KSH(1) General Commands Manual KSH(1)

NAME

ksh, rksh - KornShell, a standard/restricted command and programming language

SYNOPSIS

ksh [?abcefhiklmnprstuvxBCDEGH] [?o option] ... [-] [arg ...]

rksh [?abcefhiklmnpstuvxBCDEGH] [?o option] ... [-] [arg ...]

DESCRIPTION

Ksh is a command and programming language that executes commands read from a terminal or a file. Rksh is a restricted version of the command interpreter ksh; it is used to set up login names and execution envi? ronments whose capabilities are more controlled than those of the stan? dard shell. See Invocation below for the meaning of arguments to the shell.

Definitions.

A metacharacter is one of the following characters:

; & ( ) | < > new-line space tab

A blank is a tab or a space. An identifier is a sequence of letters,

fiers are used as components of variable names. A vname is a sequence of one or more identifiers separated by a . and optionally preceded by a .. Vnames are used as function and variable names. A word is a se? quence of characters from the character set defined by the current lo? cale, excluding non-quoted metacharacters.

A command is a sequence of characters in the syntax of the shell lan? guage. The shell reads each command and carries out the desired action either directly or by invoking separate utilities. A built-in command is a command that is carried out by the shell itself without creating a separate process. Some commands are built in purely for convenience and are not documented here. Built-ins that cause side effects in the shell environment and built-ins that are found before performing a path search (see Execution below) are documented here. For historical rea? sons, some of these built-ins behave differently than other built-ins and are called special built-ins.

Commands.

A simple-command is a list of variable assignments (see Variable As? signments below) or a sequence of blank separated words which may be preceded by a list of variable assignments (see Environment below). The first word specifies the name of the command to be executed. Ex? cept as specified below, the remaining words are passed as arguments to the invoked command. The command name is passed as argument 0 (see

it terminates normally; 256+signum if it terminates abnormally (the name of the signal corresponding to the exit status can be obtained via the -l option of the kill built-in utility).

A pipeline is a sequence of one or more commands separated by |. The standard output of each command but the last is connected by a socket? pair(2) or (if the posix shell option is on) by a pipe(2) to the stan? dard input of the next command. Each command except the last is run asynchronously in a subshell (see Subshells below). If the monitor or pipefail option is on, or the pipeline is preceded by the reserved word time, then the shell waits for all component commands in the pipeline to terminate; otherwise, the shell only waits for the last component command. The exit status of a pipeline is the exit status of its last component command, unless the pipefail option is enabled. Each pipeline can be preceded by the reserved word ! which causes the exit status of the pipeline to become 0 if the exit status of the last com? mand is non-zero, and 1 if the exit status of the last command is 0.

A list is a sequence of one or more pipelines separated by ;, &, |&, &&, or ||, and optionally terminated by ;, &, or |&. Of these five symbols, ;, &, and |& have equal precedence, which is lower than that of && and ||. The symbols && and || also have equal precedence. A semicolon (;) causes sequential execution of the preceding pipeline; an ampersand (&) causes asynchronous execution of the preceding pipeline

bol |& causes asynchronous execution of the preceding pipeline with a two-way pipe established to the parent shell; the standard input and output of the spawned pipeline can be written to and read from by the parent shell by applying the redirection operators <& and >& with arg p to commands and by using -p option of the built-in commands read and print described later. The symbol && (||) causes the list following it to be executed only if the preceding pipeline returns a zero (non-zero) value. One or more new-lines may appear in a list instead of a semi? colon, to delimit a command. The first item of the first pipeline of a list that is a simple command not beginning with a redirection, and not occurring within a while, until, or if list, can be preceded by a semicolon. This semicolon is ignored unless the showme option is en? abled as described with the set built-in below.

A command is either a simple-command or a compound-command, which is one of the following. Unless otherwise stated, the value returned by a command is that of the last simple-command executed in the command.

for vname [in word ...] ;do list ;done

Each time a for command is executed, vname is set to the next word taken from the in word list. If in word ... is omitted, then the for command executes the do list once for each posi? tional parameter that is set starting from 1 (see Parameter Ex? pansion below). Execution ends when there are no more words in

for (([expr1] ; [expr2] ; [expr3])) ;do list ;done

The arithmetic expression expr1 is evaluated first (see Arith? metic Evaluation below). The arithmetic expression expr2 is re? peatedly evaluated until it evaluates to zero and when non-zero, list is executed and the arithmetic expression expr3 evaluated. If any expression is omitted, then it behaves as if it evaluated to 1.

select vname [in word ...] ;do list ;done

A select command prints on standard error (file descriptor 2) the set of words, each preceded by a number. If in word ... is omitted, then the positional parameters starting from 1 are used instead (see Parameter Expansion below). The PS3 prompt is printed and a line is read from the standard input. If this line consists of the number of one of the listed words, then the value of the variable vname is set to the word corresponding to this number. If this line is empty, the selection list is printed again. Otherwise the value of the variable vname is set to the empty string. The contents of the line read from stan? dard input is saved in the variable REPLY. The list is executed for each selection until a break or end-of-file is encountered. If the REPLY variable is set to the empty string by the execu? tion of list, then the selection list is printed before display?

case word in [[(]pattern [| pattern] ...) list ;;] ... esac

A case command executes the list associated with the first pat? tern that matches word. The form of the patterns is the same as that used for pathname expansion (see Pathname Expansion below). The ;; operator causes execution of case to terminate. If ;& is used in place of ;; the next subsequent list, if any, is exe? cuted.

if list ;then list [;elif list ;then list] ... [;else list] ;fi

The list following if is executed and, if it returns a zero exit status, the list following the first then is executed. Other? wise, the list following elif is executed and, if its value is zero, the list following the next then is executed. Failing each successive elif list, the else list is executed. If the if list has non-zero exit status and there is no else list, then the if command returns a zero exit status.

while list ;do list ;done

until list ;do list ;done

A while command repeatedly executes the while list and, if the exit status of the last command in the list is zero, executes the do list; otherwise the loop terminates. If no commands in the do list are executed, then the while command returns a zero

loop termination test.

while inputredirection ;do list ;done

Filescan loop. This is defined by a lone input redirection fol? lowing while (see Input/Output below). It is faster than using the read built-in command in a regular while loop. The shell reads lines from the file or stream opened by inputredirection until the end is reached or the loop is broken. For each line read, the command list is executed with the line's contents as? signed to the REPLY variable and the line's fields split into the positional parameters (see Field Splitting and Positional Parameters below). Within the list, standard input is redi? rected to /dev/null. If the posix compatibility shell option is on, this loop type is disabled and inputredirection is processed like a lone redirection in any other context.

((expression))

The expression is evaluated using the rules for arithmetic eval? uation described below. If the value of the arithmetic expres? sion is non-zero, the exit status is 0, otherwise the exit sta? tus is 1.

(list)

Execute list in a subshell (see Subshells below). Note, that if

must be inserted to avoid evaluation as an arithmetic command as described above.

{ list;}

list is simply executed. Note that unlike the metacharacters (and), { and } are reserved words and must occur at the begin? ning of a line or after a ; in order to be recognized.

[[expression]]

Evaluates expression and returns a zero exit status when expres? sion is true. See Conditional Expressions below, for a descrip? tion of expression.

function varname { list ;} [redirection ...]

varname () compound-command [redirection ...]

Define a function which is referenced by varname. A function whose varname contains a . is called a discipline function and the portion of the varname preceding the last . must refer to an existing variable. The body of the function is the list of commands between { and }. A function defined with the function varname syntax can also be used as an argument to the . special built-in command to get the equivalent behavior as if the var? name() syntax were used to define it. (See Functions below.)

Defines or uses the name space identifier and runs the commands in list in this name space. (See Name Spaces below.)

time [pipeline]

If pipeline is omitted the user and system time for the current shell and completed child processes is printed on standard er? ror. Otherwise, pipeline is executed and the elapsed time as well as the user and system time are printed on standard error. The TIMEFORMAT variable may be set to a format string that spec? ifies how the timing information should be displayed. See Shell Variables below for a description of the TIMEFORMAT variable.

The following reserved words are recognized as reserved only when they are the first word of a command and are not quoted:

if then else elif fi case esac for while until do done { } function se? lect time [[ ]] !

Variable Assignments.

One or more variable assignments can start a simple command or can be arguments to the typeset, enum, export, or readonly special built-in commands as well as to other declaration commands created as types. The syntax for an assignment is of the form:

varname[word]=word

No space is permitted between varname and the = or between = and word.

varname=(assign_list)

No space is permitted between varname and the =. The variable varname is unset before the assignment. An assign_list can be one of the following:

word ...

Indexed array assignment.

[word]=word ...

Associative array assignment. If preceded by typeset -a this will create an indexed array in? stead.

assignment ...

Compound variable assignment. This creates a compound variable varname with subvariables of the form varname.name, where name is the name portion of assignment. The value of varname will contain all the assignment elements. Additional assignments made to subvariables of varname will also be displayed as part of the value of var? name. If no assignments are specified, varname will be a compound variable allowing subsequence

typeset [options] assignment ...

Nested variable assignment. Multiple assignments can be specified by separating each of them with a ;. The previous value is unset before the as? signment. Other declaration commands such as readonly, enum, and other declaration commands can be used in place of typeset.

. filename

Include the assignment commands contained in filename.

In addition, a += can be used in place of the = to signify adding to or appending to the previous value. When += is applied to an arithmetic type, word is evaluated as an arithmetic expression and added to the current value. When applied to a string variable, the value defined by word is appended to the value. For compound assignments, the previous value is not unset and the new values are appended to the current ones provided that the types are compatible.

The right hand side of a variable assignment undergoes all the expan? sion listed below except word splitting, brace expansion, and pathname expansion. When the left hand side is an assignment is a compound variable and the right hand is the name of a compound variable, the compound variable on the right will be copied or appended to the com?

Comments.

A word beginning with # causes that word and all the following charac? ters up to a new-line to be ignored.

Aliasing.

The first word of each command is replaced by the text of an alias if an alias for this word has been defined. An alias name consists of any number of characters excluding metacharacters, quoting characters, file expansion characters, parameter expansion and command substitution characters, the characters / and =. The replacement string can contain any valid shell script including the metacharacters listed above. The first word of each command in the replaced text, other than any that are in the process of being replaced, will be tested for aliases. If the last character of the alias value is a blank then the word follow? ing the alias will also be checked for alias substitution. Aliases can be used to redefine built-in commands but cannot be used to redefine the reserved words listed above. Aliases can be created and listed with the alias command and can be removed with the unalias command.

Aliasing is performed when scripts are read, not while they are exe? cuted. Therefore, for an alias to take effect, the alias definition command has to be executed before the command which references the alias is read.

The following aliases are automatically preset when the shell is in? voked as an interactive shell. Preset aliases can be unset or rede? fined.

history=?hist -l?

r=?hist -s?

Tilde Expansion.

After alias substitution is performed, each word is checked to see if it begins with an unquoted ?. For tilde expansion, word also refers to the word portion of parameter expansion (see Parameter Expansion be? low). If a word is preceded by a tilde, then it is checked up to a / to see if it matches a user name in the password database (see getpw? name(3)). If a match is found, the ? and the matched login name are replaced by the login directory of the matched user. If no match is found, the original text is left unchanged. A ? by itself, or in front of a /, is replaced by $HOME, unless the HOME variable is unset, in which case the current user's home directory as configured in the oper? ating system is used. A ? followed by a + or - is replaced by $PWD or $OLDPWD respectively.

In addition, when expanding a variable assignment (see Variable Assign? ments above), tilde expansion is attempted when the value of the as? signment begins with a ?, and when a ? appears after a :. A : also terminates a user name following a ?.

The tilde expansion mechanism may be extended or modified by defining one of the discipline functions .sh.tilde.set or .sh.tilde.get (see Functions and Discipline Functions below). If either exists, then upon encountering a tilde word to expand, that function is called with the tilde word assigned to either .sh.value (for the .sh.tilde.set func? tion) or .sh.tilde (for the .sh.tilde.get function). Performing tilde expansion within a discipline function will not recursively call that function, but default tilde expansion remains active, so literal tildes should still be quoted where required. Either function may assign a replacement string to .sh.value. If this value is non-empty and does not start with a ?, it replaces the default tilde expansion when the function terminates. Otherwise, the tilde expansion is left unchanged.

Subshells.

A subshell is a separate execution environment that is a complete du? plicate of the current shell environment, except for two things: all traps are reset to default except those for signals that are being ig? nored, and subshells cannot be interactive (i.e., they have no command prompt). Changes made within a subshell do not affect the parent envi? ronment and are lost when the subshell exits.

Particular care should be taken not to confuse a subshell with a newly invoked shell that is merely a child process of the current shell, and which (unlike a subshell) starts from scratch in terms of variables and

ternet that confuse these.

Subshells cannot be created or invoked using any command. Instead, the following are automatically run in a subshell:

? any command or group of commands enclosed in parentheses;

? command substitutions of the first and third form (see Com? mand Substitution below);

? process substitutions (see Process Substitution below);

? all elements of a pipeline except the last;

? any command executed asynchronously (i.e., in a background process).

Creating processes is expensive, so as a performance optimization, a subshell of a non-interactive shell may share the process of its parent environment. Such a subshell is known as a virtual subshell. Subshells are virtual unless or until something (such as asynchronous execution, or an attempt to set a process limit using the ulimit built-in command, or other implementation- or system-defined requirements) makes it nec? essary to fork(2) it into a separate process. Barring any bugs in the

shells except by their execution speed and their process ID. See the description of the .sh.pid variable below for more information.

Command Substitution.

The standard output from a command list enclosed in parentheses pre? ceded by a dollar sign ($(list)), or in a brace group preceded by a dollar sign (${ list;}), or in a pair of grave accents (``) may be used as part or all of a word; trailing new-lines are removed. In the second case, the { and } are treated as a reserved words so that { must be followed by a blank and } must appear at the beginning of the line or follow a ;. In the third (obsolete) form, the string between the quotes is processed for special quoting characters before the command is executed (see Quoting below). The command substitution $(cat file) can be replaced by the equivalent but faster $(<file). The command substitution $(n<#) will expand to the current byte offset for file de? scriptor n. Except for the second form, the command list is run in a subshell so that no side effects are possible. For the second form, the final } will be recognized as a reserved word after any token.

Arithmetic Expansion.

An arithmetic expression enclosed in double parentheses preceded by a dollar sign ($(())) is replaced by the value of the arithmetic ex? pression within the double parentheses.

Each command argument of the form <(list) or >(list) will run process list asynchronously connected to some file in /dev/fd if this directory exists, or else a fifo in a temporary directory. The name of this file will become the argument to the command. If the form with > is se? lected then writing on this file will provide input for list. If < is used, then the file passed as an argument will contain the output of the list process. For example,

```
paste <(cut -f1 file1) <(cut -f3 file2) | tee >(process1)
>(process2)
```

cuts fields 1 and 3 from the files file1 and file2 respectively, pastes the results together, and sends it to the processes process1 and process2, as well as putting it onto the standard output. Note that the file, which is passed as an argument to the command, is a UNIX pipe(2) so programs that expect to lseek(2) on the file will not work.

Process substitution of the form <(list) can also be used with the < redirection operator which causes the output of list to be standard in? put or the input for whatever file descriptor is specified.

Parameter Expansion.

A parameter is a variable, one or more digits, or any of the characters *, @, #, ?, -, $, and !. A variable is denoted by a vname. To create

everything before the last . must already exist. A variable has a value and zero or more attributes. Variables can be assigned values and attributes by using the typeset special built-in command. The at? tributes supported by the shell are described later with the typeset special built-in command. Exported variables pass their attributes to the environment so that a newly invoked ksh that is a child or exec'd process of the current shell will automatically import them, unless the posix shell option is on.

The shell supports both indexed and associative arrays. An element of an array variable is referenced by a subscript. A subscript for an in? dexed array is denoted by an arithmetic expression (see Arithmetic Evaluation below) between a [and a]. To assign values to an indexed array, use vname=(value ...) or set -A vname value ... . The value of all non-negative subscripts must be in the range of 0 through 4,194,303. A negative subscript is treated as an offset from the maxi? mum current index +1 so that -1 refers to the last element. Indexed arrays can be declared with the -a option to typeset. Indexed arrays need not be declared. Any reference to a variable with a valid sub? script is legal and an array will be created if necessary.

An associative array is created with the -A option to typeset. A sub? script for an associative array is denoted by a string enclosed between [and].

Referencing any array without a subscript is equivalent to referencing the array with subscript 0.

The value of a variable may be assigned by writing:

vname=value [vname=value] ...

or

vname[subscript]=value [vname[subscript]=value] ...

Note that no space is allowed before or after the =.

Attributes assigned by the typeset special built-in command apply to all elements of the array. An array element can be a simple variable, a compound variable or an array variable. An element of an indexed ar? ray can be either an indexed array or an associative array. An element of an associative array can also be either. To refer to an array ele? ment that is part of an array element, concatenate the subscript in brackets. For example, to refer to the foobar element of an associa? tive array that is defined as the third element of the indexed array, use ${vname[3][foobar]}

A nameref is a variable that is a reference to another variable. A

lent nameref command. The value of the variable at the time of that command becomes the variable that will be referenced whenever the nameref variable is used. The name of a nameref cannot contain a .. When a variable or function name contains a ., and the portion of the name up to the first . matches the name of a nameref, the variable re? ferred to is obtained by replacing the nameref portion with the name of the variable referenced by the nameref. If a nameref is used as the index of a for loop, a name reference is established for each item in the list.

