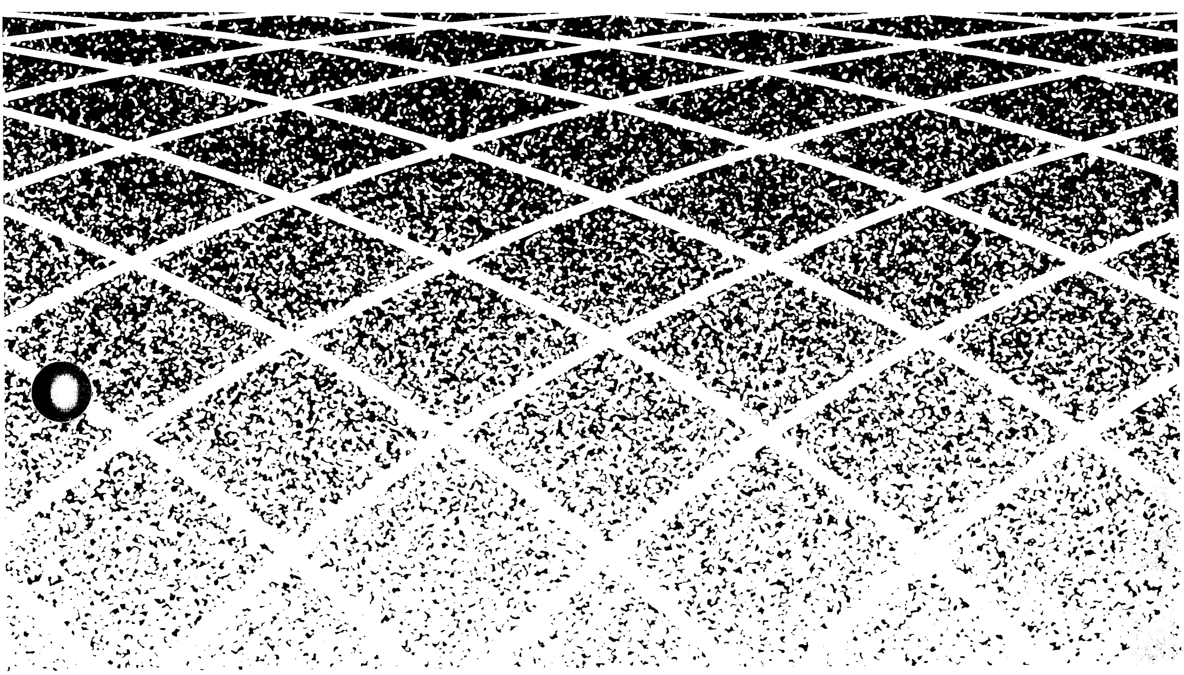
UNIX® System V
Programmer's Reference Manual



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TRADEMARKS

Introduction

This manual describes the programming features of the UNIX system. It contains individual manual pages that describe commands, system calls, subroutines, file formats, and other useful topics, such as the ASCII table shown on `ascii`(5). It provides neither a general overview of the UNIX system nor details of the implementation of the system.

Not all commands, features, and facilities described in this manual are available in every UNIX system. Some of the features require additional utilities that may not exist on your system.

The manual is divided into five sections:

1. Commands
2. System Calls
3. Subroutines:
   - 3C. C Programming Language Library Routines
   - 3S. Standard I/O Library Routines
   - 3E. Executable and Linking Format Library Routines
   - 3G. General Purpose Library Routines
   - 3M. Math Library Routines
   - 3X. Specialized Library Routines
4. File Formats
5. Miscellaneous Facilities

Section 1 (*Commands*) describes commands that support C and other programming languages.

Section 2 (*System Calls*) describes the access to the services provided by the UNIX system kernel, including the C language interface.

Section 3 (*Subroutines*) describes the available general subroutines. In many cases, several related subroutines are described on the same manual page. Their binary versions reside in various system libraries. See `intro`(3) for descriptions of these libraries and the files in which they are stored.

Section 4 (*File Formats*) documents the structure of particular kinds of files; for example, the format of the output of the link editor is given in `a.out`(4). Excluded are files used by only one command (for example, the assembler's intermediate files, if any). In general, the C language structures corresponding to these formats can be found in the directories `/usr/include` and `/usr/include/sys`.

Section 5 (*Miscellaneous Facilities*) contains a variety of things. Included are descriptions of character sets, macro packages, etc.

References with numbers other than those above mean that the utility is contained in the appropriate section of another manual. References with (1) following the command mean that the utility is contained in this manual or the *User's Reference Manual.* In these cases, the **SEE ALSO** section of the entry in which the reference appears will point you to the correct book.

Each section consists of a number of independent entries of a page or so each. Entries within each section are alphabetized, with the exception of the introductory entry that begins each section. Some entries may describe several routines, commands, etc. In such cases, the entry appears only once, alphabetized under its "primary" name, the name that appears at the upper corners of each manual page. Subsections 3C and 3S are grouped together because their functions constitute the standard C library.

All entries are based on a common format, not all of whose parts always appear:

- The **NAME** part gives the name(s) of the entry and briefly states its purpose.
- The **SYNOPSIS** part summarizes the use of the program or function being described. A few conventions are used, particularly in Section 2 (*System Calls*):
  - `Constant width typeface` strings are literals and are to be typed just as they appear.
  - *Italic* strings usually represent substitutable argument prototypes and program names found elsewhere in the manual.
  - Square brackets [ ] around an argument prototype indicate that the argument is optional. When an argument prototype is given as *name* or *file*, it always refers to a file name.
  - Ellipses ... are used to show that the previous argument prototype may be repeated.
  - A final convention is used by the commands themselves. An argument beginning with a minus – or plus + sign is often taken to be some sort of flag argument, even if it appears in a position where a file name could appear. Therefore, it is unwise to have files whose names begin with – or +.

- The **DESCRIPTION** part describes the utility.
- The **EXAMPLE(S)** part gives example(s) of usage, where appropriate.
- The **FILES** part gives the file names that are built into the program.
- The **SEE ALSO** part gives pointers to related information.
- The **DIAGNOSTICS** part discusses the diagnostic indications that may be produced. Messages that are intended to be self-explanatory are not listed.
- The **NOTES** part gives generally helpful hints about the use of the utility.

A "Table of Contents" and a "Permuted Index" derived from that table precede Section 1. The 'Permuted Index" is a list of keywords, given in the second of three columns, together with the context in which each keyword is found. Keywords are either topical keywords or the names of manual entries. Entries are identified with their section numbers shown in parentheses. This is important because there is considerable duplication of names among the sections, arising principally from commands and functions that exist only to exercise a particular system call. The right column lists the name of the manual page on which each keyword may be found. The left column contains useful information about the keyword.

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4. File Formats

5. Miscellaneous Facilities

PERMUTED INDEX

Permuted Index

COMMANDS (1)

NAME

`intro` – introduction to programming commands

DESCRIPTION

This section describes the programming commands in alphabetical order. Unless otherwise noted, the commands accept options and other arguments according to the following syntax:

name [*option*(*s*)] [*cmdarg*(*s*)]

where:

name — is the name of an executable file.

option — is *–noargletter*(*s*) or *–argletter* <> *optarg*, where:

noargletter is a single letter representing an option without an option argument;

argletter is a single letter representing an option requiring an option argument;

<> is optional white space;

optarg is an option argument (character string) satisfying the preceding *argletter*.

cmdarg — is "–" by itself, which indicates the standard input, or a path name (or other command argument) *not* beginning with "–".

Throughout the manual pages there are references to *TMPDIR, BINDIR, INCDIR,* and *LIBDIR*. These represent directory names whose value is specified on each manual page as necessary. For example, *TMPDIR* might refer to `/usr/tmp`. These are not environment variables and cannot be set. [There is an environment variable called `TMPDIR` which can be set. See `tmpnam`(3S).] There are also references to *LIBPATH,* the default search path of the link editor and other tools.

SEE ALSO

`exit`(2), `wait`(2), `getopt`(3C).
`getopts`(1) in the *User's Reference Manual.*

DIAGNOSTICS

Upon termination, each command returns two bytes of status, one supplied by the system and giving the cause for termination, and (in the case of "normal" termination) one supplied by the program [see `wait`(2) and `exit`(2)]. The former byte is 0 for normal termination; the latter is customarily 0 for successful execution and non-zero to indicate troubles such as erroneous parameters, or bad or inaccessible data. It is called variously "exit code," "exit status," or "return code," and is described only where special conventions are involved.

