library is loaded with **$ZF(-4,1,dll_name)**. Each call to **$ZF(-4,1,dll_name)** increases the reference count.

$ZF(-4,2) provides an optional decrement flag argument, *decr_flag*. Each call to **$ZF(-4,2,dll_id,1)** decrements the reference count by 1. A call to **$ZF(-4,2,dll_id,1)** unloads the library if the reference count goes to zero. A call to **$ZF(-4,2,dll_id)** (or **$ZF(-4,2,dll_id,0)**) ignores the reference count and unloads the library immediately.

A call to **$ZF(-4,5)** or **$ZF(-4,7)** establishes a library index. Subsequent calls to **$ZF(-6)** to execute a function implicitly loads the library and increment the reference count. Each call to **$ZF(-4,4,dll_index,1)** decrements this reference count by 1.

The reference count interactions between reference counts established by *dll_name* and *dll_index* are as follows:

- Libraries loaded with **$ZF(-4,1,dll_name)** are not unloaded by a call to **$ZF(-4,4,dll_index,1)** unless the reference count is zero.
- Libraries loaded with **$ZF(-4,1,dll_name)** are immediately unloaded by either **$ZF(-4,2,dll_id)** or **$ZF(-4,4,dll_index)** (with no decrement flag argument) with no regard to the reference count.
- Libraries loaded implicitly with **$ZF(-6)** are not unloaded by **$ZF(-4,2,dll_id,1)**, even if the reference count goes to zero; they can only be unloaded by **$ZF(-4,4,dll_index,1)**.
- Libraries loaded implicitly with **$ZF(-6)** are immediately unloaded by either **$ZF(-4,2,dll_id)** or **$ZF(-4,4,dll_index)** (with no decrement flag argument) with no regard to the reference count.

$ZF(-4,2) with no *dll_id* argument unloads all libraries immediately, without regard to the reference count, or whether they were loaded with **$ZF(-4,1,dll_name)** or implicitly with **$ZF(-6)**.

Loading a DLL Dependent on Another DLL

On Windows, some IRIS system DLLs that are installed in the bin directory are dependent on other DLLs in the bin directory. Windows search rules do not find the dependencies in the bin directory unless bin is added to the process's PATH. However, if one of these DLLs is invoked using **$ZF(-4)** or **$ZF(-6)**, IRIS first searches the directory from which the DLL is being loaded for dependent DLLs; if the dependent DLLs are not found there, the default search PATH is used. The IRIS system does this by using a Windows load operation that temporarily adds the originating directory to the PATH while the

DLL is loaded. This temporary PATH addition is used when the DLL is loaded by **$ZF(-4)** or **$ZF(-6)**. This temporary PATH addition is not used when the DLL is loaded by **$ZF(-3)**.

If a DLL dependency cannot be resolved, IRIS issues a <DYNAMIC LIBRARY LOAD> error.

Establishing Index Values

To index a DLL in the system DLL index table, use the following syntax:

```
$ZF(-4,5,dll_index,dll_name)
```

To index a DLL in the process DLL index table, use the following syntax:

```
$ZF(-4,7,dll_index,dll_name)
```

To look up and execute a function indexed by **$ZF(-4,5)** or **$ZF(-4,7)**, use **$ZF(-6)**.

To unload an indexed DLL, use the following syntax:

```
$ZF(-4,4,dll_index)
```

To delete an index entry in the system DLL index table, use the following syntax:

```
$ZF(-4,6,dll_index)
```

To delete an index entry in the process DLL index table, use the following syntax:

```
$ZF(-4,8,dll_index)
```

To delete all index entries in the process DLL index table, use the following syntax:

```
$ZF(-4,8)
```

For a detailed description of how to use **$ZF(-4)** and **$ZF(-5)**, refer to “Using $ZF(-5) to Access Libraries by System ID” in *Using the Callout Gateway*.

For a detailed description of how to use **$ZF(-4)** and **$ZF(-6)**, refer to “Using $ZF(-6) to Access Libraries by User Index” in *Using the Callout Gateway*.

See Also

- $ZF(-3) function
- $ZF(-5) function
- $ZF(-6) function
- Using $ZF(-5) to Access Libraries by System ID in *Using the Callout Gateway*
- Using $ZF(-6) to Access Libraries by User Index in *Using the Callout Gateway*

$ZF(-5)

Executes a DLL function loaded using $ZF(-4).

```
$ZF(-5,dll_id,func_id,args)
```

Parameters

dll_id	The ID value for the dynamic-link library (DLL), as supplied by $ZF(-4).
func_id	The ID value of the function within the DLL as supplied by $ZF(-4).
args	*Optional* — One or more arguments passed to the called function.

Description

To execute a function located in a DLL loaded using **$ZF**(-4), use the following syntax:

return=**$ZF**(-5,dll_id,func_id,*args*)

See Also

- $ZF(-4) function
- Using $ZF(-5) to Access Libraries by System ID in *Using the Callout Gateway*

$ZF(-6)

Executes a DLL function indexed using **$ZF(-4)**.

```
$ZF(-6,dll_index,func_ID,args)
```

Parameters

dll_index	A user-specified index to a DLL filename in the DLL index tables, from **$ZF(-4)**.
func_ID	*Optional* — The ID value of the function within the DLL as supplied by $ZF(-4). If omitted, call verifies the validity of *DLL_index*, loads the image, and returns the image location.
args	*Optional* — The argument(s) to pass to the function, if any, specified as a comma-separated list.

Description

$ZF(-6) provides a fast Dynamic Link Library (DLL) function interface using a user-defined index for a DLL filename. You establish this user-defined index in **$ZF(-4)** by assigning an integer (*dll_index*) to uniquely associate with a *dll_name*. You can place this entry in either a process DLL index table, or a system DLL index table.

Both **$ZF(-5)** and **$ZF(-6)** can be used to execute a function from a DLL. which has been located by **$ZF(-4)**.

For a detailed description of how to use **$ZF(-6)**, refer to "Using $ZF(-6) to Access Libraries by User Index" in *Using the Callout Gateway*.

Loading a DLL Dependent on Another DLL

On Windows, some IRIS system DLLs that are installed in the bin directory are dependent on other DLLs in the bin directory. Windows search rules do not find the dependencies in the bin directory unless bin is added to the process's PATH. However, if one of these DLLs is invoked using **$ZF(-4)** or **$ZF(-6)**, IRIS first searches the directory from which the DLL is being loaded for dependent DLLs; if the dependent DLLs are not found there, the default search PATH is used. The IRIS system does this by using a Windows load operation that temporarily adds the originating directory to the PATH while the DLL is loaded. This temporary PATH addition is used when the DLL is loaded by **$ZF(-4)** or **$ZF(-6)**. This temporary PATH addition is not used when the DLL is loaded by **$ZF(-3)**.

If a DLL dependency cannot be resolved, IRIS issues a <DYNAMIC LIBRARY LOAD> error.

See Also

- $ZF(-3) function
- $ZF(-4) function
- $ZF(-5) function
- Using $ZF(-6) to Access Libraries by User Index in *Using the Callout Gateway*

$ZF(-100)

Executes an operating system command or program as a child process.

```
$ZF(-100,flags,program,args)
```

Parameters

flags	A quoted string containing one or more keyword flags. Multiple keyword flags are separated by blank spaces. A keyword flag can take the format /keyword, /keyword=value, or /keyword+=value. Keywords are not case-sensitive. The *flags* specify how to execute *program*.
program	An operating system command or a program to be executed as a child process, specified as a quoted string. You can specify a full path, or just a program name. The operating system uses its rules, such as a PATH environment variable, to search for the specified program.
args	*Optional* — A comma-separated list of *program* options and arguments. You can specify a null argument as `""`. You can use a local array and indirection *.args* or the *args...* syntax to specify a variable number of arguments.

Description

$ZF(-100) permits an InterSystems IRIS process to invoke an executable program or a command of the host operating system. It executes the program or command specified in *program* as a spawned child process from the current console. **$ZF(-100)** allows you to invoke a program or command either synchronously or asynchronously, with or without invoking the operating system shell. **$ZF(-100)** provides similar functionality to **$ZF(-1)** and **$ZF(-2)**. Its use is preferable to **$ZF(-1)** or **$ZF(-2)**, which are both deprecated functions.

You can use a local array and indirection to specify a variable number of *args*, as shown in the following UNIX® example:

```
SET args=2
SET args(1)="-01"
SET args(2)="myfile.c"
SET status = $ZF(-100,"/ASYNC", "gcc",.args)
```

$ZF(-100) sets $ZCHILD to the PID of the started program.

You can execute **$ZF(-100)** as an argument of the DO command. **DO $ZF(-100)** differs in two ways from calling **$ZF(-100)** as a function:

- **DO** ignores the returned integer status code.
- You can append an argument postconditional expression to **$ZF(-100)**. For example, `DO:x $ZF(-100,"", "gcc",.args):y $ZF(-100,"/ASYNC", "gcc",.args):z` specifies three postconditionals. It does not execute the **DO** command when *x*=0, it does not execute “gcc” synchronously when *y*=0, and does not execute “gcc” asynchronously when *z*=0. A postconditional expression prevents execution, but does not prevent argument evaluation.

Keyword Flags

How **$ZF(-100)** executes depends on the *flags* string values:

- `/ASYNC`: Execute *program* asynchronously; do not wait for it to complete. The default is to execute synchronously.

  If `/ASYNC` is not specified and `/STDIN`, `/STDOUT`, or `/STDERR` is not specified, InterSystems IRIS attempts to use the operating systems’ current descriptors or standard handles for these files.
- `/SHELL`: Execute *program* using a shell. The default is to not use a shell.

- `/STDIN=filename`: I/O redirection input file.
- `/STDOUT=filename`: I/O redirection standard data output file. If *filename* does not exist, the system will create it. If *filename* exists, `/STDOUT=filename` will overwrite existing data; `/STDOUT+=filename` will append to existing data.
- `/STDERR=filename`: I/O redirection standard error output file. If *filename* does not exist, the system will create it. If *filename* exists, `/STDERR=filename` will overwrite existing error log data; `/STDERR+=filename` will append to existing error log data. If you specify the same file for `/STDOUT` and `/STDERR`, both types of data will be written to that file.
- `/LOGCMD`: log the resulting command line in messages.log. Because sometimes it can be hard to get the arguments for complex commands right, this keyword flag allows developers to check if the arguments passed to the command are being correctly formed (especially with regard to quoting). The log facility does not add any quotes or other delimiters. The messages.log entry is truncated at 1000 characters.
- `/NOQUOTE`: inhibit automatic quoting of commands, command arguments, or filenames. By default, **$ZF(-100)** provides automatic quoting, and escaping of spaces in paths that is appropriate for most user-supplied values. When needed, you can override this default by specifying `/NOQUOTE`; the user is then responsible for providing appropriate quotes. See Quoting User-Specified Values.

To specify **$ZF(-100)** with no keyword flags, specify the empty string for this parameter:

```
SET status = $ZF(-100,"", "ls", "-l")
```

I/O Redirection

I/O redirection for `/STDIN=filename`, `/STDOUT=filename`, and `/STDERR=filename` follow UNIX® conventions. On both UNIX and Windows systems:

- `/STDIN=filename`: The file with that filename is linked to the stdin file handle given to the process that executes the specified cmd string.
- `/STDOUT=filename`: If a file with that filename does not already exist, it is created. For an existing file, `/STDOUT=filename` truncates the file to zero size; `/STDOUT+=filename` appends to the existing file data. This file is linked to the stdout handle given to the process that executes the specified cmd string. This creates a new file containing the stdout output of the spawned command.
- `/STDERR=filename`: If a file with that filename does not already exist, it is created. For an existing file, `/STDERR=filename` truncates the file to zero size; `/STDERR+=filename` appends to the existing file data. This file is linked to the stderr handle given to the process that executes the specified cmd string. This creates a new file containing the stderr output of the spawned command.

If `/STDIN`, `/STDOUT`, or `/STDERR` is not specified:

- If `/ASYNC` is specified, the null device is used in place of the unspecified file(s). A handle that references the null device is given to the process that executes the specified cmd string as the unspecified file's handle.
- If `/ASYNC` is not specified, the handle used by the IRIS job executing the **$ZF(-100)** function is copied and is given to the process that executes the specified cmd string as the unspecified file's handle.

  Note: On a Windows system you should never omit both the `/ASYNC` and `/STDIN` *flags*.

If `/STDIN`, `/STDOUT`, or `/STDERR` specifies a file that cannot be created or opened, the null device is used in place of the file.

If `/STDOUT=filename` and `/STDERR=filename` (or `/STDOUT+=filename` and `/STDERR+=filename`) specify the same filename, the specified file is only opened or created once. The resulting file handle is duplicated and supplied as both the stdout and stderr file handles given to the process that executes the specified cmd string. **$ZF(-100)** generates an

<ILLEGAL VALUE> error if you specify the same file for `/STDOUT` and `/STDERR`, and one is specified `+=filename` and the other is specified `=filename`.

Quoting User-Specified Values

By default,**$ZF(-100)** provides automatic quoting of a command and the arguments to the command. It automatically handles blank spaces if your executable is in a directory with spaces in the name or a command argument specifies a file for output that contains a space. **$ZF(-100)** supplies delimiting double quote characters as needed. This behavior is shown in the following example:

```
DO $ZF(-100,"/LOGCMD","c:\sdelete64.exe","-nobanner","c:\dir1\nested directory\deleteme\")
```

This logs the following to messages.log; **$ZF(-100)** quoted the final argument to escape the space in the file path:

```
06/14/18-14:25:05:988 (3788) 0 $ZF(-100) cmd=c:\sdelete64.exe -nobanner "c:\dir1\nested directory\deleteme\"
06/14/18-14:25:06:020 (3788) 0 $ZF(-100) ret=0
```

If the automatic quoting provided does not correctly escape what you want escaped, you can override it using `/NOQUOTE`.

The `/NOQUOTE` flag suppresses automatic quoting; you must do your own quoting, as needed. If a specified value contains a / character or a blank space, the value must be quoted using doubled double quotes. This is shown in the following example:

```
DO $ZF(-100,"/NOQUOTE /LOGCMD","c:\sdelete64.exe","""-nobanner""","""c:\dir2\""")
```

This logs the following to messages.log:

```
06/15/18-09:27:38:619 (3788) 0 $ZF(-100) cmd=c:\sdelete64.exe "-nobanner" "c:\dir2\"
06/15/18-09:27:38:650 (3788) 0 $ZF(-100) ret=0
```

The behavior differs on UNIX® and Windows systems:

- On a Windows system, if `/SHELL` is not specified, a command line is created and passed. In this case, some arguments may need to be quoted.
- On any system, when `/SHELL` is specified, a command line is created and passed. In this case some arguments may need to be quoted.

Double quotes found within a command or command argument are escaped. On Windows these double quotes are escaped by doubling them as `""` (as shown in the above examples). On UNIX they are escaped as `\"`.

Return Status Codes

$ZF(-100) returns the following status codes:

- 0 if the child process was successfully launched asynchronously (with `/ASYNC` flag). Status of *program* execution unknown.
- -1 if the child process could not be forked.
- An integer if launched synchronously (no `/ASYNC` flag). This integer exit status code value is determined by the application called on the host operating system. Commonly it is a positive integer, but some applications may return a negative integer. For example, for most Windows command syntax errors, **$ZF(-100)** returns 1.

$ZF(-100) with the /SHELL parameter launches the default operating system shell. For further details, see "Issuing Operating System Commands" in *Using the Callout Gateway*.

If a pathname supplied in *program* contains a space character, pathname handling is platform-dependent. Windows and UNIX® permit space characters in pathnames, but the entire pathname containing spaces must be enclosed in an additional set of double quote (") characters. This is in accordance with the Windows `cmd /c` statement. For further details, specify `cmd /?` at the Windows command prompt.

You can use the **NormalizeFilenameWithSpaces()** method of the %Library.File class to handle spaces in pathnames as appropriate for the host platform.

$ZF(-100) requires the **`%System_Callout:U`** privilege. See "Adding the %System_Callout:USE Privilege" in *Using the Callout Gateway* for details.

If **$ZF(-100)** is unable to spawn a process, it generates a <FUNCTION> error.

Error Handling

$ZF(-100) generates a <NOTOPEN> error if:

- The `/STDIN=filename`, `/STDOUT=filename`, or `/STDERR=filename` could not be opened.
- The specified program could not be started.

The error is logged in SYSLOG. The operating system error number and message are available from the **%SYSTEM.Process.OSError()** method.

Auditing

An OS command audit record is added to the audit log for each **$ZF(-100)** call. This record includes information such as the following:

```
Command: /Users/myname/IRIS/jlc/bin/clmanager 4002
Flags: /ASYNC/SHELL
```

$ZF(-100) , $ZF(-1), and $ZF(-2)

These three functions are in most respects identical. They differ in the following ways:

- **$ZF(-100)** can be synchronous or asynchronous. It can execute using the operating system shell or not using the shell. It always sets **$ZCHILD**. Both **$ZF(-1)** and **$ZF(-2)** with no specified parameters launch the operating system shell; **$ZF(-100)** requires a *program* parameter (and the `/SHELL` flag) to launch the operating system shell.

  $ZF(-100) is the preferred function for all purposes, replacing both **$ZF(-1)** and **$ZF(-2)**.

- $ZF(-1) executes using the OS shell. It is synchronous; it suspends execution of the current process while awaiting completion of the spawned child process. It receives status information from the spawned process, which it returns as an exit status code (an integer value) when the spawned process completes. **$ZF(-1)** does not set **$ZCHILD**.
- $ZF(-2) executes using the OS shell. It is asynchronous; it does not suspend execution of the current process. It immediately returns a status value upon spawning the child process. Because it does not await completion of the spawned child process it cannot receive status information from that process. **$ZF(-2)** sets **$ZCHILD** if its fifth argument is true.

See Also

- $ZF(-1) function
- $ZF(-2) function
- $ZCHILD special variable
- Issuing Operating System Commands in *Using the Callout Gateway*

$ZHEX

Converts a hexadecimal string to a decimal number and vice versa.

```
$ZHEX(num)
$ZH(num)
```

Parameter

num	An expression that evaluates to a numeric value be converted, either a quoted string or an integer (signed or unsigned).

Description

$ZHEX converts a hexadecimal string to a decimal integer, or a decimal integer to a hexadecimal string.

If *num* is a string value, **$ZHEX** interprets it as the hexadecimal representation of a number, and returns that number in decimal. Be sure to place the string value within quotation marks.

If *num* is a numeric value, **$ZHEX** converts it to a string representation of the number in hexadecimal format. If either the initial or the final numeric value cannot be represented as an 8-byte signed integer, **$ZHEX** issues a <FUNCTION> error.

You can perform the same hexadecimal/decimal conversions using the **HexToDecimal()** and **DecimalToHex()** methods of the %SYSTEM.Util class:

```
WRITE $SYSTEM.Util.DecimalToHex("27")

WRITE $SYSTEM.Util.HexToDecimal("27"),!
WRITE $SYSTEM.Util.HexToDecimal("1B")
```

$ZHEX can be used with **$CHAR** to specify a Unicode character using its hexadecimal character code: `$CHAR($ZHEX("hexnum"))`.

Parameter

num

A string value or a numeric value, a variable that contains a string value or a numeric value, or an expression that evaluates to a string value or a numeric value.

A string value is read as a hexadecimal number and converted to a positive decimal integer. **$ZHEX** recognizes both uppercase and lowercase letters “A” through “F” as hexadecimal digits. It truncates leading zeros. It does not recognize plus and minus signs or decimal points. It stops evaluation of a string when it encounters a non-hexadecimal character. Therefore, the strings “F”, “f”, “00000F”, “F.7”, and “FRED” all evaluate to decimal 15. If the first character encountered in a string is not a hexadecimal character, **$ZHEX** evaluates the string as zero. Therefore, the strings “0”, “0.9”, “+F”, “-F”, and “H” all evaluate to zero. The null string ("") is an invalid value and issues a <FUNCTION> error.

An integer value is read as a decimal number and converted to hexadecimal. An integer can be positive or negative. **$ZHEX** recognizes leading plus and minus signs. It truncates leading zeros. It evaluates nested arithmetic operations. However, it does not recognize decimal points. It issues a <FUNCTION> error if it encounters a decimal point character. Therefore, the integers 217, 0000217, +217, -+-217 all evaluate to hexadecimal D9. -217, -0000217, and -+217 all evaluate to FFFFFFFFFFFFFF27 (the twos complement). Other values, such as floating point numbers, trailing signs, and nonnumeric characters result in a <FUNCTION> or <SYNTAX> error.

Examples

```
WRITE $ZHEX("F")
```

returns 15.

```
WRITE $ZHEX(15)
```

returns F.

```
WRITE $ZHEX("1AB8")
```

returns 6840.

```
WRITE $ZHEX(6840)
```

returns 1AB8.

```
WRITE $ZHEX("XXX")
```

returns 0.

```
WRITE $ZHEX(-1)
```

returns FFFFFFFFFFFFFFFF.

```
WRITE $ZHEX((3+(107*2)))
```

returns D9.

Notes

Forcing a Hexadecimal Interpretation

To force an integer value to be interpreted as hexadecimal, concatenate any non-hexadecimal character to the end of your *num* parameter. For example:

```
WRITE $ZHEX(16_"H")
```

returns 22.

See Also

- ZZDUMP command
- $ASCII function
- $CHAR function

$ZISWIDE

Checks whether a string contains any 16-bit wide characters.

```
$ZISWIDE(string)
```

Parameter

string	A string of one or more characters, enclosed in quotation marks.

Description

$ZISWIDE is a boolean function used to check whether a string contains any 16-bit wide character values. It returns one of the following values:

0	All characters have ASCII values 255 or less (8-bit characters). A null string ("") also returns 0.
1	One or more characters have an ASCII value greater than 255 (wide characters).

$ZISWIDE checks the character values to determine if they are in the ASCII range (0-255), and thus could be represented by 8 bits, or in the wide character range (256-65535) and thus use all 16 bits of the Unicode character.

Example

In the following example, the first two commands test strings that contain all narrow (8-bit) character values and return 0. The third command tests a string containing a wide character value (the second character), and therefore, returns 1:

```
WRITE $ZISWIDE("abcd"),","
WRITE $ZISWIDE($CHAR(71,83,77)),","
WRITE $ZISWIDE($CHAR(71,300,77))
```

This example returns `0,0,1`.

See Also

- $ZPOSITION function
- $ZWASCII function
- $ZWCHAR function
- $ZWIDTH function

$ZLASCII

Converts a four-byte string to a number.

```
$ZLASCII(string,position)
$ZLA(string,position)
```

Parameters

string	A string that can be specified as a value, a variable, or an expression. It must be a minimum of four bytes in length.
position	*Optional* — A starting position in the string. The default is 1.

Description

The value **$ZLASCII** returns depends on the parameters you use.

- **$ZLASCII**(*string*) returns a numeric interpretation of a four-byte string, starting with the first character position of *string*.
- **$ZLASCII**(*string*,*position*) returns a numeric interpretation of a four-byte string beginning at the starting position specified by *position.*

Upon successful completion, **$ZLASCII** always returns a positive integer. **$ZLASCII** returns -1 if *string* is of an invalid length, or *position* is an invalid value.

Notes

$ZLASCII and $ASCII

$ZLASCII is similar to **$ASCII** except that it operates on four byte (32-bit) words instead of single 8-bit bytes. For two byte (16-bit) words use **$ZWASCII**; for eight byte (64-bit) words, use **$ZQASCII**.

$ZLASCII(*string*,*position*) is the functional equivalent of:

$ASCII(*string*,*position*+3)*256 + **$ASCII**(*string*,*position*+2)*256 + **$ASCII**(*string*,*position*+1)*256 + **$ASCII**(*string*,*position*)

$ZLASCII and $ZLCHAR

The **$ZLCHAR** function is the logical inverse of the **$ZLASCII** function. For example:

```
SET x=$ZLASCII("abcd")
WRITE !,x
SET y=$ZLCHAR(x)
WRITE !,y
```

Given “abcd” **$ZLASCII** returns 1684234849. Given 1684234849 **$ZLCHAR** returns “abcd”.

See Also

- $ASCII function
- $ZLCHAR function
- $ZWASCII function
- $ZQASCII function

$ZLCHAR

Converts a number to a four-byte string.

```
$ZLCHAR(n)
$ZLC(n)
```

Parameter

n	A positive integer in the range 0 through 4294967295. It can be specified as a value, a variable, or an expression.

Description

$ZLCHAR returns a four-byte (long) character string for *n*. The bytes of the character string are presented in little-endian byte order, with the least significant byte first.

If *n* is out of range or a negative number, **$ZLCHAR** returns the null string.

Notes

$ZLASCII and $ZLCHAR

The **$ZLASCII** function is the logical inverse of **$ZLCHAR**. For example:

```
SET x=$ZLASCII("abcd")
WRITE !,x
SET y=$ZLCHAR(x)
WRITE !,y
```

Given “abcd” **$ZLASCII** returns 1684234849. Given 1684234849 **$ZLCHAR** returns “abcd”.

$ZLCHAR and $CHAR

$ZLCHAR is similar to **$CHAR**, except that it operates on four byte (32-bit) words instead of single 8-bit bytes. For two byte (16-bit) words use **$ZWASCII**; for eight byte (64-bit) words, use **$ZQASCII**.

$ZLCHAR is the functional equivalent of the following form of **$CHAR**:

```
SET n=$ZLASCII("abcd")
WRITE !,n
WRITE !,$CHAR(n#256,n\256#256,n\(256**2)#256,n\(256**3))
```

Given “abcd” **$ZLASCII** returns 1684234849. Given 1684234849, this **$CHAR** statement returns “abcd”.

See Also

- $ZLASCII function
- $CHAR function
- $ZWCHAR function
- $ZQCHAR function

$ZLN

Returns the natural logarithm of the specified number.

```
$ZLN(n)
```

Parameter

n	Any positive nonzero number, which can be specified as a value, a variable, or an expression.

Description

$ZLN returns the natural logarithm (base e) value of *n*.

Specifying zero or a negative number results in an <ILLEGAL VALUE> error.

The corresponding natural logarithm power function is $ZEXP.

Examples

The following example writes the natural log of the integers 1 through 10:

```
FOR x=1:1:10 {
  WRITE !,"The natural log of ",x," = ",$ZLN(x)
  }
QUIT
```

returns:

```
The natural log of 1 = 0
The natural log of 2 = .6931471805599453089
The natural log of 3 = 1.098612288668109691
The natural log of 4 = 1.386294361119890618
The natural log of 5 = 1.609437912434100375
The natural log of 6 = 1.791759469228055002
The natural log of 7 = 1.945910149055313306
The natural log of 8 = 2.079441541679835929
The natural log of 9 = 2.197224577336219384
The natural log of 10 = 2.302585092994045684
```

The following example shows the relationship between $ZLN and $ZEXP:

```
SET x=$ZEXP(1) ; x = 2.718281828459045236
WRITE $ZLN(x)
```

returns 1.

```
WRITE $ZLN(0)
```

issues an <ILLEGAL VALUE> error.

See Also

- $ZEXP function
- $ZLOG function
- $ZPI special variable

$ZLOG

Returns the base 10 logarithm value of the specified positive numeric expression.

```
$ZLOG(n)
```

Parameter

n	Any positive, nonzero number, which can be specified as a value, a variable, or an expression.

Description

$ZLOG returns the base 10 logarithm value of *n*.

Specifying zero or a negative number results in an <ILLEGAL VALUE> error.

The corresponding natural log (base e) function is $ZLN.

Examples

The following example writes the base 10 logarithms of the integers 1 through 10:

```
FOR x=1:1:10 {
  WRITE !,"The log of ",x," = ",$ZLOG(x)
  }
QUIT
```

returns:

```
The log of 1 = 0
The log of 2 = .301029995663981195
The log of 3 = .477121254719662437
The log of 4 = .60205999132796239
The log of 5 = .698970004336018805
The log of 6 = .778151250383643633
The log of 7 = .845098040014256831
The log of 8 = .903089986991943586
The log of 9 = .954242509439324875
The log of 10 = 1
```

```
WRITE $ZLOG($ZPI)
```

returns .4971498726941338541.

```
WRITE $ZLOG(.5)
```

returns -.301029995663981195.

```
WRITE $ZLOG(0)
```

issues an <ILLEGAL VALUE> error.

See Also

- $ZEXP function
- $ZLN function
- $ZPI special variable

$ZNAME

Validates the specified name string as a legal identifier.

```
$ZNAME(string,type,lang)
```

Parameters

string	The name to evaluate, specified as a quoted string.
type	*Optional* — An integer code specifying the type of name validation to perform. Valid values are 0 through 6. The default is 0.
lang	*Optional* — An integer code specifying the language mode to use when validating *string*. Valid values are 0 through 12. The default is to use the current language mode.

Description

$ZNAME returns 1 (true) if the *string* parameter is a legal identifier. Otherwise, **$ZNAME** returns 0 (false). The optional *type* parameter determines what type of name validation to perform on the string. If this parameter is omitted, the validation defaults to local variable naming conventions. The optional *lang* parameter specifies what language mode conventions to apply to the validation.

Your locale may not permit the use of an identifier that **$ZNAME** validates as a legal identifier. The valid identifier characters for your locale are defined in the National Language Support (NLS) Identifier locale setting; they are not user-modifiable. For further details on NLS, refer to the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$ZNAME only performs character validation; it does not perform string length validation for identifiers.

Parameters

string

A quoted string to validate as a legal identifier name. The characters a valid string can contain depend both on the type of identifier to validate (specified by *type*), the language mode (*lang*), and the definition of your locale. The *string* specifies only the identifier name; it should not include prefix characters, such as the caret (^) prefix and the optional delimited namespace name prefix for a global, or suffix characters, such an array subscript or parameter parentheses. By default, the following are valid identifier characters in InterSystems IRIS:

- Uppercase letters: A through Z ($CHAR(65) through $CHAR(90))
- Lowercase letters: a through z ($CHAR(97) through $CHAR(122))
- Letters with accent marks: ($CHAR(192) through $CHAR(255), exclusive of $CHAR(215) and $CHAR(247))
- Unicode letters: Letters in non-Latin character sets, such as Greek or Cyrillic letters. For example, $CHAR(256) through $CHAR(687) and $CHAR(913) through $CHAR(1153) exclusive of $CHAR(930) and $CHAR(1014).
- Digits: 0 through 9 ($CHAR(48) through $CHAR(57)) subject to positional restrictions for some identifiers
- The percent sign: % ($CHAR(37)) subject to positional restrictions for some identifiers

$ZNAME also accepts as valid characters $CHAR(170), $CHAR(181), and $CHAR(186).

Note: The Japanese locale does not support accented Latin letter characters in identifiers. Japanese identifiers may contain (in addition to Japanese characters) the Latin letter characters A-Z and a-z (65–90 and 97–122), and the Greek capital letter characters (913–929 and 931–937).

type

An integer code specifying the type of name validation to perform:

Value	Meaning	Restricted Characters
0	Validate a local variable name.	First character only: % Subsequent characters only: digits 0–9
1	Validate a routine name.	First character only: % Subsequent characters only: digits 0–9 and the period (.) character. A period cannot be the first or last character in a routine name.
2	Validate a label (tag) name.	First character only: %
3	Validate a global or process-private global name.	First character only: % Subsequent characters only: digits 0–9 and the period (.) character. A period cannot be the first or last character in a global name.
4	Validate a fully qualified class name.	First character only: % Subsequent characters only: digits 0–9 and the period (.) character. A period cannot be the first or last character in a routine name. (See below.)
5	Validate a method name.	First character only: % Subsequent characters only: digits 0–9
6	Validate a property name	First character only: % Subsequent characters only: digits 0–9

If *type* = 0 (or not specified), an identifier that passes validation may be used for a local variable name, or for any other type of ObjectScript name. This is the most restrictive form of validation. The first character of a valid identifier must be either a percent sign (%) or a valid letter character. The second and subsequent characters of a valid identifier must be either a valid letter character or a digit.

If *type* = 2, an identifier that passes validation may be used for a line label. This is the only type of identifier that allows a digit (0–9) as the first character. Specify only the label name; do not specify a colon prefix (used in triggers) or parameter parentheses following the label name.

If *type* = 3, an identifier that passes validation may be used for global and process-private global names. However, global and process-private global names cannot include wide characters; **$ZNAME** considers wide-character letters to be valid identifier characters for all name validation types. Therefore, if *type*=3, an identifier containing wide character letters passes **$ZNAME** validation, but generates a <WIDE CHAR> error when used as a global name or process-private global name.

If *type* = 4, an identifier that passes validation may be used for a class name. A class name can contain periods, with the following restrictions: a period may not be immediately followed by a number character or by another period. These restrictions on the use of periods do not apply to *type*=1 and *type*=3 validation. No valid identifier of any *type* may have a period as the first or last character of *string*.

lang

An integer code specifying the language mode to use for validation. InterSystems IRIS applies the conventions of the specified language mode to the validation without changing the current language mode. (For a list of available current language modes, see the **LanguageMode()** method of the %SYSTEM.Process class.) The default is for **$ZNAME** to use the language mode conventions of the current language mode. Because all InterSystems IRIS language modes use the same naming conventions, *lang* can be omitted and take the default.

Examples

The following example shows the **$ZNAME** function validating the expressions as true (1). Note that the last two examples contain periods, which are permitted in routine names (*type*=1) and global names (*type*=3):

```
WRITE !,$ZNAME("A")
WRITE !,$ZNAME("A1")
WRITE !,$ZNAME("%A1",0)
WRITE !,$ZNAME("%A1",1)
WRITE !,$ZNAME("A.1",1)
WRITE !,$ZNAME("A.1",3)
```

In the following example, the first **$ZNAME** fails validation (returns 0) because (by default) it validates for a local variable name, and the first character of a local variable name cannot be a digit. The second **$ZNAME** passes validation (returns 1) because *type*=2 specifies label validation, and first character of a label name can be a digit.

```
WRITE "local var: ",$ZNAME("1A"),!
WRITE "label: ",$ZNAME("1A",2)
```

The following example fails validation for all *type* values. InterSystems IRIS names of all types cannot contain a percent sign unless it is the first character of the name:

```
FOR i=0:1:6 {
  WRITE "type ",i," is ",$ZNAME("A%1",i),!
}
```

The following example shows the full set of valid 8-bit identifier characters for local variable names. These valid identifier characters include the letter characters ASCII 192 through ASCII 255, with the exceptions of ASCII 215 and ASCII 247, which are arithmetic symbols:

```
 FOR n=1:1:255  {
 IF $ZNAME("A"_$CHAR(n),0) & $ZNAME($CHAR(n),0){
    WRITE !,$ZNAME($CHAR(n))," ASCII code=",n," Char.=",$CHAR(n) }
 ELSEIF $ZNAME($CHAR(n),0){
    WRITE !,$ZNAME($CHAR(n))," ASCII code=",n," 1st Char.=",$CHAR(n) }
 ELSEIF $ZNAME("A"_$CHAR(n),0){
    WRITE !,$ZNAME("A"_$CHAR(n))," ASCII code=",n," Subseq. Char.=",$CHAR(n) }
 ELSE { }
}
 WRITE !,"All done"
```

The following example passes validation on InterSystems IRIS. The Greek letters specified are valid Unicode letters and thus pass **$ZNAME** validation. However, this name cannot be used for a global or process-private global (*type*=3), and may not be usable with some locales (such as the Japanese locale):

```
  WRITE $C(913)_$C(961)_$C(947)_$C(959),!
  FOR i=0:1:6 {
    WRITE "type ",i," is ",$ZNAME($C(913)_$C(961)_$C(947)_$C(959),i),!
  }
```

SQL Identifiers

SQL identifiers may include punctuation characters (underscore (_), at sign (@), pound sign (#), and dollar sign ($)) that are not valid characters in ObjectScript identifiers. SQL routine names may not include the percent sign (%) at any location other than the first character. For further details, see Identifiers in the *Using InterSystems SQL*.

See Also

- ObjectScript Symbols table
- InterSystems SQL Symbols table

$ZPOSITION

Returns the number of characters in an expression that can fit within a specified field width.

```
$ZPOSITION(expression,field,pitch)
```

Parameters

expression	A string expression.
field	An integer expression that specifies field width.
pitch	*Optional* — A numeric expression that specifies the pitch value to use for full-width characters. The default is 2. Other permissible values are 1, 1.25, and 1.5.

Description

$ZPOSITION returns the number of characters in *expression* that can fit within the *field* value. The *pitch* value determines the width to use for full-width characters. All other characters receive a default width of 1 and are considered to be half-width. Because half-width characters count as 1, *field* also expresses the number of half-width characters that fit in *field*.

$ZPOSITION adds the widths of the characters in the *expression* one at a time until the cumulative width equals the value of *field* or until there are no more characters in *expression*. The result is thus the number of characters that will fit within the specified *field* value including any fractional part of a character that would not completely fit.