A nameref provides a convenient way to refer to the variable inside a function whose name is passed as an argument to a function. For exam? ple, if the name of a variable is passed as the first argument to a function, the command typeset -n var=$1 (a.k.a. nameref var=$1) inside the function causes references and assignments to var to be references and assignments to the variable whose name has been passed to the func? tion. Note that, for this to work, the positional parameter must be assigned directly to the nameref as part of the declaration command, as in the example above; only that idiom can allow one function to access a local variable of another. For instance, typeset -n var; var=$1 won't cross that barrier, nor will typeset foo=$1; typeset -n var=foo.

If any of the floating point attributes, -E, -F, or -X, or the integer attribute, -i, is set for vname, then the value is subject to arith?

Positional parameters, parameters denoted by a number, may be assigned values with the set special built-in command. Parameter $0 is set from argument zero when the shell is invoked.

The character $ is used to introduce substitutable parameters.

${parameter}

The shell reads all the characters from ${ to the matching } as part of the same word even if it contains braces or metacharac? ters. The value, if any, of the parameter is substituted. The braces are required when parameter is followed by a letter, digit, or underscore that is not to be interpreted as part of its name, when the variable name contains a .. The braces are also required when a variable is subscripted unless it is part of an Arithmetic Expression or a Conditional Expression. If pa? rameter is one or more digits then it is a positional parameter. A positional parameter of more than one digit must be enclosed in braces. If parameter is * or @, then all the positional pa? rameters, starting with $1, are substituted (separated by a field separator character). If an array vname with last sub? script * @, or for indexed arrays of the form sub1 .. sub2. is used, then the value for each of the elements between sub1 and sub2 inclusive (or all elements for * and @) is substituted,

${#parameter}

If parameter is * or @, the number of positional parameters is substituted. Otherwise, the length of the value of the parame? ter is substituted.

${#vname[*]}

${#vname[@]}

The number of elements in the array vname is substituted.

${@vname}

Expands to the type name (See Type Variables below) or attrib? utes of the variable referred to by vname.

${!vname}

Expands to the name of the variable referred to by vname. This will be vname except when vname is a name reference.

${!vname[subscript]}

Expands to name of the subscript unless subscript is *, @. or of the form sub1 .. sub2. When subscript is *, the list of ar? ray subscripts for vname is generated. For a variable that is not an array, the value is 0 if the variable is set. Otherwise it is the empty string. When subscript is @, same as above, ex?

yields a separate argument. When subscript is of the form sub1 .. sub2 it expands to the list of subscripts between sub1 and sub2 inclusive using the same quoting rules as @.

${!prefix@}

${!prefix*}

These both expand to the names of the variables whose names be? gin with prefix. The expansions otherwise work like $@ and $*, respectively (see under Quoting below).

${parameter:-word}

If parameter is set and has a non-empty value, then substitute its value; otherwise substitute word.

${parameter:=word}

If parameter is not set or has the empty string value, then set it to word; the value of the parameter is then substituted. Po? sitional parameters may not be assigned to in this way.

${parameter:?word}

If parameter is set and has a non-empty value, then substitute its value; otherwise, print word and exit from the shell (if not interactive). If word is omitted then a standard message is printed.

${parameter:+word}

If parameter is set and has a non-empty value then substitute word; otherwise substitute the empty string.

In the above, word is not evaluated unless it is to be used as the substituted string, so that, in the following example, pwd is executed only if d is not set or has the empty string value:

print ${d:-$(pwd)}

If the colon (:) is omitted from the above expressions, then the shell only checks whether parameter is set or not.

${parameter:offset:length}

${parameter:offset}

Expands to the portion of the value of parameter starting at the character (counting from 0) determined by expanding offset as an arithmetic expression and consisting of the number of characters determined by the arithmetic expression defined by length. In the second form, the remainder of the value is used. If A negative offset counts backwards from the end of parameter. Note that one or more blanks is required in front of a minus sign to prevent the shell from interpreting the operator as :-. If parameter is * or @, or is an array name indexed by * or @, then

ments respectively. A negative offset is taken relative to one greater than the highest subscript for indexed arrays. The or? der for associative arrays is unspecified.

${parameter#pattern}

${parameter##pattern}

If the shell pattern matches the beginning of the value of para? meter, then the value of this expansion is the value of the pa? rameter with the matched portion deleted; otherwise the value of this parameter is substituted. In the first form the smallest matching pattern is deleted and in the second form the largest matching pattern is deleted. When parameter is @, *, or an ar? ray variable with subscript @ or *, the substring operation is applied to each element in turn.

${parameter%pattern}

${parameter%%pattern}

If the shell pattern matches the end of the value of parameter, then the value of this expansion is the value of the parameter with the matched part deleted; otherwise substitute the value of parameter. In the first form the smallest matching pattern is deleted and in the second form the largest matching pattern is deleted. When parameter is @, *, or an array variable with sub? script @ or *, the substring operation is applied to each ele?

${parameter/pattern/string}

${parameter//pattern/string}

${parameter/#pattern/string}

${parameter/%pattern/string}

Expands parameter and replaces the longest match of pattern with the given string. Each occurrence of \n in string is replaced by the portion of parameter that matches the n-th subpattern. In the first form, only the first occurrence of pattern is re? placed. In the second form, each match for pattern is replaced by the given string. The third form restricts the pattern match to the beginning of the string while the fourth form restricts the pattern match to the end of the string. In the first and second forms, an empty pattern never matches. In the third and fourth forms, an empty pattern matches the beginning or the end of the string, respectively. When string is empty, the pattern will be deleted and the / in front of string may be omitted. When parameter is @, *, or an array variable with subscript @ or *, the substitution operation is applied to each element in turn. In this case, the string portion of word will be re-eval? uated for each element.

Shell Variables.

The following parameters are automatically set by the shell:

- Options supplied to the shell on invocation or by the set command.

? The exit status returned by the last executed command. Its meaning depends on the command or function that de? fines it, but there are conventions that other commands often depend on: zero typically means 'success' or 'true', one typically means 'non-success' or 'false', and a value greater than one typically indicates some kind of error. Only the 8 least significant bits of $? (values 0 to 255) are preserved when the exit status is passed on to a parent process, but within the same (sub)shell envi? ronment, it is a signed integer value with a range of possible values as shown by the commands getconf INT_MIN and getconf INT_MAX. Shell functions that run in the cur? rent environment may return status values in this range.

$ The process ID of the main shell process. Note that this value will not change in a subshell, even if the subshell runs in a different process. See also .sh.pid.

_ Initially, the value of _ is an absolute pathname of the shell or script being executed as passed in the environ?

the previous command. This parameter is not set for com? mands which are asynchronous. This parameter is also used to hold the name of the matching MAIL file when checking for mail. While defining a compound variable or a type, _ is initialized as a reference to the compound variable or type. When a discipline function is invoked, _ is initialized as a reference to the variable associ? ated with the call to this function. Finally when _ is used as the name of the first variable of a type defini? tion, the new type is derived from the type of the first variable. (See Type Variables below.)

! The process ID of the last background command invoked or the most recent job put in the background with the bg built-in command.

.sh.command

When processing a DEBUG trap, this variable contains the current command line that is about to run. The value is in the same format as the output generated by the xtrace option (minus the preceding PS4 prompt).

.sh.edchar

This variable contains the value of the keyboard charac?

an ESC, ASCII 033) that has been entered when processing a KEYBD trap (see Key Bindings below). If the value is changed as part of the trap action, then the new value replaces the key (or key sequence) that caused the trap.

.sh.edcol

The character position of the cursor at the time of the most recent KEYBD trap.

.sh.edmode

Upon executing a KEYBD trap action, the value of this variable is set to the ESC control character if the shell is in vi input mode (See Vi Editing Mode below), or to the empty string value otherwise.

.sh.edtext

The characters in the input buffer at the time of the most recent KEYBD trap. The variable is unset when not processing a KEYBD trap.

.sh.file

The pathname of the file that contains the current com? mand.

The name of the current function that is being executed.

.sh.level

Set to the current call depth of functions and dot scripts. Normally, this variable is read-only, but while executing a DEBUG trap, its value may be changed to switch the current function scope to that of the speci? fied level for the duration of the trap run, making it possible to access a parent scope for debugging purposes. When trap execution ends, the variable and the scope are restored. It is an error to assign a value lower than 0 (the global scope) or higher than the current call depth.

.sh.lineno

Set during a DEBUG trap to the line number for the caller of each function.

.sh.match

Whenever a match is found in a pattern matching operation using either the [[compound command (see Conditional Ex? pressions below) or the expansions ${parameter#pattern}, ${parameter%pattern}, ${parameter/pattern/string}, or one of their variants (see Parameter Expansion above), the match and its subpattern matches are stored in this in?

element stores the complete match and the i-th element stores the i-th submatch. For //, the array is two-di? mensional, with the first subscript indicating the most recent match and subpattern match, and the second sub? script indicating which match with 0 representing the first match. If no match is found, .sh.match is not re? set or modified. Note that even matching operations per? formed on the .sh.match variable itself will overwrite it upon finding a match.

.sh.math

Used for defining arithmetic functions (see Arithmetic Evaluation below) and stores the list of user defined arithmetic functions.

.sh.name

Set to the name of the variable at the time that a disci? pline function is invoked.

.sh.subscript

Set to the name subscript of the variable at the time that a discipline function is invoked.

.sh.subshell

.sh.pid

Set to the process ID of the current shell process. Un? like $$, this is updated in a subshell when it forks into a new process. Note that a virtual subshell may have to fork mid-execution due to various system- and implementa? tion-dependent requirements, so the value should not be counted on to remain the same from one command to the next. If a persistent process ID is required for a sub? shell, it must be ensured it is running in its own process first. Any attempt to set a process limit using the ulimit built-in command, such as ulimit -t unlimited 2>/dev/null, is a reliable way to make a subshell fork if it hasn't already.

.sh.ppid

Set to the process ID of the parent of the current shell process. Unlike $PPID, this is updated in a subshell when it forks into a new process. The same note as for .sh.pid applies.

.sh.value

Set to the value of the variable at the time that the set or append discipline function is invoked. When a user

.sh.value is saved and .sh.value is set to long double precision floating point. .sh.value is restored when the function returns.

.sh.version

Set to a value that identifies the version of this shell.

COLUMNS

Width of the terminal window in character positions. Up? dated automatically at initialization and on receiving a SIGWINCH signal. The shell uses the value to define the width of the edit window for the shell edit modes and for printing select lists.

KSH_VERSION

A name reference to .sh.version.

LINENO The current line number within the script or function be? ing executed.

LINES Height of the terminal window in lines. Updated automat? ically at initialization and on receiving a SIGWINCH sig? nal. The shell uses the value to determine the column length for printing select lists: they are printed verti?

OLDPWD The previous working directory set by the cd command.

OPTARG The value of the last option argument processed by the getopts built-in command.

OPTIND The index of the last option argument processed by the getopts built-in command.

PPID The process ID of the parent of the main shell process. Note that this value will not change in a subshell, even if the subshell runs in a different process. See also .sh.ppid.

PWD The present working directory set by the cd command.

RANDOM Each time this variable is referenced, a random integer, uniformly distributed between 0 and 32767, is generated. The sequence of random numbers can be initialized by as? signing a numeric value to RANDOM.

REPLY This variable is set by the select statement and by the read built-in command when no arguments are supplied.

Each time this variable is referenced, the number of sec? onds since shell invocation is returned. If this vari? able is assigned a value, then the value returned upon reference will be the value that was assigned plus the number of seconds since the assignment.

SHLVL An integer variable that is incremented and exported each time the shell is invoked. If SHLVL is not in the envi? ronment when the shell is invoked, it is set to 1.

The following variables are used by the shell:

CDPATH The search path for the cd command.

EDITOR If the VISUAL variable is not set, the value of this variable will be checked for certain patterns and the corresponding editing option will be turned on as de? scribed with VISUAL below.

ENV If this variable is set, then parameter expansion, com? mand substitution, and arithmetic expansion are performed on the value to generate the pathname of the script that will be executed when the shell is invoked interactively (see Invocation below). This file is typically used for alias and function definitions. The default value is

/etc/ksh.kshrc initialization file, if the filename gen? erated by the expansion of ENV begins with /./ or ././ the system wide initialization file will not be executed.

FCEDIT Obsolete name for the default editor name for the hist command. FCEDIT is not used when HISTEDIT is set.

FIGNORE

A pattern that defines the set of filenames that will be ignored when performing filename matching.

FPATH The search path for function definitions. The directo? ries in this path are searched for a file with the same name as the function or command when a function with the -u attribute is referenced and when a command is not found. If an executable file with the name of that com? mand is found, then it is read and executed in the cur? rent environment. Unlike PATH, the current directory must be represented explicitly by . rather than by adja? cent : characters or a beginning or ending :.

histchars

This variable can be used to specify up to three ASCII characters that control history expansion (see History

start of a history expansion. The second (default: ^) is used for short-form substitutions. The third (default: #), when found as the first character of a word, causes history expansion to be skipped for the rest of the words on the line. Multi-byte characters (e.g. UTF-8) are not supported and produce undefined results.

HISTCMD

Number of the current command in the history file.

HISTEDIT

Name for the default editor name for the hist command.

HISTFILE

If this variable is set when the shell is invoked, then the value is the pathname of the file that will be used to store the command history (see Command Re-entry be? low).

HISTSIZE

If this variable is set when the shell is invoked, then the number of previously entered commands that are acces? sible by this shell will be greater than or equal to this number. The default is 512.

HOME The default argument (home directory) for the cd command.

IFS Internal field separators, normally space, tab, and new-line that are used to separate the results of command substitution or parameter expansion and to separate fields with the built-in command read. The first charac?ter of the IFS variable is used to separate arguments for the "$*" expansion (see Quoting below). Each single oc?currence of an IFS character in the string to be split that is not in the isspace character class, and any adja?cent characters in IFS that are in the isspace character class, delimit a field. One or more characters in IFS that belong to the isspace character class delimit a field. In addition, if the same isspace character ap?pears consecutively inside IFS and the posix shell option is not on, this character is treated as if it were not in the isspace class - for example, if IFS consists of two tab characters, then two adjacent tab characters delimit an empty field.

JOBMAX This variable defines the maximum number running back?ground jobs that can run at a time. When this limit is reached, the shell will wait for a job to complete before starting a new job.

LANG This variable determines the locale category for any cat? egory not specifically selected with a variable starting with LC_ or LANG.

LC_ALL This variable overrides the value of the LANG variable and any other LC_ variable.

LC_COLLATE

This variable determines the locale category for charac? ter collation information.

LC_CTYPE

This variable determines the locale category for charac? ter handling functions. It determines the character classes for pattern matching (see Pathname Expansion be? low).

LC_NUMERIC

This variable determines the locale category for the dec? imal point character.

MAIL If this variable is set to the name of a mail file and the MAILPATH variable is not set, then the shell informs the user of arrival of mail in the specified file.

MAILCHECK

This variable specifies how often (in seconds) the shell will check for changes in the modification time of any of the files specified by the MAILPATH or MAIL variables. The default value is 600 seconds. When the time has elapsed the shell will check before issuing the next prompt.

MAILPATH

A colon (:) separated list of file names. If this variable is set, then the shell informs the user of any modifications to the specified files that have occurred within the last MAILCHECK seconds. Each file name can be followed by a ? and a message that will be printed. The message will undergo parameter expansion, command substi? tution, and arithmetic expansion with the variable $_ de? fined as the name of the file that has changed. The de? fault message is you have mail in $_.

PATH The search path for commands (see Execution below). The user may not change PATH if executing under rksh (except in .profile).

PS1 Every time a new command line is started on an interac?

solve backslash escaping, parameter expansion, command substitution, and arithmetic expansion. The result de? fines the primary prompt string for that command line. The default is ``$ ''. The character ! in the primary prompt string is replaced by the command number (see Com? mand Re-entry below). Two successive occurrences of ! will produce a single ! when the prompt string is printed. Note that any terminal escape sequences used in the PS1 prompt thus need every instance of ! in them to be changed to !!.

PS2 Secondary prompt string, by default ``> ''.

PS3 Selection prompt string used within a select loop, by de? fault ``#? ''.

PS4 The value of this variable is expanded for parameter evaluation, command substitution, and arithmetic expan? sion and precedes each line of an execution trace. By default, PS4 is ``+ ''. In addition when PS4 is unset, the execution trace prompt is also ``+ ''.

SHELL The pathname of the shell is kept in the environment. At invocation, if the basename of this variable is rsh,

TIMEFORMAT

The value of this parameter is used as a format string specifying how the timing information for pipelines pre?fixed with the time reserved word should be displayed. The % character introduces a format sequence that is ex?panded to a time value or other information. The format sequences and their meanings are as follows.

%% A literal %.

%[p][l]R The elapsed time in seconds.

%[p][l]U The number of CPU seconds spent in user mode.

%[p][l]S The number of CPU seconds spent in system mode.

%P The CPU percentage, computed as (U + S) / R.

The brackets denote optional portions. The optional p is a digit specifying the precision, the number of frac?tional digits after a decimal point. A value of 0 causes no decimal point or fraction to be output. At most three places after the decimal point can be displayed; values of p greater than 3 are treated as 3. If p is not speci?fied, the value 3 is used.

The optional l specifies a longer format, including hours if greater than zero, minutes, and seconds of the form

the fraction is included. Seconds are zero-padded unless the posix shell option is on.

All other characters are output without change and a trailing newline is added. If the variable is unset, the default value, $'\nreal\t%2lR\nuser\t%2lU\nsys\t%2lS', is used. If the value is empty, no timing information is displayed.