NOTES

Some commands produce unexpected results when processing files containing null characters. These commands often treat text input lines as strings and therefore become confused upon encountering a null character (the string terminator) within a line.

NAME

admin – create and administer SCCS files

SYNOPSIS

admin [-n] [-i[*name*]] [-r*rel*] [-t[*name*]] [-f*flag*[*flag-val*]] [-d*flag*[*flag-val*]] [-a*login*] [-e*login*] [-m[*mrlist*]] [-y[*comment*]] [-h] [-z] *files*

DESCRIPTION

admin is used to create new SCCS files and change parameters of existing ones. Arguments to admin, which may appear in any order, consist of keyletter arguments (that begin with -) and named files (note that SCCS file names must begin with the characters s.). If a named file does not exist, it is created and its parameters are initialized according to the specified keyletter arguments. Parameters not initialized by a keyletter argument are assigned a default value. If a named file does exist, parameters corresponding to specified keyletter arguments are changed, and other parameters are left unchanged.

If a directory is named, admin behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with s.) and unreadable files are silently ignored. If a name of – is given, the standard input is read; each line of the standard input is taken to be the name of an SCCS file to be processed. Again, non-SCCS files and unreadable files are silently ignored.

The keyletter arguments are listed below. Each argument is explained as if only one named file were to be processed because the effect of each argument applies independently to each named file.

-n
: This keyletter indicates that a new SCCS file is to be created.

-i[*name*]
: The *name* of a file from which the text for a new SCCS file is to be taken. The text constitutes the first delta of the file (see -r keyletter for delta numbering scheme). If the -i keyletter is used, but the file name is omitted, the text is obtained by reading the standard input until an end-of-file is encountered. If this keyletter is omitted, then the SCCS file is created empty. Only one SCCS file may be created by an admin command on which the i keyletter is supplied. Using a single admin to create two or more SCCS files requires that they be created empty (no -i keyletter). Note that the -i keyletter implies the -n keyletter.

-r*rel*
: The *rel*ease into which the initial delta is inserted. This keyletter may be used only if the -i keyletter is also used. If the -r keyletter is not used, the initial delta is inserted into release 1. The level of the initial delta is always 1 (by default initial deltas are named 1.1).

-t[*name*]
: The *name* of a file from which descriptive text for the SCCS file is to be taken. If the -t keyletter is used and admin is creating a new SCCS file (the -n and/or -i keyletters also used), the descriptive text file name must also be supplied. In the case of existing SCCS files: (1) a -t keyletter without a file name causes removal of the descriptive text (if any) that is currently in the SCCS file, and (2) a -t keyletter with a file name causes text (if any) in the

named file to replace the descriptive text (if any) that is currently in the SCCS file.

`-f`*flag* This keyletter specifies a *flag*, and, possibly, a value for the *flag*, to be placed in the SCCS file. Several `-f` keyletters may be supplied on a single `admin` command line. The allowable *flag*s and their values are:

`b` Allows use of the `-b` keyletter on a `get` command to create branch deltas.

`c`*ceil* The highest release (i.e., ceiling): a number greater than 0 but less than or equal to 9999 that may be retrieved by a `get` command for editing. The default value for an unspecified `c` flag is 9999.

`f`*floor* The lowest release (i.e., floor): a number greater than 0 but less than 9999 that may be retrieved by a `get` command for editing. The default value for an unspecified `f` flag is 1.

`d`*SID* The default delta number (SID) to be used by a `get` command.

`i`[*str*] Causes the `No id keywords (ge6)` message issued by `get` or `delta` to be treated as a fatal error. In the absence of this flag, the message is only a warning. The message is issued if no SCCS identification keywords [see `get`(1)] are found in the text retrieved or stored in the SCCS file. If a value is supplied, the keywords must exactly match the given string. The string must contain a keyword, and no embedded newlines.

`j` Allows concurrent `get` commands for editing on the same SID of an SCCS file. This flag allows multiple concurrent updates to the same version of the SCCS file.

`l`*list* A *list* of releases to which deltas can no longer be made (`get -e` against one of these "locked" releases fails). The *list* has the following syntax:

<list> ::= <range> | *<list> , <range>*
<range> ::= RELEASE NUMBER | `a`

The character `a` in the *list* is equivalent to specifying all releases for the named SCCS file.

`n` Causes `delta` to create a null delta in each of those releases (if any) being skipped when a delta is made in a new release (e.g., in making delta 5.1 after delta 2.7, releases 3 and 4 are skipped). These null deltas serve as anchor points so that branch deltas may later be created from them. The absence of this flag causes skipped releases to be non-existent in the SCCS file, preventing branch deltas from being created from them in the future.

q text — User-definable text substituted for all occurrences of the %Q% keyword in SCCS file text retrieved by get.

m*mod* — *mod*ule name of the SCCS file substituted for all occurrences of the %M% keyword in SCCS file text retrieved by get. If the m flag is not specified, the value assigned is the name of the SCCS file with the leading s. removed.

t*type* — *type* of module in the SCCS file substituted for all occurrences of %Y% keyword in SCCS file text retrieved by get.

v[*pgm*] — Causes delta to prompt for Modification Request (MR) numbers as the reason for creating a delta. The optional value specifies the name of an MR number validity checking program [see delta(1)]. This program will receive as arguments the module name, the value of the type flag (see t*type* above), and the *mrlist*. (If this flag is set when creating an SCCS file, the m keyletter must also be used even if its value is null).

–d*flag* — Causes removal (deletion) of the specified *flag* from an SCCS file. The –d keyletter may be specified only when processing existing SCCS files. Several –d keyletters may be supplied in a single admin command. See the –f keyletter for allowable *flag* names.

(l*list* used with –d indicates a *list* of releases to be unlocked. See the –f keyletter for a description of the l flag and the syntax of a *list*.)

–a*login* — A login name, or numerical UNIX System group ID, to be added to the list of users who may make deltas (changes) to the SCCS file. A group ID is equivalent to specifying all login names common to that group ID. Several a keyletters may be used on a single admin command line. As many logins or numerical group IDs as desired may be on the list simultaneously. If the list of users is empty, then anyone may add deltas. If login or group ID is preceded by a ! they are to be denied permission to make deltas.

–e*login* — A login name, or numerical group ID, to be erased from the list of users allowed to make deltas (changes) to the SCCS file. Specifying a group ID is equivalent to specifying all login names common to that group ID. Several –e keyletters may be used on a single admin command line.

–m[*mrlist*] — The list of Modification Requests (MR) numbers is inserted into the SCCS file as the reason for creating the initial delta in a manner identical to delta. The v flag must be set and the MR numbers are validated if the v flag has a value (the name of an MR number validation program). Diagnostics will occur if the v flag is not set or MR validation fails.

–y[*comment*] — The *comment* text is inserted into the SCCS file as a comment for the initial delta in a manner identical to that of delta. Omission of the –y keyletter results in a default comment line being inserted.

The -y keyletter is valid only if the -i and/or -n keyletters are specified (i.e., a new SCCS file is being created).

-h
: Causes admin to check the structure of the SCCS file [see sccsfile(4)], and to compare a newly computed check-sum (the sum of all the characters in the SCCS file except those in the first line) with the check-sum that is stored in the first line of the SCCS file. Appropriate error diagnostics are produced. This keyletter inhibits writing to the file, nullifying the effect of any other keyletters supplied; therefore, it is only meaningful when processing existing files.

-z
: The SCCS file check-sum is recomputed and stored in the first line of the SCCS file (see -h, above). Note that use of this keyletter on a truly corrupted file may prevent future detection of the corruption.

The last component of all SCCS file names must be of the form `s.`*file*. New SCCS files are given mode 444 [see chmod(1)]. Write permission in the pertinent directory is, of course, required to create a file. All writing done by admin is to a temporary x-file, called `x.`*file*, [see get(1)], created with mode 444 if the admin command is creating a new SCCS file, or with the same mode as the SCCS file if it exists. After successful execution of admin, the SCCS file is removed (if it exists), and the x-file is renamed with the name of the SCCS file. This renaming process ensures that changes are made to the SCCS file only if no errors occurred.

It is recommended that directories containing SCCS files be mode 755 and that SCCS files themselves be mode 444. The mode of the directories allows only the owner to modify SCCS files contained in the directories. The mode of the SCCS files prevents any modification at all except by SCCS commands.

admin also makes use of a transient lock file (called `z.`*file*), which is used to prevent simultaneous updates to the SCCS file by different users. See get(1) for further information.

FILES

x-file	[see delta(1)]
z-file	[see delta(1)]
bdiff	Program to compute differences between the "gotten" file and the g-file [see get(1)].