Examples

In the following example, assume that the variable *string* contains two half-width characters followed by a full-width character.

```
WRITE $ZPOSITION(string,3,1.5)
```

returns 2.666666666666666667.

In the above example, the first two characters in *string* fit in the specified field width with one left over. The third character in *string*, a full-width character with a width of 1.5 (determined by the pitch argument), would not completely fit, although two thirds (1/1.5) of the character would fit. The fractional part of the result indicates that fact.

In the following example, *string* is now a string that contains a full-width character followed by two half-width characters. The result returned is 2.5:

```
WRITE $ZPOSITION(string,3,1.5)
```

The results are now different. This is because the first two characters, which have a combined width of 2.5, would completely fit with .5 left over. Even so, only half of the third character (.5/1) would fit.

Finally, if *string* is a string that contains three half-width characters then all three characters would completely (and exactly) fit, and the result would be 3:

```
WRITE $ZPOSITION(string,3,1.5)
```

Note: Full-width characters are determined by examining the pattern-match table loaded for your InterSystems IRIS process. Any character with the full-width attribute is considered to be a full-width character. The special ZFWCHARZ patcode can be used to check for this attribute (for example, char?1ZFWCHARZ). For more information about the full-width attribute, see the description of the $X/$Y Tab in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

See Also

- $ZWIDTH function
- $ZZENKAKU function

$ZPOWER

Returns the value of a number raised to a specified power.

```
$ZPOWER(num,exponent)
```

Parameters

num	The number to be raised to a power.
exponent	The exponent.

Description

$ZPOWER returns the value of the *num* parameter raised to the *n*th power.

This function performs the same operation as the Exponentiation operator (**). For details on valid parameter values and the value returned for specific combinations of parameter values, see Exponentiation Operator in the "Operators and Expressions" chapter of *Using ObjectScript*.

Parameters

num

The number to be raised to a power. It can be integer or floating point, negative, positive, or zero. It can be a standard InterSystems IRIS number or an IEEE double-precision binary floating-point number (a $DOUBLE number). It can be specified as a value, a variable, or an expression.

If you specify *num* as a quoted string, the string is parsed as a number, as described in "Strings as Numbers" in the "Data Types and Values" chapter of *Using ObjectScript*. The null string ("") and nonnumeric strings evaluate to zero.

exponent

The exponent is a number that can be integer or floating point, negative, positive, or zero. It can be a standard InterSystems IRIS number or an IEEE double-precision binary floating-point number (a $DOUBLE number). It can be specified as a numeric or string value, a variable, or an expression.

If you specify *exponent* as a quoted string, the string is parsed as a number, as described in "Strings as Numbers" in the "Data Types and Values" chapter of *Using ObjectScript*. The null string ("") and nonnumeric strings evaluate to zero.

The following combinations of *num* and *exponent* result in an error:

- If *num* is negative, *exponent* must be an integer. Otherwise an <ILLEGAL VALUE> error is generated.
- If *num* is 0, *exponent* must be a positive number or zero. Otherwise an <ILLEGAL VALUE> or <DIVIDE> error is generated.
- Large *exponent* values, such as `$ZPOWER(9,153)` may result in an overflow, generating a <MAXNUMBER> error, or may result in an underflow, returning 0. Which result occurs depends on whether *num* is greater than 1 (or -1), and whether *exponent* is positive or negative. A <MAXNUMBER> error occurs when an operation exceeds the largest number that InterSystems IRIS supports. For further details, refer to "Extremely Large Numbers" in the "Data Types and Values" chapter of *Using ObjectScript*.

For further details on valid parameter values and the value returned for specific combinations of parameter values, see Exponentiation Operator in the "Operators and Expressions" chapter of *Using ObjectScript*.

Examples

The following example raises 2 to the first ten powers:

```
SET x=0
WHILE x < 10 {
  SET rtn=$ZPOWER(2,x)
  WRITE !,"The ",x," power of 2=",rtn
  SET x=x+1 }
```

See Also

- $ZSQR function
- $ZEXP function
- $ZLN function
- $ZLOG function
- Operators in *Using ObjectScript*

$ZQASCII

Converts an eight-byte string to a number.

```
$ZQASCII(string,position)
$ZQA(string,position)
```

Parameters

string	A string. It can be a value, a variable, or an expression. It must be a minimum of eight bytes in length.
position	*Optional* — A starting position in the string, expressed as a positive integer. The default is 1. Position is counted in single bytes, *not* eight-byte strings. The *position* cannot be the last byte in the string, or beyond the end of the string. A numeric *position* value is parsed as an integer by truncating decimal digits, removing leading zeros and plus signs, etc.

Description

The value that **$ZQASCII** returns depends on the parameters you use.

- **$ZQASCII**(*string*) returns a numeric interpretation of an eight-byte string starting at the first character position of *string*.
- **$ZQASCII**(*string*,*position*) returns a numeric interpretation of an eight-byte string beginning at the starting byte position specified by *position*.

$ZQASCII can return either a positive or a negative integer.

$ZQASCII issues a <FUNCTION> error if *string* is of an invalid length, or *position* is an invalid value.

Example

The following example determines the numeric interpretation of the character string "abcdefgh":

```
WRITE $ZQASCII("abcdefgh")
```

It returns 7523094288207667809.

The following examples also return 7523094288207667809:

```
WRITE !,$ZQASCII("abcdefgh",1)
WRITE !,$ZQASCII("abcdefghxx",1)
WRITE !,$ZQASCII("xxabcdefghxx",3)
```

Notes

$ZQASCII and $ASCII

$ZQASCII is similar to **$ASCII** except that it operates on eight byte (64-bit) words instead of single 8-bit bytes. For 16-bit words use **$ZWASCII**; for 32-bit words, use **$ZLASCII**.

$ZQASCII and $ZQCHAR

The **$ZQCHAR** function is the logical inverse of **$ZQASCII**. For example:

```
WRITE $ZQASCII("abcdefgh")
```

returns: 7523094288207667809.

```
WRITE $ZQCHAR(7523094288207667809)
```

returns “abcdefgh”.

See Also

- $ASCII function
- $ZQCHAR function

$ZQCHAR

Converts a number to an eight-byte string.

```
$ZQCHAR(n)
$ZQC(n)
```

Parameter

n	An integer in the range -9223372036854775808 through 9223372036854775807. It can be specified as a value, a variable, or an expression.

Description

$ZQCHAR returns an eight-byte (quad) character string corresponding to the binary representation of *n*. The bytes of the character string are presented in little-endian byte order, with the least significant byte first.

$ZQCHAR issues a <FUNCTION> error if *n* is invalid.

Example

The following example returns the eight-byte string for the integer 7523094288207667809:

```
WRITE $ZQCHAR(7523094288207667809)
```

returns: “abcdefgh”

Notes

$ZQCHAR and $CHAR

$ZQCHAR is similar to **$CHAR** except that it operates on eight byte (64-bit) words instead of single 8-bit bytes. For 16-bit words use **$ZWCHAR**; for 32-bit words, use **$ZLCHAR**.

$ZQCHAR and $ZQASCII

$ZQASCII is the logical inverse of the **$ZQCHAR** function. For example:

```
WRITE $ZQCHAR(7523094288207667809)
```

returns: abcdefgh

```
WRITE $ZQASCII("abcdefgh")
```

returns: 7523094288207667809

See Also

- $ZQASCII function
- $CHAR function
- $ZLCHAR function
- $ZWCHAR function

$ZSEARCH

Returns the full file specification, pathname and filename, of a specified file.

```
$ZSEARCH(target)
$ZSE(target)
```

Parameter

target	A filename, a pathname, or a null string. May contain one or more * or ? wildcard characters.

Description

$ZSEARCH returns the full file specification (pathname and filename) of a specified target file or directory. The filename may contain wild cards so that **$ZSEARCH** can return a series of fully qualified pathnames that satisfy the wild carding.

Note: Some operating systems use the slash (/) character as the directory path delimiter. Other operating systems use the backslash (\) character. In this Description, the word “slash” means either slash or backslash, as appropriate.

If the *target* parameter does not specify a pathname, **$ZSEARCH** searches the current working directory. **$ZSEARCH** applies the rules in its matching process in the following order:

1. **$ZSEARCH** scans the target to see if it is surrounded with percent characters (%). If **$ZSEARCH** finds such text, it treats the string as an environment variable. **$ZSEARCH** performs name translation on the string.
2. **$ZSEARCH** scans the string that results from the previous step to find the final slash. If **$ZSEARCH** finds a final slash, it uses the string up to, but not including, the final slash as the path or directory to be searched. If **$ZSEARCH** does not find a final slash, it searches the current working directory, which is determined by the current namespace.
3. If **$ZSEARCH** found a final slash in the previous step, it uses the portion of the target string following the final slash as the filename search pattern. If **$ZSEARCH** did not find a final slash in the previous step, it uses the whole string that results from Step 1 as the filename search pattern.

The filename search pattern can be any legal filename string or a filename wildcard expression. The first filename that matches the search pattern is returned as the **$ZSEARCH** function value. Which is the first matching file is platform-dependent (as described in the Notes section).

If the next invocation of **$ZSEARCH** specifies the null string as the *target*, **$ZSEARCH** continues with the previous *target* and returns the next filename that matches the search pattern. When there are no more files that match the search pattern, **$ZSEARCH** returns a null string.

The **NormalizeDirectory()** method of the %Library.File class can also be used to return the full pathname of a specified file or directory, as shown in the following example:

```
NEW $NAMESPACE
SET $NAMESPACE="%SYS"
WRITE ##class(%Library.File).NormalizeDirectory("IRIS.DAT"),!
NEW $NAMESPACE
SET $NAMESPACE="USER"
WRITE ##class(%Library.File).NormalizeDirectory("IRIS.DAT")
```

However, **NormalizeDirectory()** cannot use wildcards.

Wildcards

$ZSEARCH allows the use of the following wildcard expressions within the quoted *target* string.

Wildcard	Match
*	Matches any string of zero or more characters.
?	Matches a single character. On Windows systems matches one or zero characters at the end of a name element.

These wildcards follow the host platform's usage rules. On Windows, **$ZSEARCH** performs a case-independent search, then returns the actual case of the located file or directory. For example, "j*" can match "JOURNAL", "journal", or "Journal"; the actual directory name is "Journal", which is what is returned.

On Windows and UNIX® systems you can also use the following standard pathname symbols: a single dot (.) to specify the current directory, or a double dot (..) to specify its parent directory. These symbols can be used in combination with wildcard characters.

Parameters

target

The following are the available types of values for the *target* parameter:

Target Type	Description
pathname	An expression that evaluates to a string specifying the path to the file or group of files you want to list. A path may be up to 1,024 characters in length.
filename	A filename. The default location is the current dataset.
null string ("")	Returns the next matching file name from the previous **$ZSEARCH**.

Examples

The following Windows examples find all files ending with ".DAT" as a file extension in the USER namespace.

```
  NEW $NAMESPACE
  SET $NAMESPACE="USER"
  SET file=$ZSEARCH("*.DAT")
   WHILE file'="" {
       WRITE !,file
       SET file=$ZSEARCH("")
   }
   WRITE !,"That is all the matching files"
   QUIT
```

returns:

```
c:\InterSystems\IRIS\mgr\user\IRIS.DAT
```

The following Windows example finds all files beginning with the letter "i" in the USER namespace.

```
  NEW $NAMESPACE
  SET $NAMESPACE="USER"
  SET file=$ZSEARCH("i*")
   WHILE file'="" {
       WRITE !,file
       SET file=$ZSEARCH("")
   }
   WRITE !,"That is all the matching files"
   QUIT
```

returns:

```
c:\InterSystems\IRIS\mgr\user\IRIS.DAT
c:\InterSystems\IRIS\mgr\user\iris.lck
```

Notes

Directory Locking

In order to give accurate results, the process keeps the directory open until **$ZSEARCH** has returned all files in the directory (that is, until **$ZSEARCH** returns a null string, or a new **$ZSEARCH** is started). This may prevent other operations, such as deleting the directory. When you start a **$ZSEARCH** you should always repeat the **$ZSEARCH("")** until it returns a null string. An alternative, if you do not want to retrieve all files, is to issue **$ZSEARCH** with a filename that you know does not exist, such as **$ZSEARCH(-1)**.

Windows Support

For Windows, the target parameter is a standard file specification, which may contain wildcard characters (* and ?).

- The * wildcard can be used to match a dot, but the ? wildcard cannot. Therefore, “MYFILE*” matches MYFILE-FOLDER, MYFILE.DOC, and MYFILEBACKUP.DOC; “MYFILE?DOC” does not match MYFILE.DOC.
- The ? wildcard does not match zero characters within a name element. Therefore, “MY?FILE.DOC” matches MY2FILE.DOC, but does not match MYFILE.DOC.
- The ? wildcard matches zero characters at the end of a name element. Extra trailing ? wildcards are ignored. Therefore, “MYFILE?.DOC” matches both MYFILE2.DOC and MYFILE.DOC.

If you do not specify a directory, the current working directory is used. **$ZSEARCH** returns the first matching entry in the directory in alphabetical order. It returns the full file specification or fully qualified pathname. The drive letter is always returned as an uppercase letter, regardless of how it was specified.

By default, Windows checks only the first three characters of a filename extension suffix. Therefore, `$ZSEARCH("*.doc")` would return not only all files with the `.doc` suffix, but also all files with the `.docx` suffix. If you wish to limit your search to only `.docx` files, you must specify the four character suffix: `$ZSEARCH("*.docx")`. You cannot use trailing ? wildcards to limit your search to suffixes longer than three characters.

UNIX® Support

For UNIX®, the target parameter is a standard UNIX® file specification, which may contain wildcard characters (* and ?). If you do not specify a directory, the current working directory is used.

For UNIX®, **$ZSEARCH** returns the first active entry in the directory. Since UNIX® does not keep the directory entries in alphabetical order, the returned values are not in alphabetical order. Unlike Windows platforms, the **$ZSEARCH** function does not return the full file specification or fully qualified pathnames, unless the current working directory is used.

$ZSEC

Returns the trigonometric secant of the specified angle value.

```
$ZSEC(n)
```

Parameter

n	Angle in radians ranging from 0 to 2 Pi. It can be specified as a value, a variable, or an expression.

Description

$ZSEC returns the trigonometric secant of *n*. The result is a signed decimal number. The secant of 0 is 1. The secant of pi is -1.

Note: InterSystems IRIS uses the host operating system's routines to calculate trigonometric functions. For this reason, results obtained from different operating systems may not precisely match.

Parameter

n

An angle in radians ranging from Pi to 2 Pi (inclusive). It can be specified as a value, a variable, or an expression. You can specify the value Pi by using the **$ZPI** special variable. You can specify positive or negative values smaller than Pi or larger than 2 Pi; InterSystems IRIS resolve these values to the corresponding multiple of Pi. For example, 3 Pi is equivalent to Pi, and negative Pi is equivalent to Pi.

A non-numeric string is evaluated as 0, and therefore **$ZSEC** returns 1.

Example

The following example permits you to compute the secant of a number:

```
READ "Input a number: ",num
IF $ZABS(num)>(2*$ZPI) { WRITE !,"number is a larger than 2 pi" }
ELSE {
      WRITE !,"the secant is: ",$ZSEC(num)
     }
QUIT
```

See Also

- $ZCSC function
- $ZPI special variable

$ZSEEK

Establishes a new offset into the current sequential file.

```
$ZSEEK(offset,mode)
```

Parameters

offset	The offset into the current file in characters, specified as an integer. Can be zero, a positive integer, or a negative integer.
mode	*Optional* — An integer value that determines the relative position of the offset. 0=beginning, 1=current position, 2=end. The default is 0.

Description

$ZSEEK establishes a new *offset* into the current device. The current device must be a sequential file. If the current device is not a sequential file, **$ZSEEK** issues a <FUNCTION> error.

The *mode* parameter determines the point from which *offset* is based: beginning, current position, or end.

$ZSEEK returns the current position in the file after performing the offset. **$ZSEEK** without parameters returns the current position in the file without performing an offset.

$ZSEEK can only be used when the device is a sequential file. Invoking **$ZSEEK** from the Terminal, or when there is no open sequential file results in a <FUNCTION> error. If there is no specifically set current device, **$ZSEEK** assumes that the device is the principal device.

The $ZPOS special variable contains the current file position. It is the same as the value returned by **$ZSEEK(0,1)** or **$ZSEEK()** (with no parameters).

Parameters

offset

The offset (in characters) from the point established by *mode*. This is an offset, not a position. Therefore an offset of 0 from the beginning of the file is position 1, the start of the file. An offset of 1 is position 2, the second character of the file.

An offset can be a position after the end of the file. **$ZSEEK** fills with blanks for the specified offset.

An offset can be a negative number if *mode* is 1 or 2. Specifying a negative number that results in a position before the beginning of the file results in a <FUNCTION> error.

mode

The valid values are:

0	Offset is relative to the beginning of the file (absolute).
1	Offset is relative to the current position.
2	Offset is relative to the end of the file.

If you do not specify a *mode* value, **$ZSEEK** assumes a mode value of 0.

Examples

The following Windows example opens a sequential file and writes “AAA”, **$ZSEEK(10)** establishes an offset 10 characters from the beginning of the file (filling with 7 blanks), the example writes “BBB” at that position, then **$ZSEEK()** with no parameters returns the resulting offset from the beginning of the file (in this case, 13).

```
SET $TEST=0
SET myfile="C:\InterSystems\IRIS\mgr\user\zseektestfile.txt"
OPEN myfile:("WNS"):10
  IF $TEST=0 {WRITE "OPEN failed" RETURN}
USE myfile
WRITE "AAA"
SET rtn=$ZSEEK(10)
WRITE "BBB"
SET rtnend=$ZSEEK()
CLOSE myfile
WRITE "set offset:",rtn," end position:",rtnend
```

The following Windows example writes the letter “A” to a sequential file ten times, with increasing numbers of blank spaces between them. It uses **$ZPOS** to determine the current file position:

```
SET $TEST=0
SET myfile="C:\InterSystems\IRIS\mgr\user\zseektestfile2.txt"
OPEN myfile:("WNS"):10
  IF $TEST=0 {WRITE "OPEN failed" RETURN}
USE myfile
FOR i=1:1:10 {WRITE "A" SET rtn=$ZSEEK($ZPOS+i,0)}
CLOSE myfile
```

See Also

- OPEN command
- USE command
- CLOSE command
- $ZPOS special variable
- Sequential File I/O in *I/O Device Guide*

$ZSIN

Returns the trigonometric sine of the specified angle value.

```
$ZSIN(n)
```

Parameter

n	Angle in radians ranging from Pi to 2 Pi (inclusive). Other supplied numeric values are converted to a value within this range.

Description

$ZSIN returns the trigonometric sine of *n*. The result is a signed decimal number ranging from 1 to -1 (see note). **$ZSIN(0)** returns 0. **$ZSIN($ZPI/2)** returns 1.

Note: **$ZSIN** (like all trigonometric functions) calculates its values based on pi rounded to the number of available decimal digits. Therefore, the value returned by `$ZSIN($ZPI)` is .0000000000000000000462644 and `$ZSIN($ZPI*2)` is –.00000000000000000000092529. For this reason you should not perform limit tests comparing these returned values to 0.

Parameter

n

An angle in radians ranging from Pi to 2 Pi (inclusive). It can be specified as a value, a variable, or an expression. You can specify the value Pi by using the **$ZPI** special variable. You can specify positive or negative values smaller than Pi or larger than 2 Pi; InterSystems IRIS resolve these values to the corresponding multiple of Pi. For example, 3 Pi is equivalent to Pi, and negative Pi is equivalent to Pi.

A non-numeric string is evaluated as 0.

Examples

The following example permits you to compute the sine of a number:

```
   READ "Input a number: ",num
   IF $ZABS(num)>(2*$ZPI) { WRITE !,"number is a larger than 2 pi" }
   ELSE {
         WRITE !,"the sine is: ",$ZSIN(num)
        }
   QUIT
```

The following example compares the results from InterSystems IRIS fractional numbers (**$DECIMAL** numbers) and **$DOUBLE** numbers. In both cases, the sine of pi is a fractional number (not 0), but the sine of pi/2 is set to exactly 1:

```
  WRITE !,"the sine is: ",$ZSIN($ZPI)
  WRITE !,"the sine is: ",$ZSIN($DOUBLE($ZPI))
  WRITE !,"the sine is: ",$ZSIN($ZPI/2)
  WRITE !,"the sine is: ",$ZSIN($DOUBLE($ZPI)/2)
```

In the following example, all **$ZSIN** functions return zero (0):

```
  WRITE !,"the sine is: ",$ZSIN(0.0)
  WRITE !,"the sine is: ",$ZSIN(-0.0)
  WRITE !,"the sine is: ",$ZSIN($DECIMAL(0.0))
  WRITE !,"the sine is: ",$ZSIN($DOUBLE(0.0))
  WRITE !,"the sine is: ",$ZSIN($DECIMAL(-0.0))
  WRITE !,"the sine is: ",$ZSIN($DOUBLE(-0.0))
  WRITE !,"the sine is: ",$ZSIN(-$DECIMAL(0.0))
  WRITE !,"the sine is: ",$ZSIN(-$DOUBLE(0.0))
```

This is true on all platforms, including AIX.

See Also

- $ZCOS function
- $ZARCSIN function
- $ZPI special variable

$ZSQR

Returns the square root of a specified number.

```
$ZSQR(n)
```

Parameter

n	Any positive number, or zero. (The null string and nonnumeric string values are treated as a zero.) Can be specified as a value, a variable, or an expression.

Description

$ZSQR returns the square root of *n*. It returns the square root of 1 as 1. It returns the square root of 0 and the square root of a null string ("") as 0. Specifying a negative number invokes an <ILLEGAL VALUE> error. You can use the absolute value function **$ZABS** to convert negative numbers to positive numbers.

Examples

The following example returns the square root of a user-supplied number.

```
READ "Input number for square root: ",num
IF num<0 { WRITE "ILLEGAL VALUE: no negative numbers" }
ELSE { WRITE $ZSQR(num) }
QUIT
```

Here are some specific examples:

```
WRITE $ZSQR(2)
```

returns 1.414213562373095049.

```
WRITE $ZSQR($ZPI)
```

returns 1.772453850905516027.

See Also

- $ZABS function
- $ZPOWER function

$ZSTRIP

Removes types of characters and individual characters from a specified string.

```
$ZSTRIP(string,action,remchar,keepchar)
```

Parameters

string	The string to be stripped.
action	What to strip from *string*. An *action* consists of an action code followed by a one or more mask codes. The mask code is optional when specifying *remchar*. An *action* is specified as a quoted string.
remchar	*Optional* — A string of specific character values to remove. If *action* does not contain a mask code, *remchar* lists the characters to remove. If *action* contains a mask code, *remchar* lists additional characters to remove that are not covered by the *action* parameter's mask code.
keepchar	*Optional* — A string of specific character values to *not* remove that are designated for removal by the *action* parameter's mask code. A mask code must be specified to specify *keepchar*.

Description

The **$ZSTRIP** function removes types of characters and/or individual character values from the specified *string*. In the *action* parameter you specify an action code indicating the kind of remove operation to perform, and (optionally) a mask code specifying the types of characters to remove. You can specify individual character values to remove using the *remchar* parameter. **$ZSTRIP** can remove both types of characters (such as all lowercase letters) and listed character values (such as the letters "AEIOU") in the same operation. You can use the optional *remchar* and *keepchar* parameters to modify the effects of the *action* parameter's mask code by specifying individual character values to remove or to keep.

For further information, refer to the Pattern Matching Operators section of *Using ObjectScript*. You can also select types of characters, character sequences, and ranges of characters using the Regular Expression functions $LOCATE and $MATCH.

Parameters

action

A string indicating what characters to strip, specified as an action code, optionally followed by one or more mask codes.

Action Codes

*	Strip all characters that match the mask code(s).
<	Strip leading characters that match the mask code(s).
>	Strip trailing characters that match the mask code(s).
<>	Strip leading and trailing characters that match the mask code(s).
=	Strip repeating characters that match the mask code(s). When encountering a series of repeated characters, this code strips the duplicate characters leaving a single instance. This code only strips duplicate adjacent characters. Thus stripping "a" from "aaaaaabc" yields "abc", but stripping "a" from "abaca" returns the string "abaca" unchanged. The duplicate character test is case-sensitive.
<=>	Strip leading, trailing, and repeating characters that match the mask code(s).

An action code can consist of the * character, or any combination of a single <, >, or = character.

To strip types of characters, the *action* string should consist of an action code followed by one or more mask codes. To strip specific character values, omit the mask code, and specify a *remchar* value. You can specify both a mask code and a *remchar* value. If you specify neither a mask code nor a *remchar* value, **$ZSTRIP** returns *string*.

Mask Codes

E	Strip everything.
A	Strip all alphabetic characters.
P	Strip punctuation characters, including blank spaces.
C	Strip control characters (0-31, 127-159).
N	Strip numeric characters. Note that a numeric string is *not* converted to canonical form before applying **$ZSTRIP**.
L	Strip lowercase alphabetic characters.
U	Strip uppercase alphabetic characters.
W	Strip whitespaces ($C(9), $C(32), $C(160)).

Mask codes can be specified as uppercase or lowercase characters.

A mask code character can be preceded by a Unary Not (') meaning do not remove characters of this type. You must specify at least one mask code without a Unary Not before specifying a Unary Not mask code. All mask codes without a Unary Not must precede the mask codes with a Unary Not.

remchar

Specific characters to remove, specified as a quoted string. These *remchar* characters can be specified in any order and duplicates are permitted.

If you do not specify a mask code, **$ZSTRIP** applies the *action* parameter to the *remchar* character(s). If you specify a mask code, *remchar* specifies one or more additional characters to remove. For example, if you specified in the *action* parameter that you want to remove all numeric characters ("*N"), but you also want to remove the letter “E” (used to represent scientific notation), you would add the string “E” as the *remchar* parameter, as shown in the second **$ZSTRIP**:

```
SET str="first:123 second:12E3"
WRITE $ZSTRIP(str,"*N"),!
WRITE $ZSTRIP(str,"*N","E")
```

keepchar

Specific characters not to remove. For example, if you specified that you wanted to remove all white spaces and alphabetic characters (*WA), but preserve uppercase M, you would add the string “M” as the *keepchar* parameter.

Examples

The following example strips out all numeric characters. Because a numeric string is not converted to canonical form, the characters + and E are not stripped out:

```
SET str="+123E4"
WRITE $ZSTRIP(str,"*N")
```

returns: +E

In the following example, the first **$ZSTRIP** strips all punctuation characters, the second **$ZSTRIP** strips all punctuation characters except whitespace characters.

```
SET str="ABC#$%^ DEF& *GHI***"
WRITE $ZSTRIP(str,"*P"),!
WRITE $ZSTRIP(str,"*P'W")
```

The following example strips out all characters, except lowercase letters ('L). However, the example uses the *remchar* parameter to strip the lowercase x while preserving all other lowercase characters:

```
SET str="xXx-Aa BXXbx Cxc Dd xxEeX^XXx"
WRITE $ZSTRIP(str,"*E'L","x")
```

returns: `abcde`

The following example strips out all characters, except lowercase letters ('L). In this case, the example does not specify a *remchar* parameter value (but does specify the delimiting commas), but does specify the *keepchar* parameter to preserve uppercase A, B, and C:

```
SET str="X-Aa BXXb456X CXc Dd XXEeX^XFFFfXX"
WRITE $ZSTRIP(str,"*E'L",,"ABC")
```

returns: `AaBbCcdef`

The following example does not specify a mask code; it specifies to remove the letters “X” and “x” wherever they occur in the string. All other characters in the string are returned.

```
SET str="+x $1x,x23XX4XX.X56XxxxxxX"
WRITE $ZSTRIP(str,"*","Xx")
```

returns: `+ $1,234.56`

The following example does not specify a mask code; it specifies to remove the character “x” as a leading or trailing character, and to removed repeating “x”s wherever they occurs within the string:

```
SET str="xxxxx00xx0111xxx01x0000xxxxx"
WRITE $ZSTRIP(str,"<=>","x")
```

returns: `00x0111x01x0000`

The following example strips out all numeric, alphabetic, and punctuation characters, except whitespace and lowercase letters. Note that all mask codes without a Unary Not must precede any mask codes with a Unary Not:

```
SET str="Aa66*&% B&$b Cc987 #Dd Ee"
WRITE $ZSTRIP(str,"*NAP'W'L")
```

returns: `a b c d e`

The following example strips out leading, trailing, and repeating characters that match the mask code A (all alphabetic characters):

```
SET str="ABC123DDDEEFFffffGG5555567HI JK"
WRITE $ZSTRIP(str,"<=>A")
```

It returns `123DEFfG5555567HI`; **$ZSTRIP** stripped leading characters (ABC) until it encountered a character of a type not included in the mask (1), and stripped trailing characters from the end of the string until it encountered a non-mask character (the blank space). Repeated characters of the mask type were reduced to a single occurrence (DDDEE = DE); note that the repeat test is case-sensitive (FFffff = Ff). Repeated characters that are not of the mask type (55555) are unaffected.

The following example strips out all characters except the hexadecimal digits 0–9 and A-F:

```
SET str="123$ GYJF870B-QD  @#%+"
WRITE $ZSTRIP(str,"*E'N",,"ABCDEF")
```

returns: `123F870BD`

See Also

- $EXTRACT function
- $ZCONVERT function
- $LOCATE and $MATCH functions for Regular Expressions
- Pattern Matching operators in *Using ObjectScript*

$ZTAN

Returns the trigonometric tangent of the specified angle value.

```
$ZTAN(n)
```

Parameter

n	An angle in radians ranging from Pi to 2 Pi (inclusive). Other supplied numeric values are converted to a value within this range.

Description

$ZTAN returns the trigonometric tangent of *n*. The result is a signed decimal number.

Note: $ZTAN (like all trigonometric functions) calculates its values based on pi rounded to the number of available decimal digits. Therefore, the value returned by $ZTAN($ZPI) is –.0000000000000000000462644 and $ZTAN(–$ZPI) is .0000000000000000000462644. For this reason you should not perform limit tests comparing these returned values to 0. $ZTAN(0) is 0.

Parameter

n

An angle in radians ranging from 0 to 2 Pi. It can be specified as a value, a variable, or an expression.

A non-numeric string is evaluated as 0.

Examples

The following example permits you to compute the tangent of a number:

```
READ "Input a number: ",num
WRITE !,"the tangent is: ",$ZTAN(num)
QUIT
```

The following example compares the results from InterSystems IRIS fractional numbers (**$DECIMAL** numbers) and **$DOUBLE** numbers. In both cases, the tangent of 0 is exactly 0, but the tangent of pi is a negative fractional number (not exactly 0):

```
WRITE !,"the tangent is: ",$ZTAN(0.0)
WRITE !,"the tangent is: ",$ZTAN($DOUBLE(0.0))
WRITE !,"the tangent is: ",$ZTAN($ZPI)
WRITE !,"the tangent is: ",$ZTAN($DOUBLE($ZPI))
WRITE !,"the tangent is: ",$ZTAN(1.0)
WRITE !,"the tangent is: ",$ZTAN($DOUBLE(1.0))
```

See Also

- $ZARCTAN function
- $ZSIN function
- $ZPI special variable

$ZTIME

Validates a time and converts it from internal format to the specified display format.

```
$ZTIME(htime,tformat,precision,erropt,localeopt)
$ZT(htime,tformat,precision,erropt,localeopt)
```

Parameters

htime	The internal system time that can be specified as a numeric value, the name of a variable, or as an expression.
tformat	*Optional* — An integer value that specifies the format in which you want to return the time value.
precision	*Optional* — A numeric value that specifies the number of decimal places of precision in which you want to express the time. If omitted, fractional seconds are truncated.
erropt	*Optional* — The expression returned if the *htime* parameter is considered invalid.
localeopt	*Optional* — A boolean flag that specifies which locale to use. When 0, the current locale determines the time separator, and the other characters, strings, and options used to format times. When 1, the ODBC locale determines these characters, strings, and options. The ODBC locale cannot be changed; it is used to format date and time strings that are portable between InterSystems IRIS processes that have made different National Language Support (NLS) choices. The default is 0.

Omitted parameters between specified parameter values are indicated by placeholder commas. Trailing placeholder commas are not required, but are permitted. Blank spaces are permitted between the commas that indicate an omitted parameter.

Description

The **$ZTIME** function converts an internal system time, *htime*, specified in the time format from the special variable **$HOROLOG** or **$ZTIMESTAMP**, to a printable format. If no optional parameters are used, the time will be returned in the format: “hh:mm:ss”; where “hh” is hours in a 24–hour clock, “mm” is minutes, and “ss” is seconds. Otherwise, the time will be returned in the format specified by the value of the *tformat* and *precision* parameters.

Parameters

htime

This value represents the number of elapsed seconds since midnight. It is the second component of a $HOROLOG value, which can be extracted by using `$PIECE($HOROLOG,",",2)`. *htime* can be an integer, or a fractional number with the number of fractional digits of precision specified by *precision*.

For *tformat* values –1 through 4, *htime* valid values must have their integer portion in the range 0 through 86399. (-0 is treated as 0.) Values outside of this range generate an <ILLEGAL VALUE> error. For *tformat* values 9 and 10, *htime* valid values can also include negative numbers and numbers greater than 86399.

tformat

Supported values are as follows:

tformat	Description
-1	Get the effective format value from the TimeFormat property of the current locale, which defaults to a value of 1. This is the default behavior if you do not specify *tformat* and *localeopt* is unspecified or 0.
1	Express time in the form "hh:mm:ss" (24-hour clock).
2	Express time in the form “hh:mm” (24-hour clock).
3	Express time in the form “hh:mm:ss[AM/PM]” (12-hour clock).
4	Express time in the form “hh:mm[AM/PM]” (12-hour clock).

To determine the default time format for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("TimeFormat")
```

In 12-hour clock formats, morning and evening are represented by time suffixes, here shown as AM and PM. To determine the default time suffixes for your locale, invoke the following NLS class methods:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("AM"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("PM"),!
```

precision

The function displays fractional seconds carried out to the number of decimal places specified in the *precision* parameter. For example, if you enter a value of 3 as *precision*, **$ZTIME** displays fractional seconds to three decimal places. If you enter a value of 9, **$ZTIME** displays fractional seconds to nine decimal places. Supported values are as follows:

Value	Description
-1	Gets the precision value from the TimePrecision property of the current locale, which defaults to a value of 0. This is the default behavior if you do not specify *precision*.
n	A value that is greater than or equal to 0 results in the expression of time to *n* decimal places.
0	If set to 0, or defaults to a value of 0, fractional seconds are truncated.

To determine the default time precision for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("TimePrecision")
```

erropt

This parameter suppresses error messages associated with invalid *htime* values. Instead of generating <ILLEGAL VALUE> error messages, the function returns the value indicated by *erropt*.

localeopt

This parameter selects either the user’s current locale definition (0) or the ODBC locale definition (1) as the source for time options. The ODBC locale cannot be changed; it is used to format date and time strings that are portable between InterSystems IRIS processes that have made different National Language Support (NLS) choices.

The ODBC locale time definitions are as follows:

- Time format defaults to 1. Time separator is ":". Time precision is 0 (no fractional seconds).
- AM and PM indicators are "AM" and "PM". The words "Noon" and "Midnight" are used.

Examples

To return the current local time using the special variable **$HOROLOG**, you must use the **$PIECE** function to specify the second piece of **$HOROLOG**. The following returns the time in the 24–hour clock format “13:55:11”:

```
WRITE $ZTIME($PIECE($HOROLOG,",",2),1)
```

In the examples that follow, *htime* is set to **$PIECE($HOROLOG,",",2)** for the current time. These examples show how to use the various forms of **$ZTIME** to return different time formats.

The following example in many cases returns time in the format "13:28:55"; however, this format is dependent on locale:

```
SET htime=$PIECE($HOROLOG,",",2)
WRITE $ZTIME(htime)
```

The following example returns time in the format "13:28:55":

```
SET htime=$PIECE($HOROLOG,",",2)
WRITE $ZTIME(htime,1)
```

The following example returns time in the format "13:28:55.999":

```
SET htime=$PIECE($HOROLOG,",",2)
WRITE $ZTIME(htime,1,3)
```

The following example returns time in the format "13:28:55.999999999":

```
SET htime=$PIECE($HOROLOG,",",2)
WRITE $ZTIME(htime,1,9)
```

The following example returns time in the format "13:28":

```
SET htime=$PIECE($HOROLOG,",",2)
WRITE $ZTIME(htime,2)
```

The following example returns time in the format "01:28:24PM":

```
SET htime=$PIECE($HOROLOG,",",2)
WRITE $ZTIME(htime,3)
```

The following example returns time in the format "01:28PM":

```
SET htime=$PIECE($HOROLOG,",",2)
WRITE $ZTIME(htime,4)
```

The following example returns time in the format “13:45:56.021”, the current UTC time with three decimal places of precision:

```
SET t=$ZTIME($PIECE($ZTIMESTAMP,",",2),1,3)
WRITE "Current UTC time is ",t
```

Notes

Invalid Parameter Values

- You receive a <FUNCTION> error if you specify an invalid *tformat* value.
- You receive an <ILLEGAL VALUE> error for all *tformat* except 9 and 10 if you specify a value for *htime* outside the allowed range of 0 to 86399 (inclusive) and do not supply an *erropt* value.

Decimal Delimiter

$ZTIME will use the value of the DecimalSeparator property of the current locale as the delimiter between the whole and fractional parts of numbers. The default value of DecimalSeparator is “.”; all documentation examples use this delimiter.

To determine the default decimal separator for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("DecimalSeparator")
```

Time Delimiter

By default, InterSystems IRIS uses the value of the TimeSeparator property of the current locale to determine the delimiter character for the time string. By default, the delimiter is “:”; all documentation examples use this delimiter.