TMOUT Terminal read timeout. If set to a value greater than zero, the read built-in command and the select compound command time out after TMOUT seconds when input is from a terminal. An interactive shell will issue a warning and allow for an extra 60 second timeout grace period before terminating if a line is not entered within the pre? scribed number of seconds while reading from a terminal. (Note that the shell can be compiled with a maximum bound for this value which cannot be exceeded.)

VISUAL The value of this variable is scanned when the shell is invoked and whenever its value is changed; if it is found to match certain patterns, the corresponding line editor (see In-line Editing Options below) is activated. If it matches the pattern *[Vv][Ii]*, the vi option is turned

tion is turned on; else if it matches the pattern *macs*, the emacs option is turned on. If none of the patterns match, emacs is turned on by default upon initializing an interactive shell. If the value is changed by assignment and none of the patterns match, no options are changed. The value of VISUAL overrides the value of EDITOR.

The shell gives default values to PATH, PS1, PS2, PS3, PS4, MAILCHECK, FCEDIT, TMOUT and IFS, while HOME, SHELL, ENV, histchars, and MAIL are not set at all by the shell (although HOME is set by login(1)). On some systems MAIL and SHELL are also set by login(1).

Field Splitting.

After parameter expansion and command substitution, the results of sub? stitutions are scanned for the field separator characters (those found in IFS) and split into distinct fields where such characters are found. Explicit empty fields ("" or ??) are retained. Implicit empty fields (those resulting from parameters that are unset or have empty string values or from command substitutions yielding the empty string, and that are not quoted with "") are removed.

Brace Expansion.

If the braceexpand (-B) option is set then each word, as well as any fields resulting from field splitting (see above), are checked to see

{n1..n2} , {n1..n2% fmt} , {n1..n2 ..n3} , or {n1..n2 ..n3%fmt} , where * represents any character, l1,l2 are letters and n1,n2,n3 are signed numbers and fmt is a format specified as used by printf. In each case, fields are created by prepending the characters before the { and ap? pending the characters after the } to each of the strings generated by the characters between the { and }. The resulting fields are checked to see if they have any brace patterns.

In the first form, a field is created for each string between { and ,, between , and ,, and between , and }. The string represented by * can contain embedded matching { and } without quoting. Otherwise, each { and } with * must be quoted.

In the seconds form, l1 and l2 must both be either upper case or both be lower case characters in the C locale. In this case a field is cre? ated for each character from l1 through l2.

In the remaining forms, a field is created for each number starting at n1 and continuing until it reaches n2 incrementing n1 by n3. The cases where n3 is not specified behave as if n3 where 1 if n1<=n2 and -1 oth? erwise. If forms which specify %fmt any format flags, widths and pre? cisions can be specified and fmt can end in any of the specifiers cdiouxX. For example, {a,z}{1..5..3%02d}{b..c}x expands to the 8 fields, a01bx, a01cx, a04bx, a04cx, z01bx, z01cx, z04bx and z04cx.

Pathname Expansion.

This is also known as globbing or sometimes filename generation. Path? name expansion is disabled if the -f a.k.a. --noglob shell option is on. Otherwise, if certain special characters are found in a word or in a field resulting from field splitting (see above), then the word or field is regarded as a pattern. Each literal word is scanned for the characters *, ?, [, and (, but fields resulting from field splitting are scanned only for the characters *, ?, and [for compatibility rea? sons (in which case the (character is not special and any pattern syn? tax described below that involves parentheses does not apply).

Each file name component that contains a recognized pattern character is replaced with a lexicographically sorted set of names that matches the pattern from that directory. If no file name is found that matches the pattern, then that component of the filename is left unchanged un? less the pattern is prefixed with ?(N), in which case it is removed as described below. The special traversal names . and .. are never matched. If FIGNORE is set, then each file name component that matches the pattern defined by the value of FIGNORE is ignored when generating the matching filenames. If FIGNORE is not set, the character . at the start of each file name component will be ignored unless the first character of the pattern corresponding to this component is the charac? ter . itself. Note that, for uses of pattern matching other than pathname expansion, the / and . are not treated specially.

***** Matches any string, including the empty string. When used for filename expansion, if the globstar option is on, an isolated pattern of two adjacent *s will match all files and zero or more directories and subdirectories. If followed by a / then only directories and subdirecto? ries will match.

? Matches any single character.

[...] Matches any one of the enclosed characters. A pair of characters separated by - matches any character lexically between the pair, inclusive. If the first character fol? lowing the opening [is a ! or ^, then any character not enclosed is matched. A - can be included in the charac? ter set by putting it as the first or last character.
Within [and], character classes can be specified with the syntax [:class:], where class is one of the following classes defined in the ANSI C standard (note that word is equivalent to alnum plus the character _):
alnum alpha blank cntrl digit graph lower print punct space upper word xdigit
Within [and], an equivalence class can be specified with the syntax [=c=] which matches all characters with the same primary collation weight (as defined by the cur? rent locale) as the character c. Within [and], [.sym? bol.] matches the collating symbol symbol.

A pattern-list is a list of one or more patterns separated from each other with a & or |. A & signifies that all patterns must be matched whereas | requires that only one pattern be matched. Composite pat? terns can be formed with one or more of the following subpatterns:

?(pattern-list)

Optionally matches any one of the given patterns.

*(pattern-list)

Matches zero or more occurrences of the given patterns.

+(pattern-list)

Matches one or more occurrences of the given patterns.

{n}(pattern-list)

Matches n occurrences of the given patterns.

{m,n}(pattern-list)

Matches from m to n occurrences of the given patterns.

If m is omitted, 0 will be used. If n is omitted, at least m occurrences will be matched.

@(pattern-list)

Matches exactly one of the given patterns.

!(pattern-list)

Matches anything except one of the given patterns.

By default, each pattern or subpattern will match the longest string possible consistent with generating the longest overall match. If more than one match is possible, the one starting closest to the beginning

patterns, a - can be inserted in front of the (to cause the shortest match to the specified pattern-list to be used.

When pattern-list is contained within parentheses, the backslash char?acter \ is treated specially even when inside a character class. All ANSI C character escapes are recognized and match the specified charac?ter. In addition, the following escape sequences are recognized:

\d Matches any character in the digit class.

\D Matches any character not in the digit class.

\s Matches any character in the space class.

\S Matches any character not in the space class.

\w Matches any character in the word class.

\W Matches any character not in the word class.

A pattern of the form %(pattern-pair(s)) is a subpattern that can be used to match nested character expressions. Each pattern-pair is a two-character sequence that cannot contain & or |. The first pattern-pair specifies the starting and ending characters for the match. Each subsequent pattern-pair represents the beginning and ending characters of a nested group that will be skipped over when counting starting and ending character matches. The behavior is unspecified when the first character of a pattern-pair is alphanumeric, except for the following:

D Causes the ending character to terminate the search for this pattern without finding a match.

cape character.

L Causes the ending character to be interpreted as a quote character, causing all characters to be ignored when looking for a match.

Q Causes the ending character to be interpreted as a quote character, causing all characters other than any escape character to be ignored when looking for a match.

Thus, %({}Q"E\), matches characters starting at { until the matching } is found, not counting any { or } that is inside a double-quoted string or preceded by the escape character \. Without the {}, this pattern matches any C language string.

Each subpattern in a composite pattern is numbered, starting at 1, by the location of the (within the pattern. The sequence \n, where n is a single digit and \n comes after the nth subpattern, matches the same string as the subpattern itself.

Finally, a pattern can contain subpatterns of the form ?(options:pat? tern-list), where either options or :pattern-list can be omitted. Un? like the other compound patterns, these subpatterns are not counted in the numbered subpatterns. :pattern-list must be omitted for options E, F, G, N, P, V, and X below. If options is present, it can consist of one or more of the following:

- Disable the following options.

E The remainder of the pattern uses extended regular ex? pression syntax like the -E option of the grep(1) com? mand.

F The remainder of the pattern uses the fixed pattern syn? tax of the -F option of the grep(1) command.

G The remainder of the pattern uses basic regular expres? sion syntax like the grep(1) command without options.

K The remainder of the pattern uses shell pattern syntax. This is the default.

N When it is the first letter and is used with pathname ex? pansion, and no matches occur, the file pattern expands to the empty string instead of remaining unexpanded. Otherwise, it is ignored.

X The remainder of the pattern uses augmented regular ex? pression syntax like the -X option of the AT&T AST ver? sion of the grep(1) command.

P The remainder of the pattern uses perl(1) regular expres? sion syntax. Not all perl regular expression syntax is currently implemented.

V The remainder of the pattern uses System V regular ex? pression syntax.

i Always treat the match as case-insensitive, regardless of the globcasedetect shell option.

l Left-anchor the pattern. This is the default for K style patterns.

r Right-anchor the pattern. This is the default for K style patterns.

If both options and :pattern-list are specified, then the options apply only to pattern-list. Otherwise, these options remain in effect until they are disabled by a subsequent ?(...) or at the end of the subpat? tern containing ?(...).

Quoting.

Each of the metacharacters listed earlier (see Definitions above) has a special meaning to the shell and causes termination of a word unless quoted. A character may be quoted (i.e., made to stand for itself) by preceding it with a \. The pair \new-line is removed. All characters enclosed between a pair of single quote marks (??) that is not preceded by a $ are quoted. A single quote cannot appear within the single quotes. A single quoted string preceded by an unquoted $ is processed as an ANSI C string except for the following:

\0 Causes the remainder of the string to be ignored.

\E Equivalent to the escape character (ASCII 033),

\e Equivalent to the escape character (ASCII 033),

\cx Expands to the character control-x.

\C[.name.]

Inside double quote marks (""), parameter and command substitution oc? cur and \ quotes the characters \, `, ", and $. A $ in front of a dou? ble quoted string will be ignored in the "C" or "POSIX" locale, and may cause the string to be replaced by a locale specific string otherwise. The meaning of $* and $@ is identical when not quoted or when used as a variable assignment value or as a file name. However, when used as a command argument, "$*" is equivalent to "$1d$2d...", where d is the first character of the IFS variable, whereas "$@" is equivalent to "$1" "$2" .... Inside grave quote marks (``), \ quotes the characters \, `, and $. If the grave quotes occur within double quotes, then \ also quotes the character ".

The special meaning of reserved words or aliases can be removed by quoting any character of the reserved word. The recognition of func? tion names or built-in command names listed below cannot be altered by quoting them.

Arithmetic Evaluation.

The shell performs arithmetic evaluation for arithmetic expansion, to evaluate an arithmetic command, to evaluate an indexed array subscript, and to evaluate arguments to the built-in commands shift and let as well as arguments to numeric format specifiers given to print -f and printf. Evaluations are performed using double precision floating

that provide this data type. Floating point constants follow the ANSI C programming language floating point conventions. The case-insensi? tive floating point constants NaN and Inf can be used to represent "not a number" and infinity respectively, unless the posix shell option is on. Integer constants follow the ANSI C programming language integer constant conventions although only single byte character constants are recognized and character casts are not recognized. In addition con? stants can be of the form [base#]n where base is a decimal number be? tween two and sixty-four representing the arithmetic base and n is a number in that base. The digits above 9 are represented by the lower case letters, the upper case letters, @, and _ respectively. For bases less than or equal to 36, upper and lower case characters can be used interchangeably.

An arithmetic expression uses the same syntax, precedence, and associa? tivity of expression as the C language. All the C language operators that apply to floating point quantities can be used. In addition, the operator ** can be used for exponentiation. It has higher precedence than multiplication and is left associative. In addition, when the value of an arithmetic variable or subexpression can be represented as a long integer, all C language integer arithmetic operations can be performed. Variables can be referenced by name within an arithmetic expression without using the parameter expansion syntax. When a vari? able is referenced, its value is evaluated as an arithmetic expression.

Any of the following math library functions that are in the C math li?
brary can be used within an arithmetic expression:

abs acos acosh asin asinh atan atan2 atanh cbrt ceil copysign cos cosh
erf erfc exp exp10 exp2 expm1 fabs fdim finite float floor fma fmax
fmin fmod fpclass fpclassify hypot ilogb int isfinite isgreater is?
greaterequal isinf isinfinite isless islessequal islessgreater isnan
isnormal issubnormal isunordered iszero j0 j1 jn ldexp lgamma log log10
log1p log2 logb nearbyint nextafter nexttoward pow remainder rint round
scalb scalbn signbit sin sinh sqrt tan tanh tgamma trunc y0 y1 yn

In addition, arithmetic functions can be defined as shell functions
with a variant of the function name syntax,

function .sh.math.name ident ... { list ;}

where name is the function name used in the arithmetic expres?
sion and each identifier, ident is a name reference to the long
double precision floating point argument. The value of
.sh.value when the function returns is the value of this func?
tion. User defined functions can take up to 3 arguments and
override C math library functions.

An internal representation of a variable as a double precision floating
point can be specified with the -E [n], -F [n], or -X [n] option of the

of the value to be represented using scientific notation when it is ex? panded. The optional option argument n defines the number of signifi? cant figures. The -F option causes the expansion to be represented as a floating decimal number when it is expanded. The -X option causes the expansion to be represented using the %a format defined by ISO C-99. The optional option argument n defines the number of places af? ter the decimal (or radix) point in this case.

An internal integer representation of a variable can be specified with the -i [n] option of the typeset special built-in command. The op? tional option argument n specifies an arithmetic base to be used when expanding the variable. If you do not specify an arithmetic base, base 10 will be used.

Arithmetic evaluation is performed on the value of each assignment to a variable with the -E, -F, -X, or -i attribute. Assigning a floating point number to a variable whose type is an integer causes the frac? tional part to be truncated.

Prompting.

When used interactively, the shell prompts with the value of PS1 after expanding it for parameter expansion, command substitution, and arith? metic expansion, before reading a command. In addition, each single ! in the prompt is replaced by the command number. A !! is required to

input is needed to complete a command, then the secondary prompt (i.e., the value of PS2) is issued.

Conditional Expressions.

A conditional expression is used with the [[compound command to test attributes of files and to compare strings. Field splitting and path? name expansion are not performed on the words between [[and]]. Each expression can be constructed from one or more of the following unary or binary expressions:

string Same as -n string below.

-a file

Same as -e below. This is obsolete.

-b file

True if file exists and is a block special file.

-c file

True if file exists and is a character special file.

-d file

True if file exists and is a directory.

-e file

True if file exists.

-f file

True if file exists and is an ordinary file.

-g file

True if file exists and it has its setgid bit set.

True if file exists and it has its sticky bit set.

-n string

True if length of string is non-zero.

-o ?option

True if option named option is a valid option name.

-o option

True if option named option is on.

-p file

True if file exists and is a fifo special file or a pipe.

-r file

True if file exists and is readable by current process.

-s file

True if file exists and has size greater than zero.

-t fildes

True if file descriptor number fildes is open and associ?

ated with a terminal device.

-u file

True if file exists and it has its setuid bit set.

-v name

True if variable name is a valid variable name and is

set.

-w file

True if file exists and is writable by current process.

-x file

If file exists and is a directory, then true if the cur?
rent process has permission to search in the directory.

-z string

True if length of string is zero.

-L file

True if file exists and is a symbolic link.

-h file

True if file exists and is a symbolic link.

-N file

True if file exists and the modification time is greater than the last access time.

-O file

True if file exists and is owned by the effective user ID of this process.

-G file

True if file exists and its group matches the effective group ID of this process.

-R name

True if variable name is a name reference.

-S file

True if file exists and is a socket.

file1 -nt file2

True if file1 exists and file2 does not, or file1 is newer than file2.

True if file2 exists and file1 does not, or file1 is older than file2.

file1 -ef file2

True if file1 and file2 exist and refer to the same file.

string == pattern

True if string matches pattern. Any part of pattern can be quoted to cause it to be matched as a string. With a successful match to a pattern, the .sh.match array vari? able will contain the match and subpattern matches.

string = pattern

Same as == above, but is obsolete.

string != pattern

True if string does not match pattern. When the string matches the pattern the .sh.match array variable will contain the match and subpattern matches.

string =? ere

True if string matches the pattern ?(E)ere where ere is an extended regular expression.

string1 < string2

True if string1 comes before string2 based on ASCII value of their characters.

string1 > string2

True if string1 comes after string2 based on ASCII value of their characters.

The following obsolete arithmetic comparisons are also permitted:

exp1 -eq exp2

True if exp1 is equal to exp2.

exp1 -ne exp2

True if exp1 is not equal to exp2.

exp1 -lt exp2

True if exp1 is less than exp2.

exp1 -gt exp2

True if exp1 is greater than exp2.

exp1 -le exp2

True if exp1 is less than or equal to exp2.

exp1 -ge exp2

True if exp1 is greater than or equal to exp2.

In each of the above expressions, if file is of the form /dev/fd/n, where n is an integer, then the test is applied to the open file whose descriptor number is n. The posix shell option disables this special handling.

A compound expression can be constructed from these primitives by using any of the following, listed in decreasing order of precedence:

(expression)

True if expression is true. Used to group expressions.

! expression

expression1 && expression2

True if expression1 and expression2 are both true.

expression1 || expression2

True if either expression1 or expression2 is true.

Input/Output.

Before a command is executed, its input and output may be redirected using a special notation interpreted by the shell. The following may appear anywhere in a simple-command or may precede or follow a command and are not passed on to the invoked command. Command substitution, parameter expansion, and arithmetic expansion occur before word or digit is used except as noted below. Pathname expansion occurs only if the shell is interactive and the pattern matches a single file. Field splitting is not performed.