SEE ALSO

bdiff(1), ed(1), delta(1), get(1), help(1), prs(1), what(1), sccsfile(4).

DIAGNOSTICS

Use the help command for explanations.

NOTES

If it is necessary to patch an SCCS file for any reason, the mode may be changed to 644 by the owner allowing use of a text editor. You must run admin -h on the edited file to check for corruption followed by an admin -z to generate a proper check-sum. Another admin -h is recommended to ensure the SCCS file is valid.

NAME

ar − maintain portable archive or library

SYNOPSIS

ar [−V] − *key* [*arg*] [*posname*] *afile* [*name*. . .]

DESCRIPTION

The **ar** command maintains groups of files combined into a single archive file. Its main use is to create and update library files. However, it can be used for any similar purpose. The magic string and the file headers used by **ar** consist of printable ASCII characters. If an archive is composed of printable files, the entire archive is printable.

When **ar** creates an archive, it creates headers in a format that is portable across all machines. The portable archive format and structure are described in detail in **ar**(4). The archive symbol table [described in **ar**(4)] is used by the link editor **ld** to effect multiple passes over libraries of object files in an efficient manner. An archive symbol table is only created and maintained by **ar** when there is at least one object file in the archive. The archive symbol table is in a specially named file that is always the first file in the archive. This file is never mentioned or accessible to the user. Whenever the **ar** command is used to create or update the contents of such an archive, the symbol table is rebuilt. The **s** option described below will force the symbol table to be rebuilt.

The **−V** option causes **ar** to print its version number on standard error.

Unlike command options, the *key* is a required part of the **ar** command line. The *key* is formed with one of the following letters: **drqtpmx**. Arguments to the *key*, alternatively, are made with one of more of the following set: **vuaibcls**. *posname* is an archive member name used as a reference point in positioning other files in the archive. *afile* is the archive file. The *names* are constituent files in the archive file. The meanings of the *key* characters are as follows:

d Delete the named files from the archive file.

r Replace the named files in the archive file. If the optional character **u** is used with **r**, then only those files with dates of modification later than the archive files are replaced. If an optional positioning character from the set **abi** is used, then the *posname* argument must be present and specifies that new files are to be placed after (**a**) or before (**b** or **i**) *posname*. Otherwise new files are placed at the end.

q Quickly append the named files to the end of the archive file. Optional positioning characters are invalid. The command does not check whether the added members are already in the archive. This option is useful to avoid quadratic behavior when creating a large archive piece-by-piece.

t Print a table of contents of the archive file. If no names are given, all files in the archive are listed. If names are given, only those files are listed.

p Print the named files in the archive.

m Move the named files to the end of the archive. If a positioning character is present, then the *posname* argument must be present and, as in **r**, specifies where the files are to be moved.

x Extract the named files. If no names are given, all files in the archive are extracted. In neither case does x alter the archive file.

The meanings of the other key arguments are as follows:

v Give a verbose file-by-file description of the making of a new archive file from the old archive and the constituent files. When used with t, give a long listing of all information about the files. When used with x, print the filename preceding each extraction.

c Suppress the message that is produced by default when *afile* is created.

l This option is obsolete. It is recognized, but ignored, and will be removed in the next release.

s Force the regeneration of the archive symbol table even if ar(1) is not invoked with a command which will modify the archive contents. This command is useful to restore the archive symbol table after the strip(1) command has been used on the archive.

SEE ALSO

ld(1), lorder(1), strip(1), a.out(4), ar(4).

NOTES

If the same file is mentioned twice in an argument list, it may be put in the archive twice.

Since the archiver no longer uses temporary files, the -l option is obsolete and will be removed in the next release.

By convention, archives are suffixed with the characters .a.

NAME

as – assembler

SYNOPSIS

as [*options*] *file*

DESCRIPTION

The **as** command creates object files from assembly language source *files*. The following flags may be specified in any order:

–o *objfile*	Put the output of the assembly in *objfile*. By default, the output file name is formed by removing the **.s** suffix, if there is one, from the input file name and appending a .o suffix.
–n	Turn off long/short address optimization. By default, address optimization takes place.
–m	Run the **m4** macro processor on the input to the assembler.
–R	Remove (unlink) the input file after assembly is completed.
–dl	Obsolete. Assembler issues a warning saying that it is ignoring the –dl option.
–T	Accept obsolete assembler directives.
–V	Write the version number of the assembler being run on the standard error output.
–Q{y|n}	If –Qy is specified, place the version number of the assembler being run in the object file. The default is –Qn.
–Y [md],*dir*	Find the **m4** preprocessor (m) and/or the file of predefined macros (d) in directory *dir* instead of in the customary place.

FILES

By default, **as** creates its temporary files in /usr/tmp. This location can be changed by setting the environment variable TMPDIR [see **tempnam** in **tmpnam**(3S)].

SEE ALSO

cc(1), ld(1), m4(1), nm(1), strip(1), tmpnam(3S), a.out(4).

NOTES

If the –m (m4 macro processor invocation) option is used, keywords for m4 [see m4(1)] cannot be used as symbols (variables, functions, labels) in the input file since m4 cannot determine which keywords are assembler symbols and which keywords are real m4 macros.

The .align assembler directive may not work in the .text section when long/short address optimization is performed.

Arithmetic expressions may only have one forward referenced symbol per expression.

Whenever possible, you should access the assembler through a compilation system interface program such as cc.

NAME

cb – C program beautifier

SYNOPSIS

`cb [-s] [-j] [-l` *leng*`] [-V] [`*file* ...`]`

DESCRIPTION

The `cb` comand reads syntactically correct C programs either from its arguments or from the standard input, and writes them on the standard output with spacing and indentation that display the structure of the C code. By default, `cb` preserves all user new-lines.

`cb` accepts the following options.

- `-s` Write the code in the style of Kernighan and Ritchie found in *The C Programming Language*.
- `-j` Put split lines back together.
- `-l` *leng* Split lines that are longer than *leng*.
- `-V` Print on standard error output the version of `cb` invoked.

NOTES

`cb` treats `asm` as a keyword.

The format of structure initializations is unchanged by `cb`.

Punctuation that is hidden in preprocessing directives causes indentation errors.

SEE ALSO

cc(1).

Kernighan, B. W., and Ritchie, D. M., *The C Programming Language*, Second Edition, Prentice-Hall, 1988.

NAME

cc − C compiler

SYNOPSIS

cc [*options*] *file* ...

DESCRIPTION

cc is the interface to the C compilation system. The compilation tools conceptually consist of a preprocessor, compiler, optimizer, basic block analyzer, assembler, and link editor. cc processes the supplied options and then executes the various tools with the proper arguments. cc accepts several types of files as arguments.

Files whose names end with .c are taken to be C source files and may be preprocessed, compiled, optimized, instrumented for profiling, assembled, and link edited. The compilation process may be stopped after the completion of any pass if the appropriate options are supplied. If the compilation process runs through the assembler, then an object file is produced whose name is that of the source with .o substituted for .c. However, the .o file is normally deleted if a single C file is compiled and then immediately link edited. In the same way, files whose names end in .s are taken to be assembly source files; they may be assembled and link edited. Files whose names end in .i are taken to be preprocessed C source files, and they may be compiled, optimized, instrumented for profiling, assembled, and link edited. Files whose names do not end in .c, .s, or .i are handed to the link editor, which produces an executable whose name by default is a.out.

Since cc usually creates files in the current directory during the compilation process, it is necessary to run cc in a directory in which a file can be created.

The following options are interpreted by cc:

−A *name*[(*tokens*)]
: Associates *name* as a predicate with the specified *tokens* as if by a #assert preprocessing directive.

  Preassertions: system(unix)
  cpu(i386)
  machine(i386)

−A − Causes all predefined macros (other than those that begin with __) and predefined assertions to be forgotten.

−C Cause the preprocessing phase to pass along all comments other than those on preprocessing directive lines.

−c Suppress the link editing phase of the compilation and do not remove any produced object files.

−D *name*[=*tokens*]
: Associates *name* with the specified *tokens* as if by a #define preprocessing directive. If no =*tokens* is specified, the token 1 is supplied. These predefinitions only exist under the −Xt and −Xa modes.

Predefinitions: `i386`
`unix`

-E Only preprocess the named C files and send the result to the standard output. The output will contain preprocessing directives for use by the next pass of the compilation system.

-f This option is obsolete and will be ignored.

-g Cause the compiler to generate additional information needed for the use of sdb. Use of sdb on a program compiled with both the -g and -O options is not recommended unless the user understands the behavior of optimization.