To determine the default time separator for your locale, invoke the following NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("TimeSeparator")
```

Time Suffixes

By default, InterSystems IRIS uses properties in the current locale to determine the names of its time suffixes. For **$ZTIME**, these properties (and their corresponding default values) are:

- AM (“AM”)
- PM (“PM”)

This documentation will always use these default values for these properties.

To determine the default time suffixes for your locale, invoke the following NLS class methods:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("AM"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("PM")
```

See Also

- $ZDATETIME function
- $ZDATETIMEH function
- $ZTIMEH function
- $PIECE function
- $HOROLOG special variable
- $ZTIMESTAMP special variable
- More information on locales in the section on “System Classes for National Language Support” in *Specialized System Tools and Utilities*.

$ZTIMEH

Validates a time and converts it from display format to InterSystems IRIS internal format.

```
$ZTIMEH(time,tformat,erropt,localeopt)
$ZTH(time,tformat,erropt,localeopt)
```

Parameters

time	The time value to be converted.
tformat	*Optional* — A numeric value that specifies the time format from which you are converting.
erropt	*Optional* — The expression returned if the *time* parameter is considered invalid.
localeopt	*Optional* — A boolean flag that specifies which locale to use. When 0, the current locale determines the time separator, and the other characters, strings, and options used to format times. When 1, the ODBC locale determines these characters, strings, and options. The ODBC locale cannot be changed; it is used to format date and time strings that are portable between InterSystems IRIS processes that have made different National Language Support (NLS) choices. The default is 0.

Omitted parameters between specified parameter values are indicated by placeholder commas. Trailing placeholder commas are not required, but are permitted. Blank spaces are permitted between the commas that indicate an omitted parameter.

Description

The **$ZTIMEH** function converts a time value from a format produced by the **$ZTIME** function to the format of the special variables **$HOROLOG** and **$ZTIMESTAMP**. If the optional parameter *tformat* is not specified, the input time must be in the format “hh:mm:ss.fff...”.Otherwise, the same integer format code used to produce the printable time from the **$ZTIME** function must be used for the time to be converted properly.

Parameters

tformat

Supported values are as follows:

Code	Description
-1	Get the effective format value from the TimeFormat property of the current locale, which defaults to a value of 1. This is the default behavior if you do not specify *tformat* and *localeopt* is unspecified or 0.
1	Input time is in the form "hh:mm:ss" (24-hour clock).
2	Input time is in the form “hh:mm” (24-hour clock).
3	Input time is in the form “hh:mm:ss[AM/PM]” (12-hour clock).
4	Input time is in the form “hh:mm[AM/PM]” (12-hour clock).

To determine the default time format for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("TimeFormat")
```

erropt

This parameter suppresses error messages associated with invalid *time* values. Instead of generating <ILLEGAL VALUE> error messages, the function returns the value indicated by *erropt*.

localeopt

This parameter selects either the user's current locale definition (0) or the ODBC locale definition (1) as the source for time options. The ODBC locale cannot be changed; it is used to format date and time strings that are portable between InterSystems IRIS processes that have made different National Language Support (NLS) choices.

The ODBC locale time definitions are as follows:

- Time format defaults to 1. Time separator is ":". Time precision is 0 (no fractional seconds).
- AM and PM indicators are "AM" and "PM". The words "Noon" and "Midnight" are used.

Examples

When the input time is "14:43:38", the following examples both return 53018:

```
SET time="14:43:38"
WRITE !,$ZTIMEH(time)
WRITE !,$ZTIMEH(time,1)
```

When the input time is "14:43:38.974", the following example returns 53018.974:

```
SET time="14:43:38.974"
WRITE $ZTIMEH(time,1)
```

Notes

Fractional Seconds

Unlike the **$ZTIME** function, **$ZTIMEH** does not allow you to specify a precision. Any fractional seconds in the original time format returned by **$ZTIME** are retained in the value returned by **$ZTIMEH**.

Invalid Parameter Values

You receive a <FUNCTION> error if you specify an invalid *tformat* code (an integer less than -1 or greater than 4, a zero, or a noninteger value).

If you do not supply an *erropt* value, you receive an <ILLEGAL VALUE> error under the following conditions:

- Specify a *time* with an hour value outside the allowed range of 0 to 23 (inclusive).
- Specify a *time* with a minute value outside the allowed range of 0 to 59 (inclusive).
- Specify a *time* with a second value outside the allowed range of 0 to 59 (inclusive).
- Specify a *time* value which uses a delimiter other than the value of the TimeSeparator property of the current locale.

Time Delimiter

By default, InterSystems IRIS uses the value of the TimeSeparator property of the current locale to determine the delimiter character for the time string. By default, the delimiter is ":"; all documentation examples use this delimiter.

To determine the default time separator for your locale, invoke the **GetFormatItem()** NLS class method:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("TimeSeparator")
```

Time Suffixes

By default, InterSystems IRIS uses properties in the current locale to determine the names of its time suffixes. For **$ZTIMEH**, these properties (and their corresponding default values) are:

- AM (“AM”)
- PM (“PM”)
- Midnight (“MIDNIGHT”)
- Noon (“NOON”)

This documentation will always use these default values for these properties.

To determine the default time suffixes for your locale, invoke the **GetFormatItem()** NLS class method, as follows:

```
WRITE ##class(%SYS.NLS.Format).GetFormatItem("AM"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("PM"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("Midnight"),!
WRITE ##class(%SYS.NLS.Format).GetFormatItem("Noon")
```

See Also

- $ZDATETIME function
- $ZDATETIMEH function
- $ZTIME function
- $HOROLOG special variable
- $ZTIMESTAMP special variable
- More information on locales in the section on “System Classes for National Language Support” in *Specialized System Tools and Utilities*.

$ZVERSION(1)

Returns the operating system type.

```
$ZVERSION(1)
```

Parameter

The only supported parameter value is the number 1.

Description

$ZVERSION(1) returns the current operating system type as an integer code. It returns the following values: 2 for Windows, 3 for UNIX®, and 0 if not known.

You can use the `isWINDOWS` and `isUNIX` system-supplied macros to return the same information as a boolean value.

You can use the **%SYSTEM.Version.GetOS()** to return the same information as a string.

You can use the $ZVERSION special variable to return complete InterSystems IRIS version information, including the current operating system type.

Example

The following example returns the current operating system type:

```
#Include %occInclude
  WRITE "OS type as code: ",$ZVERSION(1),!
  WRITE "OS type as Boolean: ",!
  WRITE "Windows? ",$$$isWINDOWS,"  UNIX? ",$$$isUNIX,!
  WRITE "OS type as string: ",$SYSTEM.Version.GetOS(),!
  WRITE "InterSystems IRIS Version: ",$ZVERSION
```

See Also

- $ZVERSION special variable.

$ZWASCII

Converts a two-byte string to a number.

```
$ZWASCII(string,position)
$ZWA(string,position)
```

Parameters

string	A string. It can be a value, a variable, or an expression. It must be a minimum of two bytes in length.
position	*Optional* — A starting position in the string, expressed as a positive integer. The default is 1. Position is counted in single bytes, *not* two-byte strings. The *position* cannot be the last byte in the string, or beyond the end of the string. A numeric *position* value is parsed as an integer by truncating decimal digits, removing leading zeros and plus signs, etc.

Description

The value that **$ZWASCII** returns depends on the parameters you use.

- **$ZWASCII**(*string*) returns a numeric interpretation of a two-byte string starting at the first character position of *string*.
- **$ZWASCII**(*string*,*position*) returns a numeric interpretation of a two-byte string beginning at the starting byte position specified by *position*.

Upon successful completion, **$ZWASCII** always returns a positive integer. **$ZWASCII** returns -1 if *string* is of an invalid length, or *position* is an invalid value.

Example

The following example determines the numeric interpretation of the character string "ab":

```
WRITE $ZWASCII("ab")
```

It returns 25185.

The following examples also return 25185:

```
WRITE !,$ZWASCII("ab",1)
WRITE !,$ZWASCII("abxx",1)
WRITE !,$ZWASCII("xxabxx",3)
```

In the following examples, *string* or *position* are invalid. The **$ZWASCII** function returns –1 in each case:

```
WRITE !,$ZWASCII("a")
WRITE !,$ZWASCII("aba",3)
WRITE !,$ZWASCII("ababab",99)
WRITE !,$ZWASCII("ababab",0)
WRITE !,$ZWASCII("ababab",-1)
```

Notes

$ZWASCII and $ASCII

$ZWASCII is similar to **$ASCII** except that it operates on two byte (16-bit) words instead of single 8-bit bytes. For four byte (32-bit) words, use **$ZLASCII**; For eight byte (64-bit) words, use **$ZQASCII**.

$ZWASCII(*string*,*position*) is the functional equivalent of:

$ASCII(*string*,*position*+1)*256+**$ASCII**(*string*,*position*)

$ZWASCII and $ZWCHAR

The **$ZWCHAR** function is the logical inverse of **$ZWASCII**. For example:

```
WRITE $ZWASCII("ab")
```

returns: 25185.

```
WRITE $ZWCHAR(25185)
```

returns “ab”.

See Also

- $ASCII function
- $ZWCHAR function

$ZWCHAR

Converts a number to a two-byte string.

```
$ZWCHAR(n)
$ZWC(n)
```

Parameter

n	A positive integer in the range 0 through 65535. It can be specified as a value, a variable, or an expression.

Description

$ZWCHAR returns a two-byte (wide) character string corresponding to the binary representation of *n*. The bytes of the character string are presented in little-endian byte order, with the least significant byte first. It is the functional equivalent of:

```
WRITE $CHAR(n#256,n\256)
```

If *n* is out of range or a negative number, **$ZWCHAR** returns the null string.

Example

The following example returns the two-byte string for the integer 25185:

```
WRITE $ZWCHAR(25185)
```

returns: ab

Notes

$ZWCHAR and $CHAR

$ZWCHAR is similar to **$CHAR** except that it operates on two byte (16-bit) words instead of single 8-bit bytes. For four byte (32-bit) words, use **$ZLCHAR**; For eight byte (64-bit) words, use **$ZQCHAR**.

$ZWCHAR and $ZWASCII

$ZWASCII is the logical inverse of the **$ZWCHAR** function. For example:

```
WRITE $ZWCHAR(25185)
```

returns: ab

```
WRITE $ZWASCII("ab")
```

returns: 25185

See Also

- $ZWASCII function
- $CHAR function
- $ZLCHAR function
- $ZQCHAR function

$ZWIDTH

Returns the total width of the characters in an expression.

```
$ZWIDTH(expression,pitch)
```

Parameters

expression	A string expression
pitch	*Optional* — The numeric pitch value to use for full-width characters. The default is 2. Other permissible values are 1, 1.25, and 1.5. (These values with any number of trailing zeros are permissible.) All other *pitch* values result in a <FUNCTION> error.

Description

$ZWIDTH returns the total width of the characters in *expression*. The *pitch* value determines the width to use for full-width characters. All other characters are assigned a width of 1 and are considered to be half-width.

Example

Assume that the variable *STR* contains two half-width characters followed by a full-width character:

```
WRITE $ZWIDTH(STR,1.5)
```

returns 3.5.

In this example, the two half-width characters total 2. Adding 1.5 (the specified pitch value) for the full-width characters produces a total of 3.5.

Note

Full-width characters are determined by examining the pattern-match table loaded for your InterSystems IRIS process. Any character with the full-width attribute is considered to be a full-width character. You can use the special ZFWCHARZ patcode to check for this attribute (char?1ZFWCHARZ). For more information about the full-width attribute, see the description of the $X/$Y Tab in the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

See Also

- $ZPOSITION function
- $ZZENKAKU function

$ZWPACK and $ZWBPACK

Packs two 8-bit characters into a single 16-bit character.

```
$ZWPACK(string)

$ZWBPACK(string)
```

Parameter

string	A string consisting of two or more 8-bit characters. *string* must be an even number of characters.

Description

The **$ZWPACK** function packs a string of 8-bit characters as a string of 16-bit wide characters in little-endian order. Two 8-bit characters are packed into a single 16-bit character.

$ZWBPACK performs the same task, but the 8-bit characters are stored in 16-bit wide characters in big-endian order.

Packing a string is a way to halve the character count of the string for storage and string manipulation. Unpacking restores the original 8-bit character string for display. These operations should not be used when Unicode characters are permitted in the data.

The input *string* has the following requirements:

- *string* must consist of an even number of characters. The empty string is permitted, and returns the empty string. Specifying an odd number of characters results in a <FUNCTION> error.
- *string* cannot contain any multibyte characters. You can use **$ZISWIDE** on *string* to check that it does not contain multibyte characters. If you use **$ZWPACK** or **$ZWBPACK** on a *string* containing multibyte characters, the system generates a <WIDE CHAR> error.

You can use the **IsBigEndian()** class method to determine which bit ordering is used on your operating system platform: 1=big-endian bit order; 0=little-endian bit order.

```
WRITE $SYSTEM.Version.IsBigEndian()
```

Examples

The following example shows **$ZWPACK** packing four 8-bit characters into two 16-bit wide characters. Note the little-endian order of the bytes in the wide characters of the packed string: hexadecimal `4241 4443`.

```
SET str=$CHAR(65,66,67,68)
WRITE !,$LENGTH(str)," characters: ",str
WRITE !,"$ZWPACK"
SET wstr=$ZWPACK(str)
WRITE !,$LENGTH(wstr)," packed characters: ",wstr
ZZDUMP wstr
WRITE !,"$ZWUNPACK"
SET nstr=$ZWUNPACK(wstr)
WRITE !,$LENGTH(nstr)," unpacked characters: ",nstr
```

The following example shows **$ZWBPACK** packing four 8-bit characters into two 16-bit wide characters. Note the big-endian order of the bytes in the wide characters of the packed string: hexadecimal `4142 4344`.

```
SET str=$CHAR(65,66,67,68)
WRITE !,$LENGTH(str)," characters: ",str
WRITE !,"$ZWBPACK"
SET wstr=$ZWBPACK(str)
WRITE !,$LENGTH(wstr)," packed characters: ",wstr
ZZDUMP wstr
WRITE !,"$ZWBUNPACK"
SET nstr=$ZWBUNPACK(wstr)
WRITE !,$LENGTH(nstr)," unpacked characters: ",nstr
```

The following example validates *string* before packing it:

```
SET str=$CHAR(65,66,67,68)
IF $ZISWIDE(str) {
   WRITE !,str," contains wide characters"
   QUIT }
ELSEIF $LENGTH(str) # 2  {
   WRITE !,str," contains an odd number of characters"
   QUIT }
ELSE {
   WRITE !,str," passes validation" }
WRITE !,$LENGTH(str)," characters: ",str
SET wstr=$ZWPACK(str)
WRITE !,$LENGTH(wstr)," packed characters: ",wstr
ZZDUMP wstr
```

See Also

- $LENGTH function
- $ZISWIDE function
- $ZWUNPACK and $ZWBUNPACK functions

$ZWUNPACK and $ZWBUNPACK

Unpacks a single 16-bit character to two 8-bit characters.

```
$ZWUNPACK(string)

$ZWBUNPACK(string)
```

Parameter

string	A string consisting of one or more 16-bit characters.

Description

$ZWUNPACK is a function that takes one or more two-byte wide characters and “unpacks” them, returning the corresponding pairs of single-byte characters in little endian order.

$ZWBUNPACK performs the same task, but the two-byte wide characters are unpacked in big-endian order.

Packing a string is a way to halve the character count of the string for storage and string manipulation. Unpacking restores the original 8-bit character string for display. These operations should not be used when Unicode characters are permitted in the data.

The input *string* should consist entirely of 16-bit wide characters created using **$ZWPACK** or **$ZWBPACK**. The empty string is permitted, and returns the empty string. *string* should not contain any 16-bit Unicode characters, or any 8-bit characters.

You can use **$ZISWIDE** on *string* to check that it contains multibyte characters. However, you must use **$ZISWIDE** on each character to ensure that the string does not contain a mix of 16-bit and 8-bit characters. **$ZISWIDE** does not distinguish between Unicode and packed 16-bit characters.

You can use the **IsBigEndian()** class method to determine which bit ordering is used on your operating system platform: 1=big-endian bit order; 0=little-endian bit order.

```
WRITE $SYSTEM.Version.IsBigEndian()
```

Examples

The following example unpacks a string (“ABCD”) that was packed using **$ZWPACK**. It unpacks two 16-bit wide characters into four 8-bit characters. Note the little-endian order of the bytes in the wide characters of the packed string: hexadecimal `4241 4443`.

```
SET str=$CHAR(65,66,67,68)
WRITE !,$LENGTH(str)," characters: ",str
WRITE !,"$ZWPACK"
SET wstr=$ZWPACK(str)
WRITE !,$LENGTH(wstr)," packed characters: ",wstr
ZZDUMP wstr
WRITE !,"$ZWUNPACK"
SET nstr=$ZWUNPACK(wstr)
WRITE !,$LENGTH(nstr)," unpacked characters: ",nstr
```

The following example performs the same operation as the previous example, but uses big-endian order. Note the big-endian order of the bytes in the wide characters of the packed string: hexadecimal `4142 4344`.

```
SET str=$CHAR(65,66,67,68)
WRITE !,$LENGTH(str)," characters: ",str
WRITE !,"$ZWBPACK"
SET wstr=$ZWBPACK(str)
WRITE !,$LENGTH(wstr)," packed characters: ",wstr
ZZDUMP wstr
WRITE !,"$ZWBUNPACK"
SET nstr=$ZWBUNPACK(wstr)
WRITE !,$LENGTH(nstr)," unpacked characters: ",nstr
```

The following example shows what happens when you “unpack” a string of 8-bit characters. Note that the unpacking operation assumes each character to be a 16-bit wide character, and thus supplies the missing eight bits as hexadecimal `00`. This use of **$ZWUNPACK** is not recommended.

```
SET str=$CHAR(65,66,67)
WRITE !,$LENGTH(str)," characters: ",str
SET nstr=$ZWUNPACK(str)
WRITE !,$LENGTH(nstr)," unpacked characters:"
ZZDUMP nstr
```

The following example shows what happens when you “unpack” a string of 16-bit Unicode characters; in this case, lowercase Greek letters. This use of **$ZWUNPACK** is not recommended.

```
SET str=$CHAR(945,946,947)
WRITE !,$LENGTH(str)," characters: ",str
SET nstr=$ZWUNPACK(str)
WRITE !,$LENGTH(nstr)," unpacked characters: ",nstr
ZZDUMP nstr
```

See Also

- $LENGTH function
- $ZISWIDE function
- $ZWPACK and $ZWBPACK functions

$ZZENKAKU

Converts Japanese katakana characters from half-width to full-width.

```
$ZZENKAKU(expression,flag1,flag2)
```

Parameters

expression	A string containing half-width characters. These characters may be katakana characters, Roman alphabet letters, or numbers.
flag1	*Optional* — A boolean flag to indicate whether to convert half-with katakana to full-width hiragana (0) or full-width katakana (1).
flag2	*Optional* — A boolean flag to indicate whether voiced sound processing is required (1) or not required (0).

Description

$ZZENKAKU converts Japanese katakana characters from half-width (hankaku) to full-width (zenkaku) characters. It also converts strings of Roman alphabet letters ("ABC") and Arabic numbers (123) from half-width to full-width.

$ZZENKAKU can, optionally, convert half-width katakana to full-width hiragana. Katakana characters are commonly used for foreign terms and foreign loan words; they can be represented as half-width or full-width characters. Hiragana characters are the more standard way of writing Japanese. Hiragana is always full-width.

If *flag1* is 0, **$ZZENKAKU** converts printable ASCII characters to their full-width counterparts and converts half-width katakana characters to full-width hiragana characters. The default value for *flag1* is 0.

If *flag1* is 1, **$ZZENKAKU** converts printable ASCII characters to their full-width counterparts and converts half-width katakana characters to full-width katakana characters.

If *flag2* is 1 and a half-width katakana character is followed by a voice sound mark or a semi-voice sound mark, then (if appropriate) **$ZZENKAKU** combines the half-width katakana character and the sound mark character into a target full-width hiragana or katakana character. The default value for *flag2* is 1.

You can set the physical cursor to use two physical spaces for a character as system-wide behavior by setting the *PhysicalCursor* property of the Config.NLS.Locales class.

The $WASCII function (and other $W functions) supports surrogate pairs of characters used to encode some Japanese kanji characters. For the ZFWCHARZ and ZHWKATAZ Japanese language pattern match codes, refer to ObjectScript Pattern Matching in *Using ObjectScript*.

Examples

The following example returns the half-with katakana characters “a”, “me”, “ri”, ka” (America):

```
ZZDUMP $CHAR(65383,65426,65432,65398)
```

The following example converts these half-with katakana characters to the corresponding full-width katakana characters:

```
ZZDUMP $ZZENKAKU($CHAR(65383,65426,65432,65398),1)
```

The following examples both convert these half-with katakana characters to the corresponding full-width hiragana characters. Note that **$ZZENKAKU** converts from katakana to hiragana by default:

```
ZZDUMP $ZZENKAKU($CHAR(65383,65426,65432,65398),0)
```

```
ZZDUMP $ZZENKAKU($CHAR(65383,65426,65432,65398))
```

See Also

- $ZPOSITION function
- $ZWIDTH function

ObjectScript Special Variables

Special variables are variables that are maintained by the system. They are also referred to as *system variables*, but are here referred to as special variables to avoid confusion with structured system variables.

Special variable names begin with a dollar sign ($). They can be distinguished from functions because they are not followed by parentheses and take no parameters. Special variable names are not case-sensitive. Many special variable names can be abbreviated. In the Synopsis for each special variable, the full name syntax is first presented, and below it is shown the abbreviated name (if one exists).

Historically, special variables have held *scalar* values. The system automatically updates these special variables to reflect various aspects of the operating environment. For example, the **$IO** special variable contains the ID of the current device. The **$JOB** special variable contains the ID of the current job.

Although you can set some special variables, most are read-only. With the exception of this read-only constraint, you can treat the special variables just as you would any other variable. For example, you can reference a special variable in an expression and assign its current value to another (user-defined) variable.

Any implementation-specific special variable form is marked with the abbreviation of the platform that supports it (Windows or UNIX®). Any form that is not marked with a platform abbreviation is supported by all platforms.

Special variables are listed in alphabetical order.

$DEVICE

Contains user-specified device status information.

```
$DEVICE
$D
```

Description

$DEVICE can be used to record device status information. You can use the **SET** command to place a value in **$DEVICE**. By convention, this value should describe the outcome of an I/O operation as a 3-piece string, in the form:

standard_error,user_error,explanatory_text

By default, **$DEVICE** contains the null string.

See Also

- SET command

$ECODE

Contains the current error code string.

```
$ECODE
$EC
```

Description

When an error occurs, InterSystems IRIS sets the **$ECODE** special variable to a comma-surrounded string containing the error code corresponding to the error. For example, when a reference is made to an undefined global variable, InterSystems IRIS sets the **$ECODE** special variable to the following string:

```
,M7,
```

$ECODE can contain ISO 11756-1999 standard error codes, with the form `M#`, where `#` is an integer. For example, M6 and M7 are "undefined local variable" and "undefined global variable," respectively. (M7 is issued for both globals and process-private globals.) For a complete list, see ISO 11756-1999 standard error messages in the *InterSystems IRIS Error Reference*.

$ECODE can also contain error codes that are the same as General System error codes (the error codes returned at the terminal prompt and to the **$ZERROR** special variable). However, **$ECODE** prepends a "Z" to these error codes, and removes the angle brackets. Thus the **$ECODE** error ZSYNTAX is a <SYNTAX> error, ZILLEGAL VALUE is an <ILLEGAL VALUE> error, and ZFUNCTION is a <FUNCTION> error. **$ECODE** does not retain any additional error info for those error codes that provide it; thus ZPROTECT is a <PROTECT> error; the additional info component is kept in **$ZERROR**, but not in **$ECODE**. For more information about InterSystems IRIS error codes, see $ZERROR; for a complete list, see General System Error Messages in the *InterSystems IRIS Error Reference*.

If an error occurs when **$ECODE** already contains previous error codes, the existing error stack is cleared when the new error occurs. The new error stack will contain only entries that show the state at the time of the current error. (This is a change from earlier **$ECODE** behavior, where the old error stack would persist until explicitly cleared.)

If there are multiple error codes, InterSystems IRIS appends the code for each error, in the order received, at the end of the current **$ECODE** value. Each error in the resulting **$ECODE** string is delimited by commas, as follows:

```
,ZSTORE,M6,ZILLEGAL VALUE,ZPROTECT,
```

In the above case, the most recent error is a <PROTECT> error.

You can also explicitly clear or set **$ECODE**. **$ECODE** is always cleared when you terminate the current process.

Clearing $ECODE

You can clear **$ECODE** by setting it to the empty string (""), as follows:

```
SET $ECODE=""
```

Setting **$ECODE** to the empty string has the following effects:

- It clears all existing **$ECODE** values. It has no effect on an existing **$ZERROR** value.
- It clears the error stack for your job. This means that a subsequent call to the **$STACK** function returns the current execution stack, rather than the last error stack.

You cannot **NEW** the **$ECODE** special variable. Attempting to do so generates a <SYNTAX> error.

Setting $ECODE

You can force an error by setting **$ECODE** to an value other than the empty string. Setting **$ECODE** to any non-null value forces an interpreter error during the execution of an ObjectScript routine. After InterSystems IRIS sets **$ECODE** to the non-null value that you specify, InterSystems IRIS takes the following steps:

1. Writes the specified value to **$ECODE**, overwriting any previous values.
2. Generates an <ECODETRAP> error. (This sets **$ZERROR** to the value <ECODETRAP>).
3. Passes control to any error handlers you have established. Your error handlers can check for the **$ECODE** string value you chose and take steps to handle the condition appropriately.

$ECODE String Overflow

If the length of the accumulated string in **$ECODE** exceeds 512 characters, the error code that causes the string overflow clears and replaces the current list of error codes in **$ECODE**. In this case, the list of errors in **$ECODE** is the list of errors since the most recent string overflow, beginning with the error that caused the overflow. See Using ObjectScript for more information about the maximum string data length.

Notes

Creating Your Own Error Codes

The format for the **$ECODE** special variable is a comma-surrounded list of one or more error codes. Error codes starting with the letter U are reserved for the user. All other error codes are reserved for InterSystems IRIS.

User–defined **$ECODE** values should be distinguishable from the values InterSystems IRIS automatically generates. To ensure this, always prefix your error text with the letter U. Also remember to delineate your error code with commas. For example:

```
SET $ECODE=",Upassword expired!,"
```

Check $ZERROR Rather Than $ECODE for InterSystems IRIS Errors

Your error handlers should check **$ZERROR** rather than **$ECODE** for the most recent InterSystems IRIS error.

See Also

- ZTRAP command
- $STACK function
- $ESTACK special variable
- $ZEOF special variable
- $ZERROR special variable
- $ZTRAP special variable
- Error Handling in *Using ObjectScript*
- System Error Messages in *InterSystems IRIS Error Reference*

$ESTACK

Contains the number of context frames saved on the call stack from a user-defined point.

```
$ESTACK
$ES
```

Description

$ESTACK contains the number of context frames saved on the call stack for your job from a user-defined point. You specify this point by creating a new copy of **$ESTACK** using the **NEW** command.

The **$ESTACK** special variable is similar to the **$STACK** special variable. Both contain the number of context frames currently saved on the call stack for your job or process. InterSystems IRIS increments and restores both when changing context. The major difference is that you can reset the **$ESTACK** count to zero at any point by using the **NEW** command. You cannot reset the **$STACK** count.

Context Frames and Call Stacks

When an InterSystems IRIS image is started, before any contexts have been saved on the call stack, the values of both **$ESTACK** and **$STACK** are zero. Each time a routine calls another routine with **DO**, the system saves the context of the currently executing routine on the call stack, increments **$ESTACK** and **$STACK**, and starts execution of the called routine in the newly created context. The called routine can, in turn, call another routine, and so on. Each time another routine is called, InterSystems IRIS increments **$ESTACK** and **$STACK** and places more saved contexts on the call stack.

Issuing a **DO** command, an **XECUTE** command, or a call to a user-defined function establishes a new execution context. Issuing a **GOTO** command does not.

As **DO** commands, **XECUTE** commands, or user-defined function references create new contexts, InterSystems IRIS increments the values of **$STACK** and **$ESTACK**. As **QUIT** commands cause contexts to exit, InterSystems IRIS restores the previous contexts from the call stack and decrements the values of **$STACK** and **$ESTACK**.

The **$ESTACK** and **$STACK** special variables cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Creating a New $ESTACK

You can create a new copy of **$ESTACK** in any context by using the **NEW** command. InterSystems IRIS takes the following actions:

1. Saves the old copy of **$ESTACK**.
2. Creates a new copy of **$ESTACK** with a value of zero (0).

In this way, you can establish a particular context as the **$ESTACK** level 0 context. As you create new contexts with **DO**, **XECUTE**, or user-defined functions, InterSystems IRIS increments this **$ESTACK** value. However, when you exit the context in which the new **$ESTACK** was created (**$ESTACK** at level 0), InterSystems IRIS restores the value of the previous copy of **$ESTACK**.

Examples

The following example shows the effect of a **NEW** command on **$ESTACK**. In this example, the MainRoutine displays the initial values of **$STACK** and **$ESTACK** (which are the same value). It then calls Sub1. This call increments **$STACK** and **$ESTACK**. The **NEW** command creates a **$ESTACK** with a value of 0. Sub1 calls Sub2, incrementing **$STACK** and **$ESTACK**. Returning to MainRoutine restores the initial values of **$STACK** and **$ESTACK**:

```
Main
   WRITE !,"Initial: $STACK=",$STACK," $ESTACK=",$ESTACK
   DO Sub1
   WRITE !,"Return: $STACK=",$STACK," $ESTACK=",$ESTACK
   QUIT
Sub1
     WRITE !,"Sub1Call: $STACK=",$STACK," $ESTACK=",$ESTACK
     NEW $ESTACK
     WRITE !,"Sub1NEW: $STACK=",$STACK," $ESTACK=",$ESTACK
     DO Sub2
     QUIT
Sub2
     WRITE !,"Sub2Call: $STACK=",$STACK," $ESTACK=",$ESTACK
     QUIT
```

The following example demonstrates how the value of **$ESTACK** is incremented as new contexts are created by issuing **DO** and **XECUTE** commands, and decremented as these contexts are exited. It also shows that a **GOTO** command does not create a new context or increment **$ESTACK**:

```
Main
   NEW $ESTACK
   WRITE !,"Initial Main: $ESTACK=",$ESTACK   // 0
   DO Sub1
   WRITE !,"Return Main: $ESTACK=",$ESTACK   // 0
   QUIT
Sub1
     WRITE !,"Sub1 via DO: $ESTACK=",$ESTACK  // 1
     XECUTE "WRITE !,""Sub1 XECUTE: $ESTACK="",$ESTACK"   // 2
     WRITE !,"Sub1 post-XECUTE: $ESTACK=",$ESTACK   // 1
     GOTO Sub2
Sub1Return
     WRITE !,"Sub1 after GOTO: $ESTACK=",$ESTACK  // 1
     QUIT
Sub2
     WRITE !,"Sub2 via GOTO: $ESTACK=",$ESTACK   // 1
     GOTO Sub1Return
```

Notes

Context Levels from the Terminal Prompt

A routine invoked from a program starts at a different context level than a routine you invoke with the **DO** command from the Terminal prompt. When you enter a **DO** command at the Terminal prompt, the system creates a new context for the routine called.

The routine you call can compensate by establishing a **$ESTACK** level 0 context and then use **$ESTACK** for all context-level references.

Consider the following routine:

```
START
    ; Establish a $ESTACK Level 0 Context
  NEW $ESTACK
    ; Display the $STACK context level
  WRITE !,"$STACK level in routine START is ",$STACK
   ; Display the $ESTACK context level and exit
  WRITE !,"$ESTACK level in routine START is ",$ESTACK
  QUIT
```

When you run START from a program, you see the following display:

```
$STACK level in routine START is 0
$ESTACK level in routine START is 0
```

When you run START by issuing DO ^START at the Terminal prompt, you see the following display:

```
$STACK level in routine START is 1
$ESTACK level in routine START is 0
```

$ESTACK and Error Processing

$ESTACK is particularly useful during error processing when error handlers must unwind the call stack to a specific context level. See Error Handling in *Using ObjectScript* for more information about error processing.

See Also

- $STACK function
- $STACK special variable
- Error Handling in *Using ObjectScript*
- Using %STACK to Display the Stack in the "Command-line Routine Debugging" chapter of *Using ObjectScript*

$HALT

Contains a halt trap routine call.

```
$HALT
```

Description

$HALT contains the name of the current halt trap routine. A halt trap routine is called by your application when a **HALT** command is encountered. This halt trap routine may perform clean up or logging processing before issuing a **HALT** command, or it may substitute other processing rather than halting program execution.

You set **$HALT** to a halt trap routine using the **SET** command. The halt trap routine is specified by a quoted string with the following format:

```
SET $HALT=location
```

Here *location* can be specified as *label* (a label in the current routine or procedure), ^*routine* (the beginning of a specified external routine), or *label*^*routine* (a specified label in a specified external routine).

$HALT supports *label*+*offset* in some contexts (but not in procedures). This optional +*offset* is an integer specifying the number of lines to offset from *label*. InterSystems recommends that you avoid the use of a line offset when specifying *location*.

You cannot specify an +*offset* when calling a procedure or a IRISSYS % routine. If you attempt to do so, InterSystems IRIS issues a <NOLINE> error.

$HALT defines a halt trap routine for the current context. If there is already a halt trap defined for the current context, the new one replaces it. If you specify a nonexistent routine name, a **HALT** command ignores that **$HALT** and unwinds the stack to locate a valid **$HALT** at a previous context level.

To remove the halt trap for the current context, set **$HALT** to a null string. Attempting to remove a halt trap by using the **NEW** or **KILL** commands results in a <SYNTAX> error.

Halt Trap Execution

When you issue a **HALT** command, InterSystems IRIS checks the current context for **$HALT**. If no **$HALT** is defined for the current context (or it is set to a nonexistent routine name or the null string), InterSystems IRIS unwinds the stack to the previous context and looks for **$HALT** there. This process continues until either a defined **$HALT** is located or the stack is completely unwound. InterSystems IRIS uses the value of **$HALT** to transfer execution to the specified halt trap routine. The halt trap routine executes in the context at which **$HALT** was defined. No error code is set or error message issued.

If no valid **$HALT** is set in the current context or previous contexts, issuing a **HALT** command completely unwinds the stack and performs an actual program halt.

Commonly, a halt trap routine performs some cleanup or reporting processing, and then issues a **HALT** command. Note that with **$HALT** defined, the original **HALT** command invokes the halt trap, but does not perform an actual program halt. For an actual halt to occur, the halt trap routine must contain a second **HALT** command.

A **HALT** command issued by a halt trap routine is not trapped by that halt trap, but it may be trapped by a halt trap established at a lower context level. Thus a cascading series of halt traps may be invoked by a single **HALT** command.

Similar processing is performed by the error trap ZTRAP command, and the associated $ZTRAP special variable.

$HALT and ^%ZSTOP

If you have **$HALT** set and also have code defined for **^%ZSTOP** when a **HALT** is issued, the **$HALT** is executed first. **$HALT** can prevent the termination of the process, if its halt trap routine does not contain a **HALT** command.

A **^%ZSTOP** routine is executed when the process is actually terminating. For further details on **^%ZSTOP**, see the section on "Using the ^%ZSTART and ^%ZSTOP Routines" in *Specialized System Tools and Utilities*.

Examples

The following example uses **$HALT** to establish a halt trap:

```
SET $HALT="MyTrap^CleanupRoutine"
WRITE !,"the halt trap is: ",$HALT
```

Note that it is the programmer's responsibility to make sure that the specified routine exists.