In each of the following redirections, if file is of the form /dev/sctp/host/port, /dev/tcp/host/port, or /dev/udp/host/port, where host is a hostname or host address, and port is a service given by name or an integer port number, then the redirection attempts to make a tcp, sctp or udp connection to the corresponding socket.

No intervening space is allowed between the characters of redirection operators.

>word Use file word as standard output (file descriptor 1). If the file does not exist then it is created. If the file exists, and the noclobber option is on, this causes an error; otherwise, it is truncated to zero length.

>|word Same as >, except that it overrides the noclobber option.

>;word Write output to a temporary file. If the command com? pletes successfully rename it to word, otherwise, delete the temporary file. >;word cannot be used with the exec and redirect built-ins.

>>word Use file word as standard output. If the file exists, then output is appended to it (by first seeking to the end-of-file); otherwise, the file is created.

<>word Open file word for reading and writing as standard out? put. If the posix option is active, it defaults to stan? dard input instead.

<>;word The same as <>word except that if the command completes successfully, word is truncated to the offset at command completion. <>;word cannot be used with the exec and

<<[-]word The shell input is read up to a line that is the same as word after any quoting has been removed, or to an end-of-file. No parameter expansion, command substitution, arithmetic expansion or pathname expansion is performed on word. The resulting document, called a here-document, becomes the standard input. If any character of word is quoted, then no interpretation is placed upon the charac? ters of the document; otherwise, parameter expansion, command substitution, and arithmetic expansion occur, \new-line is ignored, and \ must be used to quote the characters \, $, `. If - is appended to <<, then all leading tabs are stripped from word and from the docu? ment. If # is appended to <<, then leading spaces and tabs will be stripped off the first line of the document and up to an equivalent indentation will be stripped from the remaining lines and from word. A tab stop is assumed to occur at every 8 columns for the purposes of determin? ing the indentation.

<<<word A short form of here document in which word becomes the contents of the here-document after any parameter expan? sion, command substitution, and arithmetic expansion oc? cur.

<&digit The standard input is duplicated from file descriptor digit (see dup(2)).

>&digit The standard output is duplicated from file descriptor digit.

<&digit- The file descriptor given by digit is moved to standard input.

>&digit- The file descriptor given by digit is moved to standard output.

<&- The standard input is closed.

>&- The standard output is closed.

<&p The input from the co-process is moved to standard input.

>&p The output to the co-process is moved to standard output.

<#((expr)) Evaluate arithmetic expression expr and position file de? scriptor 0 to the resulting value bytes from the start of the file. The variables CUR and EOF evaluate to the cur? rent offset and end-of-file offset respectively when

>#((offset)) The same as <# except applies to file descriptor 1.

<#pattern Seeks forward to the beginning of the next line contain? ing pattern.

<##pattern The same as <# except that the portion of the file that is skipped is copied to standard output.

If one of the above is preceded by a digit, with no intervening space, then the file descriptor number referred to is that specified by the digit (instead of the default 0 or 1). If one of the above, other than >&- and the ># and <# forms, is preceded by {varname} with no interven? ing space, then a file descriptor number > 9 will be selected by the shell and stored in the variable varname, so it can be read from or written to with redirections like <& $varname or >& $varname. If >&- or the any of the ># and <# forms is preceded by {varname} the value of varname defines the file descriptor to close or position. For example:

... 2>&1

means file descriptor 2 is to be opened for writing as a duplicate of file descriptor 1 and

means open file named file for reading and store the file descriptor number in variable n.

A special shorthand redirection operator &>word is available; it is equivalent to >word 2>&1. It cannot be preceded by any digit or vari? able name. This shorthand is disabled if the posix shell option is ac? tive.

The order in which redirections are specified is significant. The shell evaluates each redirection in terms of the (file descriptor, file) association at the time of evaluation. For example:

... 1>fname 2>&1

first associates file descriptor 1 with file fname. It then associates file descriptor 2 with the file associated with file descriptor 1 (i.e. fname). If the order of redirections were reversed, file descriptor 2 would be associated with the terminal (assuming file descriptor 1 had been) and then file descriptor 1 would be associated with file fname.

If a command is followed by & and job control is not active, then the default standard input for the command is the empty file /dev/null. Otherwise, the environment for the execution of a command contains the

specifications.

Environment.

The environment (see environ(7)) is a list of name-value pairs that is passed to an executed program in the same way as a normal argument list. The names must be identifiers and the values are character strings. The shell interacts with the environment in several ways. On invocation, the shell scans the environment and creates a variable for each name found, giving it the corresponding value and attributes and marking it export. Executed commands inherit the environment. If the user modifies the values of these variables or creates new ones, using the export or typeset -x commands, they become part of the environment. The environment seen by any executed command is thus composed of any name-value pairs originally inherited by the shell, whose values may be modified by the current shell, plus any additions which must be noted in export or typeset -x commands.

The environment for any simple-command or function may be augmented by prefixing it with one or more variable assignments. A variable assign? ment argument is a word of the form identifier=value. Thus:

TERM=450 cmd args and

(export TERM; TERM=450; cmd args)

cept for special built-in commands listed below - those that are marked with ?).

If the obsolete -k option is set, all variable assignment arguments are placed in the environment, even if they occur after the command name. The following first prints a=b c and then c:

```
echo a=b c
set -k
echo a=b c
```

This feature is intended for use with scripts written for early ver? sions of the shell and its use in new scripts is strongly discouraged. It is likely to disappear someday.

Functions.

For historical reasons, there are two ways to define functions, the name() syntax and the function name syntax, described in the Commands section above. Shell functions are read in and stored internally. Alias names are resolved when the function is read. Functions are exe? cuted like commands with the arguments passed as positional parameters. (See Execution below.)

Functions defined by the function name syntax and called by name exe?

working directory with the caller. Traps caught by the caller are re? set to their default action inside the function. A trap condition that is not caught or ignored by the function causes the function to termi? nate and the condition to be passed on to the caller. A trap on EXIT set inside a function is executed in the environment of the caller af? ter the function completes. Ordinarily, variables are shared between the calling program and the function. However, the typeset special built-in command used within a function defines local variables whose scope includes the current function. They can be passed to functions that they call in the variable assignment list that precedes the call or as arguments passed as name references. Errors within functions re? turn control to the caller.

Functions defined with the name() syntax and functions defined with the function name syntax that are invoked with the . special built-in are executed in the caller's environment and share all variables and traps with the caller. Errors within these function executions cause the script that contains them to abort.

The special built-in command return is used to return from function calls.

Function names can be listed with the -f or +f option of the typeset special built-in command. The text of functions, when available, will

of the unset special built-in command.

Ordinarily, functions are unset when the shell executes a shell script. Functions that need to be defined across separate invocations of the shell should be placed in a directory and the FPATH variable should contain the name of this directory. They may also be specified in the ENV file.

Discipline Functions.

Each variable can have zero or more discipline functions associated with it. The shell initially understands the discipline names get, set, append, and unset but can be added when defining new types. On most systems others can be added at run time via the C programming in? terface extension provided by the builtin built-in utility. If the get discipline is defined for a variable, it is invoked whenever the given variable is referenced. If the variable .sh.value is assigned a value inside the discipline function, the referenced variable will evaluate to this value instead. If the set discipline is defined for a vari? able, it is invoked whenever the given variable is assigned a value. If the append discipline is defined for a variable, it is invoked when? ever a value is appended to the given variable. The variable .sh.value is given the value of the variable before invoking the discipline, and the variable will be assigned the value of .sh.value after the disci? pline completes. If .sh.value is unset inside the discipline, then

variable, it is invoked whenever the given variable is unset.

The variable .sh.name contains the name of the variable for which the discipline function is called, .sh.subscript is the subscript of the variable, and .sh.value will contain the value being assigned inside the set discipline function. The variable _ is a reference to the variable including the subscript if any. For the set discipline, changing .sh.value will change the value that gets assigned. Finally, the expansion ${var.name}, when name is the name of a discipline, and there is no variable of this name, is equivalent to the command substi? tution ${ var.name;}.

Name Spaces.

Commands and functions that are executed as part of the list of a name? space command that modify variables or create new ones, create a new variable whose name is the name of the name space as given by identi? fier preceded by .. When a variable whose name is name is referenced, it is first searched for using .identifier.name. Similarly, a function defined by a command in the namespace list is created using the name space name preceded by a ..

When the list of a namespace command contains a namespace command, the names of variables and functions that are created consist of the vari? able or function name preceded by the list of identifiers each preceded

Outside of a name space, a variable or function created inside a name space can be referenced by preceding it with the name space name.

By default, variables starting with .sh are in the sh name space.

Type Variables.

Typed variables provide a way to create data structure and objects. A type can be defined either by a shared library, by the enum built-in command described below, or by using the new -T option of the typeset built-in command. With the -T option of typeset, the type name, speci? fied as an option argument to -T, is set with a compound variable as? signment that defines the type. Function definitions can appear inside the compound variable assignment and these become discipline functions for this type and can be invoked or redefined by each instance of the type. The function name create is treated specially. It is invoked for each instance of the type that is created but is not inherited and cannot be redefined for each instance.

When a type is defined a special built-in command of that name is added. These built-ins are declaration commands and follow the same expansion rules as the built-in commands described below that are marked with a ? symbol. These commands can subsequently be used inside further type definitions. The man page for these commands can be gen?

scribed with getopts. The -r, -a, -A, -h, and -S options of typeset are permitted with each of these new built-ins.

An instance of a type is created by invoking the type name followed by one or more instance names. Each instance of the type is initialized with a copy of the subvariables except for subvariables that are de? fined with the -S option. Variables defined with the -S are shared by all instances of the type. Each instance can change the value of any subvariable and can also define new discipline functions of the same names as those defined by the type definition as well as any standard discipline names. No additional subvariables can be defined for any instance.

When defining a type, if the value of a subvariable is not set and the -r attribute is specified, it causes the subvariable to be a required subvariable. Whenever an instance of a type is created, all required subvariables must be specified. These subvariables become read-only in each instance.

When unset is invoked on a subvariable within a type, and the -r at? tribute has not been specified for this field, the value is reset to the default value associative with the type. Invoking unset on a type instance not contained within another type deletes all subvariables and the variable itself.

A type definition can be derived from another type definition by defin? ing the first subvariable name as _ and defining its type as the base type. Any remaining definitions will be additions and modifications that apply to the new type. If the new type name is the same as that of the base type, the type will be replaced and the original type will no longer be accessible.

The typeset command with the -T and no option argument or operands will write all the type definitions to standard output in a form that can be read in to create all they types.

Jobs.

If the monitor option of the set command is turned on, an interactive shell associates a job with each pipeline. It keeps a table of current jobs, printed by the jobs command, and assigns them small integer num? bers. When a job is started asynchronously with &, the shell prints a line which looks like:

[1] 1234

indicating that the job which was started asynchronously was job number 1 and had one (top-level) process, whose process ID was 1234.

This paragraph and the next require features that are not in all ver?

do something else you may hit the key ^Z (control-Z) which sends a STOP signal to the current job. The shell will then normally indicate that the job has been `Stopped', and print another prompt. You can then ma? nipulate the state of this job, putting it in the background with the bg command, or run some other commands and then eventually bring the job back into the foreground with the foreground command fg. A ^Z takes effect immediately and is like an interrupt in that pending out? put and unread input are discarded when it is typed.

A job being run in the background will stop if it tries to read from the terminal. Background jobs are normally allowed to produce output, but this can be disabled by giving the command stty tostop. If you set this tty option, then background jobs will stop when they try to pro? duce output like they do when they try to read input.

There are several ways to refer to jobs in the shell. A job can be re? ferred to by the process ID of any process of the job or by one of the following:

%number

The job with the given number.

%string

Any job whose command line begins with string.

%?string

Any job whose command line contains string.

%+ Equivalent to %%.

%- Previous job.

The shell learns immediately whenever a process changes state. It nor? mally informs you whenever a job becomes blocked so that no further progress is possible, but only just before it prints a prompt. This is done so that it does not otherwise disturb your work. The notify op? tion of the set command causes the shell to print these job change mes? sages as soon as they occur.

When the monitor option is on, each background job that completes trig? gers any trap set for CHLD.

When you try to leave the shell while jobs are running or stopped, you will be warned that `You have stopped(running) jobs.' You may use the jobs command to see what they are. If you immediately try to exit again, the shell will not warn you a second time, and the stopped jobs will be terminated. When a login shell receives a HUP signal, it sends a HUP signal to each job that has not been disowned with the disown built-in command described below.

Signals.

The INT and QUIT signals for an invoked command are ignored if the com? mand is followed by & and the monitor option is not active. Otherwise,

also the trap built-in command below).

Execution.

Each time a command is read, the above expansions and substitutions are carried out. If the command name matches one of the Special Built-in Commands listed below, it is executed within the current shell process. Next, the command name is checked to see if it matches a user defined function. If it does, the positional parameters are saved and then re? set to the arguments of the function call. A function is also executed in the current shell process. When the function completes or issues a return, the positional parameter list is restored. For functions de? fined with the function name syntax, any trap set on EXIT within the function is executed. The exit value of a function is the value of the last command executed. If a command name is not a special built-in command or a user defined function, but it is one of the built-in com? mands listed below, it is executed in the current shell process.

The shell variables PATH followed by the variable FPATH defines the list of directories to search for the command name. Alternative direc? tory names are separated by a colon (:). The default path is the value that was output by getconf PATH at the time ksh was compiled. The cur? rent directory can be specified by two or more adjacent colons, or by a colon at the beginning or end of the path list. If the command name contains a */*, then the search path is not used. Otherwise, each direc?

order. If the directory being searched is contained in FPATH and con? tains a file whose name matches the command being searched, then this file is loaded into the current shell environment as if it were the ar? gument to the . command except that only preset aliases are expanded, and a function of the given name is executed as described above.

If this directory is not in FPATH the shell first determines whether there is a built-in version of a command corresponding to a given path? name and if so it is invoked in the current process. If no built-in is found, the shell checks for a file named .paths in this directory. If found and there is a line of the form FPATH=path where path names an existing directory then that directory is searched immediately after the current directory as if it were found in the FPATH variable. If path does not begin with /, it is checked for relative to the directory being searched.

The .paths file is then checked for a line of the form PLUGIN_LIB=lib? name [: libname] ... . Each library named by libname will be searched for as if it were an option argument to builtin -f, and if it contains a built-in of the specified name this will be executed instead of a command by this name. Any built-in loaded from a library found this way will be associated with the directory containing the .paths file so it will only execute if not found in an earlier directory.

If the file has execute permission but is not an a.out file, it is as? sumed to be a file containing shell commands. A separate shell is spawned to read it. All non-exported variables are removed in this case. If the shell command file doesn't have read permission, or if the setuid and/or setgid bits are set on the file, then the shell exe? cutes an agent whose job it is to set up the permissions and execute the shell with the shell command file passed down as an open file. If the .paths contains a line of the form name=value in the first or sec? ond line, then the environment variable name is modified by prepending the directory specified by value to the directory list. If value is not an absolute directory, then it specifies a directory relative to the directory that the executable was found. If the environment vari? able name does not already exist it will be added to the environment list for the specified command. A parenthesized command is executed in a subshell without removing non-exported variables.

Command Re-entry.

The text of the last HISTSIZE (default 512) commands entered from a terminal device is saved in a history file. The file $HOME/.sh_history is used if the HISTFILE variable is not set or if the file it names is not writable. A shell can access the commands of all interactive shells which use the same named HISTFILE. The built-in command hist is used to list or edit a portion of this file. The portion of the file to be edited or listed can be selected by number or by giving the first

commands can be specified. If you do not specify an editor program as an argument to hist then the value of the variable HISTEDIT is used. If HISTEDIT is unset, the obsolete variable FCEDIT is used. If FCEDIT is not defined, then /bin/ed is used. The edited command(s) is printed and re-executed upon leaving the editor unless you quit without writ? ing. The -s option (and in obsolete versions, the editor name -) is used to skip the editing phase and to re-execute the command. In this case a substitution parameter of the form old=new can be used to modify the command before execution. For example, with the preset alias r, which is aliased to ?hist -s?, typing `r bad=good c' will re-execute the most recent command which starts with the letter c, replacing the first occurrence of the string bad with the string good.

History Expansion.

History expansions introduce words from the history list into the input stream, making it easy to repeat commands, repeat arguments of a previ? ous command in the current command, or fix typos in the previous com? mand. The history expansion facility is an alternative to history con? trol via the fc or hist built-in command. To enable it, turn on the -H or histexpand option using the set command (see Built-in Commands be? low).

History expansions begin with the character !. They may begin anywhere in the input. The ! may be preceded by a \ or enclosed in single

when it is followed by a space, tab, newline, = or (. History expan? sions do not nest. They are parsed separately before the shell parser is invoked, so they can override shell grammar rules.

By default, the expanded version of any line that contains a history expansion is printed, added to the history, and then immediately exe? cuted. History expansions are never added to the history themselves, regardless of whether they succeed or fail due to an error. Normally, this means that a command line with an erroneous history expansion is lost and needs to be retyped from scratch, but if the histreedit shell option is turned on and a line editor is active (see In-line Editing Options below), the erroneous line is pre-filled into the next prompt's input buffer for correcting. The histverify option causes the same to be done for the results of successful history expansions, allowing ver? ification and editing before execution.

A history expansion may have an event specification, which indicates the event from which words are to be taken, a word designator, which selects particular words from the chosen event, and/or a modifier, which manipulates the selected words.