-H Print, one per line, the path name of each file included during the current compilation on the standard error output.

-I *dir* Alter the search for included files whose names do not begin with / to look in *dir* prior to the usual directories. The directories for multiple -I options are searched in the order specified.

-K PIC
Causes position-independent code (PIC) to be generated.

-L *dir* Add *dir* to the list of directories searched for libraries by ld. This option and its argument are passed to ld.

-l *name*
Search the library lib*name*.a. Its placement on the command line is significant as a library is searched at a point in time relative to the placement of other libraries and object files on the command line. This option and its argument are passed to ld.

-O Arrange for compilation phase optimization. This option has no effect on .s files.

-o *pathname*
Produce an output object file *pathname*, instead of the default a.out. This option and its argument are passed to ld.

-P Only preprocess the named C files and leave the result in corresponding files suffixed .i. The output will not contain any preprocessing directives, unlike -E.

-p Arrange for the compiler to produce code that counts the number of times each routine is called; also, if link editing takes place, profiled versions of libc.a and libm.a (with the -lm option) are linked. A mon.out file will then be produced at normal termination of execution of the object program. An execution profile can then be generated by use of prof.

-Q *c* *c* can be either y or n. If *c* is y, identification information about each invoked compilation tool will be added to the output files (the default behavior). This can be useful for software administration. Giving n for *c* suppresses this information.

−q *c* — *c* can be either `l` or `p`. `−ql` causes the invocation of the basic block analyzer and arranges for the production of code that counts the number of times each source line is executed. A listing of these counts can be generated by use of `lprof`. `−qp` is a synonym for `−p`.

−S — Compile, optimize (if −O is present), and do not assemble or link edit the named C files. The assembler-language output is left in corresponding files suffixed `.s`.

−U *name*
: Causes any definition of *name* to be forgotten, as if by a `#undef` preprocessing directive. If the same *name* is specified for both −D and −U, *name* is not defined, regardless of the order of the options.

−V — Cause each invoked tool to print its version information on the standard error output.

−v — Cause the compiler to perform more and stricter semantic checks, and to enable certain `lint`-like checks on the named C files.

−W *tool*, arg_1[, arg_2 ...]
: Hand off the argument(s) arg_i each as a separate argument to *tool*. Each argument must be separated from the preceding by only a comma. (A comma can be part of an argument by escaping it by an immediately preceding backslash (\) character; the backslash is removed from the resulting argument.) *tool* can be one of the following:

p	A synonym for 0
0	compiler
2	optimizer
b	basic block analyzer
a	assembler
l	link editor

For example, `−Wa,−o,`*objfile* passes −o and *objfile* to the assembler, in that order.

The order in which the argument(s) are passed to a tool with respect to the other specified command line options may change.

−X *c* — Specify the degree of conformance to the ANSI C standard. *c* can be one of the following:

t (transition)
: The compiled language includes all new features compatible with older (pre-ANSI) C (the default behavior). The compiler warns about all language constructs that have differing behavior between the new and old versions and uses the pre-ANSI C interpretation. This includes, for example, warning about the use of trigraphs the new escape sequence \a, and the changes to the integral promotion rules.

a (ANSI)
: The compiled language includes all new features of ANSI C and uses the new interpretation of constructs with differing behavior. The compiler continues to warn about the integral promotion rule

changes, but does not warn about trigraph replacements or new escape sequences.

c (conformance)
: The compiled language and associated header files are ANSI C conforming, but include all conforming extensions of `-Xa`. Warnings will be produced about some of these. Also, only ANSI defined identifiers are visible in the standard header files.

The predefined macro `__STDC__` has the value `0` for `-Xt` and `-Xa`, and `1` for `-Xc`. All warning messages about differing behavior can be eliminated in `-Xa` through appropriate coding; for example, use of casts can eliminate the integral promotion change warnings.

`-Y` *item*, *dir*
: Specify a new directory *dir* for the location of *item*. *item* can consist of any of the characters representing tools listed under the `-W` option or the following characters representing directories containing special files:

`I`	directory searched last for include files: *INCDIR* (see `-I`)
`S`	directory containing the start-up object files: *LIBDIR*
`L`	obsolete. Use `-YP` instead. For this release, `-YL` will be simulated using `-YP`. `-YL` will be removed in the next release.
`U`	obsolete. Use `-YP` instead. For this release, `-YU` will be simulated using `-YP`. `-YU` will be removed in the next release.
`P`	Change the default directories used for finding libraries. *dir* is a colon-separated path list.

If the location of a tool is being specified, then the new path name for the tool will be *dir/tool*. If more than one `-Y` option is applied to any one item, then the last occurrence holds.

cc recognizes `-a`, `-e`, `-m`, `-o`, `-r`, `-s`, `-t`, `-u`, and `-z` and passes these options and their arguments to `ld`. cc also passes any unrecognized options to `ld` without any diagnostic.

When cc is put in a file *prefix*cc, the prefix will be recognized and used to prefix the names of each tool executed. For example, `OLDcc` will execute `OLDacomp`, `OLDoptim`, `OLDbasicblk`, `OLDas`, and `OLDld`, and will link the object file(s) with `OLDcrt1.o`. Therefore, be careful when moving cc around. The prefix applies to the compiler, optimizer, basic block analyzer, assembler, link editor, and the start-up routines.

FILES

file`.c`	C source file
file`.i`	preprocessed C source file
file`.o`	object file
file`.s`	assembly language file
`a.out`	link-edited output
LIBDIR`/*crti.o`	startup initialization code
LIBDIR`/*crt1.o`	startup routine

LIBDIR/*crtn.o	last startup routine
TMPDIR/*	temporary files
LIBDIR/acomp	preprocessor and compiler
LIBDIR/optim	optimizer
LIBDIR/basicblk	basic block analyzer
BINDIR/as	assembler
BINDIR/ld	link editor
LIBDIR/libc.a	standard C library
INCDIR	usually /usr/include
LIBDIR	usually /usr/ccs/lib
BINDIR	usually /usr/ccs/bin
TMPDIR	usually /usr/tmp but can be redefined by setting the environment variable TMPDIR (see tempnam in tmpnam(3S)).

SEE ALSO

as(1), ld(1), lint(1), lprof(1), prof(1), sdb(1), monitor(3C), tmpnam(3S).
The "C Compilation System" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools.*

Kernighan, B. W., and Ritchie, D. M., *The C Programming Language*, Second Edition, Prentice-Hall, 1988.

American National Standard for Information Systems – Programming Language C, X3.159-1989.

NOTES

Obsolescent but still recognized cc options include -f, -F, -YL, and -YU. The -ql and -O options do not work together; -O will be ignored.

NAME

cdc – change the delta comment of an SCCS delta

SYNOPSIS

cdc -r *SID* [-m[*mrlist*]] [-y[*comment*]] *file*...

DESCRIPTION

cdc changes the delta comment, for the SID (SCCS identification string) specified by the -r keyletter, of each named SCCS file.

The delta comment is the Modification Request (MR) and comment information normally specified via the -m and -y keyletters of the delta command.

If *file* is a directory, cdc behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with s.) and unreadable files are silently ignored. If a name of – is given, the standard input is read (see the NOTES section) and each line of the standard input is taken to be the name of an SCCS file to be processed.

Arguments to cdc, which may appear in any order, consist of keyletter arguments and file names.

All the described keyletter arguments apply independently to each named file:

-r*SID* Used to specify the *S*CCS *ID*entification (SID) string of a delta for which the delta comment is to be changed.

-m*mrlist* If the SCCS file has the v flag set [see admin(1)] then a list of MR numbers to be added and/or deleted in the delta comment of the SID specified by the -r keyletter may be supplied. A null MR list has no effect.

mrlist entries are added to the list of MRs in the same manner as that of delta. In order to delete an MR, precede the MR number with the character ! (see the EXAMPLES section). If the MR to be deleted is currently in the list of MRs, it is removed and changed into a comment line. A list of all deleted MRs is placed in the comment section of the delta comment and preceded by a comment line stating that they were deleted.

If -m is not used and the standard input is a terminal, the prompt MRs? is issued on the standard output before the standard input is read; if the standard input is not a terminal, no prompt is issued. The MRs? prompt always precedes the comments? prompt (see -y keyletter).

mrlist entries in a list are separated by blanks and/or tab characters. An unescaped new-line character terminates the MR list.

Note that if the v flag has a value [see admin(1)], it is taken to be the name of a program (or shell procedure) that validates the correctness of the MR numbers. If a non-zero exit status is returned from the MR number validation program, cdc terminates and the delta comment remains unchanged.