The following example shows how the halt trap routine executes in the context at which **$HALT** was defined. In this example, $HALT is defined at $ESTACK level 0, HALT is issued at $ESTACK level 1, and the halt trap routine executes at $ESTACK level 0.

```
Main
   NEW $ESTACK
   SET $HALT="OnHalt"
   WRITE !,"Main $ESTACK= ",$ESTACK," $HALT= ",$HALT   // 0
   DO SubA
   WRITE !,"Returned from SubA"   // not executed
   QUIT
SubA
   WRITE !,"SubA $ESTACK= ",$ESTACK," $HALT= ",$HALT   // 1
   HALT
   WRITE !,"this should never display"
   QUIT
OnHalt
   WRITE !,"OnHalt $ESTACK= ",$ESTACK   // 0
   HALT
   QUIT
```

The following example is identical to the previous example, except that $HALT is defined at $ESTACK level 1. A HALT command is issued at $ESTACK level 1, and the halt trap routine executes at $ESTACK level 1. The HALT issued by the halt trap routine unwinds the stack, and, failing to find a $HALT defined at the previous context level, it halts program execution. Thus, the WRITE command following the DO command is not executed.

```
Main
   NEW $ESTACK
   WRITE !,"Main $ESTACK= ",$ESTACK," $HALT= ",$HALT   // 0
   DO SubA
   WRITE !,"Returned from SubA"   // not executed
   QUIT
SubA
   SET $HALT="OnHalt"
   WRITE !,"SubA $ESTACK= ",$ESTACK," $HALT= ",$HALT   // 1
   HALT
   WRITE !,"this should never display"
   QUIT
OnHalt
   WRITE !,"OnHalt $ESTACK= ",$ESTACK   // 1
   HALT
   QUIT
```

The following example shows how a cascading series of halt traps can be invoked. Halt trap Halt0 is defined at $ESTACK level 0, and halt trap Halt1 is defined at $ESTACK level 1. The HALT command is issued at $ESTACK level 2. InterSystems IRIS unwinds the stack to invoke the halt trap Halt1 at $ESTACK level 1. This halt trap issues a HALT command; InterSystems IRIS unwinds the stack to invoke the halt trap Halt0 at $ESTACK level 0. This halt trap issues a HALT command that halts program execution.

```
Main
   NEW $ESTACK
   SET $HALT="Halt0"
   WRITE !,"Main $ESTACK= ",$ESTACK," $HALT= ",$HALT   // 0
   DO SubA
   WRITE !,"Returned from SubA"   // not executed
   QUIT
SubA
   SET $HALT="Halt1"
   WRITE !,"SubA $ESTACK= ",$ESTACK," $HALT= ",$HALT   // 1
   DO SubB
```

```
   WRITE !,"Returned from SubA"   // not executed
   QUIT
SubB
   WRITE !,"SubB $ESTACK= ",$ESTACK," $HALT= ",$HALT   // 2
   HALT
   WRITE !,"this should never display"
   QUIT
Halt0
   WRITE !,"Halt0 $ESTACK= ",$ESTACK   // 0
   WRITE !,"Bye-bye!"
   HALT
   QUIT
Halt1
   WRITE !,"Halt1 $ESTACK= ",$ESTACK   // 1
   HALT
   QUIT
```

See Also

- HALT command

$HOROLOG

Contains the local date and time for the current process.

```
$HOROLOG
$H
```

Description

$HOROLOG contains the date and time for the current process. It can contain the following values:

- The current local date and time.
- The current local date and time, adjusted for a different time zone offset.
- A user-specified non-incrementing date. Time continues to be the current local time.

$HOROLOG contains a character string that consists of two integer values, separated by a comma. These two integers represent the current local date and time in InterSystems IRIS storage format. These integers are counters, not user-readable dates and times. **$HOROLOG** returns the current date and time in the following format:

```
ddddd,sssss
```

The first integer, *ddddd*, is the current date expressed as a count of the number of days since December 31, 1840, where day 1 is January 1, 1841. Because InterSystems IRIS represents dates using a counter from an arbitrary starting point, InterSystems IRIS is unaffected by the Year 2000 boundary. The maximum value for this date integer is 2980013, which corresponds to December 31, 9999.

The second integer, *sssss*, is the current time, expressed as a count of the number of seconds since midnight of the current day. The system increments the time field from 0 to 86399 seconds. When it reaches 86399 at midnight, the system resets the time field to 0 and increments the date field by 1. **$HOROLOG** truncates fractional seconds; it represents time in whole seconds only.

You can obtain the same current date and time information by invoking the **Horolog()** method, as follows:

```
WRITE $SYSTEM.SYS.Horolog()
```

Refer to %SYSTEM.SYS in the *InterSystems Class Reference* for further details.

Separating Date and Time

To get just the date portion or just the time portion of **$HOROLOG**, you can use the $PIECE function, specifying the comma as the delimiter character:

```
SET dateint=$PIECE($HOROLOG,",",1)
SET timeint=$PIECE($HOROLOG,",",2)
WRITE !,"Date and time: ",$HOROLOG
WRITE !,"Date only: ",dateint
WRITE !,"Time only: ",timeint
```

To get just the date portion of a **$HOROLOG** value, you can also use the following programming trick:

```
SET dateint=+$HOROLOG
WRITE !,"Date and time: ",$HOROLOG
WRITE !,"Date only: ",dateint
```

The plus sign (+) causes InterSystems IRIS to parse the **$HOROLOG** string as a number. When InterSystems IRIS encounters a nonnumeric character (the comma), it truncates the rest of the string and returns the numeric portion. This is the date integer portion of the string.

Date and Time Functions Compared

The various ways to return the current date and time are compared, as follows:

- **$HOROLOG** contains the local, variant-adjusted date and time in InterSystems IRIS storage format. The local time zone is determined from the current value of the **$ZTIMEZONE** special variable, and then adjusted for local time variants, such as Daylight Saving Time. It returns whole seconds only; fractions of a second are truncated.
- **$NOW** returns the local date and time for the current process. **$NOW** returns the date and time in InterSystems IRIS storage format. It includes fractional seconds; the number of fractional digits is the maximum precision supported by the current operating system.
  - **$NOW()** determines the local time zone from the value of the **$ZTIMEZONE** special variable. The local time is *not* adjusted for local time variants, such as Daylight Saving Time. It therefore may not correspond to local clock time.
  - **$NOW(tzmins)** returns the time and date that correspond to the specified *tzmins* time zone parameter. The value of **$ZTIMEZONE** is ignored.
- **$ZTIMESTAMP** contains the UTC (Coordinated Universal Time) date and time, with fractional seconds, in InterSystems IRIS storage format. Fractional seconds are expressed in three digits of precision (on Windows systems), or six digits of precision (on UNIX® systems).

Date and Time Conversions

You can use the **$ZDATE** function to convert the date portion of **$HOROLOG** into external, user-readable form. You can use the **$ZTIME** function to convert the time portion of **$HOROLOG** into external user-readable form. You can use the **$ZDATETIME** function to convert both the date and time. When using **$HOROLOG**, setting the *precision* for time values in these functions always returns zeros as fractional seconds.

You can use the **$ZDATEH** function to convert a user-readable date into the date portion of **$HOROLOG**. You can use the **$ZTIMEH** function to convert a user-readable time into the time portion of **$HOROLOG**. You can use the **$ZDATETIMEH** function to convert both the date and time to a **$HOROLOG** value.

Setting the Date and Time

$HOROLOG can be set to a user-specified date for the current process using the **FixedDate()** method of the %SYSTEM.Process class. **$HOROLOG** cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

```
DO ##class(%SYSTEM.Process).FixedDate(12345)  // set $HOROLOG date
WRITE !,$ZDATETIME($HOROLOG,1,1,9)," $HOROLOG changed date"
WRITE !,$ZDATETIME($NOW(),1,1,9)," $NOW() no date change"
WRITE !,$ZDATETIME($ZDATETIMEH($ZTIMESTAMP,-3),1,1,9)," $ZTS UTC-to-local",
        " no date change"
DO ##class(%SYSTEM.Process).FixedDate(0)    // restore $HOROLOG
WRITE !,$ZDATETIME($HOROLOG,1,1,9)," $HOROLOG current date"
```

Note that **FixedDate()** changes the **$HOROLOG** value, but not the **$NOW** or **$ZTIMESTAMP** value.

Time Zone

By default, **$HOROLOG** contains the date and time for the local time zone. This time zone default is supplied by the operating system, which InterSystems IRIS uses to set the **$ZTIMEZONE** default.

Changing **$ZTIMEZONE** affects the value of **$HOROLOG** for the current process. It changes the time portion of **$HOROLOG**, and this change of time can also change the date portion of **$HOROLOG**. **$ZTIMEZONE** is a fixed offset of time zones from the Greenwich meridian; it does not adjust for local seasonal time variants, such as Daylight Saving Time.

Daylight Saving Time

$HOROLOG adjusts for seasonal time variants based on the algorithm supplied by the underlying operating system. After applying the **$ZTIMEZONE** value, InterSystems IRIS uses the operating system local time to adjust **$HOROLOG** (if needed) for seasonal time variants, such as Daylight Saving Time.

You can determine if Daylight Saving Time is in effect for the current date, or for a specified date and time using the **IsDST()** method. The following example returns the Daylight Saving Time (DST) status for the current date and time. Because this status could change while the program is running, this example checks it twice:

```
CheckDST
  SET x=$SYSTEM.Util.IsDST()
  SET local=$ZDATETIME($HOROLOG)
  SET x2=$SYSTEM.Util.IsDST()
  GOTO:x'=x2 CheckDST
  IF x=1 {WRITE local," DST in effect"}
  ELSEIF x=0 {WRITE local," DST not in effect"}
  ELSE {WRITE local," DST setting cannot be determined"}
```

The application of seasonal time variants may differ based on (at least) three considerations:

- Operating system: Within a time zone, **$HOROLOG** for a given date may differ on different computers. This is because different operating systems use different algorithms to apply time variants. Because policies governing the beginning and end dates for Daylight Saving Time (and other time variants) have changed, older operating systems may not reflect current practice, and/or calculations using older **$HOROLOG** values may be adjusted using the current beginning and end dates, rather than the ones in force at that time.
- Government policies have changed over time: There have been numerous changes to seasonal time variants since their first adoption in 1916 (much of Europe) and 1918 (United States). Daylight Saving Time has been adopted, rejected, and re-adopted by governmental policies in many places. The seasonal start and end dates for Daylight Saving Time have also changed numerous times. In the United States, recent changes of national policy have occurred in 1966, 1974–75, 1987, and 2007. Adoption of, or exemption from, national policies have also occurred due to local legislative actions. For example, the state of Arizona does not observe Daylight Saving Time.
- Geography: Daylight Saving Time is summer time; the local clock shifts forwards (“Spring ahead”) at the start of DST and shifts backwards (“Fall back”) at the end of DST. Thus the calendar start and end dates for Daylight Saving Time within the same time zone are commonly reversed in the northern hemisphere and the southern hemisphere. Equatorial nations and most of Asia and Africa do not observe Daylight Saving Time.

Local Time Variant Thresholds

$HOROLOG calculates the number of seconds from midnight by consulting the system clock. Therefore, if the system clock is automatically reset when crossing a local time variant threshold, such as the beginning or end of Daylight Saving Time, the time value of **$HOROLOG** also shifts abruptly ahead or back by the appropriate number of seconds. For this reason, comparisons of two **$HOROLOG** time values may yield unanticipated results if the period between the two values includes a local time variant threshold.

$NOW does not adjust for local time variants. Its use may be preferable when comparing date and time values if the period between the two values includes a local time variant threshold.

Dates Before 1840

$HOROLOG cannot be directly used to represent dates outside of the range of years 1840 through 9999. However, you can represent historic dates far beyond this range using the InterSystems SQL Julian date feature. Julian dates can represent a date as an unsigned integer, counting from 4711 BC (BCE). Julian dates do not have a time-of-day component.

You can convert an InterSystems IRIS $HOROLOG date to an InterSystems IRIS Julian date using the TO_CHAR SQL function, or the **TOCHAR()** method of the %SYSTEM.SQL class. You can convert an InterSystems IRIS Julian date to an InterSystems IRIS $HOROLOG date using the TO_DATE SQL function, or the **TODATE()** method of the %SYSTEM.SQL class.

The following example takes the current $HOROLOG date and converts it to a Julian date. The + before **$HOROLOG** forces InterSystems IRIS to treat it as a number, and thus truncate at the comma, eliminating the time integer:

```
WRITE !,"Horolog date = ",+$H
SET x=$SYSTEM.SQL.TOCHAR(+$HOROLOG,"J")
WRITE !,"Julian date = ",x
```

The following example takes a Julian date and converts it to an InterSystems IRIS $HOROLOG date:

```
SET x=$SYSTEM.SQL.TODATE(2455030,"J")
WRITE !,"$HOROLOG date = ",x," = ", $ZDATE(x,1)
```

Note that Julian date values smaller than 1721100 cannot be converted; an <ILLEGAL VALUE> error is generated.

For further information on Julian dates, refer to TO_DATE and TO_CHAR in the *InterSystems SQL Reference*.

Examples

The following example displays the current contents of **$HOROLOG**.

```
WRITE $HOROLOG
```

This returns a value formatted like this: 64701,49170

The following example uses **$ZDATE** to convert the date field in **$HOROLOG** to a date format.

```
WRITE $ZDATE($PIECE($HOROLOG,",",1))
```

returns a value formatted like this: 02/22/2018

The following example converts the time portion of **$HOROLOG** to a time in the form of hours:minutes:seconds on a 12-hour (a.m. or p.m.) clock.

```
CLOCKTIME
  NEW
  SET Time=$PIECE($HOROLOG,",",2)
  SET Sec=Time#60
  SET Totmin=Time\60
  SET Min=Totmin#60
  SET Milhour=Totmin\60
  IF Milhour=12 { SET Hour=12,Meridian=" pm" }
  ELSEIF Milhour>12 { SET Hour=Milhour-12,Meridian=" pm" }
  ELSE { SET Hour=Milhour,Meridian=" am" }
  WRITE !,Hour,":",Min,":",Sec,Meridian
  QUIT
```

See Also

- $NOW function
- $ZDATE function
- $ZDATEH function
- $ZDATETIME function
- $ZDATETIMEH function
- $ZTIME function
- $ZTIMEH function
- $ZTIMESTAMP special variable
- $ZTIMEZONE special variable

$IO

Contains the ID of the current input/output device.

```
$IO
$I
```

Description

$IO contains the device ID of the current device to which all input/output operations are directed. If the input and output devices are different, **$IO** contains the ID of the current input device.

InterSystems IRIS sets the value of **$IO** to the principal input/output device at login. **$PRINCIPAL** contains the ID of the principal device. You issue a **USE** command to change the current device. Only the **USE** and **CLOSE** commands, a **BREAK** command, or a return to the Terminal can change this value.

You can return the device type of the current device by using the **GetType()** method of the %Library.Device class.

On UNIX® systems, **$IO** contains the actual device name.

On Windows systems, **$IO** contains an InterSystems IRIS-generated unique identifier for the principal device. For terminal devices (TRM or TNT), this consists of a pseudo-device name enclosed in vertical bars, a colon and another vertical bar, followed by the device's process ID (pid) number. For non-terminal devices, the pseudo-device name is enclosed in vertical bars and followed by a unique numeric identifier.

For a Terminal: |TRM|:|*pid*

For a Telnet terminal: |TNT|*nodename*:*portnumber*|*pid*

For a file descriptor: |FD|*file_descriptor_number*

(File descriptors are used with CALLIN/CALLOUT remote access.)

For a TCP device: |TCP|*unique_device_identifier*

For a named pipe: |NPIPE|*unique_device_identifier*

For the default printer: |PRN|

For a printer other than the default: |PRN|*physical_device_name*

If the principal device is a null device (which is the default for a background process), **$IO** contains the null device name with ":pid" appended, thus allowing you to use **$IO** for a unique subscript. The null device name contained in **$IO** depends on the operating system.

- For Windows systems, **$IO** contains //./nul:*pid*
- For UNIX® systems, **$IO** contains /dev/null:*pid*

If the input device is redirected via a pipe or file, **$IO** contains "00".

The default device number for a device is configurable. Go to the Management Portal, select **System Administration**, **Configuration**, **Device Settings**, **Devices**. For the desired device, click "Edit" to display and modify its **Physical Device Name:** option. If you do this, **$IO** will contain the assigned device number, rather than the actual operating system device name.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

See Also

- USE command
- $PRINCIPAL special variable

- I/O Devices and Commands in *I/O Device Guide*
- Terminal I/O in *I/O Device Guide*

$JOB

Contains the ID of the current process.

```
$JOB
$J
```

Description

$JOB contains the ID number of the current process. This ID number is the host operating system's actual Process ID (PID). This ID number is unique for each process.

The format of the string returned to **$JOB** is determined for the current process by the setting of the **NodeNameInPid()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *NodeNameInPid* property of the Config.Miscellaneous class. By default, **$JOB** returns only the PID, but you can set these functions to have **$JOB** return both the PID and the node name. For example: `11284:MYCOMPUTER`.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

To establish the PID as the terminal prompt, use the **TerminalPrompt(5)** method of the %SYSTEM.Process class.

Other Information About the Current Process

You can obtain the same current process ID number by invoking the **ProcessId()** method, as follows:

```
WRITE $SYSTEM.SYS.ProcessID()
```

Refer to the %SYSTEM.SYS class in the *InterSystems Class Reference* for further details.

You can use **$JOB** to obtain the job number for the current process as follows:

```
SET JobObj=##CLASS(%SYS.ProcessQuery).%OpenId($JOB)
WRITE JobObj.JobNumber
```

Refer to the %SYS.ProcessQuery class in the *InterSystems Class Reference* for further details.

You can obtain status information about the current process from the $ZJOB special variable.

You can obtain the PID of the child process or the parent process of the current process from the $ZCHILD and $ZPARENT special variables.

You can obtain the PIDs of the current jobs in the job table from the ^$JOB structured system variable.

See Also

- JOB command

$KEY

Contains the terminator character from the most recent READ.

```
$KEY
$K
```

Description

$KEY contains the character or character sequence that terminated the last **READ** command on the current device. **$KEY** and **$ZB** are very similar in function; see below for a detailed comparison.

- If the last read terminated because of a terminator character (such as the <RETURN> key), **$KEY** contains the terminator character.
- If the last read terminated because of a timeout or a fixed-length read length limit, **$KEY** contains the null string. No terminator character was encountered.
- If the last read was a single-character read (`READ *a`), and a character was entered, **$KEY** contains the actual input character.

$KEY and **$ZB** are very similar, though not identical. See below for a comparison.

You can use the **SET** command to specify a value for **$KEY**. You can use the **ZZDUMP** command to display the value of **$KEY**.

During a terminal session, the end of every command line is recorded in **$KEY** as a carriage return (hexadecimal 0D). In addition, the **$KEY** special variable is initialized to carriage return by the process that initializes the terminal session. Therefore, to display the value of **$KEY** set by the **READ** command or a SET command during a terminal session, you must copy the **$KEY** value to a local variable within the same line of code.

Examples

In the following example, a variable-length **READ** command either receives data from the terminal or times out after 10 seconds. If the user inputs the data before the timeout, **$KEY** contains the user-input carriage return (hex 0D) that terminated the data input. If, however, the **READ** timed out, **$KEY** contains the null string, indicating that no terminator character was received.

```
READ "Ready or Not: ",x:10
ZZDUMP $KEY
```

In the following example, a fixed-length **READ** command either receives data from the terminal or times out after 10 seconds. If the user inputs the specified number of characters (in this case, one character), the user does not have to press <RETURN> to conclude the **READ** operation. The user can respond to the read prompt by pressing <RETURN> rather than entering the specified number of characters.

If the read operation timed out, both **$KEY** and **$ZB** contain the null string. If the user inputs a one-character middle initial, **$KEY** contains the null string, because the fixed-length **READ** operation concluded without a terminator character. If the user pressed <RETURN> rather than entering a middle initial, **$KEY** contains the user-input carriage return.

```
READ "Middle initial: ",z#1:10
IF $ASCII($ZB)=-1 {
  WRITE !,"The read timed out" }
ELSEIF $ASCII($KEY)=-1 {
  WRITE !,"A character was entered" }
ELSEIF $ASCII($KEY)=13 {
  WRITE !,"A line return was entered" }
ELSE {
  WRITE !,"Unexpected result" }
```

Notes

$KEY and $ZB Compared

Both **$KEY** and **$ZB** contain the character that terminates a **READ** operation. These two special variables are similar, but not identical. Here are the principal differences:

- **$KEY** can be set using the **SET** command. **$ZB** cannot be **SET**.
- Following a successful fixed-length **READ**, **$ZB** contains the final character input (for example, when the 5-digit postal code "02138" is input as a fixed-length **READ**, **$ZB** contains "8"). Following a successful fixed-length **READ**, **$KEY** contains the null string ("").
- **$KEY** does not support block-based read and write operations.

$KEY on the Command Line

When issuing commands interactively from the Terminal command line, you press <RETURN> to issue each command line. The **$KEY** and **$ZB** special variables record this command line terminator character. Therefore, when using **$KEY** or **$ZB** to return the termination status of a read operation, you must set a variable as part of the same command line.

For example, if you issue the command:

```
>READ x:10
```

from the command line, then check **$KEY**, it will *not* contain the results of the read operation; it will contain the <RETURN> character that executed the command line. To return the results of the read operation, set a local variable with **$KEY** in the same command line, as follows:

```
>READ x:10 SET rkey=$KEY
```

This preserves the value of **$KEY** set by the read operation. To display this read operation value, issue either of the following command line statements:

```
>WRITE $ASCII(rkey)
   ; returns -1 for null string (time out)
   ; returns ASCII decimal value for terminator character
>ZZDUMP rkey
   ; returns blank line for null string (time out)
   ; returns hexadecimal value for terminator character
```

See Also

- READ command
- SET command
- ZZDUMP command
- $ZB special variable

$NAMESPACE

Contains the namespace for the current stack level.

```
$NAMESPACE
SET $NAMESPACE=namespace
NEW $NAMESPACE
```

Parameter

namespace	The name of an existing namespace, specified as a literal quoted string or an expression that resolves to a quoted string. Namespace names are not case-sensitive.

Description

$NAMESPACE contains the name of the current namespace for the current stack level. You can use **$NAMESPACE** to:

- Return the name of the current namespace.
- Change the current namespace with **SET**.
- Establish a new temporary namespace context with **NEW** and **SET**.

NEW $NAMESPACE followed by **SET $NAMESPACE**=*namespace* is the preferred way to change the current namespace within a code module.

Return the Current Namespace Name

The **$NAMESPACE** special variable contains the current namespace name.

You can also obtain the name of the current namespace by invoking the **NameSpace()** method of %SYSTEM.SYS class, as follows:

```
WRITE $SYSTEM.SYS.NameSpace()
```

You can obtain the full pathname of the current namespace by using the **NormalizeDirectory()** method of %Library.File class, as follows:

```
WRITE $NAMESPACE,!
WRITE ##class(%Library.File).NormalizeDirectory("")
```

You can test whether a namespace is defined by using the **Exists()** method of the %SYS.Namespace class, as follows:

```
WRITE ##class(%SYS.Namespace).Exists("USER"),!  ; an existing namespace
WRITE ##class(%SYS.Namespace).Exists("LOSER")   ; a non-existent namespace
```

These methods are described in the *InterSystems Class Reference*.

SET $NAMESPACE

You can set **$NAMESPACE** to an existing namespace using the **SET** command.

NEW $NAMESPACE followed by **SET $NAMESPACE**=*namespace* is the preferred way to change a namespace within a code module, rather than using **SET $ZNSPACE** or the **ZNSPACE** command.

In **SET $NAMESPACE=*namespace***, specify *namespace* as a quoted string literal or a variable or expression that evaluates to a quoted string; *namespace* is not case-sensitive. However, InterSystems IRIS always displays explicit namespace names in all uppercase letters, and implied namespace names in all lowercase letters. A namespace name can contain Unicode letter characters; InterSystems IRIS converts accented lowercase letters to their corresponding accented uppercase letters.

The *namespace* name can be an explicit namespace name ("USER") or an implied namespace ("^^c:\InterSystems\IRIS\mgr\user\"). For further details on implied namespaces, refer to the ZNSPACE command.

If the specified *namespace* does not exist, **SET $NAMESPACE** generates a <NAMESPACE> error. If you do not have access privileges to a namespace, the system generates a <PROTECT> error, followed by the database path. For example, the %Developer role does not have access privileges to the %SYS namespace. If you have this role and attempt to access this namespace, InterSystems IRIS issues the following error (on a Windows system): `<PROTECT> *c:\intersystems\iris\mgr\`.

NEW $NAMESPACE

By setting **$NAMESPACE** you can change the current namespace. This is the preferred way to change a namespace in a method or other routine. By using **NEW $NAMESPACE** and **SET $NAMESPACE** you establish a namespace context that automatically reverts to the prior namespace when the method concludes or an unexpected error occurs:

```
  TRY {
   WRITE "before the method: ",$NAMESPACE,!
   DO MyNSMethod("DocBook")
   WRITE "after the method: ",$NAMESPACE
   RETURN
MyNSMethod(ns)
  NEW $NAMESPACE
  IF ##class(%SYS.Namespace).Exists(ns) {
     SET $NAMESPACE=ns }
  ELSE {SET $NAMESPACE="User" }
  WRITE "namespace changed in method: ",$NAMESPACE,!
  SET num=5/$RANDOM(2)
  QUIT
NextMethod()
  WRITE "This should not write",!
  }
  CATCH exp {
  WRITE "namespace after error in method: ",$NAMESPACE,!
  IF 1=exp.%IsA("%Exception.SystemException") {
  WRITE "System exception: ",$ZCVT(exp.Name,"O","HTML"),! }
  }
```

Quitting a routine or branching to an error trap reverts to this stacked namespace. If you create an object instance in the changed namespace, InterSystems IRIS closes the object in that namespace before reverting to the stacked namespace. This is shown in the following Terminal example:

```
USER>NEW $NAMESPACE
USER 1S1>NEW myoref
USER 2N1>SET $NAMESPACE="MYNSPACE"
MYNSPACE 2N1>SET myoref=##class(%SQL.Statement).%New()
MYNSPACE 2N1>QUIT
  /* IRIS closes myoref in the MYNSPACE namespace
     Then reverts to the USER namespace */
USER>
```

In more complex stacked namespace situations, it is the programmer's responsibility to explicitly close objects in the proper namespace.

Examples

The following example calls a routine that executes in a different namespace than the calling program. It uses **NEW $NAMESPACE** to stack the current namespace. It then uses **SET $NAMESPACE** to change the namespace for the duration of Test. The **QUIT** reverts to the stacked namespace:

```
   WRITE "before: ",$NAMESPACE,!
   DO Test
   WRITE "after: ",$NAMESPACE,!
   QUIT
Test
   NEW $NAMESPACE
   SET $NAMESPACE="USER"
   WRITE "testing: ",$NAMESPACE,!
   ; routine code
   QUIT
```

There is no need to handle an error to switch back to the old namespace; InterSystems IRIS restores the old namespace when you leave the current stack level.

The following example differs from the previous example by omitting **NEW $NAMESPACE**. Note that upon **QUIT** the namespace does not revert:

```
   WRITE "before: ",$NAMESPACE,!
   DO Test
   WRITE "after: ",$NAMESPACE,!
   QUIT
Test
   NEW
   SET $NAMESPACE="USER"
   WRITE "testing: ",$NAMESPACE,!
   ; routine code
   QUIT
```

Calling a separate routine when temporarily changing the current namespace is the preferred programming practice.

See Also

- NEW command
- SET command
- ZNSPACE command
- $ZNSPACE special variable
- Configuring Namespaces in *System Administration Guide*

$PRINCIPAL

Contains the ID of the principal I/O device.

```
$PRINCIPAL
$P
```

Description

$PRINCIPAL contains the ID of the principal I/O device for the current process. **$PRINCIPAL** operates like **$IO**. Refer to **$IO** for details of specific device types and system platforms.

If the principal device is closed, **$PRINCIPAL** does not change. If the principal input and output devices differ, **$PRINCIPAL** reflects the ID of the principal input device.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Examples

This example uses **$PRINCIPAL** to test for a principal device.

```
   IF $PIECE($PRINCIPAL,"|",4) {
     WRITE "Principal device is: ",$PRINCIPAL }
   ELSE  { WRITE "Undefined" }
```

This example uses and writes to the principal device.

```
   USE $PRINCIPAL
   WRITE "output to $PRINCIPAL"
```

Notes

$PRINCIPAL and USE 0

$PRINCIPAL is functionally equivalent to the widely used, but nonstandard, USE 0. Use **$PRINCIPAL** instead of USE 0 because it is standard, and because it makes your code more flexible.

See Also

- USE command
- $IO special variable

$QUIT

Contains a flag indicating what kind of QUIT is required to exit the current context.

```
$QUIT
$Q
```

Description

$QUIT contains a value that indicates whether an argumented **QUIT** command is required to exit from the current context. If an argumented **QUIT** is required to exit from the current context, **$QUIT** contains a one (1). If an argumented **QUIT** is not required to exit from the current context, **$QUIT** contains a zero (0).

In a context created by issuing a **DO** or **XECUTE** command, an argumented **QUIT** is not required to exit. In a context created by a user-defined function, an argumented **QUIT** is required to exit.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Example

The following example demonstrates **$QUIT** values in a **DO** context, in an **XECUTE** context, and in a user-defined function context.

The sample code is as follows:

```
QUI
  DO
  .  WRITE !,"$QUIT in a DO context = ",$QUIT
  .  QUIT
  XECUTE "WRITE !,""$QUIT in an XECUTE context = "",$QUIT"
  SET A=$$A
  QUIT
A()
  WRITE !,"$QUIT in a User-defined function context =",$QUIT
  QUIT 1
```

A sample session using this code might run as follows:

```
USER>DO ^QUI
$QUIT in a DO context = 0
$QUIT in an XECUTE context = 0
$QUIT in a User-defined function context = 1
```

Notes

$QUIT and Error Processing

The **$QUIT** special variable is particularly useful during error processing when the same error handler can be invoked at context levels that require an argumented **QUIT** and at context levels that require an argumentless **QUIT**.

See the Error Handling in *Using ObjectScript* for more information about error processing.

See Also

- DO command
- QUIT command
- XECUTE command

$ROLES

Contains the roles assigned to the current process.

```
$ROLES
```

Description

$ROLES contains the list of roles assigned to the current process. This list of roles consists of a comma-separated string that can contain both User Roles and Added Roles.

A role is assigned to a user either by using the SQL **GRANT** statement, or by using the Management Portal **System Administration**, **Security**, **Users** option. Select a user name to edit its definition, then select the **Roles** tab to assign that user to a role. A role can be defined using the SQL **CREATE ROLE** statement and deleted using the SQL **DROP ROLE** statement. A role must be defined before it can be assigned to a user. A role can be revoked from a user using the SQL **REVOKE** statement.

When a process is created using the **JOB** command, it inherits the same **$ROLES** and **$USERNAME** values as its parent process.

When a process performs I/O redirection, this redirection is performed using the user's login **$ROLES** value, not the current **$ROLES** value.

Roles Granted to Roles Not Listed

Granting a role to another role is a concept only available through InterSystems SQL. Roles granted to roles are used in SQL to determine the user's role list for checking SQL privileges. They cannot be accessed by ObjectScript. You cannot grant a role to another role through InterSystems IRIS System Security. Therefore, the **$ROLES** special variable list does not contain any roles that SQL operations have granted to the current roles. For further details, refer to the GRANT command in the InterSystems SQL Reference.

SET $ROLES

You can use the **SET** command to change the Added Roles part of the list contained in **$ROLES**. Setting **$ROLES** only alters a process' Added Roles. It cannot alter its User Roles. To set **$ROLES** to a different list of Added Roles is a restricted system capability. However, such restrictions do not apply to setting **$ROLES** to a null string, which deletes the list of Added Roles.

A role must be defined before it can be added. You can define a role using the SQL **CREATE ROLE** command. **CREATE ROLE** does not give any privileges to a role. To assign privileges to a role use either the SQL **GRANT** statement, or the Management Portal **System Administration**, **Security**, **Roles** interface.

You must issue a **NEW $ROLES** statement before escalating the process roles using **SET $ROLES**.

NEW $ROLES

NEW $ROLES stacks the current values of both **$ROLES** and **$USERNAME**. You can use the **NEW** command on **$ROLES** without security restrictions.

Issue a **NEW $ROLES** and then **SET $ROLES** to supply Added Roles. You can then create an object instance that uses these Added Roles. If you quit this routine, InterSystems IRIS closes the object with the Added Roles before reverting to the stacked **$ROLES** value.

Examples

The following example returns the list of roles for the current process.

```
WRITE $ROLES
```

The following example first creates the roles Vendor, Sales, and Contractor. It then displays the comma-separated list of default roles (which contain both User Roles and Added Roles). The first **SET $ROLES** replaces the list of Added Roles with the two roles Sales and Contractor. The second **SET $ROLES** concatenates the Vendor role to the list of Added Roles. The final **SET $ROLES** sets the Added Roles list to the null string, removing all Added Roles. The User Roles remain unchanged throughout:

```
CreateRoles
   &sql(CREATE ROLE Vendor)
   &sql(CREATE ROLE Sales)
   &sql(CREATE ROLE Contractor)
   IF SQLCODE=0 {
     WRITE !,"Created new roles"
     DO SetRoles }
   ELSEIF SQLCODE=-118 {
     WRITE !,"Role already exists"
     DO SetRoles }
   ELSE { WRITE !,"CREATE ROLE failed, SQLCODE=",SQLCODE }
SetRoles()
     WRITE !,"Initial: ",$ROLES
     NEW $ROLES
     SET $ROLES="Sales,Contractor"
     WRITE !,"Replaced: ",$ROLES
     NEW $ROLES
     SET $ROLES=$ROLES_",Vendor"
     WRITE !,"Concatenated: ",$ROLES
     SET $ROLES=""
     WRITE !,"Nulled: ",$ROLES
```

See Also

- ObjectScript: SET command NEW command $USERNAME special variable
- InterSystems SQL: CREATE ROLE DROP ROLE GRANT REVOKE %CHECKPRIV

$STACK

Contains the number of context frames saved on the call stack.

```
$STACK
$ST
```

Description

$STACK contains the number of context frames currently saved on the call stack for your process. You can also look at **$STACK** as the zero-based context level number of the currently executing context. Therefore, when an InterSystems IRIS job is started, before any contexts have been saved on the call stack, the value of **$STACK** is zero (0).

Each time a routine calls another routine with a **DO** command, the context of the currently executing routine is saved on the call stack and execution starts in the newly created context of the called routine. The called routine can, in turn, call another routine and so on. Each additional call causes another saved context to be placed on the call stack.

An **XECUTE** command and a user-defined function reference also establish a new execution context. A **GOTO** command does not.

As new contexts are created by **DO** commands, **XECUTE** commands, or user-defined function references, the value of **$STACK** is incremented. As contexts are exited with the **QUIT** command, previous context are restored from the call stack and the value of **$STACK** is decremented.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

$ESTACK is identical to **$STACK**, except that you can establish a **$ESTACK** level of 0 (zero) at any point by issuing a **NEW $ESTACK** command. You cannot **NEW** the **$STACK** special variable.

Error Handling

When an error occurs, all context information is immediately saved on your process error stack. This changes the value of **$STACK**. The context information is then accessible using the $STACK function until the value of $ECODE is cleared by an error handler. In other words, while the value of **$ECODE** is non-null, the **$STACK** function returns information about a context saved on the error stack rather than an active context at the same specified context level.

Context Levels from the Terminal Prompt

A routine that is invoked from a program starts at a different context level than a routine invoked from the Terminal prompt with a **DO** command. The **DO** command typed at the Terminal prompt causes a new context to be created. The following example shows the routine START invoked from a routine or from the Terminal prompt:

Consider the following routine:

```
START
  ; Display the context level and exit
  WRITE !,"Context level in routine START is ",$STACK
  QUIT
```

When you run START from a program, you see the following display:

```
Context level in routine START is 0
```

When you run START by issuing DO ^START at the Terminal prompt, you see the following display:

```
Context level in routine START is 1
```

Examples

The following example demonstrates how the value of **$STACK** is incremented as new contexts are create and decremented as contexts are exited.