An event specification can be:

n A number, referring to a particular event.

event.

The current event.

! The previous event (equivalent to -1).

s The most recent event whose first word begins with the string s.

?s? The most recent event which contains the string s. The second ? can be omitted if it is immediately followed by a newline.

For example, consider this bit of someone's history list as might be output by the hist -l command:

9 nroff -man wumpus.man

10 cp wumpus.man wumpus.man.old

11 vi wumpus.man

12 diff wumpus.man.old wumpus.man

The commands are shown with their event numbers. The current event, which we haven't typed in yet, is event 13. !11 and !-2 refer to event 11. !! refers to the previous event, 12. !! can be abbreviated ! if it is followed by : (see below). !n refers to event 9, which begins with n. !?old? also refers to event 12, which contains old. Without word designators or modifiers, history references simply expand to the entire event, so we might type !cp to redo the copy command or !!|more

To select words from an event, the event specification can be followed by a : and a designator for the desired words. The words of an input line are numbered from 0, the first word (usually the command name) be? ing 0, the second word (first argument) being 1, etc. The basic word designators are:

0	The first word (command name).
n	The nth argument.
^	The first argument, equivalent to 1.
$	The last argument.
%	The word matched by the most recent ?s? search.
x-y	A range of words.
-y	Equivalent to 0-y.
*	Equivalent to ^-$, but returns nothing if the event con? tains only 1 word.
x*	Equivalent to x-$.
x-	Equivalent to x*, but omitting the last word ($).

Selected words are inserted into the command line separated by single blanks. For example, the diff command in the previous example might have been typed as diff !!:1.old !!:1 (using :1 to select the first ar? gument from the previous event) or diff !-2:2 !-2:1 to select and swap the arguments from the cp command. If we didn't care about the order

cp command might have been written cp wumpus.man !#:1.old, using # to refer to the current event. !n:- hurkle.man would reuse the first two words from the nroff command to say nroff -man hurkle.man.

The : separating the event specification from the word designator can be omitted if the argument selector begins with a ^, $, *, % or -. For example, our diff command might have been diff !!^.old !!^ or, equiva? lently, diff !!$.old !!$. However, if !! is abbreviated !, an argument selector beginning with - will be interpreted as an event specifica? tion.

The word(s) in a history reference can be edited by following them with one or more modifiers, each preceded by a colon (:):

h Remove a trailing pathname component, leaving the head.

t Remove all leading pathname components, leaving the tail.

r Remove a filename extension .xxx, leaving the root name.

e Remove all but the extension.

s/l/r/ Substitute l for r. l is simply a string like r, not a regular expression as in the eponymous ed(1) command. Any character may be used as the delimiter in place of /; a \ can be used to quote the delimiter inside l and r. The character & in the r is replaced by l; \ also quotes &. If l is empty, the l from the previous substitution is used,

The trailing delimiter may be omitted if it is immediately followed by a newline.

& Repeat the previous substitution.

g Global substitution, for example :gs/foo/bar/ or :g&. Ap? plies the s or & modifier to the entire command line.

a Same as g.

p Print the new command line but do not execute it.

q Quote the expanded words, preventing further expansions.

x Like q, but break into words at blanks, tabs and newlines.

Modifiers are applied to only the first modifiable word (unless g or a is used). It is an error for no word to be modifiable.

For example, the diff command might have been written as diff wum? pus.man.old !#^:r, using :r to remove .old from the first argument on the same line (!#^). We might follow mail -s "I forgot my password" rot with !:s/rot/root to correct the spelling of root.

History expansions also occur when an input line begins with ^. When it is the first character on an input line, it is an abbreviation of !:s^. Thus we might have said ^rot^root to make the spelling correc? tion in the previous example. This is the only history expansion that does not explicitly begin with !.

#, history expansion is ignored for the rest of that line. This usu? ally causes the shell parser (which uses the same character to signal a comment) to treat the rest of the line as a comment as well, but as history expansion is parsed separately from the shell grammar and with different rules, this cannot be guaranteed in all cases. If the his? tory comment character is changed, the shell grammar comment character does not change along with it.

The three characters used to signal history expansion can be changed using the histchars shell variable; see Shell Variables above.

In-line Editing Options.

Normally, each command line entered from a terminal device is simply typed followed by a new-line (`RETURN' or `LINE FEED'). If either the emacs, gmacs, or vi option is active, the user can edit the command line. To be in either of these edit modes, set the corresponding op? tion. An editing option is automatically selected each time the VISUAL or EDITOR variable is assigned a value matching any of these editor names; for details, see Shell Variables above under VISUAL.

The editing features require that the user's terminal accept `RETURN' as carriage return without line feed and that a space (` ') must over? write the current character on the screen.

cept where the user is looking through a window at the current line. The window width is the value of COLUMNS if it is defined, otherwise 80. If the window width is too small to display the prompt and leave at least 8 columns to enter input, the prompt is truncated from the left. If the line is longer than the window width minus two, a mark is displayed at the end of the window to notify the user. As the cursor moves and reaches the window boundaries, the window will be centered about the cursor. The mark is a > (<, *) if the line extends on the right (left, both) side(s) of the window.

The search commands in each edit mode provide access to the history file. Only strings are matched, not patterns, although a leading ^ in the string restricts the match to begin at the first character in the line.

Each of the edit modes has an operation to list the files or commands that match a partially entered word. When applied to the first word on the line, or the first word after a ;, |, &, or (, and the word does not begin with ? or contain a /, the list of aliases, functions, and executable commands defined by the PATH variable that could match the partial word is displayed. Otherwise, the list of files that match the given word is displayed. If the partially entered word does not con? tain any file expansion characters, a * is appended before generating these lists. After displaying the generated list, the input line is

name listing, respectively. There are additional operations, referred to as command name completion and file name completion, which compute the list of matching commands or files, but instead of printing the list, replace the current word with a complete or partial match. For file name completion, if the match is unique, a / is appended if the file is a directory and a space is appended if the file is not a direc? tory. Otherwise, the longest common prefix for all the matching files replaces the word. For command name completion, only the portion of the file names after the last / are used to find the longest command prefix. If only a single name matches this prefix, then the word is replaced with the command name followed by a space. When using a tab for completion that does not yield a unique match, a subsequent tab will provide a numbered list of matching alternatives. A specific se? lection can be made by entering the selection number followed by a tab. Neither completion nor listing operations are attempted before the first character in a line.

Key Bindings.

The KEYBD trap can be used to intercept keys as they are typed and change the characters that are actually seen by the shell. This trap is executed after each character (or sequence of characters when the first character is ESC) is entered while reading from a terminal. The variable .sh.edchar contains the character or character sequence which generated the trap. Changing the value of .sh.edchar in the trap ac?

the keyboard rather than the original value.

The variable .sh.edcol is set to the input column number of the cursor at the time of the input. The variable .sh.edmode is set to ESC when in vi input mode (see below) and set to the empty string otherwise. Prepending ${.sh.editmode} to a value assigned to .sh.edchar will cause the shell to change to control mode if it is not already in this mode.

This trap is not invoked for characters entered as arguments to editing directives, or while reading input for a character search.

Emacs Editing Mode.

This mode is entered by enabling either the emacs or gmacs option. The only difference between these two modes is the way they handle ^T. To edit, the user moves the cursor to the point needing correction and then inserts or deletes characters or words as needed. All the editing commands are control characters or escape sequences. The notation for control characters is caret (^) followed by the character. For exam? ple, ^F is the notation for control F. This is entered by depressing `f' while holding down the `CTRL' (control) key. The `SHIFT' key is not depressed. (The notation ^? indicates the DEL (delete) key.)

The notation for escape sequences is M- followed by a character. For example, M-f (pronounced Meta f) is entered by depressing ESC (ASCII

`SHIFT' (capital) `F'.)

All edit commands operate from any place on the line (not just at the beginning). Neither the `RETURN' nor the `LINE FEED' key is entered after edit commands except when noted.

The M-[multi-character commands below are DEC VT220 escape sequences generated by special keys on standard PC keyboards, such as the arrow keys. You could type them directly but they are meant to recognize the keys in question, which are indicated in parentheses.

^F Move cursor forward (right) one character.

M-[C (Right arrow) Same as ^F.

M-f Move cursor forward one word. (The emacs editor's idea of a word is a string of characters consisting of only letters, digits and underscores.)

M-[1;3C (Alt-Right arrow) Same as M-f.

M-[1;5C (Ctrl-Right arrow) Same as M-f.

M-[1;9C (iTerm2 Alt-Right arrow) Same as M-f.

^B Move cursor backward (left) one character.

M-[D (Left arrow) Same as ^B.

M-b Move cursor backward one word.

M-[1;3D (Alt-Left arrow) Same as M-b.

M-[1;5D (Ctrl-Left arrow) Same as M-b.

^A Move cursor to start of line.

M-[H (Home) Same as ^A.

M-[1~ Same as ^A.

M-[7~ Same as ^A.

^E Move cursor to end of line.

M-[F (End) Same as ^E.

M-[4~ Same as ^E.

M-[8~ Same as ^E.

M-[Y Same as ^E.

M-OA (Up Arrow) Same as M-[A.

M-OB (Down Arrow) Same as M-[B.

M-OC (Right Arrow) Same as M-[C.

M-OD (Left Arrow) Same as M-[D.

M-O5C (Ctrl-Right Arrow) Same as M-f.

M-O5D (Ctrl-Left Arrow) Same as M-b.

^]char Move cursor forward to character char on current line.

M-^]char Move cursor backward to character char on current line.

^X^X Interchange the cursor and mark.

erase (User defined erase character as defined by the stty(1) com?
mand, usually ^H.) Delete previous character.

lnext (User defined literal next character as defined by the
stty(1) command, or ^V if not defined.) Removes the next
character's editing features (if any).

^D Delete current character.

M-d Delete current word.

M-[3;5~ (Ctrl-Delete) Same as M-d.

M-^H (Meta-backspace) Delete previous word.

M-h Delete previous word.

M-^? (Meta-DEL) Delete previous word (if your interrupt character is ^? (DEL, the default) then this command will not work).

^T Transpose current character with previous character and advance the cursor in emacs mode. Transpose two previous characters in gmacs mode.

^C Capitalize current character.

M-c Capitalize current word.

M-l Change the current word to lower case.

^K Delete from the cursor to the end of the line. If preceded by a numerical parameter whose value is less than the current cursor position, then delete from given position up to the cursor. If preceded by a numerical parameter whose value is greater than the current cursor position, then delete from cursor up to given cursor position.

^W Kill from the cursor to the mark.

M-p Push the region from the cursor to the mark on the stack.

kill (User defined kill character as defined by the stty(1) command, usually ^U.) Kill the entire current line. If two kill characters are entered in succession, all kill characters from then on cause a line feed (useful when using paper

change.

^Y Restore last item removed from line. (Yank item back to the line.)

^X^E Return the command hist -e ${VISUAL:-${EDITOR:-vi}} in the input buffer to call a full editor ? vi by default ? on the current command line.

^L Line feed and print current line.

M-^L Clear the screen.

^@ (Null character) Set mark.

M-space (Meta space) Set mark.

^J (New line) Execute the current line.

^M (Return) Execute the current line.

eof End-of-file character, normally ^D, is processed as an End-of-file only if the current line is empty.

^P Fetch previous command. Each time ^P is entered the previous command back in time is accessed. Moves back one line when not on the first line of a multi-line command.

M-[A (Up arrow) If the cursor is at the end of the line, it is equivalent to ^R with string set to the contents of the cur? rent line. Otherwise, it is equivalent to ^P.

M-< Fetch the least recent (oldest) history line.

M-> Fetch the most recent (youngest) history line.

^N Fetch next command line. Each time ^N is entered the next command line forward in time is accessed.

^Rstring Reverse search history for a previous command line containing string. If a parameter of zero is given, the search is for? ward. String is terminated by a `RETURN' or `NEW LINE'. If string is preceded by a ^, the matched line must begin with string. If string is omitted, then the next command line containing the most recent string is accessed. In this case a parameter of zero reverses the direction of the search.

^G Exit reverse search mode.

^O Operate - Execute the current line and fetch the next line relative to current line from the history file.

M-digits (Escape) Define numeric parameter, the digits are taken as a parameter to the next command. The commands that accept a parameter are ^F, ^B, erase, ^C, ^D, ^K, ^R, ^P, ^N, ^], M-., M-^], M-_, M-=, M-b, M-c, M-d, M-f, M-h, M-l, M-^H, and the arrow keys and forward-delete key.

M-letter Soft-key - Your alias list is searched for an alias by the name _letter and if an alias of this name is defined, its value will be inserted on the input queue. The letter must not be one of the above meta-functions.

M-[letter Soft-key - Your alias list is searched for an alias by the name __letter and if an alias of this name is defined, its value will be inserted on the input queue. This can be used to program function keys on many terminals.

M-. The last word of the previous command is inserted on the

parameter determines which word to insert rather than the last word.

M-_ Same as M-..

M-* Attempt pathname expansion on the current word. An asterisk is appended if the word doesn't match any file or contain any special pattern characters.

M-ESC Command or file name completion as described above.

^I tab Attempts command or file name completion as described above. If a partial completion occurs, repeating this will behave as if M-= were entered. If no match is found or entered after space, a tab is inserted.

M-= If not preceded by a numeric parameter, it generates the list of matching commands or file names as described above. Oth? erwise, the word under the cursor is replaced by the item corresponding to the value of the numeric parameter from the most recently generated command or file list. If the cursor is not on a word, it is inserted instead.

^U Multiply parameter of next command by 4.

\ If the backslashctrl shell option is on (which is the default setting), this escapes the next character. Editing charac? ters, the user's erase, kill and interrupt (normally ^C) characters may be entered in a command line or in a search string if preceded by a \. The \ removes the next charac? ter's editing features (if any). See also Inext which is not

M-^V Display version of the shell.

M-[2~ (Insert) Escape the next character.

M-# If the line does not begin with a #, a # is inserted at the beginning of the line and after each new-line, and the line is entered. This causes a comment to be inserted in the his? tory file. If the line begins with a #, the # is deleted and one # after each new-line is also deleted.

Vi Editing Mode.

There are two typing modes. Initially, when you enter a command you are in the input mode. To edit, the user enters control mode by typing ESC (033) and moves the cursor to the point needing correction and then inserts or deletes characters or words as needed. Most control com? mands accept an optional repeat count prior to the command.

The notation for control characters used below is ^ followed by a char? acter. For instance, ^H is entered by holding down the Control key and pressing H. ^[(Control+[) is equivalent to the ESC key. The notation for escape sequences is ^[followed by one or more characters.

The ^[[(ESC [) multi-character commands below are DEC VT220 escape se? quences generated by special keys on standard PC keyboards, such as the arrow keys, which are indicated in parentheses. When in input mode, these keys will switch you to control mode before performing the asso?

ters, but only when the ^[and the subsequent [are entered into the input buffer at the same time, such as when pressing one of those keys.

Input Edit Commands

By default the editor is in input mode.

erase (User defined erase character as defined by the stty(1) command, usually ^H or #.) Delete previous character.

^W Delete the previous blank separated word.

eof As the first character of the line causes the shell to terminate unless the ignoreeof option is set. Other? wise this character is ignored.

lnext (User defined literal next character as defined by the stty(1) or ^V if not defined.) Removes the next char? acter's editing features (if any).

\ If the backslashctrl shell option is on (which is the default setting), this escapes the next erase or kill character.

^I tab Attempts command or file name completion as described above and returns to input mode. If a partial comple? tion occurs, repeating this will behave as if = were entered from control mode. If no match is found or entered after space, a tab is inserted.

Motion Edit Commands

These commands will move the cursor.

[count]l Cursor forward (right) one character.

[count]^[[C

(Right arrow) Same as l.

[count]w Cursor forward one alphanumeric word.

[count]W Cursor to the beginning of the next word that follows a blank.

[count]e Cursor to end of word.

[count]E Cursor to end of the current blank delimited word.

[count]h Cursor backward (left) one character.

[count]^[[D

(Left arrow) Same as h.

[count]b Cursor backward one word.

[count]B Cursor to preceding blank separated word.

[count]| Cursor to column count.

[count]fc Find the next character c in the current line.

[count]Fc Find the previous character c in the current line.

[count]tc Equivalent to f followed by h.

[count]Tc Equivalent to F followed by l.

[count]; Repeats count times, the last single character find command, f, F, t, or T.

[count], Reverses the last single character find command count

0 Cursor to start of line.

^[[H (Home) Same as 0.

^[[1~ Same as 0.

^[[7~ Same as 0.

^[[1;3D (Alt-Left arrow) Same as b.

^[[1;5D (Ctrl-Left arrow) Same as b.

^[[1;9D (iTerm2 Alt-Left arrow) Same as b.

^[[1;3C (Alt-Right arrow) Same as w.

^[[1;5C (Ctrl-Right arrow) Same as w.

^[[1;9C (iTerm2 Alt-Right arrow) Same as w.

^[[2~ (Insert) Same as i.

^[[3;5~ (Ctrl-Delete) Same as dw.

^[OA (Up Arrow) Same as ^[[A.

^[OB (Down Arrow) Same as ^[[B.

^[OC (Right Arrow) Same as ^[[C.

^[OD (Left Arrow) Same as ^[[D.

^[O5C (Ctrl-Right Arrow) Same as w.

^[O5D (Ctrl-Left Arrow) Same as b.

^ Cursor to first non-blank character in line.

$ Cursor to end of line.

^[[F (End) Same as $.

^[[4~ Same as $.

^[[8~ Same as $.