−y[comment]
: Arbitrary text used to replace the *comment*(s) already existing for the delta specified by the **−r** keyletter. The previous comments are kept and preceded by a comment line stating that they were changed. A null *comment* has no effect.

  If **−y** is not specified and the standard input is a terminal, the prompt `comments?` is issued on the standard output before the standard input is read; if the standard input is not a terminal, no prompt is issued. An unescaped new-line character terminates the *comment* text.

If you made the delta and have the appropriate file permissions, you can change its delta comment. If you own the file and directory you can modify the delta comment.

EXAMPLES

```
cdc -r1.6 -m"bl88-12345 !bl87-54321 bl89-00001" -ytrouble s.file
```

adds bl88-12345 and bl89-00001 to the MR list, removes bl87-54321 from the MR list, and adds the comment `trouble` to delta 1.6 of `s.file`.

Entering:

```
cdc -r1.6 s.file
MRs? !bl87-54321 bl88-12345 bl89-00001
comments? trouble
```

produces the same result.

FILES

x-file [see **delta**(1)]
z-file [see **delta**(1)]

SEE ALSO

admin(1), **delta**(1), **get**(1), **help**(1), **prs**(1), **sccsfile**(4).

DIAGNOSTICS

Use `help` for explanations.

NOTES

If SCCS file names are supplied to the **cdc** command via the standard input (− on the command line), then the **−m** and **−y** keyletters must also be used.

NAME

`cflow` – generate C flowgraph

SYNOPSIS

`cflow [-r] [-ix] [-i_] [-d`*num*`]` *files*

DESCRIPTION

The `cflow` command analyzes a collection of C, `yacc`, `lex`, assembler, and object files and builds a graph charting the external function references. Files suffixed with `.y`, `.l`, and `.c` are processed by `yacc`, `lex`, and the C compiler as appropriate. The results of the preprocessed files, and files suffixed with `.i`, are then run through the first pass of `lint`. Files suffixed with `.s` are assembled. Assembled files, and files suffixed with `.o`, have information extracted from their symbol tables. The results are collected and turned into a graph of external references that is written on the standard output.

Each line of output begins with a reference number, followed by a suitable number of tabs indicating the level, then the name of the global symbol followed by a colon and its definition. Normally only function names that do not begin with an underscore are listed (see the `-i` options below). For information extracted from C source, the definition consists of an abstract type declaration (e.g., `char *`), and, delimited by angle brackets, the name of the source file and the line number where the definition was found. Definitions extracted from object files indicate the file name and location counter under which the symbol appeared (e.g., *text*). Leading underscores in C-style external names are deleted. Once a definition of a name has been printed, subsequent references to that name contain only the reference number of the line where the definition may be found. For undefined references, only <> is printed.

As an example, suppose the following code is in `file.c`:

```
int   i;

main()
{
        f();
        g();
        f();
}

f()
{
        i = h();
}
```

The command

```
cflow -ix file.c
```

produces the output

```
1       main: int(), <file.c 4>
2               f: int(), <file.c 11>
3                       h: <>
4                       i: int, <file.c 1>
5               g: <>
```

When the nesting level becomes too deep, the output of `cflow` can be piped to the `pr` command, using the `-e` option, to compress the tab expansion to something less than every eight spaces.

In addition to the `-D`, `-I`, and `-U` options [which are interpreted just as they are by `cc`], the following options are interpreted by `cflow`:

`-r` Reverse the "caller:callee" relationship producing an inverted listing showing the callers of each function. The listing is also sorted in lexicographical order by callee.

`-ix` Include external and static data symbols. The default is to include only functions in the flowgraph.

`-i_` Include names that begin with an underscore. The default is to exclude these functions (and data if `-ix` is used).

-d*num* The *num* decimal integer indicates the depth at which the flowgraph is cut off. By default this number is very large. Attempts to set the cutoff depth to a nonpositive integer will be ignored.

SEE ALSO

as(1), cc(1), `lex`(1), `lint`(1), nm(1), yacc(1).
`pr`(1) in the *User's Reference Manual*.

DIAGNOSTICS

Complains about multiple definitions and only believes the first.

NOTES

Files produced by `lex` and `yacc` cause the reordering of line number declarations, which can confuse `cflow`. To get proper results, feed `cflow` the `yacc` or `lex` input.

NAME

chrtbl – generate character classification and conversion tables

SYNOPSIS

chrtbl [*file*]

DESCRIPTION

The chrtbl command creates two tables containing information on character classification, upper/lower-case conversion, character-set width, and numeric editing. One table is an array of (257*2) + 7 bytes that is encoded so a table lookup can be used to determine the character classification of a character, convert a character (see ctype(3C)), and find the byte and screen width of a character in one of the supplementary code sets. The other table is 2 bytes long: the first byte specifies the decimal delimiter; the second byte specifies the thousands delimiter.

chrtbl reads the user-defined character classification and conversion information from *file* and creates three output files in the current directory. To construct *file*, use the file supplied in /usr/lib/locale/C/chrtbl_C as a starting point. You may add entries, but do not change the original values supplied with the system. For example, for other locales you may wish to add eight-bit entries to the ASCII definitions provided in this file.

One output file, ctype.c (a C-language source file), contains a (257*2)+7-byte array generated from processing the information from *file*. You should review the content of ctype.c to verify that the array is set up as you had planned. (In addition, an application program could use ctype.c.) The first 257 bytes of the array in ctype.c are used for character classification. The characters used for initializing these bytes of the array represent character classifications that are defined in /usr/include/ctype.h; for example, _L means a character is lower case and _S|_B means the character is both a spacing character and a blank. The second 257 bytes of the array are used for character conversion. These bytes of the array are initialized so that characters for which you do not provide conversion information will be converted to themselves. When you do provide conversion information, the first value of the pair is stored where the second one would be stored normally, and vice versa; for example, if you provide <0x41 0x61>, then 0x61 is stored where 0x41 would be stored normally, and 0x61 is stored where 0x41 would be stored normally. The last 7 bytes are used for character width information for up to three supplementary code sets.

The second output file (a data file) contains the same information, but is structured for efficient use by the character classification and conversion routines (see ctype(3C)). The name of this output file is the value you assign to the keyword LC_CTYPE read in from *file*. Before this file can be used by the character classification and conversion routines, it must be installed in the /usr/lib/locale/*locale* directory with the name LC_CTYPE by someone who is super-user or a member of group bin. This file must be readable by user, group, and other; no other permissions should be set. To use the character classification and conversion tables in this file, set the LC_CTYPE environment variable appropriately (see environ(5) or setlocale(3C)).

The third output file (a data file) is created only if numeric editing information is specified in the input file. The name of this output file is the value you assign to the keyword `LC_NUMERIC` read in from *file*. Before this file can be used, it must be installed in the `/usr/lib/locale/`*locale* directory with the name `LC_NUMERIC` by someone who is super-user or a member of group `bin`. This file must be readable by user, group, and other; no other permissions should be set. To use the numeric editing information in this file, set the `LC_NUMERIC` environment variable appropriately (see `environ`(5) or `setlocale`(3C)).

The name of the locale where you install the files `LC_CTYPE` and `LC_NUMERIC` should correspond to the conventions defined in *file*. For example, if French conventions were defined, and the name for the French locale on your system is `french`, then you should install the files in `/usr/lib/locale/french`.

If no input file is given, or if the argument "−" is encountered, `chrtbl` reads from standard input.

The syntax of *file* allows the user to define the names of the data files created by `chrtbl`, the assignment of characters to character classifications, the relationship between upper and lower-case letters, byte and screen widths for up to three supplementary code sets, and two items of numeric editing information: the decimal delimiter and the thousands delimiter. The keywords recognized by `chrtbl` are:

`LC_CTYPE`	name of the data file created by `chrtbl` to contain character classification, conversion, and width information
`isupper`	character codes to be classified as upper-case letters
`islower`	character codes to be classified as lower-case letters
`isdigit`	character codes to be classified as numeric
`isspace`	character codes to be classified as spacing (delimiter) characters
`ispunct`	character codes to be classified as punctuation characters
`iscntrl`	character codes to be classified as control characters
`isblank`	character code for the blank (space) character
`isxdigit`	character codes to be classified as hexadecimal digits
`ul`	relationship between upper- and lower-case characters
`cswidth`	byte and screen width information (by default, each is one character wide)
`LC_NUMERIC`	name of the data file created by `chrtbl` to contain numeric editing information
`decimal_point`	decimal delimiter
`thousands_sep`	thousands delimiter

Any lines with the number sign (#) in the first column are treated as comments and are ignored. Blank lines are also ignored.