The sample code is as follows:

```
STA
  WRITE !,"Context level in routine STA = ",$STACK
  DO A
  WRITE !,"Context level after routine A = ",$STACK
  QUIT
A
  WRITE !,"Context level in routine A = ",$STACK
  DO B
  WRITE !, "Context level after routine B = ",$STACK
  QUIT
B
  WRITE !,"Context level in routine B = ",$STACK
  XECUTE "WRITE !,""Context level in XECUTE = "",$STACK"
  WRITE !,"Context level after XECUTE = ",$STACK
  QUIT
```

A sample session using this code might run as follows:

```
USER>DO ^STA
Context level in routine STA = 1
Context level in routine A = 2
Context level in routine B = 3
Context level in XECUTE = 4
Context level after XECUTE = 3
Context level after routine B = 2
Context level after routine A = 1
```

See Also

- $STACK function
- $ESTACK special variable
- Error Handling in *Using ObjectScript*
- Using %STACK to Display the Stack in the “Command-line Routine Debugging” chapter of *Using ObjectScript*

$STORAGE

Contains the number of bytes available for local variable storage.

```
$STORAGE
$S
```

Description

$STORAGE returns the number of bytes available for local variable storage in the current process partition. The initial value of **$STORAGE** is established by the value of **$ZSTORAGE**, the maximum amount of memory available to the process. The larger the **$ZSTORAGE** value (in kilobytes), the larger the **$STORAGE** value (in bytes). However, this relationship between **$ZSTORAGE** and **$STORAGE** is not a simple 1:1 ratio.

The **$STORAGE** value is affected by the following operations:

- **$STORAGE** decreases as local variables are defined in the local variable space, for example, by using the **SET** command. The decrease in **$STORAGE** corresponds to the amount of space required to store the value of the local variable; the size of the name of the local variable has no effect on **$STORAGE**, but the number of subscript levels does affect **$STORAGE**. The **$STORAGE** value increases as local variables are removed, for example, by using the **KILL** command.
- **$STORAGE** decreases when you issue a NEW command. **NEW** establishes a new execution level; space set aside for local variables (whether or not used) at the previous execution level is not available at the new execution level. The initial **NEW** decreases **$STORAGE** by approximately 15000; each subsequent **NEW** decreases **$STORAGE** by 12288. The **$STORAGE** value increases when you issue a **QUIT** command to exit an execution level.
- **$STORAGE** decreases when you define a flow-of-control statement, such as **IF** or **FOR**, or a block structure such as **TRY** and **CATCH**. Storage is allocated to compile these structures, not to execute them. Therefore, a **FOR** statement consumes the same amount of storage regardless whether it loops or how many times it loops; each **IF**, **ELSEIF**, and **ELSE** clause consumes a set amount of storage, regardless of how many branches are executed. The space is allocated from the process that compiled the code. Note that a **FOR** loop commonly defines a local variable as a counter.

The **$STORAGE** value is not affected by setting process-private globals, global variables, or special variables. The **$STORAGE** value is not affected by changing namespaces.

The **$STORAGE** special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Low Memory and <STORE> Errors

The **$STORAGE** value may be a positive or negative number. A value of zero does not indicate no available storage, but indicates that storage is in extremely short supply. If **$STORAGE** decreases to less than zero, at some point a <STORE> error occurs. For example, if **$STORAGE** decreases to -7000, allocating storage for another local variable might fail due to a <STORE> error, indicating insufficient available storage space to store a local variable value, or to establish a new execution level.

The first <STORE> error occurs when **$STORAGE** is some value less than zero; the exact negative **$STORAGE** value threshold depends upon context. This <STORE> error indicates that you must get additional storage, either by increasing $ZSTORAGE, or by freeing some allocated storage through **KILL** or **QUIT** operations. When this first <STORE> error occurs, the system automatically makes 1Mb of additional memory available to the process to enable error processing and recovery. InterSystems IRIS does not change **$ZSTORAGE**; it allows **$STORAGE** to go further into negative number values.

When this first <STORE> error occurs, InterSystems IRIS internally designates the process as being in a low memory state. While in this low memory state the process may continue to allocate memory and the value of **$STORAGE** may continue to decrease into lower negative numbers. While in this low memory state the process may free some allocated memory, causing the value of **$STORAGE** to rise. Thus, the value of **$STORAGE** may rise or fall within a range of values without issuing additional <STORE> errors. Also, after the first <STORE> error you may see a small rise in **$STORAGE** caused by InterSystems IRIS freeing some internal memory.

This first <STORE> error provides some memory cushion that allows your process to call diagnostics, perform saves to disk, exit gracefully, free memory, and continue.

A process remains in a low memory state until either of the following occurs:

- The process makes available sufficient memory. Your process can do this by increasing the $ZSTORAGE allocation, and/or by freeing allocated storage through **KILL** or **QUIT** operations. When the value of **$STORAGE** exceeds 256K (or 25% of **$ZSTORAGE**, whichever is smaller), InterSystems IRIS removes the process from low memory state. At that point the process can again issue a <STORE> error if the available memory decreases into negative numbers.
- The process consumes the additional memory. When the value of **$STORAGE** reaches -1048576, a second <STORE> error occurs. If your process arrives at this point, no more memory is available to the process and further process operations become unpredictable. It is likely the process will immediately terminate.

You can determine the reason for a <STORE> error by calling the **$SYSTEM.Process.MemoryAutoExpandStatus()** method.

Examples

The following example shows how **$STORAGE** becomes smaller when **$ZSTORAGE** is set to a smaller value. Note that the relationship (ratio) between these two values is variable:

```
SET $ZS=262144
FOR i=1:1:10 {
        WRITE "$ZS=",$ZS," $S=",$S," ratio=",$NORMALIZE($S/$ZS,3),!
        IF $ZS>30000 {SET $ZS=$ZS-30000 }
}
```

The following example shows how **$STORAGE** decreases as local variables are assigned, and increases when local variables are killed:

```
WRITE "$STORAGE=",$S," initial value",!
FOR i=1:1:30 {SET a(i)="abcdefghijklmnopqrstuvwxyz"
  WRITE "$STORAGE=",$S,! }
KILL a
WRITE !,"$STORAGE=",$S," after KILL",!
```

The following example shows how the number of subscript levels of an assigned local variable affect **$STORAGE**:

```
WRITE "No subscripts:",!
SET before=$S
SET a="abcdefghijklmnopqrstuvwxyz"
WRITE " memory allocated ",before-$S,!
KILL a
WRITE "One subscript level:",!
SET before=$S
SET a(1)="abcdefghijklmnopqrstuvwxyz"
WRITE " memory allocated ",before-$S,!
KILL a(1)
WRITE "Nine subscript levels:",!
SET before=$S
SET a(1,2,3,4,5,6,7,8,9)="abcdefghijklmnopqrstuvwxyz"
WRITE " memory allocated ",before-$S,!
KILL a(1,2,3,4,5,6,7,8,9)
```

The following example shows how **$STORAGE** decreases (becomes unavailable at that level) as **NEW** establishes a new execution level:

```
WRITE "increasing levels:",!
FOR i=1:1:10 {WRITE "$STORAGE=",$S,! NEW }
```

The following example shows how **$STORAGE** decreases as local variables are assigned until it enters low memory state, issuing a <STORE> error. The <STORE> error is caught by a **CATCH** block that invokes the **StoreErrorReason()** method to determine what caused the error. Note that entering the **CATCH** block consumes a significant amount of storage. Once in the **CATCH** block, this example allocates one more variable.

```
TRY {
  WRITE !,"TRY block",!
  SET init=$ZSTORAGE
  SET $ZSTORAGE=456
  WRITE "Initial $STORAGE=",$STORAGE,!
  FOR i=1:1:1000 {
     SET pre=$STORAGE
     SET var(i)="1234567890abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ"
     IF $STORAGE<0 {WRITE "var(",i,") negative memory=",$STORAGE,! }
     ELSEIF pre<$STORAGE {WRITE "var(",i,") new allocation $S=",$STORAGE,! }
     ELSE {WRITE "var(",i,") $S=",$STORAGE,! }
  }
}
CATCH myexp {
    WRITE !,"CATCH block exception handler",!!
    WRITE "Name: ",$ZCVT(myexp.Name,"O","HTML"),!
      IF myexp.Name="<STORE>" {WRITE "store error reason=",
                                $SYSTEM.Process.StoreErrorReason(),! }
    WRITE "$S=",$STORAGE,!
    SET j=i
    SET var(j)="1234567890abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ"
    WRITE "var(",j,") added one more variable $S=",$STORAGE,!
    SET $ZSTORAGE=init
    RETURN
}
```

See Also

- $ZSTORAGE special variable
- Local variables in the “Variables” chapter of *Using ObjectScript*

$SYSTEM

Contains system information about system objects.

```
$SYSTEM
$SY
$SYSTEM.class.method()
```

Description

$SYSTEM can be invoked as either a special variable or as a class which invokes methods that return system information.

$SYSTEM Special Variable

$SYSTEM as a special variable contains the local system name and the name of the current instance of InterSystems IRIS, separated by a colon (:). The name of the machine follows the case conventions of the local operating system and the name of the instance is in uppercase. For example:

```
MyComputer:IRIS181
```

You can also determine your local system name using the **LocalHostName()** method:

```
WRITE $SYSTEM,!
WRITE $SYSTEM.INetInfo.LocalHostName()
```

The abbreviation **$SY** can only be used for **$SYSTEM** as a special variable.

$SYSTEM Class

$SYSTEM as a class provides access to a variety of system objects. You can invoke a method that returns information, or a method that performs some operation such as upgrading or loading and returns status information. InterSystems IRIS supports several classes of system objects, including the following:

- Version: for version numbers of IRIS and its components
- SYS: for the system itself
- OBJ: for Objects
- SQL: for SQL queries

Note that object class names and method names are case-sensitive. Specifying the wrong case for these names results in a <CLASS DOES NOT EXIST> or <METHOD DOES NOT EXIST> error. If you do not specify parentheses with the method name, it issues a <SYNTAX> error.

For further information on using dot syntax with **$SYSTEM** to access these objects, refer to the chapter "Working with Registered Objects" of *Defining and Using Classes*. For further information on using %SYSTEM.OBJ, refer to Flags and Qualifiers. **$SYSTEM** can access the System API classes in the %SYSTEM class package, described in the *InterSystems Class Reference* documentation.

Flags and Qualifiers

These are arguments which can be used to control the import of external sources into InterSystems IRIS, compile existing applications, and export these to external destinations. In the class documentation for %SYSTEM.OBJ, these are often supplied as the value of the parameter, *qspec*. The available settings for each can be displayed by the commands:

```
DO $SYSTEM.OBJ.ShowFlags()
```

and

```
DO $SYSTEM.OBJ.ShowQualifiers()
```

Flags

Of the two, the flags are the earlier. They were modeled on UNIX® command-line parameters and thus are one- or two-character sequences. The existing flags and their meanings (excluding deprecated flags) are:

Table E–1: Existing Flags

Flag	Meaning	Default
b	Includes subclasses and classes that reference the current class in SQL usage.	
c	Compiles the class definitions after loading.	
d	Display. Flag set by default.	X
e	Deletes the extent definition that describes the global storage used by the extent, and deletes the data.	
h	Shows hidden classes.	
i	Validates XML export format against schema on Load. Flag set by default.	X
k	Keep source. When this flag is set, source code of generated routines will be kept.	
l	Locks classes while compiling. Flag set by default.	X
p	Includes classes whose names begin with the "%" character.	
r	Recursive. Compiles all the classes that are dependency predecessors.	
s	System. Processes system messages or application messages.	
u	Update only. Skip compilation of classes that are already up-to-date.	
y	Includes classes that are related to the current class; classes that either reference the current class in SQL usage, or are referenced by the current class in SQL usage.	
o1, o2, o3, o4	Optimization specifiers. Deprecated and ignored by the class compiler.	

Note: Flags may be turned off by preceding them with a dash (-).

Qualifiers

InterSystems IRIS also includes a more extensible set of controls to supplement flags: qualifiers. The flag mechanism remains fully supported. In addition, a qualifier exists whose meaning is the same as each existing flag, and the two may be used in the same specifier.

Since there are so many more qualifiers, they are organized into groups according to the function they control as shown in the following tables. Deprecated qualifiers are not shown.

You can also set these qualifiers for the current namespace (the default) or system-wide using the **SetQualifiers()** method.

Table E–2: Compiler Qualifiers

Flag	Meaning	Default
/autoinclude	Automatically includes any classes that are not up to date that are required to compile this class.	1

Flag	Meaning	Default
/checkschema	Validates imported XML files against the schema definition.	1
/checksysutd	Checks system classes for up-to-dateness.	0
/checkuptodate	Skips classes or expanded classes that are up-to-date.	expandedonly
/compile	Causes classes loaded to be compiled as well.	0
/cspcompileclass	Causes classes created by CSP or CSR load to be compiled.	1
/cspdeployclass	When CSP page loaded deploys the class generated.	0
/csphidden	Classes generated from CSP and CSR compilation are marked as hidden.	1
/defaultowner	When loading classes, if the classowner keyword is not defined, insert the user name specified in this string into the class definition as the class owner. If the value of this string is $USERNAME, insert the current user name into the class definition as the class owner.	—
/defines	Comma separated list of macros to define and, optionally, their values.	—
/deleteextent	Deletes the extent definition that describes the global storage used by the extent, and deletes the data.	0
/diffexport	Does not include any time or platform information in export so the files can be run through diff/merge tools.	0
/display	Alias qualifier for /displaylog and /displayerror.	—
/displayerror	Displays error information.	1
/displaylog	Displays log information.	1
/expand	Alias qualifier for /predecessorclasses, /subclasses and /relatedclasses.	—
/exportgenerated	When exporting classes also exports generated classes where the class generating them is also included.	0
/exportselectivity	Exports the selectivity values stored in the storage definition for this class.	1
/filterin	Alias qualifier for /application, /system and /percent.	—
/generated	Determines when expanding patterns or lists of classes in a package whether to include generated items (routines, classes, etc.).	1
/generatemap	Generates the map file.	1
/importselectivity	0: Do not import selectivity values from the XML file. 1: Import the selectivity values stored in the storage definition when importing XML file. 2: Keep the existing class selectivity values, but if the existing class does not have selectivity specified for something that is present in the XML file then use the selectivity value from the XML file.	2

Flag	Meaning	Default
/includesubpackages	Includes sub-packages.	1
/journal	Journaling enabled while performing a class compile. If the process performing the compile has specifically disabled journaling, /journal defaults to 0, rather than the system-wide default of 1.	1
/keepsource	Keeps the source code of generated routines.	0
/lock	Uses LOCK command while compiling classes.	1
/mapped	Includes classes mapped from another database. If you specifically ask to compile a class from another database (**CompileList()** method), the class will be compiled regardless of the /mapped setting. /mapped only applies when the code is searching for classes, for example, using the **CompileAll()** method.	0
/mergeglobal	If importing a global from XML file merges the global with existing data.	0
/multicompile	Enables multiple users' jobs to compile classes.	1
/percent	Includes percent classes.	0
/predecessorclasses	Recursively includes dependency predecessor classes.	0
/relatedclasses	Recursively includes related classes.	0
/retainstorage	When a class is compiled, the compiler generates a storage definition. By default, if the storage definition is updated the class definition is updated with the updated storage definition. If a new version of the class is loaded from an external source, that updated storage definition is overwritten by whatever is defined in the new version of the class definition. If the new version of the class does not include a storage definition then the existing storage definition is removed. Setting /retainstorage saves the existing storage definition temporarily and restores it after the new version of a class is loaded. If the new version of the class also defines the storage definition, the existing storage definition is overwritten and not retained. If the new version of the class does not define the storage definition, the previous version of the storage definition is restored.	0
/subclasses	Recursively includes sub-classes.	0
/system	Processes system messages or application messages.	0

Table E–3: Export Qualifiers

Flag	Meaning	Default
/checksysutd	Checks system classes for up-to-dateness.	0
/checkuptodate	Checks if classes are up-to-date when projecting.	expandedonly

Flag	Meaning	Default
/createdirs	Creates directories if they do not exist.	0
/cspdeployclass	When CSP page loaded deploys the class generated.	0
/diffexport	Does not include any time or platform information in export so the files can be run through diff/merge tools.	0
/display	Alias qualifier for /displaylog and /displayerror.	—
/displayerror	Displays error information.	1
/displaylog	Displays log information.	1
/documatichost	Host that is used in JavaDoc generation.	—
/documaticnamespace	Namespace that is used in JavaDoc generation.	—
/documaticport	Port that is used in JavaDoc generation.	—
/exportgenerated	When exporting classes also exports generated classes where the class generating them is also included.	0
/exportselectivity	Exports the selectivity values stored in the storage definition for this class.	1
/exportversion	Specifies the InterSystems platform and version of the system that you are exporting to. Specify the platform as iris or cache. Specify the version as a three-part release version, for example 2018.1.1. For example, /exportversion=iris2018.1.1 or /exportversion=cache2018.1.2. IRIS uses the /exportversion value when the exporting and importing systems are not the same InterSystems version. The system handles changes in the export format across versions by removing class keywords that were not implemented in the earlier InterSystems version. Specifying /exportversion does not guarantee compatibility of code between the exporting and importing systems.	The current version of InterSystems IRIS
/generatemap	Generates the map file.	1
/generationtype	Generation mode.	—
/genserialuid	Generates serialVersionUID.	1
/importselectivity	0: do not import selectivity values from the XML file; 1: import the selectivity values stored in the storage definition when importing XML file; 2: keep any existing selectivity values but if a property does not have an existing value then use the selectivity from the XML file.	2
/includesubpackages	Includes sub-packages.	1
/javadoc	Does not create javadoc.	1
/make	Only generates dependency or class if timestamp of last compilation is greater than timestamp of last generation.	0
/mapped	Includes classes mapped from another database.	0

Flag	Meaning	Default
/mergeglobal	If importing a global from XML file merges the global with existing data.	0
/newcollections	Uses native Java collections.	1
/percent	Includes percent classes.	0
/pojo	POJO generation mode.	0
/predecessorclasses	Recursively includes dependency predecessor classes.	0
/primitivedatatypes	Uses Java primitives for %Integer, %Boolean, %BigInt, %Decimal.	0
/projectabstractstream	Projects classes that contain methods whose arguments are abstract streams or whose return type is an abstract stream.	0
/projectbyrefmethodstopojo	Projects byref methods to pojo implementation.	0
/recursive	Exports classes recursively.	1
/relatedclasses	Recursively includes related classes.	0
/skipstorage	Does not export the class storage information.	0
/subclasses	Recursively includes sub-classes.	0
/system	Processes system messages or application messages.	0
/unconditionallyproject	Projects regardless of problems that may prevent code from compiling or working correctly.	0
/usedeepestbase	Uses deepest base in which method or property is defined for method or property definition. If P is defined in A,B, and C and A extends B extends C, then C is a deeper base for P.	0

Table E–4: ShowClassAndObject Qualifiers

Flag	Meaning	Default
/detail	Shows detailed information.	0
/diffexport	Does not include any time or platform information in export so the files can be run through diff/merge tools.	0
/hidden	Shows hidden classes.	0
/system	Processes system messages or application messages.	0

Table E–5: UnitTest

Flag	Meaning	Default
/autoload	Specifies the directory to be auto-loaded.	—
/cleanup	Cleans up globals upon completion of unit test. By default, globals are not cleaned up. Even when set, Analytics globals are not cleaned up.	0

Flag	Meaning	Default
/debug	Causes the Asserts to BREAK if they fail.	0
/delete	Determines if loaded classes should be deleted.	1
/display	Alias qualifier for /displaylog and /displayerror.	—
/displayerror	Displays error information.	1
/displaylog	Displays log information.	1
/findleakedvariables	When enabled, the public variables currently set in the process are recorded before a test is run, then compared with those set after the test is completed. Other than a predetermined set of known context and output variables, such as SQLCODE, any newly defined variables are reported, with their values, as a test failure.	0
/load	Determines if classes should be loaded; if not, then only classnames are obtained from the directories.	1
/loadudl	Loads UDL files produced by Atelier. When set, loads .cls, .mac, .int, and .inc files. /loadudl and /loadxml can be used to limit what types of files are loaded; by default, all files are loaded. UDL files are always loaded as UTF8 so that Unicode characters are loaded correctly.	1
/loadxml	Loads XML files produced by Studio. When set, loads .xml files. /loadudl and /loadxml can be used to limit what types of files are loaded; by default, all files are loaded.	1
/recursive	Determines if tests in subdirectories should run recursively.	1
/run	Determines if tests should run.	1

These qualifiers are given in the qspec as they appear, for example, "/compile/displayerror/subclasses". No spaces are allowed between qualifiers.

Note: Qualifiers may be negated by preceding the qualifier with "no" as in "/nodisplaylog". Alternatively, the value of the qualifier can be specified explicitly as in "/displaylog=0".

Qualifiers For Flags

The following table gives the existing flag and the equivalent qualifier. Some flags map into multiple qualifiers, and also have different meanings when used for differing purposes.

Table E–6: Flag Qualifier Mapping

Flag	Group	Qualifier	Default
b	Compiler	/subclasses	0
c	Compiler	/compile	0
d	Compiler	/displayerror	1
d	Compiler	/displaylog	1
d	UnitTest	/displayerror	1
d	UnitTest	/displaylog	1

Flag	Group	Qualifier	Default
e	Compiler	/deleteextent	0
i	Compiler	/checkschema	1
k	Compiler	/keepsource	0
l	Compiler	/lock	1
p	Compiler	/percent	0
r	Compiler	/predecessorclasses	0
r	Compiler	/includesubpackages	1
s	Compiler	/system	0
y	Compiler	/relatedclasses	0
b	Export	/subclasses	0
d	Export	/displayerror	1
d	Export	/displaylog	1
g	Export	/exportselectivity	0
p	Export	/percent	0
r	Export	/includesubpackages	1
r	Export	/recursive	1
r	Export	/predecessorclasses	0
s	Export	/system	0
y	Export	/relatedclasses	0
h	ShowClassAndObject	/hidden	0
s	ShowClassAndObject	/system	0

Order Of Processing

The *qspec* is processed from left to right. The setting for a given flag or qualifier overrides the current setting whether it came from the environment defaults, or from an occurrence earlier in the *qspec*.

When both flags and qualifiers appear, the flags must be placed before (to the left of) the qualifiers. This means that qualifier settings always override any flag settings.

Examples

The following is an example of using **$SYSTEM** to invoke a method that displays a list of the classes available in the current namespace:

```
DO $SYSTEM.OBJ.ShowClasses()
```

This displays results like the following:

```
%SYS>d $system.OBJ.ShowClasses()
%SYS.APIManagement
%SYS.Audit
%SYS.AuditString
%SYS.ClusterInfo
%SYS.DatabaseQuery
...
SYS.WSMon.wsProcess
SYS.WSMon.wsResource
SYS.WSMon.wsSystem
```

You can list all of the methods for the OBJ class as follows. (By changing the class name, you can use this method to get a list for any system class):

```
DO $SYSTEM.OBJ.Help()
```

To list information about just one method in a class, specify the method name in the Help argument list, as shown in the following example:

```
DO $SYSTEM.OBJ.Help("Load")
```

The following are a few more examples of **$SYSTEM** that invoke methods:

```
DO $SYSTEM.OBJ.Upgrade()
WRITE !,"* * * * * * * * * * * * "
DO $SYSTEM.CSP.DisplayConfig()
WRITE !,"* * * * * * * * * * * * "
WRITE !,$SYSTEM.Version.GetPlatform()
WRITE !,"* * * * * * * * * * * * "
WRITE !,$SYSTEM.SYS.TimeStamp()
```

The following example calls the same methods as the previous example, using the ##class(%SYSTEM) syntax form:

```
DO ##class(%SYSTEM.OBJ).Upgrade()
DO ##class(%SYSTEM.CSP).DisplayConfig()
WRITE !,##class(%SYSTEM.Version).GetPlatform()
WRITE !,##class(%SYSTEM.SYS).TimeStamp()
```

The previous two examples requires that UnknownUser have assigned the %DB_IRISSYS role.

See Also

- $ISOBJECT function
- $ZVERSION special variable
- Working with Registered Objects in *Defining and Using Classes*

$TEST

Contains the truth value resulting from the last command using the timeout option.

```
$TEST
$T
```

Description

$TEST contains the truth value (1 or 0) resulting from the last command with a timeout. **$TEST** is set by the following commands, regardless of whether they are entered at the Terminal prompt or encountered in routine code:

- A timed **JOB** sets **$TEST** to 1 if the attempt to start the new job succeeds before the timeout expires. If the timeout expires, **$TEST** is set to 0.
- A timed **LOCK** sets **$TEST** to 1 if the lock attempt succeeds before the timeout expires. If the timeout expires, **$TEST** is set to 0.
- A timed **OPEN** sets **$TEST** to 1 if the open attempt succeeds before the timeout expires. If the timeout expires, **$TEST** is set to 0.
- A timed **READ** sets **$TEST** to 1 if the read completes before the timeout expires. If the timeout expires, **$TEST** is set to 0.

Issuing these commands without a timeout does not set **$TEST**.

Setting $TEST

You can use the **SET** command to set **$TEST** to a boolean value. A value of 1, or any non-zero numeric value, sets **$TEST**=1. A value of 0, or a non-numeric string value, sets **$TEST**=0.

$TEST can be set by any command or function that can return a logical condition.

Maintaining $TEST

A successful **JOB**, **LOCK**, **OPEN**, or **READ** command that did not specify a timeout does not change the existing value of **$TEST**.

The **DO** command maintains the value of **$TEST** when calling a procedure, but not when calling a subroutine. For details, refer to the DO command.

The **ZBREAK** command maintains the value of **$TEST** when calling *execute_code*. For details, refer to the ZBREAK command.

Example

The following code performs a timed read and uses **$TEST** to test for completion of the read.

```
   READ !,"Type a letter: ",a#1:10
   IF $TEST { DO Success(a) }
   ELSE { DO TimedOut }
Success(val)
   WRITE !,"Received data: ",val
TimedOut()
   WRITE !,"Timed out"
```

Notes

Operations That Do Not Set $TEST

JOB, **LOCK**, **OPEN**, and **READ** commands without a timeout have no effect on **$TEST**. Postconditional expressions also have no effect on **$TEST**.

The block-oriented **IF** command does not use **$TEST** in any way.

Unsuccessful Timed Operations

InterSystems IRIS does not produce an error message after an unsuccessful timed operation. Your application must check **$TEST** and then produce an appropriate message.

See Also

- JOB command
- LOCK command
- OPEN command
- READ command

$THIS

Contains the current class context.

```
$THIS
```

Description

$THIS contains the current class context. The class context for an instance method is the current object reference (OREF). The class context for a class method is the current classname as a string value. For example, if you issue the command `DO ..method()` or `SET ..property = value` from within a class method, the .. context is resolved using the current value of **$THIS**. When making a reference within an object instance, the relative dot syntax (..) is preferred.

$THIS is commonly used when you are within an object instance and you call a function that is on another object. In this circumstance, you can use **$THIS** to pass the current class context to that function, so that it can return a value to your current object instance.

When **$THIS** does not contain a valid object reference, InterSystems IRIS returns a <NO CURRENT OBJECT> error.

$THIS can be used in the contexts such as the following:

```
SET x = ##class(otherclassname).method($THIS)

DO ##class(superclass)$THIS.method(args)
```

This special variable cannot be set to a value using the **SET** command. Attempting to do so results in a <FUNCTION> error.

For further details, refer to "$this Syntax" in Object-specific ObjectScript Features chapter of *Defining and Using Classes*. For information on OREFs, see "OREF Basics" in *Defining and Using Classes*.

See Also

- $CLASSNAME function

$THROWOBJ

Contains the OREF from an unsuccessful THROW.

```
$THROWOBJ
```

Description

$THROWOBJ contains the object reference (OREF) thrown by the most recent unsuccessful **THROW** operation. InterSystems IRIS writes an OREF to **$THROWOBJ** when it issues a <THROW> error. Commonly, this occurs when attempting to issue a **THROW** when not inside a **TRY** or **CATCH** block.

A successful **THROW** operation resets **$THROWOBJ** to the empty string.

For information on **TRY**, **THROW**, and **CATCH**, see "The TRY-CATCH Mechanism" in the "Error Processing" chapter of *Using ObjectScript*.

For information on OREFs, see "OREF Basics" in *Defining and Using Classes*.

Setting $THROWOBJ

You can also explicitly reset **$THROWOBJ** as follows:

```
SET $THROWOBJ=""
```

$THROWOBJ cannot be set to any value other than the empty string using the **SET** command. Attempting to do so results in a <ILLEGAL VALUE> error.

See Also

- THROW command
- Error Processing in *Using ObjectScript*

$TLEVEL

Contains the current nesting level for transaction processing.

```
$TLEVEL
$TL
```

Description

$TLEVEL contains the current transaction level, the number of nested open transactions. The number of **TSTART** commands issued determines the transaction level.

- Each TSTART increments **$TLEVEL** by 1.
- Each TCOMMIT decrements **$TLEVEL** by 1.
- Each TROLLBACK 1 decrements **$TLEVEL** by 1.
- A TROLLBACK resets **$TLEVEL** to 0.

A **$TLEVEL** of 0 cannot be decremented. Issuing a **TROLLBACK** (or **TROLLBACK 1**) when **$TLEVEL**=0 performs no operation. Issuing a **TCOMMIT** when **$TLEVEL**=0 results in a <COMMAND> error.

The maximum number of transaction levels is 255. Attempting to exceed 255 transaction levels generates a <TRANSACTION LEVEL> error.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

SQL and $TLEVEL

$TLEVEL is also set by SQL transaction statements as follows:

- An initial START TRANSACTION sets **$TLEVEL** to 1. Additional **START TRANSACTION** statements have no effect on **$TLEVEL**.
- Each SAVEPOINT statement increments **$TLEVEL** by 1.
- A ROLLBACK TO SAVEPOINT pointname statement decrements **$TLEVEL**. The amount of decrement depends on the savepoint specified.
- A COMMIT resets **$TLEVEL** to 0.
- A ROLLBACK resets **$TLEVEL** to 0.

Despite their shared use of **$TLEVEL**, ObjectScript transaction processing differs from, and is incompatible with, SQL transaction processing. An application should not attempt to mix the two types of transaction processing statements within the same transaction.

Transaction Level and the Terminal Prompt

By default, if **$TLEVEL** is greater than 0 at the conclusion of a command line or program executed from the Terminal prompt, the current transaction level is displayed as a Terminal prompt prefix.

- When **$TLEVEL**=0, the Terminal prompt displays the namespace name (by default). For example, `USER>`
- When **$TLEVEL**>0, the Terminal prompt displays the TL*n*: prefix before the namespace name, *n* being an integer 1 through 255. For example, `TL4:USER>`.

This Terminal prompt display is configurable, as described in ZNSPACE.

The SQL Shell prompt does not display the current transaction level. Upon exiting the SQL Shell the current **$TLEVEL** value is displayed at the Terminal prompt. This can including transaction levels established before entering the SQL Shell and transaction level changes that occurred while in the SQL Shell.

Examples

The following example shows that each **TSTART** increments **$TLEVEL** and each **TCOMMIT** decrements **$TLEVEL**:

```
WRITE !,"transaction level ",$TLEVEL  // 0
TSTART
WRITE !,"transaction level ",$TLEVEL  // 1
TSTART
WRITE !,"transaction level ",$TLEVEL  // 2
TCOMMIT
WRITE !,"transaction level ",$TLEVEL  // 1
TCOMMIT
WRITE !,"transaction level ",$TLEVEL  // 0
```

The following example shows that repeated invocations of **TSTART** increment **$TLEVEL**, and **TROLLBACK 1** decrements **$TLEVEL**.

```
WRITE !,"transaction level ",$TLEVEL  // 0
TSTART
WRITE !,"transaction level ",$TLEVEL  // 1
TSTART
WRITE !,"transaction level ",$TLEVEL  // 2
TROLLBACK 1
WRITE !,"transaction level ",$TLEVEL  // 1
```

The following example shows that repeated invocations of **TSTART** increment **$TLEVEL**, and **TROLLBACK** resets **$TLEVEL** to 0.

```
WRITE !,"transaction level ",$TLEVEL  // 0
TSTART
TSTART
TSTART
WRITE !,"transaction level ",$TLEVEL  // 3
TROLLBACK
WRITE !,"transaction level ",$TLEVEL  // 0
```

The following example shows that if **$TLEVEL** is 0, **TROLLBACK** commands have no effect:

```
WRITE !,"transaction level ",$TLEVEL  // 0
TROLLBACK
WRITE !,"transaction level ",$TLEVEL  // 0
TROLLBACK 1
WRITE !,"transaction level ",$TLEVEL  // 0
TROLLBACK
WRITE !,"transaction level ",$TLEVEL  // 0
```

See Also

- TCOMMIT command
- TROLLBACK command
- TSTART command
- Using ObjectScript for Transaction Processing in *Using ObjectScript*

$USERNAME

Contains the username for the current process.

```
$USERNAME
```

Description

$USERNAME contains the username for the current process. This can be in one of two forms:

- The name of the current user; for example: `Mary`. This value is returned if multiple security domains are not allowed.
- The name and system address of the current user; for example: `Mary@jupiter`. This value is returned if multiple security domains are allowed.

To allow multiple security domains, go to the Management Portal, select **System Administration**, **Security**, **System Security**, **System-wide Security Parameters**. Select the **Allow multiple security domains** check box. Changes to this setting apply to new invoked processes; changing it does not affect the value returned by the current process.

You cannot use the **SET** command or the **NEW** command to modify this value. However, **NEW $ROLES** also stacks the current **$USERNAME** value.

Commonly, the **$USERNAME** value is the username specified at connection time. However, if unauthenticated access is permitted, a user terminal or an ODBC client may connect to InterSystems IRIS without specifying a username. In this case, **$USERNAME** contains the string “UnknownUser”.

When a process is created using the JOB command, it inherits the same **$USERNAME** and **$ROLES** values as its parent process.

A username can be created using the SQL **CREATE USER** statement and deleted using the SQL **DROP USER** statement. A user password can be changed using the SQL **ALTER USER** statement. A user can have roles assigned to it, either by using the SQL **GRANT** statement, or by using system utilities to add a role to the user. You can access the list of roles assigned to the current process with the **$ROLES** special variable. A role can be revoked from a user using the SQL **REVOKE** statement.

$USERNAME is used in InterSystems SQL as the USER, CURRENT_USER, and SESSION_USER default field values.

You can return the username for the current process, or for a specified process, by invoking the **$SYSTEM.Process.UserName()** method.

Examples

The following example returns the username for the current process.

```
WRITE $USERNAME
```

The following example returns the domain name for the current process.

```
WRITE $PIECE($USERNAME,"@",2)
```

See Also

- ObjectScript $ROLES special variable
- InterSystems SQL: CREATE TABLE CREATE USER DROP USER ALTER USER GRANT REVOKE %CHECKPRIV

$X

Contains the current horizontal position of the cursor.

```
$X
```

Description

$X contains the current horizontal position of the cursor. As characters are written to a device, InterSystems IRIS updates **$X** to reflect the horizontal cursor position.

Each printable character that is output increments **$X** by 1. A carriage return (ASCII 13) or form feed (ASCII 12) resets **$X** to 0 (zero).

$X is a 16-bit unsigned integer. **$X** wraps to 0 when its value reaches 16384 (the two remaining bits are used for Japanese pitch encoding).

You can use the **SET** command to give a value to **$X** and **$Y**. For example, you may use special escape sequences that alter the physical cursor position without updating the **$X** and **$Y** values. In this case, use **SET** to assign the correct values to **$X** and **$Y** after you use the escape sequences.

Notes

NLS Character Mapping

The National Language Support (NLS) utility $X/$Y tab defines the **$X** and **$Y** cursor movement characters for the current locale. For further details, refer to the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$X with Terminal I/O

The following table shows the effects of different characters on **$X**.

Echoed Character	ASCII Code	Effect on $X
<FORM FEED>	12	$X=0
<RETURN>	13	$X=0
<LINE FEED>	10	$X=$X
<BACKSPACE>	8	$X=$X-1
<TAB>	9	$X=$X+1
Any printable ASCII character	32-126	$X=$X+1
Nonprintable characters (such as escape sequences)	127-255	See Using ObjectScript.

The S(ecret) protocol of the **OPEN** and **USE** commands turns off echoing. It also prevents **$X** from being changed during input, so it indicates the true cursor position.

WRITE $CHAR() changes **$X**. **WRITE *** does not change **$X**. For example, `WRITE $X,"/",$CHAR(8),$X` performs the backspace (deleting the / character) and resets **$X** accordingly, returning 01. In contrast, `WRITE $X,"/",*8,$X` performs the backspace (deleting the / character) but does not reset **$X**; it returns 02. (See the WRITE command for further details.)

Using **WRITE ***, you can send a control sequence to your terminal and **$X** will still reflect the true cursor position. Since some control sequences do move the cursor, you can use the **SET** command to set **$X** directly. For example, the following commands move the cursor to column 20 and line 10 on a Digital VT100 terminal (or equivalent) and set **$X** and **$Y** accordingly:

```
SET dy=10,dx=20
WRITE *27,*91,dy+1,*59,dx+1,*72
SET $Y=dy,$X=dx
```

ANSI standard control sequences (such as escape sequences) that the device acts on but does not output can produce a discrepancy between the **$X** and **$Y** values and the true cursor position. To avoid this problem use the **WRITE *** (integer expression) syntax and specify the ASCII value of each character in the string. For example, instead of using:

```
WRITE !,$CHAR(27)_"[1m"
WRITE !,$X
```

use this equivalent form:

```
WRITE !,*27,*91,*49,*109
WRITE !,$X
```

As a rule, after any escape sequence that explicitly moves the cursor, you should update **$X** and **$Y** to reflect the actual cursor position.