^[[Y Same as $.

% Moves to balancing (,), {, }, [, or]. If cursor is not on one of the above characters, the remainder of the line is searched for the first occurrence of one of the above characters first.

Search Edit Commands

These commands access your command history.

[count]k Fetch previous command. Each time k is entered the previous command back in time is accessed.

[count]- Equivalent to k.

[count]^[[A

(Up arrow) If cursor is at the end of the line it is equivalent to / with string set to the contents of the current line. Otherwise, it is equivalent to k.

[count]j Fetch next command. Each time j is entered the next command forward in time is accessed.

[count]+ Equivalent to j.

[count]^[[B

(Down arrow) Equivalent to j.

[count]G The command number count is fetched. The default is the least recent history command.

/string Search backward through history for a previous command containing string. String is terminated by a `RETURN'

matched line must begin with string. If string is empty, the previous string will be used.

?string Same as / except that search will be in the forward direction.

n Search for next match of the last pattern to / or ? commands.

N Search for next match of the last pattern to / or ?, but in reverse direction.

Text Modification Edit Commands

These commands will modify the line.

a Enter input mode and enter text after the current character.

A Append text to the end of the line. Equivalent to $a.

[count]cmotion

c[count]motion

Delete current character through the character that motion would move the cursor to and enter input mode. If motion is c, the entire line will be deleted and input mode entered.

C Delete the current character through the end of line and enter input mode. Equivalent to c$.

S Equivalent to cc.

D Delete the current character through the end of line. Equivalent to d$.

[count]dmotion

d[count]motion

Delete current character through the character that motion would move to. If motion is d , the entire line will be deleted.

i Enter input mode and insert text before the current character.

I Insert text before the first non-blank character. Equivalent to ^i.

[count]P Place the previous text modification before the cur? sor.

[count]p Place the previous text modification after the cursor.

R Enter input mode and replace characters on the screen with characters you type overlay fashion.

[count]rc Replace the count character(s) starting at the current cursor position with c, and advance the cursor.

[count]x Delete current character.

[count]^[[3~

(Forward delete) Same as x.

[count]X Delete preceding character.

[count]. Repeat the previous text modification command.

[count]? Invert the case of the count character(s) starting at

[count]_ Causes the count word of the previous command to be appended and input mode entered. The last word is used if count is omitted.

* Causes an * to be appended to the current word and pathname expansion attempted. If no match is found, it rings the bell. Otherwise, the word is replaced by the matching pattern and input mode is entered.

\ Command or file name completion as described above.

Other Edit Commands

Miscellaneous commands.

[count]ymotion

y[count]motion

Yank current character through character that motion would move the cursor to and puts them into the delete buffer. The text and cursor are unchanged.

yy Yanks the entire line.

Y Yanks from current position to end of line. Equiva? lent to y$.

u Undo the last text modifying command.

U Undo all the text modifying commands performed on the line.

[count]v Returns the command hist -e ${VISUAL:-${EDITOR:-vi}}

by default ? on a history entry. If count is omitted, then the current line is used.

^L Line feed and print current line. Has effect only in control mode.

^J (New line) Execute the current line, regardless of mode.

^M (Return) Execute the current line, regardless of mode.

If the first character of the command is a #, then this command deletes this # and each # that follows a newline. Otherwise, sends the line after inserting a # in front of each line in the command. Useful for causing the current line to be inserted in the history as a comment and uncommenting previously commented commands in the history file.

[count]= If count is not specified, it generates the list of matching commands or file names as described above. Otherwise, the word under the cursor is replaced by the count item from the most recently generated com? mand or file list. If the cursor is not on a word, it is inserted instead.

@letter Your alias list is searched for an alias by the name _letter and if an alias of this name is defined, its value will be inserted on the input queue for process? ing.

Built-in Commands.

The simple-commands listed below are built in to the shell and are exe? cuted in the same process as the shell. The effects of any added In? put/Output redirections are local to the command, except for the exec and redirect commands. Unless otherwise indicated, the output is writ? ten on standard output (file descriptor 1) and the exit status, when there is no syntax error, is zero. Except for :, true, false, and echo, all built-in commands accept -- to indicate end of options, and are self-documenting.

The self-documenting commands interpret the option --man as a request to display that command's own manual page, --help as a request to dis? play the OPTIONS section from their manual page, and -? as a request to print a brief usage message. All these are processed as error mes? sages, so they are written on standard error (file descriptor 2) and to pipe them into a pager such as more(1) you need to add a 2>&1 redirec? tion before the |. The display of boldface text depends on whether standard error is on a terminal, so is disabled when using a pager. Ex? porting the ERROR_OPTIONS environment variable with a value containing emphasis will force this on; a value containing noemphasis forces it off. The test/[command needs an additional -- argument to recognize self-documentation options, e.g. test --man --. The exec and redirect commands, as they make redirections permanent, should use self-documen?

--man) 2>&1. There are advanced output options as well; see getopts --man for more information.

Commands that are preceded by a ? symbol below are special built-in commands and are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assign? ments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.

Commands that are preceded by a ? symbol below are declaration com? mands. Any following words that are in the format of a variable as? signment are expanded with the same rules as a variable assignment. This means that tilde expansion is performed after the = sign, array assignments of the form varname=(assign_list) are supported, and field splitting and pathname expansion are not performed.

? : [arg ...]

The command only expands parameters.

? . name [arg ...]

If name is a function defined with the function name reserved

(as if it had been defined with the name() syntax). Otherwise if name refers to a file, the file is read in its entirety and the commands are executed in the current shell environment. The search path specified by PATH is used to find the directory con? taining the file. If any arguments arg are given, they become the positional parameters while processing the . command and the original positional parameters are restored upon completion. Otherwise the positional parameters are unchanged. The exit status is the exit status of the last command executed.

[expression]

The [command is the same as test, with the exception that an additional closing] argument is required. See test below.

alias [-ptx] [name[=value]] ...

alias with no arguments prints the list of aliases in the form name=value on standard output. The -p option causes the word alias to be inserted before each one. When one or more argu? ments are given, an alias is defined for each name whose value is given. A trailing space in value causes the next word to be checked for alias substitution. With the -t option, each name is looked up as a command in $PATH and its path is added to the hash table as a 'tracked alias'. If no name is given, this prints the hash table. See hash. Without the -t option, for

name and value of the alias is printed. The obsolete -x option has no effect in most contexts, although if it's used with -t it will suppress all output. The exit status is non-zero if a name is given, but no value, and no alias has been defined for the name.

autoload name ...

Marks each name undefined so that the FPATH variable will be searched to find the function definition when the function is referenced. The same as typeset -fu.

bg [job...]

This command is only on systems that support job control. Puts each specified job into the background. The current job is put in the background if job is not specified. See Jobs for a de? scription of the format of job.

? break [n]

Exit from the enclosing for, while, until, or select loop, if any. If n is specified, then break n levels.

builtin [-ds] [-f file] [name ...]

If name is not specified, and no -f option is specified, the built-ins are printed on standard output. The -s option prints

pathname whose basename is the name of the built-in. The entry point function name is determined by prepending b_ to the built-in name. A built-in specified by a pathname will only be exe? cuted when that pathname would be found during the path search. Built-ins found in libraries loaded via the .paths file will as? sociate with the pathname of the directory containing the .paths file.

The ISO C/C++ prototype is b_mycommand(int argc, char *argv[], void *context) for the builtin command mycommand where argv is array an of argc elements and context is an optional pointer to a Shell_t structure as described in <ast/shell.h>.

Special built-ins cannot be bound to a pathname or deleted. The -d option deletes each of the given built-ins. On systems that support dynamic loading, the -f option names a shared library containing the code for built-ins. The shared library prefix and/or suffix, which depend on the system, can be omitted. Once a library is loaded, its symbols become available for subsequent invocations of builtin. Multiple libraries can be specified with separate invocations of the builtin command. Libraries are searched in the reverse order in which they are specified. When a library is loaded, it looks for a function in the library whose name is lib_init() and invokes this function with an argu?

cd [-L] [-eP] [arg]

cd [-L] [-eP] old new

This command can be in either of two forms. In the first form it changes the current directory to arg. If arg is - the direc? tory is changed to the previous directory. The shell variable HOME is the default arg. The variable PWD is set to the current directory. The shell variable CDPATH defines the search path for the directory containing arg. Alternative directory names are separated by a colon (:). The default path is the empty string (specifying the current directory). Note that the cur? rent directory may be specified by a dot (.) or by an empty path name, either of which can appear immediately after the equal sign or between the colon delimiters anywhere else in the path list. If arg begins with a / then the search path is not used. Otherwise, each directory in the path is searched for arg.

The second form of cd substitutes the string new for the string old in the current directory name, PWD, and tries to change to this new directory.

By default, symbolic link names are treated literally when find? ing the directory name. This is equivalent to the -L option.

The -P option causes symbolic links to be resolved when deter? mining the directory. The last instance of -L or -P on the com?

If -e and -P are both in effect and the correct PWD could not be determined after successfully changing the directory, cd will return with exit status one and produce no output. If any other error occurs while both flags are active, the exit status is greater than one.

The cd command may not be executed by rksh.

command [-pvxV] name [arg ...]

With the -v option, command is equivalent to the built-in whence command described below. The -V option causes command to act like whence -v.

Without the -v or -V options, command executes name with the ar? guments given by arg. Functions and aliases will not be searched for when finding name. If name refers to a special built-in, as marked with ? in this manual, command disables the special properties described above for that mark, executing the command as a regular built-in. (For example, using command set -o option-name prevents a script from terminating when an in? valid option name is given.)

The -p option causes the operating system's standard utilities path (as output by getconf PATH) to be searched rather than the one defined by the value of PATH.

The -x option searches for name as an external command, bypass? ing built-ins. If the arguments contain at least one word that expands to multiple arguments, for example *.txt or "$@", then the -x option also allows executing external commands with argu? ment lists that are longer than the operating system allows. This functionality is similar to xargs(1) but is easier to use. The shell does this by invoking the external command multiple times if needed, dividing the expanded argument list over the invocations. Any arguments that come before the first word that expands to multiple arguments, as well as any that follow the last such word, are repeated for each invocation. This allows each invocation to use the same command options, as well as the same trailing destination arguments for commands like cp(1) or mv(1). When all invocations are completed, command -x exits with the status of the invocation that had the highest exit sta? tus. (Note that command -x may still fail with an "argument list too long" error if a single argument exceeds the maximum length of the argument list, or if a long arguments list con? tains no word that expands to multiple arguments.)

? compound vname[=value] ...

Causes each vname to be a compound variable. The same as type? set -C.

Resume the next iteration of the enclosing for, while, until, or select loop. If n is specified, then resume at the n-th enclos? ing loop.

disown [job...]

Causes the shell not to send a HUP signal to each given job, or all active jobs if job is omitted, when a login shell termi? nates.

echo [arg ...]

When the first arg does not begin with a -, and none of the ar? guments contain a \, then echo prints each of its arguments sep? arated by a space and terminated by a new-line. Otherwise, the behavior of echo is system dependent and print or printf de? scribed below should be used. See echo(1) for usage and de? scription.

? enum [-i] type[=(value ...)] ...

Creates, for each type specified, an enumeration type declara? tion command named type. Variables of the created type can only store any one of the values given. For example, enum bool=(false true) creates a Boolean variable type of which vari? ables may be declared like bool x=true y=false. If =(value ...) is omitted, then type must be an indexed array variable with at

variable. If -i is specified the values are case-insensitive. Declaration commands are created as special builtins that cannot be removed or overridden by shell functions. Each created dec? laration command has a --man option that shows documentation on its type's behavior and possible values.

Within arithmetic expressions (see Arithmetic Evaluation above), enumeration type values translate to index numbers between 0 and the number of defined values minus 1. It is an error for an arithmetic expression to assign a value outside of that range. Decimal fractions are ignored. Taking the bool type from the example above, if a variable of this type is used in an arith? metic expression, false translates to 0 and true to 1. Enumera? tion values may also be used directly in an arithmetic expres? sion that refers to a variable of an enumeration type. To con? tinue our example, for a bool variable v, ((v==true)) is the same as ((v==1)) and if a variable named true exists, it is ig? nored.

? eval [arg ...]

The arguments are read as input to the shell and the resulting command(s) executed.

? exec [-c] [-a name] [arg ...]

cuted in place of this shell without creating a new process. The value of the SHLVL environment variable is decreased by one, unless the shell replaced is a subshell. The -c option causes the environment to be cleared before applying variable assign? ments associated with the exec invocation. The -a option causes name rather than the first arg, to become argv[0] for the new process. If arg is not given and only I/O redirections are given, then this command persistently modifies file descriptors as in redirect.

? exit [n]

Causes the shell to exit with the exit status specified by n. The value will be the least significant 8 bits of n (if speci? fied) or of the exit status of the last command executed. An end-of-file will also cause the shell to exit, except for an in? teractive shell that has the ignoreeof option turned on (see set below).

?? export [-p] [name[=value]] ...

If name is not given, the names and values of each variable with the export attribute are printed with the values quoted in a manner that allows them to be re-input. The export command is the same as typeset -x except that if you use export within a function, no local variable is created. The -p option causes

given names are marked for automatic export to the environment of subsequently-executed commands.

false Does nothing, and exits 1. Used with until for infinite loops.

fc [-e ename] [-N num] [-nlr] [first [last]]

fc -s [old=new] [command]

The same as hist.

fg [job...]

This command is only on systems that support job control. Each job specified is brought to the foreground and waited for in the specified order. Otherwise, the current job is brought into the foreground. See Jobs for a description of the format of job.

? float vname[=value] ...

Declares each vname to be a long floating point number. The same as typeset -lE.

functions [-Stux] [name ...]

Lists functions. The same as typeset -f.

getconf [name [pathname]]

Prints the current value of the configuration parameter given by

POSIX 1003.1 and IEEE POSIX 1003.2 standards. (See pathconf(2) and sysconf(3).) The pathname argument is required for parame? ters whose value depends on the location in the file system. If no arguments are given, getconf prints the names and values of the current configuration parameters. The pathname / is used for each of the parameters that requires pathname.

getopts [-a name] optstring vname [arg ...]

Checks arg for legal options. If arg is omitted, the positional parameters are used. An option argument begins with a + or a -. An option not beginning with + or - or the argument -- ends the options. Options beginning with + are only recognized when opt? string begins with a +. optstring contains the letters that getopts recognizes. If a letter is followed by a :, that option is expected to have an argument. The options can be separated from the argument by blanks. The option -? causes getopts to generate a usage message on standard error. The -a argument can be used to specify the name to use for the usage message, which defaults to $0.

getopts places the next option letter it finds inside variable vname each time it is invoked. The option letter will be prepended with a + when arg begins with a +. The index of the next arg is stored in OPTIND. The option argument, if any, gets stored in OPTARG.

an invalid option in OPTARG, and to set vname to ? for an un? known option and to : when a required option argument is miss? ing. Otherwise, getopts prints an error message. The exit sta? tus is non-zero when there are no more options.

There is no way to specify any of the options :, +, -, ?, [, and]. The option # can only be specified as the first option.

hash [-r] [utility]

hash displays or modifies the hash table with the locations of recently used programs. If given no arguments, it lists all com? mand/path associations (a.k.a. 'tracked aliases') in the hash table. Otherwise, hash performs a PATH search for each utility supplied and adds the result to the hash table. The -r option empties the hash table. This can also be achieved by resetting PATH.

hist [-e ename] [-N num] [-nlr] [first [last]]

hist -s [old=new] [command]

In the first form, a range of commands from first to last is se? lected from the last HISTSIZE commands that were typed at the terminal. The arguments first and last may be specified as a number or as a string. A string is used to locate the most re? cent command starting with the given string. A negative number is used as an offset to the current command number. If the -l

Otherwise, the editor program ename is invoked on a file con? taining these keyboard commands. If ename is not supplied, then the value of the variable HISTEDIT is used. If HISTEDIT is not set, then FCEDIT (default /bin/ed) is used as the editor. When editing is complete, the edited command(s) is executed if the changes have been saved. If last is not specified, then it will be set to first. If first is not specified, the default is the previous command for editing and -16 for listing. The option -r reverses the order of the commands and the option -n suppresses command numbers when listing. In the second form, command is interpreted as first described above and defaults to the last command executed. The resulting command is executed after the optional substitution old=new is performed. The option -N causes hist to start num commands back.

? integer vname[=value] ...

Declares each vname to be a long integer number. The same as typeset -li.

jobs [-lnp] [job ...]

Lists information about each given job; or all active jobs if job is omitted. The -l option lists process IDs in addition to the normal information. The -n option only displays jobs that have stopped or exited since last notified. The -p option

scription of the format of job.

kill [-s signame] job ...

kill [-n signum] job ...

kill -Ll [sig ...]

Sends either the TERM (terminate) signal or the specified signal to the specified jobs or processes. Signals are either given by number with the -n option or by name with the -s option (as given in <signal.h>, stripped of the prefix ``SIG''. For back? ward compatibility, the n and s can be omitted and the number or name placed immediately after the -. If the signal being sent is TERM (terminate) or HUP (hangup), then the job or process will be sent a CONT (continue) signal if it is stopped. The ar? gument job can be the process ID of a process that is not a mem? ber of one of the active jobs. See Jobs for a description of the format of job. In the third form, kill -l or kill -L, if sig is not specified, the signal names are listed. The -l op? tion lists only the signal names. The -L option lists each sig? nal name and corresponding number. Otherwise, for each sig that is a name, the corresponding signal number is listed. For each sig that is a number, the signal name corresponding to the least significant 8 bits of sig is listed.

let arg ...

let only recognizes octal numbers starting with 0 when the set option letoctal is on. See Arithmetic Evaluation above for a description of arithmetic expression evaluation.