Characters for **isupper**, **islower**, **isdigit**, **isspace**, **ispunct**, **iscntrl**, **isblank**, **isxdigit**, and **ul** can be represented as a hexadecimal or octal constant (for example, the letter **a** can be represented as **0x61** in hexadecimal or **0141** in octal). Hexadecimal and octal constants may be separated by one or more space and/or tab characters.

The dash character (–) may be used to indicate a range of consecutive numbers. Zero or more space characters may be used for separating the dash character from the numbers.

The backslash character (\) is used for line continuation. Only a carriage return is permitted after the backslash character.

The relationship between upper- and lower-case letters (**ul**) is expressed as ordered pairs of octal or hexadecimal constants: *<upper-case_character lower-case_character>*. These two constants may be separated by one or more space characters. Zero or more space characters may be used for separating the angle brackets (< >) from the numbers.

The following is the format of an input specification for **cswidth**:
n1:s1,n2:s2,n3:s3
where,

- *n1* byte width for supplementary code set 1, required
- *s1* screen width for supplementary code set 1
- *n2* byte width for supplementary code set 2
- *s2* screen width for supplementary code set 2
- *n3* byte width for supplementary code set 3
- *s3* screen width for supplementary code set 3

EXAMPLE

The following is an example of an input file used to create the ASCII code set definition table in a file named **ascii**.

```
LC_CTYPE  ascii
isupper   0x41 - 0x5a
islower   0x61 - 0x7a
isdigit   0x30 - 0x39
isspace   0x20 0x9 - 0xd
ispunct   0x21 - 0x2f   0x3a - 0x40 \
          0x5b - 0x60   0x7b - 0x7e
iscntrl   0x0 - 0x1f    0x7f
isblank   0x20
isxdigit  0x30 - 0x39   0x61 - 0x66 \
          0x41 - 0x46
ul       <0x41 0x61> <0x42 0x62> <0x43 0x63>  \
         <0x44 0x64> <0x45 0x65> <0x46 0x66>  \
         <0x47 0x67> <0x48 0x68> <0x49 0x69>  \
         <0x4a 0x6a> <0x4b 0x6b> <0x4c 0x6c>  \
         <0x4d 0x6d> <0x4e 0x6e> <0x4f 0x6f>  \
         <0x50 0x70> <0x51 0x71> <0x52 0x72>  \
         <0x53 0x73> <0x54 0x74> <0x55 0x75>  \
```

```
                <0x56 0x76> <0x57 0x77> <0x58 0x78> \
                <0x59 0x79> <0x5a 0x7a>
cswidth         1:1,0:0,0:0
LC_NUMERIC  num_ascii
decimal_point           .
thousands_sep           ,
```

FILES

`/usr/lib/locale/`*locale*`/LC_CTYPE`
: data files containing character classification, conversion, and character-set width information created by `chrtbl`

`/usr/lib/locale/`*locale*`/LC_NUMERIC`
: data files containing numeric editing information created by `chrtbl`

`/usr/include/ctype.h`
: header file containing information used by character classification and conversion routines

`/usr/lib/locale/C/chrtbl_C`
: input file used to construct `LC_CTYPE` and `LC_NUMERIC` in the default locale.

SEE ALSO

`environ`(5).
`ctype`(3C), `setlocale`(3C) in the *Programmer's Reference Manual.*

DIAGNOSTICS

The error messages produced by `chrtbl` are intended to be self-explanatory. They indicate errors in the command line or syntactic errors encountered within the input file.

WARNING

Changing the files in `/usr/lib/locale/C` will cause the system to behave unpredictably.

NAME

`cof2elf` – COFF to ELF object file translation

SYNOPSIS

`cof2elf [-iqV] [-Q{yn}] [-s` *directory*`]` *files*

DESCRIPTION

`cof2elf` converts one or more COFF object *files* to ELF. This translation occurs in place, meaning the original file contents are modified. If an input file is an archive, each member will be translated as necessary, and the archive will be rebuilt with its members in the original order. `cof2elf` does not change input files that are not COFF.

Options have the following meanings.

`-i` Normally, the files are modified only when full translation occurs. Unrecognized data, such as unknown relocation types, are treated as errors and prevent translation. Giving the `-i` flag ignores these partial translation conditions and modifies the file anyway.

`-q` Normally, `cof2elf` prints a message for each file it examines, telling whether the file was translated, ignored, etc. The `-q` flag (for quiet) suppresses these messages.

`-Q`*arg* If *arg* is `y`, identification information about `cof2elf` will be added to the output files. This can be useful for software administration. Giving `n` for *arg* explicitly asks for no such information, which is the default behavior.

`-s`*directory* As mentioned above, `cof2elf` modifies the input files. This option saves a copy of the original files in the specified *directory*, which must exist. `cof2elf` does not save files it does not modify.

`-V` This flag tells `cof2elf` to print a version message on standard error.

SEE ALSO

`ld`(1), `elf`(3E), `a.out`(4), `ar`(4).

NOTES

Some debugging information is discarded. Although this does not affect the behavior of a running program, it may affect the information available for symbolic debugging.

`cof2elf` translates only COFF relocatable files. It does not translate executable or static shared library files for two main reasons. First, the operating system supports executable files and static shared libraries, making translation unnecessary. Second, those files have specific address and alignment constraints determined by the file format. Matching the constraints with a different object file format is problematic.

When possible, programmers should recompile their source code to build new object files. `cof2elf` is provided for those times when source code is unavailable.

NAME

colltbl – create collation database

SYNOPSIS

colltbl [*file* | –]

DESCRIPTION

The colltbl command takes as input a specification file, *file*, that describes the collating sequence for a particular language and creates a database that can be read by strxfrm(3C) and strcoll(3C). strxfrm(3C) transforms its first argument and places the result in its second argument. The transformed string is such that it can be correctly ordered with other transformed strings by using strcmp(3C), strncmp(3C) or memcmp(3C). strcoll(3C) transforms its arguments and does a comparison.

If no input file is supplied, *stdin* is read.

The output file produced contains the database with collating sequence information in a form usable by system commands and routines. The name of this output file is the value you assign to the keyword codeset read in from *file*. Before this file can be used, it must be installed in the /usr/lib/locale/*locale* directory with the name LC_COLLATE by someone who is super-user or a member of group bin. *locale* corresponds to the language area whose collation sequence is described in *file*. This file must be readable by user, group, and other; no other permissions should be set. To use the collating sequence information in this file, set the LC_COLLATE environment variable appropriately (see environ(5) or setlocale(3C)).

The colltbl command can support languages whose collating sequence can be completely described by the following cases:

- Ordering of single characters within the codeset. For example, in Swedish, V is sorted after U, before X and with W (V and W are considered identical as far as sorting is concerned).
- Ordering of "double characters" in the collation sequence. For example, in Spanish, ch and ll are collated after c and l, respectively.
- Ordering of a single character as if it consists of two characters. For example, in German, the "sharp s", β, is sorted as ss. This is a special instance of the next case below.
- Substitution of one character string with another character string. In the example above, the string β is replaced with ss during sorting.
- Ignoring certain characters in the codeset during collation. For example, if – were ignored during collation, then the strings re-locate and relocate would be equal.
- Secondary ordering between characters. In the case where two characters are sorted together in the collation sequence, (i.e., they have the same "primary" ordering), there is sometimes a secondary ordering that is used if two strings are identical except for characters that have the same primary ordering. For example, in French, the letters e and è have the same primary ordering but e comes before è in the secondary ordering. Thus the word lever would be ordered before lèver, but lèver would be sorted before levitate. (Note

that if e came before è in the primary ordering, then `lèver` would be sorted after `levitate`.)

The specification file consists of three types of statements:

1. `codeset` *filename*

   filename is the name of the output file to be created by `colltbl`.

2. `order is` *order_list*

   order_list is a list of symbols, separated by semicolons, that defines the collating sequence. The special symbol, `...`, specifies symbols that are lexically sequential in a short-hand form. For example,

   ```
   order is    a;b;c;d;...;x;y;z
   ```

   would specify the list of lower_case letters. Of course, this could be further compressed to just `a;...;z`.

   A symbol can be up to two bytes in length and can be represented in any one of the following ways:

   - the symbol itself (e.g., a for the lower-case letter a),
   - in octal representation (e.g., `\141` or `0141` for the letter a), or
   - in hexadecimal representation (e.g., `\x61` or `0x61` for the letter a).