You can set how **$X** handles escape sequences for the current process using the **DX()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *DX* property of the Config.Miscellaneous class.

$X with TCP and Interprocess Communication

When you use the **WRITE** command to send data to either a client or server TCP device, InterSystems IRIS first stores the data in a buffer. It also updates **$X** to reflect the number of characters in the buffer. It does not include the ASCII characters <RETURN> and <LINE FEED> in this count because they are considered to be part of the record.

If you flush the **$X** buffer with the **WRITE !** command, InterSystems IRIS resets **$X** to 0 and increments the **$Y** value by 1. If you flush the **$X** and **$Y** buffers with the **WRITE #** command, InterSystems IRIS writes the ASCII character <FORM FEED> as a separate record and resets both **$X** and **$Y** to 0.

See Also

- WRITE command
- $Y special variable
- I/O Devices and Commands in *I/O Device Guide*
- Terminal I/O in *I/O Device Guide*
- Local Interprocess Communication in *I/O Device Guide*
- TCP Communication in *I/O Device Guide*

$Y

Contains the current vertical position of the cursor.

```
$Y
```

Description

$Y contains the current vertical position of the cursor. As characters are written to a device, InterSystems IRIS updates **$Y** to reflect the vertical cursor position.

Each line feed (newline) character (ASCII 10) that is output increments **$Y** by 1. A form feed character (ASCII 12) resets **$Y** to 0.

$Y is a 16-bit unsigned integer. **$Y** wraps to 0 when its value reaches 65536. In other words, if **$Y** is 65535, the next output character resets it to 0.

You can use the **SET** command to give a value to **$X** and **$Y**. For example, you may use special escape sequences that alter the physical cursor position without updating the **$X** and **$Y** values. In this case, use **SET** to assign the correct values to **$X** and **$Y** after you use the escape sequences.

Notes

NLS Character Mapping

The National Language Support (NLS) utility $X/$Y tab defines the **$X** and **$Y** cursor movement characters for the current locale. For further details, refer to the section on "System Classes for National Language Support" in *Specialized System Tools and Utilities*.

$Y with Terminal I/O

The following table shows the effects of different characters on **$Y**.

Echoed Character	ASCII Code	Effect on $Y
<FORM FEED>	12	$Y=0
<RETURN>	13	$Y=$Y
<LINE FEED>	10	$Y=$Y+1
<BACKSPACE>	8	$Y=$Y
<TAB>	9	$Y=$Y
Any printable ASCII character	32-126	$Y=$Y

The S(ecret) protocol of the **OPEN** and **USE** commands turns off echoing. It also prevents **$Y** from being changed during input, so it indicates the true cursor position.

A **WRITE $CHAR()** that changes vertical position also changes **$Y**. A **WRITE *** that changes vertical position does not change **$Y**. For example, `WRITE $Y,$CHAR(10),$Y` performs the line feed and increments **$Y**. In contrast, `WRITE $Y,*10,$Y` performs the line feed but does not increment **$Y**. (See the WRITE command for further details.)

Because **WRITE *** does not change **$Y**, you can send a control sequence to your terminal and **$Y** will still reflect the true cursor position. Since some control sequences do move the cursor, you can use the **SET** command to set **$Y** directly. For example, the following commands move the cursor to column 20 and line 10 on a VT100-type terminal and set **$X** and **$Y** accordingly:

```
SET dy=10,dx=20
WRITE *27,*91,dy+1,*59,dx+1,*72
SET $Y=dy,$X=dx
```

ANSI standard control sequences (such as escape sequences) that the device acts on but does not output can produce a discrepancy between the **$X** and **$Y** values and the true cursor position. To avoid this problem, use the **WRITE *** statement and specify the ASCII value of each character in the string. For example, instead of using the following code:

```
WRITE $CHAR(27)_"[1m"
```

use this equivalent form:

```
WRITE *27,*91,*49,*109
```

As a rule, after any escape sequence that explicitly moves the cursor, you should update **$X** and **$Y** to reflect the actual cursor position.

See Also

- $X special variable
- I/O Devices and Commands in *I/O Device Guide*
- Terminal I/O in *I/O Device Guide*
- Interprocess Communication in *I/O Device Guide*

$ZA

Contains the status of the last READ on the current device.

```
$ZA
```

Description

$ZA contains the status of the last **READ** on the current device.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

$ZA with Terminal I/O

$ZA is implemented as a sequence of bit flags, with each bit indicating a specific piece of information. The following table shows the possible values, their meanings, and how to test them using the modulo (#) and integer divide (\) operators:

Bit	Test	Meaning
0	$ZA#2	A <CTRL-C> arrived, whether or not breaks were enabled.
1	$ZA\2#2	The **READ** timed out.
2	$ZA\4#2	I/O error.
8	$ZA\256#2	InterSystems IRIS detected an invalid escape sequence.
9	$ZA\512#2	The hardware detected a parity or framing error.
11	$ZA\2048#2	The process is disconnected from its principal device.
12	$ZA\4096#2	For COM ports: CTS (Clear To Send). A signal sent from the modem to its computer indicating that transmission can proceed. For TCP devices: the device is functioning in Server mode.
13	$ZA\8192#2	For COM ports: DSR (Data Set Ready). A signal sent from the modem to its computer indicating that it is ready to operate. For TCP devices: the device is currently in the Connected state talking to a remote host.
14	$ZA\16384#2	Ring set if TRUE.
15	$ZA\32768#2	Carrier detect set if TRUE.
16	$ZA\65536#2	CE_BREAK COM port error state.
17	$ZA\131072#2	CE_FRAME COM port error state.
18	$ZA\262144#2	CE_IOE COM port error state.
19	$ZA\524288#2	CE_OVERRUN COM port error state.
20	$ZA\1048576#2	CE_RXPARITY COM port error state.
21	$ZA\2097152#2	CE_TXFULL COM port error state.
22	$ZA\4194304#2	TXHOLD COM port error state. Set if any of the following fields are true in the error mask returned by ClearCommError(): fCtsHold, fDsrHold, fRlsdHold, fXoffHold, fXoffSent.
24 & 25	$ZA\16777216#4	InterSystems IRIS requested DTR (Data Terminal Ready) setting: 0=DTR off. 1=DTR=on. 2=DTR handshaking. When set (1), indicates readiness to transmit and receive data.

While many of the conditions that **$ZA** shows are errors, they do not interrupt the program's flow by trapping to **$ZTRAP**. (A <CTRL-C> with breaks enabled traps to **$ZTRAP**.) A program concerned with these errors must check **$ZA** after every **READ**.

COM ports use bits 12 through 15, 24 and 25 to report the status of modem control pins. This can be done regardless of whether InterSystems IRIS modem control checking is on or off for the port. A user can enable or disable **$ZA** error reporting for COM ports by setting the **OPEN** or **USE** command *portstate* parameter (byte 8, to be specific). If error reporting is enabled, the port error state is reported in bits 16 through 22. For further details, see Terminal I/O in *I/O Device Guide*.

You can use the **DisconnectErr()** method of the %SYSTEM.Process class for modem disconnect detection for the current process. The system-wide default behavior can be established by setting the *DisconnectErr* property of the Config.Miscellaneous class.

See Also

- READ command
- $ZB special variable
- $ZTRAP special variable
- I/O Devices and Commands in *I/O Device Guide*
- Terminal I/O in *I/O Device Guide*
- Sequential File I/O in *I/O Device Guide*

$ZB

Contains status information for the current I/O device.

```
$ZB
```

Description

$ZB contains status information specific to the current I/O device following a **READ** operation.

- When reading from a terminal, sequential file, or other character-based I/O device, **$ZB** contains the *terminating* character of the read operation. This can be a terminator character (such as <RETURN>), the final character of the input data if the read operation does not require a terminator character, or the null string if a terminator character is required but was not received (for example, if the read operation timed out).
- When reading from a block-based I/O device **$ZB** contains the number of bytes remaining in the I/O buffer. **$ZB** also contains the number of bytes in the I/O buffer when writing to a block-based I/O device.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

$ZB and **$KEY** can both be used to return the **READ** termination character when reading from a character-based device or file. For character-based reads, these two special variables are very similar, but not identical. For block-based reads and writes use **$ZB**; **$KEY** does not provide support for block-based read and write operations. See $KEY for further details.

End-of-File Behavior

By default, InterSystems IRIS handles an end-of-file on a sequential file by issuing an <ENDOFFILE> error; it does not set **$ZB**. You can configure **$ZB** end-of-file behavior so that when an end-of-file is encountered, InterSystems IRIS does not issue an error, but sets **$ZB** to "" (the null string), and sets **$ZEOF** to -1.

To configure end-of-file handling, go to the Management Portal, select **System Administration**, **Configuration**, **Additional Settings**, **Compatibility**. View and edit the current setting of **SetZEOF**. When set to “true”, InterSystems IRIS sets **$ZB** to "" (the null string), and sets **$ZEOF** to -1. The default is “false”.

You can control end-of-file handling for the current process using the **SetZEOF()** method of the %SYSTEM.Process class. The system-wide default behavior can be established by setting the *SetZEOF* property of the Config.Miscellaneous class.

Reading from a Terminal or File

$ZB contains the terminating character (or character sequence) from a read operation involving a terminal, sequential file, or other character-based I/O device. **$ZB** can contain any of the following:

- A termination character, such as a carriage return.
- An escape sequence (up to 16 characters).
- The *n*th character in a fixed-length **READ** *x#n*. (In this case, the **$KEY** special variable returns the null string.)
- The single character of **READ** **x*.
- A null string ("") after a timed **READ** expires.

For example, consider the following variable-length read with a five-second timeout:

```
Zbread
  READ !,"Enter number:",num:5
  WRITE !, num
  WRITE !, $ASCII($ZB)
  QUIT
```

If the user types 123 at the **READ** prompt and presses <RETURN>, InterSystems IRIS stores 123 in the *num* variable and stores <RETURN> (ASCII decimal code 13, hexadecimal 0D) in **$ZB**. If the **READ** times out, **$ZB** contains the null string; **$ASCII("")** returns a value of –1.

$ZB on the Command Line

When issuing commands interactively from the Terminal command line, you press <RETURN> to issue each command line. The **$ZB** and **$KEY** special variables record this command line terminator character. Therefore, when using **$ZB** or **$KEY** to return the termination status of a read operation, you must set a variable as part of the same command line.

For example, if you issue the command:

```
>READ x:10
```

from the command line, then check **$ZB** it will *not* contain the results of the read operation; it will contain the <RETURN> character that executed the command line. To return the results of the read operation, set a local variable with **$ZB** in the same command line, as follows:

```
>READ x:10 SET rzb=$ZB
```

This preserves the value of **$ZB** set by the read operation. To display this read operation value, issue either of the following command line statements:

```
>WRITE $ASCII(rzb)
   ; returns -1 for null string (time out),
   ; returns ASCII decimal value for terminator character
>ZZDUMP rkey
   ; returns blank line for null string (time out)
   ; returns hexadecimal value for terminator character
```

See Also

- READ command
- WRITE command
- $KEY special variable
- $ZA special variable
- $ZEOF special variable
- I/O Devices and Commands in *I/O Device Guide*
- Terminal I/O in *I/O Device Guide*
- Sequential File I/O in *I/O Device Guide*
- The Spool Device in *I/O Device Guide*

$ZCHILD

Contains the ID of the last child process.

```
$ZCHILD
$ZC
```

Description

$ZCHILD contains the ID of the last child process (the PID) that the current process created with the **JOB** command or the $ZF(-100) function. If your process has not used **JOB** or **$ZF(-100)** to create a child process, **$ZCHILD** returns 0 (zero).

$ZCHILD being set does not mean that the job was successfully started. It only means that the process was created and the parameters were passed successfully.

For example, if you use **JOB** to spawn a routine that does not exist, both **$TEST** and **$ZCHILD** report that the **JOB** command succeeded, although that new job immediately dies with a <NOROUTINE> error.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

See Also

- JOB command
- $ZF(-100) function
- ^$JOB structured system variable
- $JOB special variable
- $TEST special variable
- $ZPARENT special variable

$ZEOF

Contains flag indicating whether end-of-file has been reached.

```
$ZEOF
```

Description

Following each sequential file **READ**, InterSystems IRIS sets the **$ZEOF** special variable to indicate whether or not the end of the file has been reached.

InterSystems IRIS sets **$ZEOF** to the file status of the last device used. For example, if you read from a sequential file then write to the principal device, InterSystems IRIS resets **$ZEOF** from the sequential file end-of-file status to the principal device status. Therefore, you should check the **$ZEOF** value (and, if necessary, copy it to a variable) immediately after a sequential file **READ**.

InterSystems IRIS sets **$ZEOF** to the following values:

–1 End-of-file reached

0 Not at end-of-file

To use this feature, you must disable the <ENDOFFILE> error for sequential files.

- To disable this for the current process, call the **SetZEOF()** method of the %SYSTEM.Process class.
- To disable this system-wide, either set the *SetZEOF* property of the Config.Miscellaneous class, or go to the Management Portal and select **System Administration**, **Configuration**, **Additional Settings**, **Compatibility**. View and edit the current setting of **SetZEOF**. This option controls the behavior when InterSystems IRIS encounters an unexpected end-of-file when reading a sequential file. When set to “true”, InterSystems IRIS sets the **$ZEOF** special variable to indicate that you have reached the end of the file. When set to “false”, InterSystems IRIS issues an <ENDOFFILE> error. The default is “false”.

When the end of a file is reached, rather than issuing an <ENDOFFILE> error, the **READ** will return a null string, set **$ZB**=null and set **$ZEOF**=–1.

$ZEOF does not identify file delimiter characters or I/O errors. **$ZEOF** does not check for proper file termination with file delimiter characters. I/O errors are detected by a **READ** command error, not by **$ZEOF**.

You cannot modify this special variable using the **SET** command. Attempting to do so results in a <SYNTAX> error.

See Also

- $ZB special variable
- Sequential File I/O in *I/O Device Guide*

$ZEOS

Contains end-of-stream status when reading a compressed stream.

```
$ZEOS
```

Description

$ZEOS contains a boolean value that indicates whether the end of an incoming (compressed) stream has been received and processed. If **$ZEOS**=1, an end-of-stream for a compressed data stream has been received. The **$ZEOS** value is only meaningful when stream compression/decompression is active (/GZIP=1). You activate stream compression/decompression by issuing the /GZIP command keyword from an **OPEN** or **USE** command.

You must check the **$ZEOS** value before disabling stream compression/decompression by changing the setting to /GZIP=0. If you issue a **USE** command with /GZIP=0 before the end of a compressed incoming stream has been processed, the **USE** generates a <TRANSLATE> error. If the end of the compressed incoming stream has not been reached (**$ZEOS**=0) you must issue block READ commands until **$ZEOS**=1.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Example

The following example begins with /GZIP=1 (compression enabled). It performs a loop which tests for **$ZEOS**=1, and issues **READ** commands until **$ZEOS**=1. It then can set /GZIP=0 (compression disabled):

```
OPEN dev:/GZIP=1
READ block#length
FOR {QUIT:$ZEOS
     READ x:10 }
USE dev:/GZIP=0
```

See Also

- Sequential File I/O chapter of *I/O Device Guide*
- TCP Client/Server Communication chapter of *I/O Device Guide*
- Terminal I/O chapter of *I/O Device Guide*

$ZERROR

Contains the name and location of the last error.

```
$ZERROR
$ZE
```

Description

$ZERROR contains the name of the most recent error, the location of the most recent error (where applicable), and (for certain error codes) additional information about what caused the error. **$ZERROR** always contains the most recent error for the appropriate language mode.

The **$ZERROR** value is intended for use immediately following an error. Because a **$ZERROR** value may not be preserved across routine calls, users that wish to preserve a **$ZERROR** value for later use should copy it to a variable. It is strongly recommended that users set **$ZERROR** to the null string ("") immediately after use.

The string contained in **$ZERROR** can be in any of the following forms:

```
<error>
<error>entryref
<error> info
<error>entryref info
```

<error>	The error name. The error name is always returned in all capital letters, enclosed in angle brackets. It may contain blank spaces.
entryref	A reference to the line of code in which the error occurred. This consists of the label name and line offset from that label, followed by a ^ and the program name. This *entryref* follows immediately after the closing angle bracket of the error name. When invoking **$ZERROR** from Terminal, this *entryref* information is not meaningful and is therefore not returned. A reference to the routine most recently loaded into the routine buffer using **ZLOAD**.
info	Additional information specific to certain error types (see table below). This information is separated from *<error>* or *<error>entryref* by a blank space. If there are multiple components to *info*, they are separated by a comma.

For example, a program (named zerrortest) contains the following routine (named ZerrorMain) which attempts to write the contents of *fred*, an undefined local variable:

```
ZerrorMain
  TRY {
  SET $ZERROR=""
  WRITE "$ZERROR = ",$ZERROR,!
  WRITE fred }
  CATCH {
  WRITE "$ZERROR = ",$ZCVT($ZERROR,"O","HTML")
  }
```

In the above example, the first **$ZERROR** contains a null string (""), because no errors have occurred since **$ZERROR** was reset to the null string. The attempt to write an undefined variable sets **$ZERROR** and throws it to the **CATCH** block. This **$ZERROR** contains `<UNDEFINED>ZerrorMain+4^zerrortest *fred`, specifying the name of the error, the location, and additional information specific to that type of error. In this case, the additional information is the name of the undefined local variable *fred*; the asterisk prefix indicates that it is a local variable. (Note that `$ZCVT($ZERROR,"O","HTML")` is used in this example because InterSystems IRIS error names are enclosed in angle brackets and this example is run from a web browser.)

An *entryref* can appear as follows:

```
ZerrorMain+4^zerrortest -- 4 line offset from label ZerrorMain in program zerrortest
ZerrorMain^zerrortest -- no offset from label ZerrorMain in program zerrortest; error occurred in the
 label line
+3^zerrortest -- 3 line offset from beginning of program zerrortest; no label precedes the error line
```

The maximum length of the **$ZERROR** value is 512 characters. A value exceeding that length is truncated to 512 characters.

AsSystemError() Method

The **AsSystemError()** method of the %Exception.SystemException class returns the same value as **$ZERROR**. This is shown in the following example:

```
  TRY {
       KILL mylocal
       WRITE mylocal
      }
  CATCH myerr {
       WRITE "AsSystemError is: ",myerr.AsSystemError(),!
       WRITE "$ZERROR is:       ",$ZERROR
      }
```

AsSystemError() is preferable to **$ZERROR** in a **TRY**/**CATCH** exception handling block structure, because **$ZERROR** could be overwritten by an error occurring during exception handling.

Additional Information For Some Errors

When certain types of errors occurs, **$ZERROR** returns the error in the following format:

```
<ERRORCODE>entryref info
```

The *info* component contains additional information about what caused the error. The following table gives a list of errors that include additional info and the format of that information. The error code is separated from the *info* component by a space character.

Error Code	Info Component
<UNDEFINED>	The name of the undefined variable (including any subscripts used). This may be a local variable, a process-private global, a global, or a multidimensional class property. Local variable names are prefixed by an asterisk. Multidimensional property names start with a period to distinguish them from local variable names. You can change InterSystems IRIS behavior to not generate an <UNDEFINED> error when referencing an undefined variable by setting the **%SYSTEM.Process.Undefined()** method.
<SUBSCRIPT>	The subscript reference in error: the line reference (routine and line offset) that generated the error, the subscripted variable, and which subscript level is in error. For a Structured System Variable (SSVN), only the line reference (routine and line offset) is provided. You can change InterSystems IRIS behavior to not generate a <SUBSCRIPT> error when referencing a global variable with a null string subscript by setting the **%SYSTEM.Process.NullSubscripts()** method. Null string subscripts are not permitted for local variables.
<NOROUTINE>	Prefixed by an asterisk, the referenced routine name.
<CLASS DOES NOT EXIST>	Prefixed by an asterisk, the referenced class name.
<PROPERTY DOES NOT EXIST>	Prefixed by an asterisk, the name of the referenced property, followed by a comma separator and the class name it is supposed to be in.
<METHOD DOES NOT EXIST>	Prefixed by an asterisk, the name of the method invoked, followed by a comma separator and the class name it is supposed to be in.
<PROTECT>	The name of the global referenced and the name of the directory containing it, separated by a comma. When attempting to access a dismounted database, specifies the database name.
<THROW>	Prefixed by an asterisk, the object name, followed by the value returned by the **DisplayString()** method.
<COMMAND>	When invoking **TCOMMIT** when not in a transaction, the *info* component is `*NoTransaction`. When invoking a user-defined function that does not return a value, the *info* component is a message that includes the location of the command that should have returned the value.
<DIRECTORY>	Prefixed by an asterisk, the full pathname of the invalid directory.
<FRAMESTACK>	When a <FRAMESTACK> error terminates a process, the <FRAMESTACK> error with additional information is written as a message to mgr/messages.log. The informational message shows the process id (pid) of the terminated process and the line reference (routine and line offset) that generated the error. For example: (pid) 0 <FRAMESTACK> at +13^|"USER"|mytest

The names of variables local to routines (or methods), as well as the names of undefined routines, classes, properties, and methods, are prefixed with an asterisk (*). Process-private globals are identified by their ^|| prefix. Global variables are identified by their ^ (caret) prefix. Class names are presented in their %-prefix form.

The following examples show additional error information specifying the cause of the error. In each case, the specified item does not exist. Note that the *info* component of the generated error is separated from the error name by a blank space. The asterisk (*) indicates a local variable, a class, a property, or a method. The caret (^) indicates a global, and ^|| indicates a process-private global.

Examples of <UNDEFINED> errors:

```
UndefTest ;
   ZNSPACE "SAMPLES"
   KILL x,abc(2)
   KILL ^xyz(1,1),^|"USER"|xyz(1,2)
   KILL ^||ppg(1),^||ppg(2)
   TRY {WRITE x }             // undefined local variable
     CATCH {WRITE $ZERROR,! }
   TRY {WRITE abc(2)}         // undefined subscripted local variable
     CATCH {WRITE $ZERROR,! }
   TRY {WRITE ^xyz(1,1) }          // undefined global
     CATCH {WRITE $ZERROR,! }
   TRY {WRITE ^|"USER"|xyz(1,2) }  // undefined global in another namespace
     CATCH {WRITE $ZERROR,! }
   TRY {WRITE ^||ppg(1) }     // undefined process-private global
     CATCH {WRITE $ZERROR,! }
   TRY {WRITE ^|"^"|ppg(2) }  // undefined process-private global
     CATCH {WRITE $ZERROR,! }

<UNDEFINED>UndefTest+5^MyProg *x
<UNDEFINED>UndefTest+7^MyProg *abc(2)
<UNDEFINED>UndefTest+9^MyProg ^xyz(1,1)
<UNDEFINED>UndefTest+11^MyProg ^xyz(1,2)
<UNDEFINED>UndefTest+13^MyProg ^||ppg(1)
<UNDEFINED>UndefTest+15^MyProg ^||ppg(2)
```

Examples of <SUBSCRIPT> errors:

```
SubscriptTest ;
   DO $SYSTEM.Process.NullSubscripts(0)
   KILL abc,xyz
   TRY {SET abc(1,2,3,"")=123 }
   CATCH {WRITE $ZERROR,! }
   TRY {SET xyz(1,$JUSTIFY(1,1000))=1}
   CATCH {WRITE $ZERROR,! }

<SUBSCRIPT>SubscriptTest+3^MyProg *abc() Subscript 4 is ""
<SUBSCRIPT>SubscriptTest+5^MyProg *xyz() Subscript 2 > 511 chars
```

Examples of <NOROUTINE> errors:

```
NoRoutineTest ;
   KILL ^NotThere
   TRY {DO ^NotThere }
     CATCH {WRITE $ZERROR,! }
   TRY {JOB ^NotThere }
     CATCH {WRITE $ZERROR,! }
   TRY {GOTO ^NotThere }
     CATCH {WRITE $ZERROR,! }

<NOROUTINE>NoRoutineTest+2^MyProg *NotThere
<NOROUTINE>NoRoutineTest+4^MyProg *NotThere
<NOROUTINE>NoRoutineTest+6^MyProg *NotThere
```

Examples of object errors:

```
WRITE $SYSTEM.XXQL.MyMethod()
<CLASS DOES NOT EXIST> *%SYSTEM.XXQL

DO $SYSTEM.SQL.MyMethod()
<METHOD DOES NOT EXIST> *MyMethod,%SYSTEM.SQL

SET x=##class(%SQL.Statement).%New()
WRITE x.MyProp
<PROPERTY DOES NOT EXIST> *MyProp,%SQL.Statement
```

Example of <PROTECT> error (on Windows):

```
   // user does not have access privileges for %SYS namespace
   SET x=^|"%SYS"|var
  <PROTECT> ^var,c:\intersystems\iris\mgr\
```

Example of a <COMMAND> error when invoking a user-defined function. In this example, the MyFunc **QUIT** command does not return a value. This generates a <COMMAND> error with the *entryref* specifying the location of the call to $$MyFunc, and the *info* message specifying the location of the **QUIT** command:

```
Main
   TRY {
     KILL x
     SET x=$$MyFunc(7,10)
     WRITE "returned value is ",x,!
     RETURN
   }
   CATCH {  WRITE "$ZERROR = ",$ZCVT($ZERROR,"O","HTML"),!
   }
MyFunc(a,b)
   SET c=a+b
   QUIT
```

The same <COMMAND> error when invoking the function as a procedure with the PUBLIC keyword:

```
Main
   TRY {
     KILL x
     SET x=$$MyFunc(7,10)
     WRITE "returned value is ",x,!
     RETURN
   }
   CATCH {  WRITE "$ZERROR = ",$ZCVT($ZERROR,"O","HTML"),!
   }
MyFunc(a,b) PUBLIC {
   SET c=a+b
   QUIT }
```

Example of <DIRECTORY> error (on Windows):

```
  TRY { SET prev=$SYSTEM.Process.CurrentDirectory("bogusdir")
        WRITE "previous directory: ",prev,!
        RETURN }
  CATCH { WRITE "$ZERROR = ",$ZCVT($ZERROR,"O","HTML"),!
          QUIT }
```

Notes

ZLOAD and Error Messages

Following a **ZLOAD** operation, the name of the routine loaded into the routine buffer appears in the *entryref* portion of subsequent error messages. This persists for the duration of the process, or until removed using **ZREMOVE**, or removed or replaced by another **ZLOAD**. The following example shows this display of the contents of the routine buffer:

```
SAMPLES>ZLOAD Sample.Person.1
SAMPLES>WRITE 6/0
<DIVIDE>^Sample.Person.1
SAMPLES>WRITE fred
<UNDEFINED>^Sample.Person.1 *fred
SAMPLES>WRITE ^fred
<UNDEFINED>^Sample.Person.1 ^fred
SAMPLES>ZNAME "USER"
USER>WRITE 7/0
<DIVIDE>^Sample.Person.1
USER>ZREMOVE
USER>WRITE ^fred
<UNDEFINED> ^fred
```

$ZERROR and the Program Stack

The <error> portion of the **$ZERROR** string contains the most recent error message. The contents of the *entryref* portion of the **$ZERROR** string reflect the stack level of the most recent error. The following terminal session attempts to call the nonsense command GOBBLEDEGOOK, resulting in a <SYNTAX> error. It also runs ZerrorMain (specified above), resulting in the **$ZERROR** value <UNDEFINED>. Subsequent **$ZERROR** values during this terminal session reflect this program call, as shown in the following:

```
USER>gobbledegook
USER>WRITE $ZERROR
<SYNTAX>
USER>DO ^zerrortest
USER>WRITE $ZERROR
<UNDEFINED>ZerrorMain+2^zerrortest *FRED
USER 2d0>gobbledegook
USER 2d0>WRITE $ZERROR
<SYNTAX>^zerrortest
USER 2d0>QUIT
USER>WRITE $ZERROR
<SYNTAX>^zerrortest
USER>gobbledegook
USER>WRITE $ZERROR
<SYNTAX>
```

$ZERROR Actions when $ZTRAP is Set

When an error occurs and **$ZTRAP** is set, InterSystems IRIS returns the error message in **$ZERROR** and branches to the error-trap handler specified for **$ZTRAP**. (For a list of the possible error texts, refer to System Error Messages in *InterSystems IRIS Error Reference*.)

Setting $ZERROR

You can set **$ZERROR** with the **SET** command to a value of up to 512 characters only in InterSystems IRIS mode. Values longer than 512 characters are truncated to 512.

Resetting **$ZERROR** to the null string ("") is strongly recommended following error processing.

See Also

- CATCH command
- ZTRAP command
- $ECODE special variable
- $ZTRAP special variable
- Error Handling chapter in *Using ObjectScript*
- System Error Messages in *InterSystems IRIS Error Reference*

$ZHOROLOG

Contains the number of seconds elapsed since InterSystems IRIS startup.

```
$ZHOROLOG
$ZH
```

Description

$ZHOROLOG contains the number of seconds that have elapsed since the most recent InterSystems IRIS startup. This is a count, which is independent of clock changes and day boundaries. The value is expressed as a floating point number, indicating seconds and fractions of a second. The number of decimal digits is platform-dependent. **$ZHOROLOG** truncates trailing zeros in this fractional portion.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Note: Because of a limitation in the Windows operating system, putting your Windows system into hibernate or standby mode may cause **$ZHOROLOG** to return unpredictable values. This problem does not affect **$HOROLOG** or **$ZTIMESTAMP** values.

Examples

This example outputs the current **$ZHOROLOG** value.

```
   WRITE $ZHOROLOG
```

returns a value such as: `1036526.244932`.

The following example shows how you might use **$ZHOROLOG** to time events and do benchmarks. This example times an application through 100 executions, then finds the average runtime.

```
Cycletime
  SET start=$ZHOROLOG
    FOR i=1:1:100 { DO Myapp }
  SET end=$ZHOROLOG
  WRITE !,"Average run was ",(end-start)/100," seconds."
   QUIT
Myapp
   WRITE !,"executing my application"
  ; application code goes here
   QUIT
```

See Also

- $HOROLOG special variable
- $ZTIMESTAMP special variable

$ZIO

Contains information about the current terminal I/O device.

```
$ZIO
$ZI
```

Description

$ZIO contains information about the current I/O device.

For a terminal device that is a Terminal, **$ZIO** contains the string `TRM:`. If the current terminal device is connected remotely, **$ZIO** contains information about the remote connection.

For a terminal device connected through TELNET, **$ZIO** contains the following: *host*|*port*:

host	The remote host IP address, in either IPv4 format:*nnn.nnn.nnn.nnn*, where *nnn* is a decimal number, or in IPv6 format: *h:h:h:h:h:h:h:h*, where *h* is a hexadecimal number. Further details on IPv4 and IPv6 formats can be found in the section "Use of IPv6 Addressing" in the chapter "Server Configuration Options" in the *Orientation Guide for Server-Side Programming*.
port	The remote IP port number.

These two values are separated by a vertical bar character. For example, `127.0.0.1|23`. For further information, refer to the %Library.NetworkAddress class, a subclass of the data type class %Library.String.

If the current device is not a terminal:

- If a file, **$ZIO** contains the full canonical pathname of the file.
- If not a file, **$ZIO** contains the null string.

The following example returns the current device information:

```
SET x=$CASE($ZIO,"TRM:":"a terminal",
             "CON:":"a console",
             "":"neither terminal nor file")
WRITE "The current device is ",x
```

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

See Also

- $IO special variable
- $PRINCIPAL special variable
- I/O Devices and Commands in *I/O Device Guide*
- Terminal I/O in *I/O Device Guide*

$ZJOB

Contains job status information.

```
$ZJOB
$ZJ
```

Description

$ZJOB contains a number in which each bit represents one particular aspect of the job's status. **$ZJOB** returns an integer that consists of the total of the set status bits. For example, if **$ZJOB** = 5, this means that the 1 bit and the 4 bit are set.

To test individual **$ZJOB** bit settings, you can use the integer divide (\) and modulo (#) operators. For example, `$ZJOB\x#2`, where *x* is the bit number. The following table shows the layout of the bits (by bit positional value), their settings and meanings:

Bit	Set to	Meaning
1	1	Job started from the Terminal prompt.
	0	Job started from a routine.
2	1	Job started by the **JOB** command.
	0	Job started by signing on either at the Terminal prompt or from a routine.
4	1	<INTERRUPT> enabled. A **CTRL-C** can interrupt a running program. Refer to BREAK flag for details.
	0	<INTERRUPT> disabled except for terminal lines for which <INTERRUPT> has been explicitly enabled by **OPEN** or **USE** commands.
8	1	<INTERRUPT> received and pending.
	0	<INTERRUPT> not received. The value 8 is cleared by the **OPEN** and **USE** commands and by an error trap caused by a **CTRL-C**.
1024	1	Journaling is disabled regardless of other conditions.
	0	Journaling is enabled for this job if other conditions indicate journaling.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Examples

The following example returns **$ZJOB** as an integer:

```
WRITE $ZJOB
```

The following example returns each **$ZJOB** bit value:

```
WRITE "   bit 1=",$ZJOB\1#2,!
WRITE "   bit 2=",$ZJOB\2#2,!
WRITE "   bit 4=",$ZJOB\4#2,!
WRITE "   bit 8=",$ZJOB\8#2,!
WRITE "bit 1024=",$ZJOB\1024#2
```

Bit 1 can also be returned using `$ZJOB#2`.

See Also

- JOB command

- $JOB special variable

$ZMODE

Contains current I/O device OPEN parameters.

```
$ZMODE
$ZM
```

Description

$ZMODE contains the parameters specified with the **OPEN** or **USE** command for the current device. The string returned contains the parameters used to open the current I/O device in canonical form. These parameter values are separated by backslash delimiters. Open parameters like "M" on TCP/IP IO are canonicalized to "PSTE". The "Y" and "K" parameter values are always placed last.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Examples

The following example uses **$ZMODE** to return the parameters of the current device:

```
  WRITE !,"The current OPEN modes are: ",$PIECE($ZMODE,"\")
  WRITE !,"The NLS collation is: ",$PIECE($ZMODE,"\",2)
  WRITE !,"The network encoding is: ",$PIECE($ZMODE,"\",4)
```

The following example sets parameters for the current device with the **USE** command. It checks the current parameters with **$ZMODE** before and after the **USE** command. To test whether a specific parameter was set, this example uses the **$PIECE** function with the backslash delimiter, and tests for a value using the Contains operator ([). (See Operators in *Using ObjectScript*.):

```
Zmodetest
  WRITE !, $ZMODE
    IF $PIECE($ZMODE,"\")["S" {
      WRITE !, "S is set"  }
    ELSE {WRITE !, "S is not set" }
  USE 0:("":"IS":$CHAR(13,10))
  WRITE !, $ZMODE
    IF $PIECE($ZMODE,"\")["S" {
      WRITE !, "S is set"  }
    ELSE {WRITE !, "S is not set" }
  QUIT
```

SAMPLES>**`DO ^zmodetest`**

RY\Latin1\K\UTF8\

S is not set

SIRY\Latin1\K\UTF8\

S is set

See Also

- OPEN command
- USE command
- $IO special variable
- I/O Devices and Commands in *I/O Device Guide*

$ZNAME

Contains the current routine name.

```
$ZNAME
$ZN
```

Description

$ZNAME contains the name of the routine executing on the current process. Commonly, this is the current routine loaded by ZLOAD. If no routine is currently executing, **$ZNAME** contains a null string.

When **ZLOAD** loads a routine, it becomes the currently loaded routine for the current process in all namespaces. Therefore, you can use **$ZNAME** to display the name of the currently loaded routine from any namespace, not just the namespace that it was loaded from.

Routine names are case-sensitive.

Note that a failed attempt to **ZLOAD** a routine removes the currently loaded routine, setting **$ZNAME** to the null string.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

The **$ZNAME** value can be set by the any of the following commands:

- ZLOAD command
- ZSAVE command
- Argumentless ZREMOVE command (sets to a null string)
- DO command
- GOTO command with ^*routine*

$ZNSPACE

Contains the current namespace name.

```
$ZNSPACE
```

Description

$ZNSPACE contains the name of the current namespace. By setting **$ZNSPACE**, you can change the current namespace.