The exit status is 0 if the value of the last expression is non-zero, and 1 otherwise.

? nameref vname[=refname] ...

Declares each vname to be a variable name reference. The same as typeset -n.

print [-CRenprsv] [-u unit] [-f format] [arg ...]

With no options or with option - or --, each arg is printed on standard output. The -f option causes the arguments to be printed as described by printf. In this case, any e, n, r, R options are ignored. Otherwise, unless the -C, -R, -r, or -v are specified, the following escape conventions will be applied:

\a The alert character (ASCII 07).

\b The backspace character (ASCII 010).

\c Causes print to end without processing more arguments and not adding a new-line.

\f The formfeed character (ASCII 014).

\n The newline character (ASCII 012).

\r The carriage return character (ASCII 015).

\t The tab character (ASCII 011).

\E The escape character (ASCII 033).

\\ The backslash character \.

\0x The character defined by the 1, 2, or 3-digit octal string given by x.

The -R option will print all subsequent arguments and options other than -n. The -e causes the above escape conventions to be applied. This is the default behavior. It reverses the effect of an earlier -r. The -p option causes the arguments to be written onto the pipe of the process spawned with |& instead of standard output. The -v option treats each arg as a variable name and writes the value in the printf %B format. The -C op? tion treats each arg as a variable name and writes the value in the printf %#B format. The -s option causes the arguments to be written onto the history file instead of standard output. The -u option can be used to specify a one digit file descriptor unit number unit on which the output will be placed. The de? fault is 1. If the option -n is used, no new-line is added to the output.

printf [-v vname] format [arg ...]

The arguments arg are printed on standard output in accordance with the ANSI C formatting rules associated with the format string format. If the number of arguments exceeds the number of

maining arguments. The following extensions can also be used:

%b A %b format can be used instead of %s to cause escape se? quences in the corresponding arg to be expanded as de? scribed in print.

%B A %B option causes each of the arguments to be treated as variable names and the binary value of variable will be printed. The alternate flag # causes a compound variable to be output on a single line. This is most useful for compound variables and variables whose attribute is -b.

%H A %H format can be used instead of %s to cause characters in arg that are special in HTML and XML to be output as their entity name. The alternate flag # formats the out? put for use as a URI.

%p A %p format will convert the given number to hexadecimal.

%P A %P format can be used instead of %s to cause arg to be interpreted as an extended regular expression and be printed as a shell pattern.

%q A %q format can be used instead of %s to cause the re? sulting string to be quoted in a manner than can be rein? put to the shell. When q is preceded by the alternative format specifier, #, the string is quoted in manner suit? able as a field in a .csv format file.

%(date-format)T

A %(date-format)T format can be used to treat an argument

ing to the date-format.

%Q A %Q format will convert the given number of seconds to readable time.

%R A %R format can be used instead of %s to cause arg to be interpreted as a shell pattern and to be printed as an extended regular expression.

%Z A %Z format will output a byte whose value is 0.

%d The precision field of the %d format can be followed by a . and the output base. In this case, the # flag charac? ter causes base# to be prepended. When an output base is specified without giving a precision (e.g. %..2d), the precision defaults to 1 instead of 0.

The # flag, when used with the %d format without an out? put base, displays the output in powers of 1000 indicated by one of the following suffixes: k M G T P E, and when used with the %i format displays the output in powers of 1024 indicated by one of the following suffixes: Ki Mi Gi Ti Pi Ei.

= The = flag centers the output within the specified field width.

L The L flag, when used with the %c or %s formats, treats precision as character width instead of byte count.

, The , flag, when used with the %d or %f formats, sepa? rates groups of digits with the grouping delimiter (, on

The -v option assigns the output directly to a variable instead of writing it to standard output. This is faster than capturing the output using a command substitution and avoids the latter's stripping of final linefeed characters (\n). The vname argument should be a valid variable name, optionally with one or more ar? ray subscripts in square brackets. Note that square brackets should be quoted to avoid pathname expansion.

pwd [-LP]

Outputs the value of the current working directory. The -L op? tion is the default; it prints the logical name of the current directory. If the -P option is given, all symbolic links are resolved from the name. The last instance of -L or -P on the command line determines which method is used.

read [-ACSaprsv] [-d delim] [-n n] [-N n] [-t timeout] [-u unit] [vname?prompt] [vname ...]

The shell input mechanism. One line is read and is broken up into fields using the characters in IFS as separators. The es? cape character, \, is used to remove any special meaning for the next character and for line continuation. The first field is assigned to the first vname, the second field to the second vname, etc., with leftover fields assigned to the last vname.

When vname has the binary attribute and -n or -N is specified, the bytes that are read are stored directly into the variable. If you append ?prompt to the first vname, then read will display prompt on standard error before reading if standard input is a terminal or pipe; the ? should be quoted to protect it from pathname expansion. The exit status is 0 unless an end-of-file is encountered or read has timed out. The options for the read command have meaning as follows:

-A Causes the variable vname to be unset and each field that is read to be stored in successive elements of the indexed array vname.

-C Causes the variable vname to be read as a compound vari? able. Blanks will be ignored when finding the beginning open parenthesis.

-N Causes n bytes to be read unless an end-of-file has been encountered or the read times out because of the -t op? tion.

-S Causes the line to be treated like a record in a .csv format file so that double quotes can be used to allow the delimiter character and the new-line character to appear within a field.

-a Same as -A.

-d Causes the read to continue to the first character of delim instead of the newline control character. Multi?

-n Causes at most n bytes to be read instead of a full line, but will return when reading from a slow device as soon as any characters have been read.

-p Input is read from the current co-process spawned by the shell using ?&. An end-of-file causes read to discon? nect the co-process so that another can be created.

-r Raw mode. The \ character is not treated specially.

-s The input will be saved as a command in the history file.

-t Used to specify a timeout in seconds when reading from a terminal or pipe.

-u This option can be used to specify a one-digit file de? scriptor unit unit to read from. The file descriptor can be opened with the exec or redirect built-in com? mand. If unit is p, input is read from the current co-process as with the -p option. The default value of unit is 0.

-v The value of the first vname will be used as a default value when reading from a terminal device.

?? readonly [-p] [vname[=value]] ...

If vname is not given, the names and values of each variable with the read-only attribute is printed with the values quoted in a manner that allows them to be re-input. The -p option

wise, the given vnames are marked read-only and these names can? not be changed by subsequent assignment. Unlike typeset -r , readonly does not create a function-local scope and the given vnames are marked globally read-only by default. When defining a type, if the value of a read-only subvariable is not defined, the value is required when creating each instance.

redirect

This command only accepts input/output redirections. It can open and close files and modify file descriptors from 0 to 9 as specified by the input/output redirection list (see the In? put/Output section above), with the difference that the effect persists past the execution of the redirect command. When in? voking another program, file descriptors greater than 2 that were opened with this mechanism are only passed on if they are explicitly redirected to themselves as part of the invocation (e.g. 4>&4) or if the posix option is set.

? return [n]

Causes a shell function, dot script (see . and source), or pro? file script to return to the invoking shell environment with the exit status specified by n. This status value can use the full signed integer range as shown by the commands getconf INT_MIN and getconf INT_MAX. A value outside that range will produce a

value of $? is assumed, i.e., the exit status of the last com? mand executed is passed on. If return is invoked while not in a function, dot script, or profile script, then it behaves the same as exit.

? set [?BCGHabefhkmnprstuvx] [?o [option]] ... [?A vname] [arg ...]

The options for this command have meaning as follows:

-A Array assignment. Unset the variable vname and assign values sequentially from the arg list. If +A is used, the variable vname is not unset first.

-B Enable brace group expansion. On by default, except if ksh is invoked as sh or rsh.

-C Prevents redirection > from truncating existing files. Files that are created are opened with the O_EXCL mode. Requires >| to truncate a file when turned on.

-G Enables recursive pathname expansion. This adds the double-star pattern ** to the pathname expansion (see Pathname Expansion above). By itself, it matches the recursive contents of the current directory, which is to say, all files and directories in the current directory and in all its subdirectories, sub-subdirectories, and so on. If the pathname pattern ends in **/, only direc? tories and subdirectories are matched, including sym?

rectory name is not included in the results unless that directory was itself found by a pattern. For example, dir/** matches the recursive contents of dir but not dir itself, whereas di[r]/** matches both dir itself and the recursive contents of dir. Symbolic links to non-direc? tories are not followed. Symbolic links to directories are followed if they are specified literally or match a pattern as described under Pathname Expansion, but not if they result from a double-star pattern.

-H Enable !-style history expansion similar to csh(1). See History Expansion above.

-a All variables that are assigned a value while this op? tion is on are automatically exported, unless they have a dot in their name. Variables created in namespaces declared with the namespace keyword (see Name Spaces above) are only exported while their name space is ac? tive.

-b Prints job completion messages as soon as a background job changes state rather than waiting for the next prompt. If one of the shell line editors is in use (see In-line Editing Options above), the completion message is inserted directly above the command line being typed.

-e Unless contained in a || or && command, or the command following an if while or until command or in the

status, execute the ERR trap, if set, and exit. This mode is disabled while reading profiles.

-f Disables pathname expansion.

-h Obsolete; no effect.

-k All variable assignment arguments are placed in the environment for a command, not just those that precede the command name.

-m Background jobs will run in a separate process group and a line will print upon completion. The exit status of background jobs is reported in a completion message. A pipeline will not terminate until all component commands of the pipeline have terminated. On systems with job control, this option is turned on automatically for interactive shells.

-n Read commands and check them for syntax errors, but do not execute them. Ignored for interactive shells.

-o The following argument can be one of the following option names:

allexport

Same as -a.

backslashctrl

The backslash character \ escapes the next control character in the emacs built-in editor and the next erase or kill character in the vi

bgnice All background jobs are run at a lower priority.
This is the default mode.

braceexpand
Same as -B.

emacs Activates the emacs-style command line editor.
See Emacs Editing Mode above.

errexit Same as -e.

functrace
Causes the -x option's state and the DEBUG trap
action to be inherited by functions defined us?
ing the function keyword (see Functions above)
instead of being reset to default. Changes made
to them within the function do not propagate
back to the parent scope. Similarly, this op?
tion also causes the DEBUG trap action to be in?
herited by subshells.

globcasedetect
When this option is turned on, globbing (see
Pathname Expansion above) and file name listing
and completion (see In-line Editing Options
above) automatically become case-insensitive on
file systems where the difference between upper-
and lowercase is ignored for file names. This is
transparently determined for each directory, so

can be part case-sensitive and part case-insen?
sitive. In more precise terms, each slash-sepa?
rated path name component pattern p is treated
as ~(i:p) if its parent directory exists on a
case-insensitive file system. This option is
only present on operating systems that support
case-insensitive file systems.

globstar
Same as -G.

gmacs Activates the emacs-style command line editor
with modified ^T. See Emacs Editing Mode above.

histexpand
Same as -H.

histreedit
If a history expansion (see -H) fails, the com?
mand line is reloaded into the next prompt's
edit buffer, allowing corrections.

histverify
The results of a history expansion (see -H) are
not immediately executed. Instead, the expanded
line is loaded into the next prompt's edit
buffer, allowing further changes.

ignoreeof
An interactive shell will not exit on end-of-

keyword Same as -k.

letoctal

The let command allows octal numbers starting with 0. On by default if ksh is invoked as sh or rsh.

markdirs

All directory names resulting from pathname ex? pansion have a trailing / appended.

monitor Same as -m.

multiline

The built-in editors will use multiple lines on the screen for lines that are longer than the width of the screen. This may not work for all terminals. The shell uses the system default tput(1) command to obtain the terminal escape codes for the necessary operations. Multi-line editing is disabled if this fails. On most sys? tems, setting the TERM variable to your termi? nal's type and exporting it corrects this situa? tion. The multiline option is ineffectual on systems whose tput(1) command supports neither terminfo(5) nor termcap(5) capability names.

noclobber

Same as -C.

noglob Same as -f.

nolog Obsolete; has no effect.

notify Same as -b.

nounset Same as -u.

pipefail

The exit status of the entire pipeline will be that of the last component command that exited with a non-zero exit status, or zero if no com? mand exited with a non-zero exit status. The shell will wait for all component commands of the pipeline to terminate, instead of only wait? ing for the last component command.

posix Enables the POSIX standard mode for maximum com? patibility with other compliant shells. At the moment that the posix option is turned on, it also turns on letoctal and turns off -B/braceex? pand; the reverse is done when posix is turned back off. (These options can still be controlled independently in between.) Furthermore, the posix option is automatically turned on upon in? vocation if the shell is invoked as sh or rsh, or if -o posix or --posix is specified on the shell invocation command line, or when executing scripts without a #! path with this option ac?

invoked shell will not import type attributes for variables (such as integer or left/right justify) from the environment.

In addition, while on, the posix option

? disables exporting variable type attributes to the environment for other ksh processes to import;

? disallows brace expansion on the results of unquoted expansions (if the -B/braceexpand option is turned back on);

? disables the special handling of repeated is? space class characters in the IFS variable;

? causes file descriptors > 2 to be left open when invoking another program;

? disables the &> redirection shorthand;

? disables fast filescan loops of type while inputredirection ;do list ;done;

? makes the <> redirection operator default to redirecting standard input if no file de? scriptor number precedes it;

? causes the shell to use a standard UNIX pipe(2) instead of a socketpair(2) to connect commands in a pipeline (when reading directly from a pipeline, the <#pattern and <##pattern

-n option to the read built-in will not re? turn early when reading from a slow device);

? disables the special floating point constants Inf and NaN in arithmetic evaluation so that, e.g., $((inf)) and $((nan)) refer to the variables by those names;

? enables the recognition of a leading zero as introducing an octal number in all arithmetic evaluation contexts, except in the let built- in while letoctal is off;

? disables zero-padding of seconds in the out? put of the time and times built-ins;

? stops the . command (but not source) from looking up functions defined with the func? tion syntax;

? disables the recognition of unexpanded shell arithmetic expressions for the numerical con? version specifiers of the printf built-in command, causing them to print a warning for operands that are not valid decimal, 0x-pre? fixed hexadecimal or 0-prefixed octal num? bers;

? disables the special handling of /dev/fd/n in file existence and access test operators in

the file /dev/fd/n in the file system;

? disables the recognition of unexpanded shell arithmetic expressions in the numerical com? parison operators -eq, -ne, -gt, -ge, -lt and -le of the test/[built-in command, causing them to accept only decimal numbers as operands;

? changes the test/[built-in command to make its deprecated expr1 -a expr2 and expr1 -o expr2 operators work even if expr1 equals "!" or "(" (which means the nonstandard unary -a file and -o option operators cannot be di? rectly negated using ! or wrapped in paren? theses); and

? disables a hack that makes test -t ([-t]) equivalent to test -t 1 ([-t 1]).

privileged

Same as -p.

showme When enabled, simple commands or pipelines pre? ceded by a semicolon (;) will be displayed as if the xtrace option were enabled but will not be executed. Otherwise, the leading ; will be ig? nored.

trackall

verbose Same as -v.

vi Activates the vi-style command line editor, ini? tially in input mode. See Vi Editing Mode above.

viraw Obsolete; has no effect.

xtrace Same as -x.

If no option name is supplied, then the current option settings are printed.

-p Disables processing of the $HOME/.profile file and uses the file /etc/suid_profile instead of the ENV file. This mode is on whenever the effective UID (GID) is not equal to the real UID (GID). Turning this off causes the effective UID and GID to be set to the real UID and GID.

-r Enables the restricted shell. This option cannot be un? set once set.

-s Sort the positional parameters lexicographically.

-t (Obsolete). Exit after reading and executing one com? mand.

-u Treat unset parameters as an error when substituting. $@ and $* are exempt.

-v Print shell input lines as they are read.

-- Do not change any of the options; useful in setting $1 to a value beginning with -. If no arguments follow this option then the positional parameters are unset.

As an obsolete feature, if the first arg is - then the -x and -v options are turned off and the next arg is treated as the first argument. Using + rather than - causes these options to be turned off. These options can also be used upon invocation of the shell. The current set of options may be found in $-. Un? less -A is specified, the remaining arguments are positional pa? rameters and are assigned, in order, to $1 $2 .... If no argu? ments are given, then the names and values of all variables are printed on the standard output.

? shift [n]

The positional parameters from $n+1 ... are renamed $1 ... , default n is 1. The parameter n can be any arithmetic expres? sion that evaluates to a non-negative number less than or equal to $#.

sleep [-s] duration

Suspends execution for the number of decimal seconds or frac? tions of a second given by duration. duration can be an inte? ger, floating point value or ISO 8601 duration specifying the

to terminate when it receives any signal. If duration is not specified in conjunction with -s, sleep will wait for a signal indefinitely.

source name [arg ...]

Same as ., except it is not treated as a special built-in com? mand.

stop job ...