   Any combination of these may be used as well.

   The backslash character, \ , is used for continuation. No characters are permitted after the backslash character.

   Symbols enclosed in parenthesis are assigned the same primary ordering but different secondary ordering. Symbols enclosed in curly brackets are assigned only the same primary ordering. For example,

   ```
   order is    a;b;c;ch;d;(e;è);f;...;z;\
               {1;...;9};A;...;Z
   ```

   In the above example, e and è are assigned the same primary ordering and different secondary ordering, digits 1 through 9 are assigned the same primary ordering and no secondary ordering. Only primary ordering is assigned to the remaining symbols. Notice how double letters can be specified in the collating sequence (letter ch comes between c and d).

   If a character is not included in the `order is` statement it is excluded from the ordering and will be ignored during sorting.

3. `substitute` *string* `with` *repl*

   The `substitute` statement substitutes the string *string* with the string *repl*. This can be used, for example, to provide rules to sort the abbreviated month names numerically:

```
substitute "Jan" with "01"
substitute "Feb" with "02"
      .
      .
      .
substitute "Dec" with "12"
```

A simpler use of the `substitute` statement that was mentioned above was to substitute a single character with two characters, as with the substitution of β with `ss` in German.

The `substitute` statement is optional. The `order is` and `codeset` statements must appear in the specification file.

Any lines in the specification file with a `#` in the first column are treated as comments and are ignored. Empty lines are also ignored.

EXAMPLE

The following example shows the collation specification required to support a hypothetical telephone book sorting sequence.

The sorting sequence is defined by the following rules:

a. Upper and lower case letters must be sorted together, but upper case letters have precedence over lower case letters.

b. All special characters and punctuation should be ignored.

c. Digits must be sorted as their alphabetic counterparts (e.g., `0` as `zero`, `1` as `one`).

d. The `Ch`, `ch`, `CH` combinations must be collated between `C` and `D`.

e. `V` and `W`, `v` and `w` must be collated together.

The input specification file to `colltbl` will contain:

```
codeset     telephone

order is    A;a;B;b;C;c;CH;Ch;ch;D;d;E;e;F;f;\
            G;g;H;h:I;i;J;j;K;k;L;l;M;m;N;n;O;o;P;p;\
            Q;q;R;r;S;s;T;t;U;u;{V;W};{v;w};X;x;Y;y;Z;z

substitute "0" with "zero"
substitute "1" with "one"
substitute "2" with "two"
substitute "3" with "three"
substitute "4" with "four"
substitute "5" with "five"
substitute "6" with "six"
substitute "7" with "seven"
substitute "8" with "eight"
substitute "9" with "nine"
```

FILES

/lib/locale/*locale*/LC_COLLATE
: LC_COLLATE database for *locale*

/usr/lib/locale/C/colltbl_C
: input file used to construct LC_COLLATE in the default locale.

SEE ALSO

memory(3C), setlocale(3C), strcoll(3C), string(3C), strxfrm(3C), environ(5) in the *Programmer's Reference Manual*.

NAME

comb – combine SCCS deltas

SYNOPSIS

`comb [-o] [-s] [-p`*SID*`] [-c`*list*`]` *files*

DESCRIPTION

comb generates a shell procedure [see **sh**(1)] that, when run, reconstructs the given SCCS files. The reconstructed files are typically smaller than the original files. The arguments may be specified in any order, but all keyletter arguments apply to all named SCCS files. If a directory is named, **comb** behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with `s.`) and unreadable files are silently ignored. If a name of – is given, the standard input is read; each line of the input is taken to be the name of an SCCS file to be processed; non-SCCS files and unreadable files are silently ignored. The generated shell procedure is written on the standard output.

The keyletter arguments are as follows. Each argument is explained as if only one named file is to be processed, but the effects of any keyletter argument apply independently to each named file.

–o For each `get -e`, this argument causes the reconstructed file to be accessed at the release of the delta to be created, otherwise the reconstructed file would be accessed at the most recent ancestor. Use of the –o keyletter may decrease the size of the reconstructed SCCS file. It may also alter the shape of the delta tree of the original file.

–s This argument causes **comb** to generate a shell procedure that, when run, produces a report that gives for each file: the file name, size (in blocks) after combining, original size (also in blocks), and percentage change computed by:

100 * (*original* – *combined*) / *original*

It is recommended that before any SCCS files are actually combined, one should use this option to determine exactly how much space is saved by the combining process.

–p*SID* The SCCS identification string (SID) of the oldest delta to be preserved. All older deltas are discarded in the reconstructed file.

–c*list* A *list* of deltas to be preserved. All other deltas are discarded. See `get`(1) for the syntax of a *list*.

If no keyletter arguments are specified, **comb** preserves only leaf deltas and the minimal number of ancestors needed to preserve the tree.

FILES

`s.COMB`	the reconstructed SCCS file
`comb?????`	temporary file

SEE ALSO

`admin`(1), `delta`(1), `get`(1), `help`(1), `prs`(1), `sccsfile`(4).

sh(1) in the *User's Reference Manual*.

DIAGNOSTICS

Use help(1) for explanations.

NOTES

comb may rearrange the shape of the tree of deltas.

comb may not save any space; in fact, it is possible for the reconstructed file to be larger than the original.

NAME

convert – convert archive files to common formats

SYNOPSIS

convert [-x] *infile outfile*

DESCRIPTION

The convert command transforms input *infile1 to output outfile. infile* must be a UNIX System V Release 1.0 archive file and *outfile* will be the equivalent UNIX System V Release 2.0 archive file. All other types of input to the convert command will be passed unmodified from the input file to the output file (along with appropriate warning messages).

The -x option is required to convert a XENIX archive. (XENIX is a registered trademark of Microsoft Corporation.) Using this option will convert the general archive but leave archive members unmodified.

infile must be different from *outfile.*

FILES

TMPDIR/conv* temporary files

TMPDIR is usually /usr/tmp but can be redefined by setting the environment variable TMPDIR [see tempnam() in tmpnam(3S)].

SEE ALSO

ar(1), tmpnam(3S), a.out(4), ar(4).

NAME

cscope − interactively examine a C program

SYNOPSIS

cscope [*options*] *files*...

DESCRIPTION

cscope is an interactive screen-oriented tool that allows the user to browse through C source files for specified elements of code.

By default, **cscope** examines the C (`.c` and `.h`), `lex` (`.l`), and **yacc** (`.y`) source files in the current directory. **cscope** may also be invoked for source files named on the command line. In either case, **cscope** searches the standard directories for `#include` files that it does not find in the current directory. **cscope** uses a symbol cross-reference, `cscope.out` by default, to locate functions, function calls, macros, variables, and preprocessor symbols in the files.

cscope builds the symbol cross-reference the first time it is used on the source files for the program being browsed. On a subsequent invocation, **cscope** rebuilds the cross-reference only if a source file has changed or the list of source files is different. When the cross-reference is rebuilt, the data for the unchanged files are copied from the old cross-reference, which makes rebuilding faster than the initial build.

The following options can appear in any combination:

−b Build the cross-reference only.

−C Ignore letter case when searching.

−c Use only ASCII characters in the cross-reference file, that is, do not compress the data.

−d Do not update the cross-reference.

−e Suppress the **^e** command prompt between files.

−f *reffile* Use *reffile* as the cross-reference file name instead of the default `cscope.out`.

−I *incdir* Look in *incdir* (before looking in *INCDIR*, the standard place for header files, normally `/usr/include`) for any `#include` files whose names do not begin with / and that are not specified on the command line or in *namefile* below. (The `#include` files may be specified with either double quotes or angle brackets.) The *incdir* directory is searched in addition to the current directory (which is searched first) and the standard list (which is searched last). If more than one occurrence of −I appears, the directories are searched in the order they appear on the command line.

−i *namefile* Browse through all source files whose names are listed in *namefile* (file names separated by spaces, tabs, or new-lines) instead of the default (`cscope.files`). If this option is specified, **cscope** ignores any files appearing on the command line.

`-L`	Do a single search with line-oriented output when used with the *-num pattern* option.
`-l`	Line-oriented interface (see "Line-Oriented Interface" below).
-num pattern	Go to input field *num* (counting from 0) and find *pattern*.
`-P` *path*	Prepend *path* to relative file names in a pre-built cross-reference file so you do not have to change to the directory where the cross-reference file was built. This option is only valid with the `-d` option.
`-p` *n*	Display the last *n* file path components instead of the default (1). Use 0 to not display the file name at all.
`-s` *dir*	Look in *dir* for additional source files. This option is ignored if source files are given on the command line.
`-T`	Use only the first eight characters to match against C symbols. A regular expression containing special characters other than a period (`.`) will not match any symbol if its minimum length is greater than eight characters.
`-U`	Do not check file time stamps (assume that no files have changed).
`-u`	Unconditionally build the cross-reference file (assume that all files have changed).
`-V`	Print on the first line of screen the version number of **cscope**.