To obtain the current namespace name:

```
SET ns=$ZNSPACE
WRITE ns
```

You can also obtain the name of the current namespace by invoking the **NameSpace()** method of %SYSTEM.SYS class, as follows:

```
SET ns=$SYSTEM.SYS.NameSpace()
```

You can test whether a namespace is defined by using the **Exists()** method of the %SYS.Namespace class, as follows:

```
WRITE ##class(%SYS.Namespace).Exists("USER"),!  ; an existing namespace
WRITE ##class(%SYS.Namespace).Exists("LOSER")   ; a non-existent namespace
```

These methods are described in the *InterSystems Class Reference*.

For UNIX® systems, the default namespace is established as a System Configuration option. For Windows systems, it is set using a command line start-up option.

Namespace names are not case-sensitive. InterSystems IRIS always displays explicit namespace names in all uppercase letters, and implied namespace names in all lowercase letters.

To obtain the namespace name of a specified process, use a method of the %SYS.ProcessQuery class, as shown in the following example:

```
WRITE ##CLASS(%SYS.ProcessQuery).%OpenId($JOB).NameSpaceGet()
```

Setting the Current Namespace

You can change the current namespace using the **ZNSPACE** command, **SET $NAMESPACE**, **SET $ZNSPACE**, or the %CD utility.

- From the Terminal command prompt the ZNSPACE command is the preferred way to change namespaces. **SET $ZNSPACE** is functionally identical to the **ZNSPACE** command.
- Within a code routine **NEW $NAMESPACE** followed by **SET $NAMESPACE**=*namespace* is the preferred way to change the current namespace. By using **NEW $NAMESPACE** and **SET $NAMESPACE** you establish a namespace context that automatically reverts to the prior namespace when the method concludes or an unexpected error occurs. See $NAMESPACE special variable for details.

You can use **SET $ZNSPACE** to change the current namespace for the process. Specify the new namespace as a string literal or a variable or expression that evaluates to a quoted string. You can specify an explicit namespace (`"namespace"`) or an implied namespace (`"^system^dir"` or `"^^dir"`).

If you specify the current namespace, **SET $ZNSPACE** performs no operation and returns no error. If you specify an undefined namespace, **SET $ZNSPACE** generates a <NAMESPACE> error.

You cannot **NEW** the **$ZNSPACE** special variable.

Example

In the following example, if the current namespace is not USER, a **SET $ZNSPACE** command changes the current namespace to USER. Note that because of the **IF** test, the namespace must be specified in all uppercase letters.

```
SET ns="USER"
IF $ZNSPACE=ns {
  WRITE !,"Namespace already was ",$ZNSPACE }
ELSEIF 1=##class(%SYS.Namespace).Exists(ns) {
  WRITE !,"Namespace was ",$ZNSPACE
  SET $ZNSPACE=ns
  WRITE !,"Set namespace to ",$ZNSPACE }
ELSE { WRITE !,ns," is not a defined namespace" }
QUIT
```

This example requires that UnknownUser have assigned the %DB_IRISSYS and the %DB_USER roles.

See Also

- SET command
- ZNSPACE command
- $NAMESPACE special variable
- Configuring Namespaces in *System Administration Guide*

$ZORDER

Contains the value of the next global node.

```
$ZORDER
$ZO
```

Description

$ZORDER contains the value of the next global node (in **$QUERY** sequence, not **$ORDER** sequence), after the current global reference. If there is no next global node, accessing **$ZORDER** results in an <UNDEFINED> error, indicating the *last global successfully accessed* by **$ZORDER**. For further details on <UNDEFINED> errors, refer to **$ZERROR**.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Example

The following example uses a **WHILE** loop to repeatedly call **$ZORDER** to traverse a series of subscript nodes:

```
SET ^||a="groceries"
SET ^||a(1)="fruit"
SET ^||a(1,1)="apples"
SET ^||a(1,2)="oranges"
SET ^||a(3)="nuts"
SET ^||a(3,1)="peanuts"
SET ^||a(2)="vegetables"
SET ^||a(2,1)="lettuce"
SET ^||a(2,2)="tomatoes"
SET ^||a(2,1,1)="iceberg"
SET ^||a(2,1,2)="romaine"
SET $ZERROR="unset"
WRITE !,"last referenced: ",^||a(1,1)
WHILE $ZERROR="unset" {
    WRITE !,$ZORDER }
QUIT
```

The above example starts with the last-referenced global (in this case, process-private globals): ^||a(1,1). **$ZORDER** does not contain the value of ^||a(1,1), but works forward from that point. Calls to **$ZORDER** traverse the subscript tree nodes in the following order: (1,2), (2), (2,1), (2,1,1), (2,1,2), (2,2), (3), (3,1). Each **WRITE $ZORDER** displays the data value in each successive node. It then runs out of nodes and generates the following error: `<UNDEFINED> ^||a(3,1)`. Note that ^||a(3,1) is *not* undefined; it is specified because **$ZORDER** could not find another global after this one.

See Also

- $ORDER function
- $QUERY function
- $ZERROR special variable

$ZPARENT

Contains the ID of the parent process of the current process.

```
$ZPARENT
$ZP
```

Description

$ZPARENT contains the ID of the parent process that created the current process with the **JOB** command. If the current process was not created with the **JOB** command, **$ZPARENT** contains 0 (zero).

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

See Also

- JOB command
- $ZCHILD special variable
- $JOB special variable

$ZPI

Contains the value of pi.

```
$ZPI
```

Description

$ZPI contains the value of the numeric constant Pi to eighteen decimal places (3.141592653589793238).

This value is frequently used with trigonometric functions, such as the sine function $ZSIN.

$ZPOS

Contains the current file position during the reading of a sequential file.

```
$ZPOS
```

Description

$ZPOS contains the current file position during sequential file reads. If no sequential file read is in progress, **$ZPOS** contains 0 (zero).

When you open a file for sequential reads, each **READ** from that device sets **$ZPOS** to the position within the file at which the next read will occur. The **$ZPOS** value is the actual file offset in bytes at the conclusion of a **READ**, **READ ***, or **READ #n**. The user must take appropriate care when reading multi-byte character sets.

The current file position can be set using the **$ZSEEK** function. This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

See Also

- READ command
- $ZSEEK function
- Sequential File I/O in *I/O Device Guide*

$ZREFERENCE

Contains the current global reference.

```
$ZREFERENCE
$ZR
```

Description

$ZREFERENCE contains the name and subscript(s) of the last global reference. This is known as the naked indicator.

Note: The last global reference is the most recently accessed global node. Usually, this is the most recent explicit reference to a global. However, certain commands may internally use the **$ORDER** function to traverse global subscripts (the **ZWRITE** command is an example of this), or they may refer internally to some other global. When this occurs, **$ZREFERENCE** contains the last accessed global node, which may not be the global node specified to the command.

The last global reference can be either a global (^myglob) or a process-private global (^||myppg). **$ZREFERENCE** returns the process-private global prefix in the form that was initially used for that variable, regardless of which process-private global prefix is used subsequently for that variable. In the description of **$ZREFERENCE** that follows, the word “global” refers to both types of variables.

The last global reference is the global most recently referred to by a command or a function. Because ObjectScript performs operations in left-to-right order, the last global reference is always the rightmost global. When a command or function takes multiple arguments, the global specified in the rightmost argument is the last global reference. When an argument contains multiple global references, the rightmost specified global is the last global reference. This strict left-to-right order holds true even if parentheses are used to define the order of operations.

InterSystems IRIS updates **$ZREFERENCE** when an explicit global reference is issued. Invoking an expression (such as a local variable) that evaluates to a global reference does not update **$ZREFERENCE**.

$ZREFERENCE contains the most recent global reference, even if this global reference was not successful. When a command references an undefined global, issuing an <UNDEFINED> error, InterSystems IRIS updates **$ZREFERENCE** to that global reference, just as if the global were defined. This behavior is unaffected by setting the **%SYSTEM.Process.Undefined()** method.

$ZREFERENCE often contains the most recent global reference, even if the command execution was not successful. InterSystems IRIS updates **$ZREFERENCE** as each global is referenced. For example, a command issuing a <DIVIDE> error (attempting to divide a number by 0) updates **$ZREFERENCE** to the last global referenced in the command before the error occurred. However, a <SYNTAX> error does not update **$ZREFERENCE**.

Long Global Names

If a global name is longer than 31 characters (excluding global prefix character(s), such as ^), **$ZREFERENCE** returns the global name shortened to 31 characters. For further information on the handling of long global names, refer to the Global Variables section of the “Variables” chapter of *Using ObjectScript*.

Naked Global Reference

If the last global reference was a naked global reference, **$ZREFERENCE** contains the external, readable, full form of the current naked global reference. This is demonstrated in the following example:

```
SET ^MyData(1)="fruit"
SET ^MyData(1,1)="apples" ; Full global reference
SET ^(2)="oranges"        ; Naked global reference,
                          ; implicitly ^MyData(1,2)
WRITE !,$ZREFERENCE       ; Returns "^MyData(1,2)"
```

For further details on naked global references, see Using InterSystems IRIS Multidimensional Storage (Globals) in *Using Globals*.

Extended Global Reference

Extended global reference is used to reference a global that is in a namespace other than the current namespace. If a command references a global variable using an extended global reference, the **$ZREFERENCE** value contains that extended global reference. InterSystems IRIS returns an extended global reference in the following circumstances:

- If the last global reference uses an extended reference to refer to a global in another namespace.
- If the last global reference uses an extended reference to refer to a global in the current namespace.
- If the last global reference is a remote reference (a global on a remote system).

In all cases, **$ZREFERENCE** returns the namespace name in all capital letters, regardless of how it was specified in the global reference.

For further details on global subscripts and extended global references, see Global Structure in *Using Globals*.

Operations that Update $ZREFERENCE

The **$ZREFERENCE** special variable is initialized to the null string (""). Changing the current namespace resets **$ZREFERENCE** to the null string.

The following operations set **$ZREFERENCE** to the most recently referenced global:

- A command or function that uses a global as an argument. If it uses multiple globals, **$ZREFERENCE** is set to the rightmost occurrence of a global. (Note, however, the exception of **$ORDER**.)
- A command that uses a global as a postconditional expression.
- Following a **ZWRITE**, InterSystems IRIS sets **$ZREFERENCE** to the last accessed subscript node of the specified global reference.
- A command or function that references an undefined global, and either generates an <UNDEFINED> error, or, in the case of **$INCREMENT**, defines the global.

Setting $ZREFERENCE

You can set this special variable using the **SET** command, as follows:

- Set to the null string (""). Doing so deletes the naked indicator. If the next global reference is a naked global reference, InterSystems IRIS issues a <NAKED> error.
- Set to a valid global reference (defined or undefined). This causes subsequent naked references to use the value you set as if it were the last actual global reference.

$ZREFERENCE cannot be otherwise modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Examples

The following example returns the last global reference:

```
SET ^a(1,1)="Hello"  ; Full global reference
SET ^(2)=" world!"   ; Naked global reference
WRITE $ZREFERENCE
```

returns:

```
^a(1,2)
```

The following example returns global references from several different commands. Note that **WRITE** and **ZWRITE** set different representations of the same global reference.

```
SET (^barney,^betty,^wilma,^fred)="flintstone"
WRITE !,$ZREFERENCE
KILL ^flies
WRITE !,$ZREFERENCE
WRITE !,^fred
WRITE !,$ZREFERENCE,!
ZWRITE ^fred
WRITE !,$ZREFERENCE
```

returns:

```
^fred          ; last of several globals set in left-to-right order
^flies         ; KILL sets global indicator, though no global to kill
flintstone               ; WRITE global
^fred                      ; global from WRITE
^fred="flintstone"   ; ZWRITE global
^fred("")                ; global from ZWRITE
```

The following example returns an extended global reference. Note that the namespace name is always returned in uppercase letters:

```
SET ^["samples"]a(1,1)="Hello"
SET ^(2)=" world!"
WRITE $ZREFERENCE
QUIT
```

returns:

```
^["SAMPLES"]a(1,2)
```

The following example returns the last global reference. In this case, it is ^a(1), used as an argument to the **$LENGTH** function:

```
SET ^a(1)="abcdefghijklmnopqrstuvwxyz"
SET ^b(1)="1234567890"
SET x=$LENGTH(^a(1))
WRITE $ZREFERENCE
QUIT
```

The following example returns the value set for **$ZREFERENCE** as if it were the last global reference. In this case, it is ^a(1,1).

```
SET ^a(1,1)="abcdefghijklmnopqrstuvwxyz"
SET ^b(1,1)="1234567890"
WRITE !,^(1)
          ; Naked reference uses last global
SET $ZREFERENCE="^a(1,1)"
WRITE !,$ZREFERENCE
WRITE !,^(1)
          ; Naked reference uses $ZREFERENCE
          ; value, rather than last global.
```

The following example sets an extended global reference. Note the doubled quotation marks:

```
KILL ^x
WRITE !,$ZREFERENCE
SET $ZREFERENCE="^[""samples""]a(1,2)"
WRITE !,$ZREFERENCE
```

See Also

- ZNSPACE command
- $NAMESPACE special variable
- $ZNSPACE special variable
- Configuring Namespaces in *System Administration Guide*

- Global Structure in *Using Globals*
- Naked Global Reference in *Using Globals*

$ZSTORAGE

Contains the maximum available memory for a process.

```
$ZSTORAGE
$ZS
```

Description

$ZSTORAGE contains the maximum amount of memory, in Kbytes, for a job's process-private memory. This memory is available for local variables, stacks, and other tables. This memory limit does not include space for the routine object code. This memory is allocated to the process as needed, for example when allocating an array.

Once this memory is allocated to the process, it is generally not deallocated until the process exits. However, when a large amount of memory is used (for example greater than 32MB) and then freed, InterSystems IRIS attempts to release deallocated memory back to the operating system, where possible.

You can also use **$ZSTORAGE** to set the maximum memory size. For example, the following statement sets the job's maximum process-private memory to 524288 Kbytes:

```
SET $ZSTORAGE=524288
```

Changing **$ZSTORAGE** changes the initial value for the $STORAGE special variable, which contains the current available memory (in bytes) for the process.

The maximum value for **$ZSTORAGE** is 2147483647. The **$ZSTORAGE** default is 262144. The minimum value for **$ZSTORAGE** is 128. **$ZSTORAGE** values larger than the maximum or smaller than the minimum automatically default to the maximum or minimum value. **$ZSTORAGE** is set to an integer value; InterSystems IRIS truncates any fractional portion (if specified).

You can change the **$ZSTORAGE** default by changing the **Maximum per Process Memory (KB)** system configuration setting. In the Management Portal, select **System Administration**, **Configuration**, **Systtem Configuration**, **Memory and Startup**. You can increase **Maximum per Process Memory (KB)** as desired, up to a maximum of 2147483647 Kbytes. Changing **Maximum per Process Memory (KB)** changes the **$ZSTORAGE** value for subsequently initiated processes; it has no effect on the **$ZSTORAGE** value for current processes.

Example

The following example sets **$ZSTORAGE** to its maximum and minimum values. Attempting to set **$ZSTORAGE** to a value (16) that is less than the minimum value automatically sets **$ZSTORAGE** to its minimum value (128):

```
SET $ZS=128
WRITE "minimum storage=",$ZS,!
SET $ZS=16
WRITE "less than minimum storage=",$ZS,!
SET $ZS=2147483647
WRITE "maximum storage=",$ZS,!
```

See Also

SET command

KILL command

$STORAGE special variable

$ZTIMESTAMP

Contains the current date and time in Coordinated Universal Time format.

```
$ZTIMESTAMP
$ZTS
```

Description

$ZTIMESTAMP contains the current date and time as a Coordinated Universal Time value. This is a worldwide time and date standard; this value is very likely to differ from your local time (and date) value.

$ZTIMESTAMP represents date and time as a string with the format:

```
ddddd,sssss.fff
```

Where *ddddd* is an integer specifying the number of days since December 31, 1840; *sssss* is an integer specifying the number of seconds since midnight of the current day, and *fff* is a varying number of digits specifying fractional seconds. This format is similar to **$HOROLOG**, except that **$HOROLOG** does not contain fractional seconds.

Suppose the current date and time (UTC) is as follows:

`2018-02-22 15:17:27.984`

At that time, **$ZTIMESTAMP** has the value:

`64701,55047.984`

$ZTIMESTAMP reports the Coordinated Universal Time (UTC), which is independent of time zone. Consequently, **$ZTIMESTAMP** provides a time stamp that is uniform across time zones. This may differ from both the local time value and the local date value.

The **$ZTIMESTAMP** time value is a decimal numeric value that counts the time in seconds and fractions thereof. The number of digits in the fractional seconds may vary from zero to nine, depending on the precision of your computer's time-of-day clock. On Windows systems the fractional precision is three decimal digits; on UNIX® systems it is six decimal digits. **$ZTIMESTAMP** suppresses trailing zeroes or a trailing decimal point in this fractional portion. Note that within the first second after midnight, seconds are represented as 0.*fff* (for example, `0.123`); this number is not in ObjectScript canonical form (for example, `.123`), which affects the string sorting order of these values. You can prepend a plus sign (+) to force conversion of a number to canonical form before performing a sort operation.

The various ways to return the current date and time are compared, as follows:

- **$ZTIMESTAMP** contains the UTC date and time, with fractional seconds, in InterSystems IRIS storage (**$HOROLOG**) format. Fractional seconds are expressed in three digits of precision (on Windows systems), or six digits of precision (on UNIX® systems).
- **$NOW** returns the local date and time for the current process; local time variants (such as Daylight Saving Time) are *not* applied. **$NOW** with no parameter value determines the local time zone from the value of the **$ZTIMEZONE** special variable. **$NOW** with a parameter value returns the time and date that correspond to the specified time zone parameter. **$NOW(0)** returns the UTC date and time. The value of **$ZTIMEZONE** is ignored. **$NOW** returns the date and time in InterSystems IRIS storage (**$HOROLOG**) format. It includes fractional seconds; the number of fractional digits is the maximum precision supported by the current operating system. For this reason, **$NOW(0)** may return UTC time with greater fractional second precision than **$ZTIMESTAMP**.
- **$HOROLOG** contains the local, variant-adjusted date and time in InterSystems IRIS storage format. It does not record fractional seconds. How **$HOROLOG** resolves fractional seconds depends on the operating system platform: On Windows, it rounds up any fractional second to the next whole second. On UNIX®, it truncates the fractional portion.

Note: Exercise caution when comparing local time and UTC time:

- The preferred way to convert UTC time to local time is to use the **$ZDATETIMEH(utc,-3)** function. This function adjusts for local time variants.
- You cannot interconvert local time and UTC time by simply adding or subtracting the value of $ZTIMEZONE * 60. This is because, in many cases, local time is adjusted for local time variants (such as Daylight Saving Time, which seasonally adjusts local time by one hour). These local time variants are not reflected in **$ZTIMEZONE**.
- UTC time is calculated using a count of time zones from the Greenwich meridian. It is not the same as local Greenwich time. The term Greenwich Mean Time (GMT) may be confusing; local time at Greenwich is the same as UTC during the winter; during the summer it differs from UTC by one hour. This is because a local time variant, known as British Summer Time, is applied.
- Both the timezone offset from UTC and local time variants (such as the seasonal shift to Daylight Saving Time) can affect the date as well as the time. Converting from local time to UTC time (or vice versa) may change the date as well as the time.

This special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Coordinated Universal Time Conversions

You can represent local time information as Coordinated Universal Time (UTC) using the **$ZDATETIME** and **$ZDATETIMEH** functions with *tformat* values 7 or 8, as shown in the following example:

```
WRITE !,$ZDATETIME($ZTIMESTAMP,1,1,2)
WRITE !,$ZDATETIME($HOROLOG,1,7,2)
WRITE !,$ZDATETIME($HOROLOG,1,8,2)
WRITE !,$ZDATETIME($NOW(),1,7,2)
WRITE !,$ZDATETIME($NOW(),1,8,2)
```

The above **$ZDATETIME** functions all return the current time as Coordinated Universal Time (rather than local time). These time value conversions from local time may differ, because $NOW *does not* adjust for local time variants; **$ZTIMESTAMP** and $HOROLOG do adjust for local time variants and may adjust the date accordingly, if necessary. The **$ZTIMESTAMP** display value and the *tformat* 7 or 8 converted display values are not identical. The *tformat* values 7 and 8 insert the letter “T” before, and the letter “Z” after the time value. Also, because **$HOROLOG** time does not contain fractional seconds, the *precision* of 2 in the above example pads those decimal digits with zeros.

You can obtain the same time stamp information as **$ZTIMESTAMP** by invoking the **TimeStamp()** class method, using either of the following syntax forms:

```
WRITE !,$SYSTEM.SYS.TimeStamp()
WRITE !,##class(%SYSTEM.SYS).TimeStamp()
```

Refer to the $SYSTEM special variable in this manual and the %SYSTEM.SYS class in the *InterSystems Class Reference* for further details.

Examples

The following example converts the value of **$ZTIMESTAMP** to local time, and compares it with two representations of local time: **$NOW()** and **$HOROLOG**:

```
SET stamp=$ZTIMESTAMP,clock=$HOROLOG,miliclock=$NOW()
WRITE !,"local date and time: ",$ZDATETIME(clock,1,1,2)
WRITE !,"local date and time: ",$ZDATETIME(miliclock,1,1,2)
WRITE !,"UTC date and time:   ",$ZDATETIME(stamp,1,1,2)
IF $PIECE(stamp,",",2) = $PIECE(clock,",",2) {
   WRITE !,"Local time is UTC time" }
ELSEIF $PIECE(stamp,",") '= $PIECE(clock,",") {
  WRITE !,"Time difference affects date" }
ELSE {
      SET localutc=$ZDATETIMEH(stamp,-3)
      WRITE !,"UTC converted to local: ",$ZDATETIME(localutc,1,1,2)
}
QUIT
```

The following example compares the values returned by **$ZTIMESTAMP** and **$HOROLOG**, and shows how the time portion of **$ZTIMESTAMP** may be converted. (Note that in this simple example only one adjustment is made for local time variations, such as Daylight Saving Time. Other types of local variation may cause *clocksecs* and *stampsecs* to contain irreconcilable values.)

```
SET stamp=$ZTIMESTAMP,clock=$HOROLOG
WRITE !,"local date and time: ",$ZDATETIME(clock,1,1,2)
WRITE !,"UTC date and time:   ",$ZDATETIME(stamp,1,1,2)
IF $PIECE(stamp,",") '= $PIECE(clock,",") {
  WRITE !,"Time difference affects date" }
SET clocksecs=$EXTRACT(clock,7,11)
SET stampsecs=$EXTRACT(stamp,7,11)-($ZTIMEZONE*60)
IF clocksecs=stampsecs {
   WRITE !,"No local time variant"
   WRITE !,"Local time is timezone time" }
ELSE {
      SET stampsecs=stampsecs+3600
      IF clocksecs=stampsecs {
        WRITE !,"Daylight Saving Time variant:"
        WRITE !,"Local time offset 1 hour from timezone time" }
      ELSE { WRITE !,"Cannot reconcile due to local time variant" }
}
QUIT
```

See Also

- $NOW function
- $ZDATETIME function
- $ZDATETIMEH function
- $HOROLOG special variable
- $ZTIMEZONE special variable

$ZTIMEZONE

Contains the time zone offset from the Greenwich meridian.

```
$ZTIMEZONE
$ZTZ
```

Description

$ZTIMEZONE can be used in two ways:

- To return the local time zone offset for your computer.
- To set the local time zone offset for the current process.

$ZTIMEZONE contains the time zone offset from the Greenwich meridian in minutes. (The Greenwich meridian includes all of Great Britain and Ireland.) This offset is expressed as a signed integer in the range -1440 to 1440. Time zones west of Greenwich are specified as positive numbers; time zones east of Greenwich are specified as negative numbers. (Time zones must be expressed in minutes, because not all time zone differences are in whole hours.) By default, **$ZTIMEZONE** is initialized to the time zone set for the computer's operating system.

CAUTION: **$ZTIMEZONE** adjusts the local time by a fixed offset. It does not adjust for Daylight Saving Time or other local time variants. InterSystems IRIS takes its local time from the underlying operating system, which applies the local time variant for the location configured for that computer. Therefore, a local time adjusted using **$ZTIMEZONE** takes its local time variation from the configured locale, not the time zone specified in **$ZTIMEZONE**.

UTC time is calculated using a count of time zones from the Greenwich meridian (**$ZTIMEZONE**=0). It is not the same as local Greenwich time. The term Greenwich Mean Time (GMT) may be confusing; local time at Greenwich is the same as UTC during the winter; during the summer it differs from UTC by one hour. This is because a local time variant, known as British Summer Time, is applied.

For functions and programs that use **$ZTIMEZONE**, elapsed local time is always continuous, but the time value may need to be seasonally adjusted to correspond to local clock time. For more details on local seasonal time variants, refer to $HOROLOG.

Setting the Time Zone

You can use **$ZTIMEZONE** to set the time zone used by the current InterSystems IRIS process. Setting **$ZTIMEZONE** does not change the default InterSystems IRIS time zone or your computer's time zone setting.

Note: Changing the **$ZTIMEZONE** special variable is a feature designed for some special situations. Changing **$ZTIMEZONE** is not a consistent way to change the time zone that InterSystems IRIS uses for local date/time operations. The **$ZTIMEZONE** special variable should not be changed except by those programs that are prepared to handle all the inconsistencies that result.

On some platforms there may be a better way to change time zones than changing the **$ZTIMEZONE** special variable. If the platform has a process-specific time zone setting (for example, the TZ environment variable on POSIX systems) then making an external system call to change the process-specific time zone may work better than changing **$ZTIMEZONE**. Changing the process-specific time zone at the operating system level will change both the local time offset from UTC and apply the corresponding algorithm that determines when local time variants are applied. This is especially important if the default system time zone is in the Northern Hemisphere, while the desired process time zone is in the Southern Hemisphere. Changing **$ZTIMEZONE** changes the local time to a new time zone offset from UTC, but the algorithm that determines when local time variants are applied remains unchanged.

Use the **SET** command to set **$ZTIMEZONE** to a specified signed integer number of minutes. Leading zeros and decimal portions of numbers are ignored. If you specify a nonnumeric value or no value when setting **$ZTIMEZONE**, InterSystems IRIS sets **$ZTIMEZONE** to 0 (Greenwich meridian).

For example, North American Eastern Standard Time (EST) is five hours west of Greenwich. Therefore, to set the current InterSystems IRIS process to EST you would specify 300 minutes. To specify a time zone one hour east of Greenwich, you would specify –60 minutes. To specify Greenwich itself, you would specify 0 minutes.

Setting **$ZTIMEZONE**:

- affects the argumentless **$NOW()** local time value. It changes the time portion of **$NOW()**, and this change of time can also change the date portion of **$NOW()** for the current process. **$NOW()** reflects the **$ZTIMEZONE** setting exactly, its value is not adjusted for local time variants.
- affects the **$HOROLOG** local time value. **$HOROLOG** takes its time zone value from **$ZTIMEZONE**, then seasonally adjusts for local time variants such as Daylight Saving Time. **$HOROLOG** therefore always conforms to local clock time, but **$HOROLOG** elapsed time is not continuous throughout the year.
- affects the %SYSTEM.Util class methods **IsDST()**, **UTCtoLocalWithZTIMEZONE()**, and **LocalWithZTIMEZONEtoUTC()**.
- *does not* affect **$ZTIMESTAMP** or **$ZHOROLOG** values.
- *does not* affect the date and time format conversions performed by **$ZDATE**, **$ZDATEH**, **$ZDATETIME**, **$ZDATETIMEH**, **$ZTIME**, and **$ZTIMEH** functions.
- *does not* affect the **$NOW(n)** function.
- *does not* affect the **FixedDate()** class method of the %SYSTEM.Process class, which sets the date in **$HOROLOG** to a fixed value.

The following anomalies occur after changing **$ZTIMEZONE**:

- `$ZDATETIME($HOROLOG,1,7)` usually returns an UTC time, but it will not return UTC time if **$ZTIMEZONE** has changed.
- `$ZDATETIME($HOROLOG,1,5)` will not return the correct time zone offset if **$ZTIMEZONE** has changed.
- `$ZDATETIME($HOROLOG,-3)` and `$ZDATETIMEH($ZTIMESTAMP,-3)` conversions between Local time and UTC time will not be correct if **$ZTIMEZONE** has changed.

Other Time Zone Methods

You can obtain the same time zone information by invoking the **TimeZone()** class method, as follows:

```
WRITE $SYSTEM.SYS.TimeZone()
```

Refer to the %SYSTEM.SYS class in the *InterSystems Class Reference* for further details.

You can return your local time variation as part of a date and time string by using the **$ZDATETIME** and **$ZDATETIMEH** functions with *tformat* values 5 or 6, as shown in the following example:

```
WRITE !,$ZDATETIME($HOROLOG,1,5)
```

This returns a value such as:

```
04/06/2011T12:31:16-04:00
```

The last part of this string (`-04:00`) indicates the system's local time variation setting as an offset in hours and minutes from the Greenwich meridian. Note that this variation is not necessarily the time zone offset. In the above case, the time zone is 5 hours west of Greenwich (`-5:00`), but the local time variant (Daylight Saving Time) offsets the time zone time by one hour to `-04:00`. Setting **$ZTIMEZONE** changes the current process date and time returned by `$ZDATETIME($HOROLOG,1,5)`, but does not change the system local time variation setting.

$ZDATETIMEH Uses Time Zone Setting

You can use **$ZDATETIMEH** with *dformat*=-3 to convert a Coordinated Universal Time (UTC) date and time value to a local time. This function takes as input a UTC value (**$ZTIMESTAMP**). It uses the local time zone setting to return the corresponding date and time with local time variants (such as Daylight Saving Time) applied where applicable.

```
SET clock=$HOROLOG
SET stamp=$ZDATETIMEH($ZTIMESTAMP,-3)
WRITE !,"local/local date and time: ",$ZDATETIME(clock,1,1,2)
WRITE !,"UTC/local date and time:   ",$ZDATETIME(stamp,1,1,2)
```

Local/UTC Conversion Methods Using $ZTIMEZONE

Two class methods of the %SYSTEM.Util class convert between local date and time and UTC date and time: **UTCtoLocalWithZTIMEZONE()** and **LocalWithZTIMEZONEtoUTC()**. These methods are affected by changes to **$ZTIMEZONE**.

```
WRITE $SYSTEM.Util.UTCtoLocalWithZTIMEZONE($ZTIMESTAMP),!
WRITE $HOROLOG,!
WRITE $SYSTEM.Util.LocalWithZTIMEZONEtoUTC($H),!
WRITE $ZTIMESTAMP
```

Examples

The following example returns your current time zone:

```
SET zone=$ZTIMEZONE
IF zone=0 {
  WRITE !,"Your time zone is Greenwich Mean Time" }
ELSEIF zone>0 {
  WRITE !,"Your time zone is ",zone/60," hours west of Greenwich" }
ELSE {
  WRITE !,"Your time zone is ",(-zone)/60," hours east of Greenwich" }
```

The following example shows that setting the time zone can change the date as well as the time:

```
SET zonesave=$ZTIMEZONE
WRITE !,"Date in my current time zone:  ",$ZDATE($HOROLOG)
IF $ZTIMEZONE=0 {
  SET $ZTIMEZONE=720 }
ELSEIF $ZTIMEZONE>0 {
  SET $ZTIMEZONE=($ZTIMEZONE-720) }
ELSE {
  SET $ZTIMEZONE=($ZTIMEZONE+720) }
WRITE !,"Date halfway around the world: ",$ZDATE($HOROLOG)
WRITE !,"Date at Greenwich Observatory: ",$ZDATE($ZTIMESTAMP)
SET $ZTIMEZONE=zonesave
```

The following example determines if your local time is the same as your time zone time:

```
SET localnow=$HOROLOG, stamp=$ZTIMESTAMP
WRITE !,"local date and time: ",$ZDATETIME(localnow,1,1)
SET clocksecs=$PIECE(localnow,",",2)
SET stampsecs=$EXTRACT(stamp,7,11)-($ZTIMEZONE*60)
IF clocksecs=stampsecs {
   WRITE !,"No local time variant:"
   WRITE !,"Local time is timezone time" }
ELSE {
      IF clocksecs=stampsecs+3600 {
        WRITE !,"Daylight Saving Time variant:"
        WRITE !,"Local time offset 1 hour from timezone time" }
      ELSE { WRITE !,"Local time and time zone time are "
             WRITE !,(clocksecs-stampsecs)/60," minutes different" }
}
QUIT
```

See Also

- $HOROLOG special variable
- $ZTIMESTAMP special variable

$ZTRAP

Contains the location of the current error trap handler.

```
$ZTRAP
$ZT
```

Description

$ZTRAP contains the location of the current error trap handler. For a description of how to code an error trap handler, refer to "Handling Errors with $ZTRAP" in the "Error Processing" chapter of *Using ObjectScript*.

- In a routine, **$ZTRAP** can reference a label within the routine or within another routine. It contains the label name and the routine name. For example, if you set **$ZTRAP** to the label MyHandler within the routine MyRou, the **$ZTRAP** special variable contains `MyHandler^MyRou`.
- In a procedure, **$ZTRAP** must reference a label within that procedure. It contains the line offset of the label from the procedure name. For example, if you set **$ZTRAP** to the private label MyHandler within the procedure MyProc, the **$ZTRAP** special variable contains `+17^MyProc`.

There are three ways to set **$ZTRAP**:

- SET $ZTRAP="location"
- SET $ZTRAP="*location"
- SET $ZTRAP="^%ETN"

You cannot **KILL $ZTRAP**; attempting to do so results in a <SYNTAX> error. To eliminate the current **$ZTRAP** value, specify **$ZTRAP=""**.

Location

Using the **SET** command you can specify *location* as a quoted string.

- In a routine, you can specify *location* as *label* (a line label in the current routine), *^routine* (the beginning of a specified external routine), or *label^routine* (a specified label in a specified external routine). Do not specify a *location* in a routine that references a procedure or a label within a procedure. This is a invalid *location*; it results in a runtime error when InterSystems IRIS attempts to execute **$ZTRAP**.
- In a procedure, you can specify *location* as *label*; a private label within that procedure block. **$ZTRAP** in a procedure block cannot be used to go to a *location* that is outside the body of the procedure; **$ZTRAP** in a procedure block can only reference a *location* within that procedure block. Therefore, in a procedure you cannot set **$ZTRAP** to *^routine* or *label^routine*. Attempted to do so results in a <SYNTAX> error.

  In a procedure, you set **$ZTRAP** to a private label name, but the **$ZTRAP** value is not the private label name; it is the offset from the procedure label (the top of the procedure) to the line location of the private label. For example, `+17^myproc`.

Note: **$ZTRAP** provides legacy support for *label+offset* in some contexts (but not in procedures). This optional *+offset* is an integer specifying the number of lines to offset from *label*. The *label* must be in the same routine. The use of *+offset* is deprecated, and may result in a compilation warning error. InterSystems recommends that you avoid the use of a line offset when specifying *location*.

You cannot specify an *+offset* when calling a procedure or a IRISSYS % routine. If you attempt to do so, InterSystems IRIS issues a <NOLINE> error.

The **$ZTRAP** *location* must be in the current namespace. **$ZTRAP** does not support extended routine reference.

If you specify a nonexistent line label, a *location* that does not exist in the current routine, the following occurs:

- Displaying **$ZTRAP**: In a routine, **$ZTRAP** contains *label^routine*. For example, `DummyLabel^MyRou`. In a procedure, **$ZTRAP** contains the maximum possible offset: `+34463^MyProc`.
- Invoking **$ZTRAP**: InterSystems IRIS issues a <NOLINE> error message.

Each stack level can have its own **$ZTRAP** value. When you set **$ZTRAP**, the system saves the value of **$ZTRAP** for the previous stack level. InterSystems IRIS restores this value when the current stack level ends. To enable error trapping at the current stack level, set **$ZTRAP** to the error trap handler by specifying its *location*. For example:

```
IF $ZTRAP="" {WRITE !,"$ZTRAP not set" }
ELSE {WRITE !,"$ZTRAP already set: ",$ZTRAP
      SET oldtrap=$ZTRAP }
SET $ZTRAP="Etrap1^Handler"
WRITE !,"$ZTRAP set to: ",$ZTRAP
//  program code
SET $ZTRAP=oldtrap
WRITE !,"$ZTRAP restored to: ",$ZTRAP
```

When an error occurs, this format unwinds the call stack and transfers control to the specified error trap handler.

In SqlComputeCode, do not set $ZTRAP=$ZTRAP. This can result in significant problems with transactional processing and error reporting.

To disable error trapping, set **$ZTRAP** to the null string (""). This clears any error trap set at the current **DO** stack level.

Note: Use of **$ZTRAP** from the Terminal prompt is limited to the current line of code. The **SET $ZTRAP** command and the command generating the error must be in the same line of code. Terminal restores **$ZTRAP** to the system default at the beginning of each command line.