Sends a SIGSTOP signal to one or more processes specified by job, suspending them until they receive SIGCONT. The same as kill -s STOP.

suspend

Sends a SIGSTOP signal to the main shell process, suspending the script or child shell session until it receives SIGCONT (for in? stance, when typing fg in the parent shell). Equivalent to kill -s STOP "$$", except that it accepts no operands and re? fuses to suspend a login shell.

test expression

The test and [commands execute conditional expressions similar to those specified for the [[compound command under Conditional Expressions above, but with several important differences. The

tern matching; == is nonstandard and unportable. The && and || operators are not available. Instead, the -a and -o binary oper? ators can be used, but they are fraught with pitfalls due to grammatical ambiguities and therefore deprecated in favor of in? voking separate test commands. Most importantly, as test and [are simple regular commands, field splitting and pathname expan? sion are performed on all their arguments and all aspects of regular shell grammar (such as redirection) remain active. This is usually harmful, so care must be taken to quote arguments and expansions to avoid this. To avoid the many pitfalls arising from these issues, the [[compound command should be used in? stead. The primary purpose of the test and [commands is compat? ibility with other shells that lack [[.

The test/[command does not parse options except if there are two arguments and the second is --. To access the inline docu? mentation with an option such as --man, you need one of the forms test --man -- or [--man --].

times Displays the accumulated user and system CPU times, one line with the times used by the shell and another with those used by all of the shell's child processes. No options are supported. Seconds are zero-padded unless the posix shell option is on.

The -p option causes the trap action associated with each trap as specified by the arguments to be printed with appropriate quoting. Otherwise, action will be processed as if it were an argument to eval when the shell receives signal(s) sig. Each sig can be given as a number or as the name of the signal. Trap commands are executed in order of signal number. Any attempt to set a trap on a signal that was ignored on entry to the current shell is ineffective. If action is omitted and the first sig is a number, or if action is -, then the trap(s) for each sig are reset to their original values. If action is the empty string, then this signal is ignored by the shell and by the commands it invokes. If sig is ERR then action will be executed whenever a command has a non-zero exit status. If sig is DEBUG then action will be executed before each command. The variable .sh.command will contain the current command line when action is running, in the same format as the output generated by the xtrace option (minus the preceding PS4 prompt). If the exit status of the trap is 2 the command will not be executed. If the exit status of the trap is 255 and inside a function or a dot script, the function or dot script will return. If sig is 0 or EXIT and the trap statement is executed inside the body of a function defined with the function name syntax, then the command action is exe? cuted after the function completes. If sig is 0 or EXIT for a trap set outside any function then the command action is exe?

be executed whenever a key is read while in emacs, gmacs, or vi mode. The trap command with no arguments prints a list of com? mands associated with each signal number.

An exit or return without an argument in a trap action will preserve the exit status of the command that invoked the trap.

true Does nothing, and exits 0. Used with while for infinite loops.

type [-afpPqt] name ...

The same as whence -v.

?? typeset [?ACHSbflmnprstux] [?EFLRXZi[n]] [+-M [mapname]] [-T [tname=(assign_list)]] [-h str] [-a [[type]]] [vname[=value]] ...

Sets attributes and values for shell variables and functions. When invoked inside a function defined with the function name syntax, a new instance of the variable vname is created, and the variable's value and type are restored when the function com? pletes. The following list of attributes may be specified:

-A Declares vname to be an associative array. Subscripts are strings rather than arithmetic expressions.

-C Causes each vname to be a compound variable. If value names a compound variable, it is copied into vname. Oth?

-a Declares vname to be an indexed array. This is the de? fault. Subscripts are numerical and start at 0. To make it possible to use alphanumeric enumeration constants of a given type as subscripts, an option value of the form [type] can be specified (including the surrounding square brackets), which should be quoted to avoid pathname ex? pansion), where type must be the name of an enumeration type created with the enum command.

-E Declares vname to be a double precision floating point number. If n is non-zero, it defines the number of sig? nificant figures that are used when expanding vname. Otherwise, ten significant figures will be used.

-F Declares vname to be a double precision floating point number. If n is non-zero, it defines the number of places after the decimal point that are used when expand? ing vname. Otherwise ten places after the decimal point will be used.

-H This option provides UNIX to host-name file mapping on non-UNIX machines.

-L Left justify and remove leading blanks from value. If n is non-zero, it defines the width of the field, otherwise it is determined by the width of the value of first as? signment. When the variable is assigned to, it is filled on the right with blanks or truncated, if necessary, to

-M Use the character mapping mapping defined by wctrans(3). such as tolower and toupper when assigning a value to each of the specified operands. When mapping is speci? fied and there are not operands, all variables that use this mapping are written to standard output. When map? ping is omitted and there are no operands, all mapped variables are written to standard output.

-R Right justify and fill with leading blanks. If n is non- zero, it defines the width of the field, otherwise it is determined by the width of the value of first assignment. The field is left filled with blanks or truncated from the end if the variable is reassigned. The -L option is turned off.

-S When used within the assign_list of a type definition, it causes the specified subvariable to be shared by all in? stances of the type. When used inside a function defined with the function reserved word, the specified variables will have function static scope. Otherwise, the variable is unset prior to processing the assignment list.

-T If followed by tname, it creates a type named by tname using the compound assignment assign_list to tname. Oth? erwise, it writes all the type definitions to standard output.

-X Declares vname to be a double precision floating point

is non-zero, it defines the number of hex digits after the radix point that is used when expanding vname. The default is 10.

-Z Right justify and fill with leading zeros if the first non-blank character is a digit and the -L option has not been set. Remove leading zeros if the -L option is also set. If n is non-zero, it defines the width of the field, otherwise it is determined by the width of the value of first assignment.

-f The names refer to function names rather than variable names. No assignments can be made and the only other valid options are -S, -t, -u and -x. The -S can be used with discipline functions defined in a type to indicate that the function is static. For a static function, the same method will be used by all instances of that type no matter which instance references it. In addition, it can only use value of variables from the original type defin? ition. These discipline functions cannot be redefined in any type instance. The -t option turns on execution tracing for this function. The -u option causes this function to be marked undefined. The FPATH variable will be searched to find the function definition when the function is referenced. If no options other than -f is specified, then the function definition will be displayed

taining the function name followed by a shell comment containing the line number and path name of the file where this function was defined, if any, is displayed. The exit status can be used to determine whether the function is defined so that typeset -f .sh.math.name will return 0 when math function name is defined and non-zero otherwise.

-b The variable can hold any number of bytes of data. The data can be text or binary. The value is represented by the base64 encoding of the data. If -Z is also speci? fied, the size in bytes of the data in the buffer will be determined by the size associated with the -Z. If the base64 string assigned results in more data, it will be truncated. Otherwise, it will be filled with bytes whose value is zero. The printf format %B can be used to out? put the actual data in this buffer instead of the base64 encoding of the data.

-g Forces variables to be created or modified at the global scope, even when typeset is executed in a function de? fined by the function name syntax (see Functions above) or in a name space (see Name Spaces above).

-h Used within type definitions to add information when gen? erating information about the subvariable on the man page. It is ignored when used outside of a type defini?

with the corresponding discipline function.

-i Declares vname to be represented internally as integer. The right hand side of an assignment is evaluated as an arithmetic expression when assigning to an integer. If n is non-zero, it defines the output arithmetic base, oth? erwise the output base will be ten.

-l Used with -i, -E or -F, to indicate long integer, or long float. Otherwise, all uppercase characters are converted to lowercase. The uppercase option, -u, is turned off. Equivalent to -M tolower .

-m Moves or renames the variable. The value is the name of a variable whose value will be moved to vname. The orig? inal variable will be unset. Cannot be used with any other options.

-n Declares vname to be a reference to the variable whose name is defined by the value of variable vname. This is usually used to reference a variable inside a function whose name has been passed as an argument. Cannot be used with other options except -g.

-p The name, attributes and values for the given vnames are written on standard output in a form that can be used as shell input. If +p is specified, then the values are not displayed.

-r The given vnames are marked read-only and these names

-s When given along with -i, restricts integer size to short.

-t Tags the variables. Tags are user definable and have no special meaning to the shell.

-u When given along with -i, specifies unsigned integer. Otherwise, all lowercase characters are converted to up? percase. The lowercase option, -l, is turned off. Equivalent to -M toupper .

-x The given vnames are marked for automatic export to the environment of subsequently-executed commands. Variables whose names contain a . cannot be exported.

The -i, -F, -E, and -X options cannot be specified along with -R, -L, or -Z. The -b option cannot be specified along with -L, -u, or -l. The -f, -m, -n, and -T options cannot be used to? gether with any other option.

Using + rather than - causes these options to be turned off. If no vname arguments are given, a list of vnames (and optionally the values) of the variables is printed. (Using + rather than - keeps the values from being printed.) The -p option causes typeset followed by the option letters to be printed before each name rather than the names of the options. If any option other than -p is given, only those variables which have all of the

of all variables that have attributes are printed.

ulimit [-HSaMctdfkxlqenVuPpmrRbiswTv] [limit]

Set or display a resource limit. The available resource limits are listed below. Many systems do not support one or more of these limits. The limit for a specified resource is set when limit is specified. The value of limit can be a number in the unit specified below with each resource, or the value unlimited. The -H and -S options specify whether the hard limit or the soft limit for the given resource is set. A hard limit cannot be in? creased once it is set. A soft limit can be increased up to the value of the hard limit. If neither the H nor S option is spec? ified, the limit applies to both. The current resource limit is printed when limit is omitted. In this case, the soft limit is printed unless H is specified. When more than one resource is specified, then the limit name and unit is printed before the value.

-a Lists all of the current resource limits.

-b The socket buffer size in bytes.

-c The number of 512-byte blocks on the size of core dumps.

-d The number of K-bytes on the size of the data area.

-e The scheduling priority.

-f The number of 512-byte blocks on files that can be writ? ten by the current process or by child processes (files

-i The signal queue size.

-k The max number of kqueues created by the current user.

-l The locked address space in K-bytes.

-M The address space limit in K-bytes.

-m The number of K-bytes on the size of physical memory.

-n The number of file descriptors plus 1.

-P The max number of pseudo-terminals created by the current user.

-p The number of 512-byte blocks for pipe buffering.

-q The message queue size in K-bytes.

-R The max time a real-time process can run before blocking, in microseconds. If this limit is exceeded the process is sent a SIGXCPU signal.

-r The max real-time priority.

-s The number of K-bytes on the size of the stack area.

-T The number of threads.

-t The number of CPU seconds to be used by each process.

-u The number of processes.

-V The number of open vnode monitors.

-v The number of K-bytes for virtual memory.

-w The swap size in K-bytes.

-x The number of file locks.

If no option is given, -f is assumed.

umask [-S] [mask]

The user file-creation mask is set to mask (see umask(2)). mask can either be an octal number or a symbolic value as described in chmod(1). If a symbolic value is given, the new umask value is the complement of the result of applying mask to the comple? ment of the previous umask value. If mask is omitted, the cur? rent value of the mask is printed. The -S option causes the mode to be printed as a symbolic value. Otherwise, the mask is printed in octal.

unalias [-a] name ...

The aliases given by the list of names are removed from the alias list. The -a option causes all the aliases to be unset.

? unset [-fnv] vname ...

The variables given by the list of vnames are unassigned, i.e., except for subvariables within a type, their values and attrib? utes are erased. For subvariables of a type, the values are re? set to the default value from the type definition. Readonly variables cannot be unset. If the -f option is set, then the names refer to function names. If the -v option is set, then the names refer to variable names. The -f option overrides -v. If -n is set and name is a name reference, then name will be un? set rather than the variable that it references. The default is

RANDOM, SECONDS, TMOUT, and _ removes their special meaning even if they are subsequently assigned to.

wait [job ...]

Wait for the specified job and report its termination status. If job is not given, then all currently active child processes are waited for. The exit status from this command is that of the last process waited for if job is specified; otherwise it is zero. See Jobs for a description of the format of job.

whence [-afpPqtv] name ...

For each name, indicate how it would be interpreted if used as a command name.

The -v option produces a more verbose report. The -f option skips the search for functions. The -p and -P options do a path search for name even if name is an alias, a function, or a re? served word. Both of these options turn off the -v option. The -q option causes whence to enter quiet mode. whence will return zero if all arguments are built-ins, functions, or are programs found on the path. The -t option only outputs the type of the given command. Like -p and -P, -t will turn off the -v option. The -a option is similar to the -v option but causes all inter? pretations of the given name to be reported.

If the shell is invoked by exec(2), initialization depends on argument zero ($0) as follows. If the first character of $0 is -, or the -l option is given on the invocation command line, then the shell is assumed to be a login shell. If the basename of the command path in $0 is rsh, rksh, or krsh, then the shell becomes restricted. If the basename is sh or rsh, or the -o posix option is given on the invocation command line, then the shell is initialized in full POSIX compliance mode (see the set builtin command above for more information). After this, if the shell was assumed to be a login shell, commands are read from /etc/profile and then from $HOME/.profile if it exists. Alternatively, the option -l causes the shell to be treated as a login shell. Next, for interactive shells, commands are read from the file named by ENV if the file exists, its name being determined by performing parameter expansion, command substitution, and arithmetic expansion on the value of that environment variable. If the -s option is not present and arg and a file by the name of arg exists, then it reads and executes this script. Otherwise, if the first arg does not contain a /, a path search is performed on the first arg to determine the name of the script to execute. The script arg must have execute permission and any setuid and setgid settings will be ignored. If the script is not found on the path, arg is processed as if it named a built-in command or function. Commands are then read as described below; the following options are interpreted by the shell when it is invoked:

will be printed on standard output and the shell will exit. This set of strings will be subject to language translation when the locale is not C or POSIX. No commands will be exe? cuted.

-E or -o rc or --rc

Read the file named by the ENV variable or by $HOME/.kshrc if not defined after the profiles. On by default for interactive shells. Use +E, +o rc or --norc to turn off.

-c Read and execute a script from the first arg instead of a file. The second arg, if present, becomes that script's command name ($0). Any third and further args become positional parameters starting at $1.

-s Read and execute a script from standard input instead of a file. The command name ($0) cannot be set. Any args become the positional parameters starting at $1. This option is forced on if no arg is given and is ignored if -c is also spec? ified.

-i or -o interactive or --interactive

If the -i option is present or if the shell's standard input and standard error are attached to a terminal (as told by tcge?

is ignored (so that kill 0 does not kill an interactive shell)
and INTR is caught and ignored (so that wait is interruptible).
In all cases, QUIT is ignored by the shell.

-r or -o restricted or --restricted
If the -r option is present, the shell is a restricted shell.

The remaining options and arguments are described under the set command above. An optional - as the first argument is ignored.

Rksh Only.
Rksh is used to set up login names and execution environments whose ca? pabilities are more controlled than those of the standard shell. The actions of rksh are identical to those of ksh, except that the follow? ing are disallowed:

? unsetting the restricted option

? changing directory (see cd(1))

? setting or unsetting the value or attributes of SHELL, ENV, FPATH, or PATH

? specifying path or command names containing /

- redirecting output (>, >|, <>, and >>)
- adding or deleting built-in commands
- using command -p to invoke a command

The restrictions above are enforced after .profile and the ENV files are interpreted.

When a command to be executed is found to be a shell procedure, rksh invokes ksh to execute it. Thus, it is possible to provide to the end-user shell procedures that have access to the full power of the stan? dard shell, while imposing a limited menu of commands; this scheme as? sumes that the end-user does not have write and execute permissions in the same directory.

The net effect of these rules is that the writer of the .profile has complete control over user actions, by performing guaranteed setup ac? tions and leaving the user in an appropriate directory (probably not the login directory).

The system administrator often sets up a directory of commands (e.g., /usr/rbin) that can be safely invoked by rksh.

Errors detected by the shell, such as syntax errors, cause the shell to return a non-zero exit status. If the shell is being used non-interac? tively, then execution of the shell file is abandoned unless the error occurs inside a subshell in which case the subshell is abandoned. Oth? erwise, the shell returns the exit status of the last command executed (see also the exit command above). Run time errors detected by the shell are reported by printing the command or function name and the er? ror condition. If the line number that the error occurred on is greater than one, then the line number is also printed in square brack? ets ([]) after the command or function name.

FILES

/etc/profile

The system wide initialization file, executed for login shells.

$HOME/.profile

The personal initialization file, executed for login shells af? ter /etc/profile.

$HOME/.kshrc

Default personal initialization file, executed for interactive shells when ENV is not set.

/etc/suid_profile

sonal initialization file when the real and effective user or group ID do not match.

/dev/null

The null device.

SEE ALSO

cat(1), cd(1), chmod(1), cut(1), date(1), echo(1), emacs(1), env(1), gmacs(1), grep(1), stty(1), test(1), umask(1), vi(1), dup(2), exec(2), fork(2), getpwnam(3), ioctl(2), lseek(2), paste(1), pathconf(2), pipe(2), sysconf(3), umask(2), ulimit(2), wait(2), strftime(3), wc? trans(3), rand(3), profile(5), environ(7).

Morris I. Bolsky and David G. Korn, The New KornShell Command and Pro? gramming Language, Prentice Hall, 1995.

POSIX - Part 2: Shell and Utilities, IEEE Std 1003.2-1992, ISO/IEC 9945-2, IEEE, 1993.

CAVEATS

If a command is executed, and then a command with the same name is in? stalled in a directory in the search path before the directory where the original command was found, the shell will continue to exec the original command. Use the hash command or the -t option of the alias

Using the hist built-in command within a compound command will cause the whole command to disappear from the history file.

The built-in command . file reads the whole file before any commands are executed. Therefore, alias and unalias commands in the file will not apply to any commands defined in the file.

Traps are not processed while a job is waiting for a foreground process. Thus, a trap on CHLD won't be executed until the foreground job terminates.

In locales that use a multibyte character set such as UTF-8, the KEYBD trap is only triggered for ASCII characters (1-127).

It is a good idea to leave a space after the comma operator in arith? metic expressions to prevent the comma from being interpreted as the decimal point character in certain locales.