*Location

In a routine, you can choose to leave the call stack as it is after the error has occurred. To do so, place an asterisk (*) before *location* and within the double quotes. This form is not valid for use within procedures; attempted to do so results in a <SYNTAX> error. It can only be used in subroutines that are not procedures, as in this example:

```
Main
   SET $ZTRAP="*OnError"
   WRITE !,"$ZTRAP set to: ",$ZTRAP
  // program code
OnError
   // Error handling code
   QUIT
```

This format simply causes a **GOTO** to the line label specified in **$ZTRAP**; **$STACK** and **$ESTACK** are unchanged. The context frame of the **$ZTRAP** error handling routine is the same as the context frame where the error occurred. However, InterSystems IRIS resets $ROLES to the value that was in effect for the execution level at which **$ZTRAP** was set; this prevents the **$ZTRAP** error handler from using elevated privileges that were granted to the routine after establishing the error handler. Upon completion of the **$ZTRAP** error handling routine, InterSystems IRIS unwinds the stack to the previous context level. This form of **$ZTRAP** is especially useful for analyzing unexpected errors.

Note that the asterisk sets a **$ZTRAP** option; it is not part of the *location*. For this reason, this asterisk does not display when performing a **WRITE** or **ZZDUMP** on **$ZTRAP**.

^%ETN

In a routine, **SET $ZTRAP="^%ETN"** establishes the system-supplied error routine **%ETN** as the current error trap handler. **%ETN** executes in the context in which the error occurred that invoked it. (**%ET** is a legacy name for **%ETN**. Their functionality is identical, though **%ETN** is slightly more efficient.) The ^%ETN error handler always behaves as if it were preceded by an asterisk (*).

Because **$ZTRAP** in a procedure block cannot be used to go to a *location* that is outside the body of the procedure, **SET $ZTRAP="^%ETN"** cannot be used in a procedure. Attempting to do so results in a <SYNTAX> error.

For more information on **%ETN** and its entrypoints FORE^%ETN, BACK^%ETN, and LOG^%ETN, see the "Logging Application Errors" section of the "Error Processing" chapter of *Using ObjectScript*.

TRY / CATCH and $ZTRAP

You cannot set **$ZTRAP** within a **TRY** block. Attempting to do so generates a compilation error. You can set **$ZTRAP** prior to the **TRY** block, or within the **CATCH** block.

An error that occurs within a **TRY** block is handled by the **CATCH** block, regardless of whether a **$ZTRAP** has previously been set. An error that occurs within a **CATCH** block is handled by the current error trap handler.

The first of the following examples shows an error occurring in a **TRY** block. The second of the following examples shows an exception being thrown in a **TRY** block. In both cases, the **CATCH** block, not the **$ZTRAP**, is taken:

```
  SET $ZTRAP="Ztrap"
  TRY { WRITE 1/0 }    /* divide-by-zero error */
  CATCH { WRITE "Catch taken" }
  QUIT
Ztrap
  WRITE "$ZTRAP taken"
  SET $ZTRAP=""
  QUIT
```

```
  SET $ZTRAP="Ztrap"
  TRY { SET myvar=##class(Sample.MyException).%New("Example Error",999,,errdatazero)
        WRITE !,"Throwing an exception!",!
        THROW myvar
        QUIT  }
  CATCH { WRITE "Catch taken" }
  QUIT
Ztrap
  WRITE "$ZTRAP taken"
  SET $ZTRAP=""
  QUIT
```

However, a **TRY** block can call code that sets and uses **$ZTRAP**. In the following example, the divide-by-zero error is caught by **$ZTRAP**, rather than the **CATCH** block:

```
  TRY { DO Errsub }
  CATCH { WRITE "Catch taken" }
  QUIT
Errsub
  SET $ZTRAP="Ztrap"
  WRITE 1/0   /* divide-by-zero error */
  QUIT
Ztrap
  WRITE "$ZTRAP taken"
  SET $ZTRAP=""
  QUIT
```

A **THROW** command from a **CATCH** block can also invoke a **$ZTRAP** error handler.

Examples

The following example sets **$ZTRAP** to the OnError routine in this program. It then calls SubA in which an error occurs (attempting to divide a number by 0). When the error occurs, InterSystems IRIS calls the OnError routine specified in **$ZTRAP**. OnError is invoked at the context level at which **$ZTRAP** was set. Because OnError is at the same context level as Main, execution does not return to Main.

```
Main
   NEW $ESTACK
   SET $ZTRAP="OnError"
   WRITE !,"$ZTRAP set to: ",$ZTRAP
   WRITE !,"Main $ESTACK= ",$ESTACK   // 0
   WRITE !,"Main $ECODE= ",$ECODE
   DO SubA
   WRITE !,"Returned from SubA"   // not executed
   WRITE !,"MainReturn $ECODE= ",$ECODE
   QUIT
SubA
   WRITE !,"SubA $ESTACK= ",$ESTACK   // 1
   WRITE !,6/0    // Error: division by zero
   WRITE !,"fine with me"
   QUIT
OnError
   WRITE !,"OnError $ESTACK= ",$ESTACK   // 0
   WRITE !,"$ECODE= ",$ECODE
   QUIT
```

The following example is identical to the previous example, with one exception: The **$ZTRAP** *location* is prefaced by an asterisk (*). When the error occurs in SubA, this asterisk causes InterSystems IRIS to call the OnError routine at the context level of SubA (where the error occurred), not at the context level of Main (where **$ZTRAP** was set). Therefore, when OnError completes, execution returns to Main at the line following the **DO** command.

```
Main
   NEW $ESTACK
   SET $ZTRAP="*OnError"
   WRITE !,"$ZTRAP set to: ",$ZTRAP
   WRITE !,"Main $ESTACK= ",$ESTACK   // 0
   WRITE !,"Main $ECODE= ",$ECODE
   DO SubA
   WRITE !,"Returned from SubA"   // executed
   WRITE !,"MainReturn $ECODE= ",$ECODE
   QUIT
SubA
   WRITE !,"SubA $ESTACK= ",$ESTACK   // 1
   WRITE !,6/0    // Error: division by zero
   WRITE !,"fine with me"
   QUIT
OnError
   WRITE !,"OnError $ESTACK= ",$ESTACK   // 1
   WRITE !,"$ECODE= ",$ECODE
   QUIT
```

See Also

- THROW command
- ZINSERT command
- $ECODE special variable
- $ESTACK special variable
- $STACK special variable
- Error Processing in *Using ObjectScript*

$ZVERSION

Contains a string describing the current version of InterSystems IRIS.

```
$ZVERSION
$ZV
```

Description

$ZVERSION contains a string showing the version of the currently running instance of InterSystems IRIS® data platform.

The following example returns the **$ZVERSION** string:

```
WRITE $ZVERSION
```

This returns a version string such as the following:

```
IRIS for Windows (x86-64) 2018.1 (Build 487U) Tue Dec 26 2017 22:47:10 EST
```

This string includes the type of InterSystems IRIS installation (product and platform, including CPU type), the version number (2018.1), the build number within that version (the "U" in the build number indicates Unicode), and the date and time that this version of InterSystems IRIS was created. "EST" is Eastern Standard Time (the time zone for the Eastern United States), "EDT" is Eastern Daylight Saving Time (see Daylight Saving Time for details).

The same information can be returned by invoking the **GetVersion()** class method, as follows:

```
WRITE $SYSTEM.Version.GetVersion()
```

You can get the component parts of this version string by invoking other %SYSTEM.Version methods, which you can list by invoking:

```
DO $SYSTEM.Version.Help()
```

Version and build number information can be viewed by going to the InterSystems IRIS launcher and selecting **About...**.

The **$ZVERSION** special variable cannot be modified using the **SET** command. Attempting to do so results in a <SYNTAX> error.

Examples

The following example extracts the create date from the version string to calculate how old the current version of InterSystems IRIS is, in days. Note that this example is specific to Windows platforms:

```
SET createdate=$PIECE($ZVERSION," ",9,11)
WRITE !,"Creation date: ",createdate
WRITE !,"Current date:  ",$ZDATE($HOROLOG,6)
SET nowcount=$PIECE($HOROLOG,",")
SET thencount=$ZDATEH(createdate,6)
WRITE !,"This version is ",(nowcount-thencount)," days old"
```

The following example performs the same operation by calling a class method:

```
SET createdate=$SYSTEM.Version.GetBuildDate()
WRITE !,"Creation date: ",$ZDATE(createdate,6)
WRITE !,"Current date:  ",$ZDATE($HOROLOG,6)
SET nowcount=$PIECE($HOROLOG,",")
WRITE !,"This version is ",(nowcount-createdate)," days old"
```

See Also

- $ZVERSION(1) function
- $SYSTEM special variable

Structured System Variables

A structured system variable name, or SSVN, is a *nonscalar* system variable that is organized like a global variable. SSVNs allow you to write portable programs that can retrieve information about system data. The same ObjectScript code can retrieve system data information from any InterSystems IRIS® implementation using structured system variables.

Each SSVN has a structure where subscript values are any of the following:

- Entity identifiers
- Literals
- Attribute keywords.

You provide information about entities by providing values for subscripts which are identifiers and for attribute nodes.

SSVNs use the caret and dollar sign (^$) as a standard prefix followed by:

1. An optional (extended syntax) specification of the namespace about which you want information
2. One of a designated list of names.

You then follow the name with one or more expressions in parentheses. These expressions are called *subscripts*. The syntax is as follows:

`^$[|`*namespace*`|]` *ssvn_name*`(`*expression*`)`

Generally, you cannot use **SET** and **KILL** commands for structured system variables because they do not necessarily have data values. The information that structured system variables provide is often the existence of specific subscript values. In most cases, you can use the **$DATA**, the **$ORDER**, and the **$QUERY** functions to examine subscript values.

InterSystems IRIS® supports the following structured system variables:

- ^$GLOBAL
- ^$JOB
- ^$LOCK
- ^$ROUTINE

The meaning of each of these SSVNs and use of their subscripts is explained in the following sections.

Each description identifies which functions are allowed with the particular structured system variable. Each description contains one or more examples about how to use structured system variable as arguments to the **$DATA**, **$ORDER**, and **$QUERY** functions to scan system table information.

^$GLOBAL

Provides information about globals and process-private globals.

```
^$|nspace|GLOBAL(global_name)
^$|nspace|G(global_name)

^$||GLOBAL(global_name)
^$||G(global_name)
```

Parameters

|nspace| or *[nspace]*	*Optional* — An extended SSVN reference, either an explicit namespace name or an implied namespace. Must evaluate to a quoted string, which is enclosed in either square brackets (["nspace"]) or vertical bars (|"nspace"|). Namespace names are not case-sensitive; they are stored and displayed in uppercase letters.
global_name	An expression that evaluates to a string containing an unsubscripted global name. Global names are case-sensitive. When using **^$||GLOBAL()** syntax, an unsubscripted global name that corresponds to the process-private global: ^a for ^||a.

Description

You can use **^$GLOBAL** as an argument to the **$DATA**, **$ORDER**, and **$QUERY** functions to return information about the existence of global variables in the current namespace (the default), or in a specified namespace. You can also use **^$GLOBAL** to return information about existence of process-private global variables.

For more information on global variables, refer to Using InterSystems IRIS Multidimensional Storage in *Using Globals*.

Process-Private Globals

You can use **^$GLOBAL** to get information about the existence of process-private global variables in all namespaces. You can specify lookup of a process-private global as either **^$||GLOBAL** or **^$|"^"|GLOBAL**.

For example, to get information about the process-private global `^||a` and its descendents, you would specify `$DATA(^$||GLOBAL("^a"))`. Process-private globals are not namespace-specific, so this lookup returns information about `^||a` regardless of the current namespace when the process-private global was defined.

Note that **^$GLOBAL** does not support specifying process-private global syntax in the *global_name* itself. Attempting to specify *global_name* with process-private global syntax results in a <NAME> error.

Parameters

nspace

This optional parameter allows **^$GLOBAL** to look up a *global_name* that is defined in another namespace. This is known as extended SSVN reference. You can specify the namespace name either explicitly, as a quoted string literal, as a variable, or by specifying an implied namespace. Namespace names are not case-sensitive. You can use either bracket syntax ["USER"] or environment syntax |"USER"|. No spaces are allowed before or after the *nspace* delimiters.

You can test whether a namespace is defined by using the following method:

```
WRITE ##class(%SYS.Namespace).Exists("USER"),!  ; an existing namespace
WRITE ##class(%SYS.Namespace).Exists("LOSER")   ; a non-existent namespace
```

You can use the **$NAMESPACE** special variable to determine the current namespace. The preferred way to change the current namespace is **NEW $NAMESPACE** then **SET $NAMESPACE="nspacename"**.

global_name

An expression that evaluates to a string containing an unsubscripted global name. Globals are case-sensitive.

- **^$GLOBAL("^a")**: The *global_name* `"^a"` looks up this global and its descendents in the current namespace. It does not look up the process-private global `"^||a"`.
- **^$|"USER"|GLOBAL("^a")**: The *global_name* `"^a"` looks up this global and its descendents in the “USER” namespace. It does not look up the process-private global `"^||a"`.
- **^$||GLOBAL("^a")**: The *global_name* `"^a"` looks up the process-private global `"^||a"` and its descendents in all namespaces. It does not look up the global `"^a"`.

Examples

The following examples show how to use **^$GLOBAL** as an argument to the **$DATA**, **$ORDER**, and **$QUERY** functions.

As an Argument to $DATA

^$GLOBAL as an argument to **$DATA** returns an integer value that signifies whether the global name you specify exists as a **^$GLOBAL** node. The integer values that **$DATA** can return are shown in the following table.

Value	Meaning
0	Global name does not exist
1	Global name is an existing node with data but has no descendants.
10	Global name is an existing node with no data but has descendants.
11	Global name is an existing node with data and has descendants.

The following example tests for the existence of the specified global variable in the current namespace:

```
KILL ^GBL
WRITE $DATA(^$GLOBAL("^GBL")),!
SET ^GBL="test"
WRITE $DATA(^$GLOBAL("^GBL")),!
SET ^GBL(1,1,1)="subscripts test"
WRITE $DATA(^$GLOBAL("^GBL"))
```

returns 0, then 1, then 11.

The following example tests for the existence of the specified global variable in the USER namespace:

```
SET $NAMESPACE="USER"
SET ^GBL(1)="test"
SET $NAMESPACE="%SYS"
WRITE $DATA(^$|"USER"|GLOBAL("^GBL"))
```

returns 10.

The following example tests for the existence of the specified process-private global variable in any namespace:

```
SET $NAMESPACE="USER"
SET ^||PPG(1)="test"
SET $NAMESPACE="%SYS"
WRITE $DATA(^$||GLOBAL("^PPG"))
```

returns 10.

As an Argument to $ORDER

$ORDER(^$|*nspace*|GLOBAL(*global_name),direction*)

^$GLOBAL as an argument to **$ORDER** returns the next or previous global name in collating sequence to the global name you specify. If no such global name node exists in **^$GLOBAL**, **$ORDER** returns a null string.

The *direction* argument specifies whether to return the next or the previous global name. If you do not provide a *direction* argument, InterSystems IRIS returns the next global name in collating sequence to the one you specify. For further details, refer to the $ORDER function.

The following subroutine searches the current namespace and stores the global names in a local array named GLOBAL.

```
GLOB
  SET NAME=""
  WRITE !,"The following globals are in ",$NAMESPACE
  FOR I=1:1 {
    SET NAME=$ORDER(^$GLOBAL(NAME))
    WRITE !,NAME
    QUIT:NAME=""
    SET GLOBAL(I)=NAME
  }
  WRITE !,"All done"
  QUIT
```

As an Argument to $QUERY

^$GLOBAL as an argument to **$QUERY** returns the next global name in collating sequence to the global name you specify. If no such global name exists as a node in **^$GLOBAL**, **$QUERY** returns a null string.

In the following example, three globals (^GBL1, ^GBL2 and ^GBL3) are present in the USER namespace.

```
  NEW $NAMESPACE
  SET $NAMESPACE="USER"
  SET (^GBL1,^GBL2,^GBL3)="TEST"
  NEW $NAMESPACE
  SET $NAMESPACE="%SYS"
  WRITE $QUERY(^$|"USER"|GLOBAL("^GBL1")),!
  WRITE $QUERY(^$|"USER"|GLOBAL("^GBL2"))
  NEW $NAMESPACE
  SET $NAMESPACE="USER"
  KILL ^GBL1,^GBL2,^GBL3
```

The first **WRITE** returns `^$|"USER"|GLOBAL("^GBL2")`

The second **WRITE** returns `^$|"USER"|GLOBAL("^GBL3")`

As an Argument to MERGE

^$GLOBAL as the *source* argument of the MERGE command copies the global directory to the *destination* variable. **MERGE** adds each global name as a *destination* subscript with a null value. This is shown in the following example:

```
   MERGE gbls=^$GLOBAL("")
   ZWRITE gbls
```

See Also

- $DATA function
- $ORDER function
- $QUERY function
- ZNSPACE command
- $NAMESPACE special variable
- Configuring Namespaces in *System Administration Guide*

^$JOB

Provides InterSystems IRIS process (job) information.

```
^$JOB(job_number)
^$J(job_number)
```

Parameter

job_number	The system-specific job number created when you enter the ObjectScript command. Every active InterSystems IRIS process has a unique job number. Logging in to the system initiates a job. On UNIX® systems, the job number is the pid of the child process started when InterSystems IRIS was invoked. *job_number* must be specified as an integer; hexadecimal values are not supported.

Description

You can use the ^$JOB structured system variable as an argument to the **$DATA**, **$ORDER**, and **$QUERY** functions to get information about the existence of InterSystems IRIS jobs on the local InterSystems IRIS system.

Examples

The following examples show how to use ^$JOB as an argument to the **$DATA**, **$ORDER**, and **$QUERY** functions.

As an Argument to $DATA

$DATA(^$JOB(*job_number*))

^$JOB as an argument to **$DATA** returns an integer value that indicates whether the specified job exists as a node in ^$JOB. The integer values that **$DATA** can return are shown in the following table.

Value	Meaning
0	Job does not exist.
1	Job exists.

The following example tests for the existence of an InterSystems IRIS process.

```
SET x=$JOB
WRITE !,$DATA(^$JOB(x))
```

The variable x is set to the job number of the current process (for example: 4294219937). The **WRITE** returns the boolean 1, indicating this process exists.

As an Argument to $ORDER

$ORDER(^$JOB(*job_number*),*direction*)

^$JOB as an argument to **$ORDER** returns the next or previous ^$JOB job number in collating sequence to the job number you specify. If no such job number exists as a ^$JOB node, **$ORDER** returns a null string.

The *direction* argument specifies whether to return the next or the previous job number. If you do not provide a *direction* argument, InterSystems IRIS returns the next job number in collating sequence to the one you specify. For further details, refer to the $ORDER function.

The following subroutine searches the InterSystems IRIS job table and stores the job numbers in a local array named JOB.

```
JOB
   SET pid=""
   FOR i=1:1 {
      SET pid=$ORDER(^$JOB(pid))
      QUIT:pid=""
      SET JOB(i)=pid
    }
    WRITE "Total Jobs in Job Table: ",i
    QUIT
```

As an Argument to $QUERY

$QUERY(^$JOB(*job_number*))

^$JOB as an argument to **$QUERY** returns the next ^$JOB job number in collating sequence to the job number you specify. If no such job number exists as a node in ^$JOB, **$QUERY** returns a null string.

The following example returns the first two jobs in the InterSystems IRIS job table. Note the use of the indirection operator (@):

```
   SET x=$QUERY(^$JOB(""))
   WRITE !,x
   WRITE !,$QUERY(@x)
```

returns values for these jobs such as the following:

```
^$JOB("4294117993")
```

```
^$JOB("4294434881")
```

See Also

- JOB command
- $DATA function
- $ORDER function
- $QUERY function
- $JOB special variable
- $ZJOB special variable
- $ZCHILD special variable
- $ZPARENT special variable

^$LOCK

Provides lock name information.

```
^$|nspace|LOCK(lock_name,info_type,pid)
^$|nspace|L(lock_name,info_type,pid)
```

Parameters

|nspace| or *[nspace]*	*Optional* — An extended SSVN reference, either an explicit namespace name or an implied namespace. Must evaluate to a quoted string, which is enclosed in either square brackets (["nspace"]) or vertical bars (|"nspace"|). Namespace names are not case-sensitive; they are stored and displayed in uppercase letters.
lock_name	An expression that evaluates to a string containing a lock variable name, either subscripted or unsubscripted. If a literal, must be specified as a quoted string.
info_type	*Optional* — An expression that resolves to a keyword in all capital letters specified as a quoted string. The *info_type* specifies what type of information about *lock_name* to return. The available options are "OWNER", "FLAGS", "MODE", and "COUNTS". Required when **^$LOCK** is invoked as a stand-alone function.
pid	*Optional* — For use with the "COUNTS" keyword. An integer that specifies the process ID of the owner of the lock. If specified, at most one list element is returned for "COUNTS". If omitted (or specified as 0), a list element is returned for each owner holding the specified lock. *pid* has no effect on the other *info_type* keywords.

Description

The **^$LOCK** structured system variable returns information about locks in the current namespace or a specified namespace on the local system. You can use **^$LOCK** in two ways:

- With *info_type* as a stand-alone function that returns information on a specified lock.
- Without *info_type* as an argument to the **$DATA**, **$ORDER**, or **$QUERY** functions.

Note: **^$LOCK** retrieves lock table information from the lock table on the local system. It will not return information from a lock table on a remote server.

^$LOCK in an ECP Environment

- Local System: When invoking **^$LOCK** for locks held by the local system, the behavior of **^$LOCK** is the same as without ECP, with one exception: the "FLAGS" *info_type* returns an asterisk (*), signifying that the lock is in an ECP environment. This means that remote InterSystems IRIS instances have the ability to hold the lock once it is released.
- Application Server: When invoking **^$LOCK** on an application server for a lock held on another server via ECP (either a data server or another application server), **^$LOCK** does not return any information. Note that this is the same behavior as if the lock did not exist.
- Data Server: When invoking **^$LOCK** on a data server for a lock held by an application server, **^$LOCK** will have slightly different behavior than on a local system, as follows:
  - "OWNER": If the lock is held by an application server connected to a data server that invokes **^$LOCK**, **^$LOCK(lockname, "OWNER")** returns “ECPConfigurationName:MachineName:InstanceName” for the instance holding the lock, but does not identify the specific process holding the lock.

- "FLAGS": If the lock is held by an application server connected to a data server that invokes **^$LOCK**, **^$LOCK(lockname, "FLAGS")** for an exclusive lock returns a “Z” flag. This “Z” signifies a type of legacy lock that is no longer used in InterSystems IRIS except in ECP environments.
- "MODE": If the lock is held by an application server connected to a data server that invokes **^$LOCK**, **^$LOCK(lockname, "MODE")** for an exclusive lock returns “ZAX” instead of “X”. ZA is a type of legacy lock that is no longer used in InterSystems IRIS except in ECP environments. For a shared lock, **^$LOCK(lockname, "MODE")** returns “S”, the same as for a local lock.

Parameters

nspace

This optional parameter allows you to specify a global in another namespace by using an extended SSVN reference. You can specify the namespace name either explicitly, as a quoted string literal or as a variable, or by specifying an implied namespace. Namespace names are not case-sensitive. You can use either bracket syntax ["USER"] or environment syntax |"USER"|. No spaces are allowed before or after the *nspace* delimiters.

You can test whether a namespace is defined by using the following method:

```
WRITE ##class(%SYS.Namespace).Exists("USER"),!  ; an existing namespace
WRITE ##class(%SYS.Namespace).Exists("LOSER")   ; a non-existent namespace
```

You can use the **$NAMESPACE** special variable to determine the current namespace. The preferred way to change the current namespace is **NEW $NAMESPACE** then **SET $NAMESPACE="nspacename"**.

lock_name

An expression that evaluates to a string containing a lock variable name, either subscripted or unsubscripted. A lock variable (commonly a global variable) is defined using the **LOCK** command.

info_type

An *info_type* keyword is required when **^$LOCK** is invoked as a stand-alone function, it is optional when **^$LOCK** is used as an argument to another function. The *info_type* must be specified in capital letters as a quoted string.

- "OWNER" returns the process ID (pid) of the owner(s) of the lock. If the lock is a shared lock, it returns the process IDs of all of the owners of the lock as a comma-separated list. If the specified lock does not exist, **^$LOCK** returns the empty string.
- "FLAGS" returns the state of the lock. It can return the following values: "D" — in delock pending state; "P" — in lock pending state; "N" — this is a node lock, the descendants are not locked; "Z" — this lock is in ZAX mode; "L" — lock is lost, the server no longer has this lock; "*" — this is a remote lock. If the specified lock is in a normal lock state, or does not exist, **^$LOCK** returns the empty string.
- "MODE" returns the lock mode of the current node. It returns 'X' for exclusive lock mode, 'S' for shared lock mode, and 'ZAX' for ZALLOCATE lock mode. If the specified lock does not exist, **^$LOCK** returns the empty string.
- "COUNTS" returns the lock counts for the lock, specified as a binary list structure. For an exclusive lock, the list contains one element; for a shared lock the list contains an element for each owner of the lock. You can use the *pid* parameter to return only the list element for a specified owner of the lock. Each element contains the owner's pid, the exclusive mode increment count, and the shared mode increment count. If both the exclusive and shared mode increment counts are 0 (or " "), the lock is in 'ZAX' mode. An increment count may be followed by a 'D' to indicate that the lock has been unlocked in the current transaction, but its release is delayed ('D') until the transaction is committed or rolled back. If the specified lock does not exist, **^$LOCK** returns the empty string.

The *info_type* keyword must be specified in all capital letters. Specifying an invalid *info_type* keyword generates a <SUBSCRIPT> error.

pid

A process ID of the owner of a lock. Only meaningful when using the "COUNTS" keyword. Used to limit the "COUNTS" return value to (at most) one list element. The *pid* is specified as an integer on all platforms. If the *pid* matches the process ID of an owner of *lock_name* **^$LOCK** returns that owner's "COUNTS" list element; if *pid* does not match the process ID of an owner of *lock_name* **^$LOCK** returns the empty string. Specifying *pid* as 0 is the same as omitting *pid*; **^$LOCK** returns all "COUNTS" list elements. The *pid* parameter is permitted with the "OWNER", "FLAGS", or "MODE" keyword, but is ignored.

Examples

The following example shows the values returned by *info_type* keywords for an exclusive lock:

```
LOCK ^B(1,1)  ; define lock
WRITE !,"lock owner: ",^$LOCK("^B(1,1)","OWNER")
WRITE !,"lock flags: ",^$LOCK("^B(1,1)","FLAGS")
WRITE !,"lock mode: ",^$LOCK("^B(1,1)","MODE")
WRITE !,"lock counts: "
ZZDUMP ^$LOCK("^B(1,1)","COUNTS")
LOCK -^B(1,1) ; delete lock
```

The following example shows how the value returned by *info_type* "COUNTS" changes as you increment and decrement an exclusive lock:

```
LOCK ^B(1,1)      ; define exclusive lock
ZZDUMP ^$LOCK("^B(1,1)","COUNTS")
LOCK +^B(1,1) ; increment lock
ZZDUMP ^$LOCK("^B(1,1)","COUNTS")
LOCK +^B(1,1) ; increment lock again
ZZDUMP ^$LOCK("^B(1,1)","COUNTS")
LOCK -^B(1,1) ; decrement lock
ZZDUMP ^$LOCK("^B(1,1)","COUNTS")
LOCK -^B(1,1) ; decrement lock again
ZZDUMP ^$LOCK("^B(1,1)","COUNTS")
LOCK -^B(1,1) ; delete exclusive lock
```

The following example shows how the value returned by *info_type* "COUNTS" changes as you increment and decrement a shared lock:

```
LOCK ^S(1,1)#"S"   ; define shared lock
ZZDUMP ^$LOCK("^S(1,1)","COUNTS")
LOCK +^S(1,1)#"S" ; increment lock
ZZDUMP ^$LOCK("^S(1,1)","COUNTS")
LOCK +^S(1,1)#"S" ; increment lock again
ZZDUMP ^$LOCK("^S(1,1)","COUNTS")
LOCK -^S(1,1)#"S" ; decrement lock
ZZDUMP ^$LOCK("^S(1,1)","COUNTS")
LOCK -^S(1,1)#"S" ; decrement lock again
ZZDUMP ^$LOCK("^S(1,1)","COUNTS")
LOCK -^S(1,1)#"S" ; delete shared lock
```

The following examples show how to use **^$LOCK** as an argument to the **$DATA**, **$ORDER**, and **$QUERY** functions.

As an Argument to $DATA

$DATA(^$|*nspace*|LOCK(*lock_name*))

^$LOCK as an argument to **$DATA** returns an integer value that specifies whether the lock name exists as a node in **^$LOCK**. The integer values that **$DATA** can return are shown in the following table.

Value	Meaning
0	Lock name information does not exist
10	Lock name information exists

Note that **$DATA** used in this context can only return 0 or 10, with 10 meaning that the specified lock exists. It cannot determine if a lock has descendents, and cannot return 1 or 11.

The following example tests for the existence of a lock name in the current namespace. The first WRITE returns 10 (lock name exists), the second WRITE returns 0 (lock name does not exist):

```
LOCK ^B(1,2)  ; define lock
WRITE !,$DATA(^$LOCK("^B(1,2)"))
LOCK -^B(1,2) ; delete lock
WRITE !,$DATA(^$LOCK("^B(1,2)"))
```

As an Argument to $ORDER

$ORDER(^$|*nspace*|LOCK(*lock_name*),*direction*)

^$LOCK as an argument to **$ORDER** returns the next or previous **^$LOCK** lock name node in collating sequence to the lock name you specify. If no such lock name exists as a **^$LOCK** node, **$ORDER** returns a null string.

Locks are returned in case-sensitive string collation order. Subscripts of a named lock are returned in subscript tree order, using numeric collation.

The *direction* argument specifies whether to return the next or the previous lock name. If you do not provide a *direction* argument, InterSystems IRIS returns the next lock name in collating sequence to the one you specify. For further details, refer to the $ORDER function.

The following subroutine searches the locks in the SAMPLES namespace and stores the lock names in a local array named LOCKET.

```
LOCKARRAY
  SET lname=""
  FOR I=1:1 {
      SET lname=$ORDER(^$|"SAMPLES"|LOCK(lname))
      QUIT:lname=""
      SET LOCKET(I)=lname
      WRITE !,"the lock name is: ",lname
  }
  WRITE !,"All lock names listed"
  QUIT
```

As an Argument to $QUERY

$QUERY(^$|*nspace*|LOCK(*lock_name*))

^$LOCK as an argument to **$QUERY** returns the next lock name in collating sequence to the lock name you specify. If there is no next lock name defined as a node in **^$LOCK**, **$QUERY** returns a null string.

Locks are returned in case-sensitive string collation order. Subscripts of a named lock are returned in subscript tree order, using numeric collation.

In the following example, five global lock names are created (in random order) in the current namespace.

```
LOCK (^B(1),^A,^D,^A(1,2,3),^A(1,2))
WRITE !,"lock name: ",$QUERY(^$LOCK(""))
WRITE !,"lock name: ",$QUERY(^$LOCK("^C"))
WRITE !,"lock name: ",$QUERY(^$LOCK("^A(1,2)"))
```

$QUERY treats all global lock variable names, subscripted or unsubscripted, as character strings and retrieves them in string collating order. Therefore, $QUERY(^$LOCK("")) retrieve the first lock name in collating sequence order: either ^$LOCK("^A") or an InterSystems IRIS-defined lock higher in the collating sequence. $QUERY(^$LOCK("^C")) retrieves the next lock name in collating sequence after the nonexistent ^C: ^$LOCK("^D"). $QUERY(^$LOCK("^A(1,2)")) retrieve ^$LOCK("^A(1,2,3)") which follows it in collation sequence.

See Also

- LOCK command

- $DATA function
- $ORDER function
- $QUERY function
- $NAMESPACE special variable
- Configuring Namespaces in *System Administration Guide*

^$ROUTINE

Provides routine information.

```
^$|nspace|ROUTINE(routine_name)
^$|nspace|R(routine_name)
```

Parameters

|*nspace*| or [*nspace*]	*Optional* — An extended SSVN reference, either an explicit namespace name or an implied namespace. Must evaluate to a quoted string, which is enclosed in either square brackets (["nspace"]) or vertical bars (|"nspace"|). Namespace names are not case-sensitive; they are stored and displayed in uppercase letters.
routine_name	An expression that evaluates to a string containing the name of a routine.

Description

You can use the **^$ROUTINE** structured system variable as an argument to the **$DATA**, **$ORDER**, and **$QUERY** functions to return routine information from the current namespace (the default) or a specified namespace. **^$ROUTINE** returns routine information on the OBJ code version of the routine.

In InterSystems ObjectScript, a rountine exists in three code versions: MAC (user-written code, which may include macro pre-processor statements); INT (compiled MAC code, which performs macro preprocessing), and OBJ (executable object code). You can use the ^ROUTINE global to return information on the INT code version. You can use **^$ROUTINE** to return information on the OBJ code version.

Parameters

nspace

This optional parameter allows you to specify a global in another namespace by using an extended SSVN reference. You can specify the namespace name either explicitly, as a quoted string literal or as a variable, or by specifying an implied namespace. Namespace names are not case-sensitive. You can use either bracket syntax ["USER"] or environment syntax |"USER"|. No spaces are allowed before or after the *nspace* delimiters.

You can test whether a namespace is defined by using the following method:

```
WRITE ##class(%SYS.Namespace).Exists("USER"),!  ; an existing namespace
WRITE ##class(%SYS.Namespace).Exists("LOSER")   ; a non-existent namespace
```

You can use the **$NAMESPACE** special variable to determine the current namespace. The preferred way to change the current namespace is **NEW $NAMESPACE** then **SET $NAMESPACE="nspacename"**.

routine_name

An expression that evaluates to a string containing the name of an existing routine. A routine name must be unique within the first 255 characters; routine names longer than 220 characters should be avoided.

Examples

The following are examples of using **^$ROUTINE** as an argument to the **$DATA**, **$ORDER**, and **$QUERY** functions.

As an Argument to $DATA

$DATA(^$|*nspace*|ROUTINE(*routine_name*))

^$ROUTINE as an argument to **$DATA** returns an integer value that specifies whether the *routine_name* OBJ code version exists as a node in **^$ROUTINE**. The integer values that **$DATA** can return are shown in the following table.

Value	Meaning
0	Routine name does not exist
1	Routine name exists

The following Terminal example tests for the existence of the OBJ code version of the myrou routine. This example assumes that there is a compiled MAC routine named myrou in the USER namespace:

```
USER>WRITE ^ROUTINE("myrou",0,"GENERATED")  // INT code version exists
1
USER>WRITE $DATA(^$ROUTINE("myrou"))        // OBJ code version exists
1
USER>KILL ^rOBJ("myrou")                    // Kills the OBJ code version

USER>DO ^myrou

DO ^myrou
^
<NOROUTINE> *myrou
USER>WRITE ^ROUTINE("myrou",0,"GENERATED")  // INT code version exists
1
USER>WRITE $DATA(^$ROUTINE("myrou"))        // OBJ code version does not exist
0
USER>
```

As an Argument to $ORDER

$ORDER(^$|*nspace*|ROUTINE(*routine_name),direction*)

^$ROUTINE as an argument to **$ORDER** returns the next or previous routine name in collating sequence to the routine name you specify. If no such routine name exists as a node in **^$ROUTINE**, **$ORDER** returns a null string.

The *direction* argument specifies whether to return the next or the previous routine name: 1=next, -1=previous. If you do not provide a *direction* argument, InterSystems IRIS returns the next routine name in collating sequence to the one you specify. For further details, refer to the $ORDER function.

The following subroutine searches the USER namespace and stores the routine names in a local array named ROUTINE.

```
  SET rname=""
  FOR I=1:1 {
      SET rname=$ORDER(^$|"USER"|ROUTINE(rname))
      QUIT:rname=""
      SET ROUTINE(I)=rname
      WRITE !,"Routine name: ",rname
  }
  WRITE !,"All routines stored"
  QUIT
```

As an Argument to $QUERY

$QUERY(^$|*nspace*|ROUTINE(*routine_name*))

^$ROUTINE as an argument to **$QUERY** returns the next routine name in collating sequence to the routine name you specify. The specified routine name does not have to exist. If there is no routine name later in the collating sequence, **$QUERY**(**^$ROUTINE**) returns a null string.

In the following example, two **$QUERY** functions return the next routine after the specified routine name in the USER namespace.

```
  SET rname=""
  WRITE !,"1st routine: ",$QUERY(^$|"USER"|ROUTINE(rname))
  SET rname="%m"
  WRITE !,"1st ",rname, " routine: ",$QUERY(^$|"USER"|ROUTINE(rname))
   QUIT
```

See Also

- $DATA function
- $ORDER function
- $QUERY function
- $NAMESPACE special variable
- Configuring Namespaces in *System Administration Guide*