The `-I`, `-p`, and `-T` options can also be in the `cscope.files` file.

Requesting the Initial Search

After the cross-reference is ready, **cscope** will display this menu:

```
Find this C symbol:
Find this function definition:
Find functions called by this function:
Find functions calling this function:
Find this text string:
Change this text string:
Find this egrep pattern:
Find this file:
Find files #including this file:
```

Press the `TAB` key repeatedly to move to the desired input field, type the text to search for, and then press the `RETURN` key.

Issuing Subsequent Requests

If the search is successful, any of these single-character commands can be used:

`1-9`	Edit the file referenced by the given line number.
`SPACE`	Display next set of matching lines.
`+`	Display next set of matching lines.

–	Display previous set of matching lines.
^e	Edit displayed files in order.
>	Append the displayed list of lines to a file.
|	Pipe all lines to a shell command.

At any time these single-character commands can also be used:

TAB	Move to next input field.
RETURN	Move to next input field.
^n	Move to next input field.
^p	Move to previous input field.
^y	Search with the last text typed.
^b	Move to previous input field and search pattern.
^f	Move to next input field and search pattern.
^c	Toggle ignore/use letter case when searching. (When ignoring letter case, search for `FILE` will match `File` and `file`.)
^r	Rebuild the cross-reference.
!	Start an interactive shell (type `^d` to return to **cscope**).
^l	Redraw the screen.
?	Give help information about **cscope** commands.
^d	Exit **cscope**.

Note: If the first character of the text to be searched for matches one of the above commands, escape it by typing a \ (backslash) first.

Substituting New Text for Old Text

After the text to be changed has been typed, **cscope** will prompt for the new text, and then it will display the lines containing the old text. Select the lines to be changed with these single-character commands:

1-9	Mark or unmark the line to be changed.
*	Mark or unmark all displayed lines to be changed.
SPACE	Display next set of lines.
+	Display next set of lines.
–	Display previous set of lines.
a	Mark all lines to be changed.
^d	Change the marked lines and exit.
ESCAPE	Exit without changing the marked lines.
!	Start an interactive shell (type `^d` to return to **cscope**).
^l	Redraw the screen.
?	Give help information about **cscope** commands.

Special Keys

If your terminal has arrow keys that work in `vi(1)`, you can use them to move around the input fields. The up-arrow key is useful to move to the previous input field instead of using the TAB key repeatedly. If you have CLEAR, NEXT, or PREV keys they will act as the `^l`, `+`, and `–` commands, respectively.

Line-Oriented Interface

The `-l` option lets you use **cscope** where a screen-oriented interface would not be useful, e.g., from another screen-oriented program.

cscope will prompt with >> when it is ready for an input line starting with the field number (counting from 0) immediately followed by the search pattern, e.g., `1main` finds the definition of the `main` function. If you just want a single search, instead of the `-1` option use the `-L` and *-num pattern* options, and you won't get the >> prompt.

For `-l`, **cscope** outputs the number of reference lines

```
cscope: 2 lines
```

For each reference found, **cscope** outputs a line consisting of the file name, function name, line number, and line text, separated by spaces, e.g.,

```
main.c main 161 main(argc, argv)
```

Note that the editor is not called to display a single reference, unlike the screen-oriented interface.

You can use the `r` command to rebuild the database.

cscope will quit when it detects end-of-file, or when the first character of an input line is `^d` or `q`.

ENVIRONMENT VARIABLES

EDITOR	Preferred editor, which defaults to `vi`(1).
INCLUDEDIRS	Colon-separated list of directories to search for `#include` files.
HOME	Home directory, which is automatically set at login.
SHELL	Preferred shell, which defaults to `sh`(1).
SOURCEDIRS	Colon-separated list of directories to search for additional source files.
TERM	Terminal type, which must be a screen terminal.
TERMINFO	Terminal information directory full path name. If your terminal is not in the standard `terminfo` directory, see `curses` and `terminfo` for how to make your own terminal description.
TMPDIR	Temporary file directory, which defaults to `/usr/tmp`.
VIEWER	Preferred file display program [such as pg], which overrides EDITOR (see above).
VPATH	A colon-separated list of directories, each of which has the same directory structure below it. If VPATH is set, **cscope** searches for source files in the directories specified; if it is not set, **cscope** searches only in the current directory.

FILES

`cscope.files`	Default files containing `-I`, `-p`, and `-T` options and the list of source files (overridden by the `-i` option).
`cscope.out`	Symbol cross-reference file, which is put in the home directory if it cannot be created in the current directory.
`ncscope.out`	Temporary file containing new cross-reference before it replaces the old cross-reference.
INCDIR	Standard directory for `#include` files (usually `/usr/include`).

SEE ALSO

The "**cscope**" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.
`curses` and `terminfo` in the *Programmer's Guide: Character User Interface (FMLI and ETI)*.

NOTES

cscope recognizes function definitions of the form:

fname blank (*args*) *white arg_decs white* {

where:

fname	is the function name
blank	is zero or more spaces or tabs, not including newlines
args	is any string that does not contain a " or a newline
white	is zero or more spaces, tabs, or newlines
arg_decs	are zero or more argument declarations (*arg_decs* may include comments and white space)

It is not necessary for a function declaration to start at the beginning of a line. The return type may precede the function name; **cscope** will still recognize the declaration. Function definitions that deviate from this form will not be recognized by **cscope**.

The `Function` column of the search output for the menu option `Find functions called by this function:` input field will only display the first function called in the line, that is, for this function

```
e()
{
        return (f() + g());
}
```

the display would be

```
Functions called by this function: e

File Function Line
a.c  f        3 return(f() + g());
```

Occasionally, a function definition or call may not be recognized because of braces inside `#if` statements. Similarly, the use of a variable may be incorrectly recognized as a definition.

A `typedef` name preceding a preprocessor statement will be incorrectly recognized as a global definition, e.g.,

```
LDFILE *
#if AR16WR
```

Preprocessor statements can also prevent the recognition of a global definition, e.g.,

```
char flag
#ifdef ALLOCATE_STORAGE
        = -1
#endif
;
```

A function declaration inside a function is incorrectly recognized as a function call, e.g.,

```
f()
{
        void g();
}
```

is incorrectly recognized as a call to `g()`.

cscope recognizes C++ classes by looking for the class keyword, but doesn't recognize that a `struct` is also a class, so it doesn't recognize inline member function definitions in a structure. It also doesn't expect the class keyword in a `typedef`, so it incorrectly recognizes `X` as a definition in

```
typedef class X * Y;
```

It also doesn't recognize operator function definitions

```
Bool Feature::operator==(const Feature & other)
{
        ...
}
```

NAME

ctrace – C program debugger

SYNOPSIS

ctrace [*options*] [*file*]

DESCRIPTION

The ctrace command allows the user to monitor the sequential execution of a C program as each program statement executes. The effect is similar to executing a shell procedure with the -x option. ctrace reads the C program in *file* (or from standard input if the user does not specify *file*), inserts statements to print the text of each executable statement and the values of all variables referenced or modified, and writes the modified program to the standard output. The output of ctrace must be placed into a temporary file because the cc(1) command does not allow the use of a pipe. This file can then be compiled and executed.

As each statement in the program executes, it will be listed at the terminal, followed by the name and value of any variables referenced or modified in the statement; these variable names and values will be followed by any output from the statement. Loops in the trace output are detected and tracing is stopped until the loop is exited or a different sequence of statements within the loop is executed. A warning message is printed after each 1000 loop cycles to help the user detect infinite loops. The trace output goes to the standard output so the user can put it into a file for examination with an editor or the bfs(1) or tail(1) commands.

The options commonly used are:

-f *functions* Trace only these *functions*.
-v *functions* Trace all but these *functions*.

The user may want to add to the default formats for printing variables. Long and pointer variables are always printed as signed integers. Pointers to character arrays are also printed as strings if appropriate. char, short, and int variables are also printed as signed integers and, if appropriate, as characters. double variables are printed as floating point numbers in scientific notation. The user can request that variables be printed in additional formats, if appropriate, with these options:

-o Octal
-x Hexadecimal
-u Unsigned
-e Floating point

These options are used only in special circumstances:

-l *n* Check *n* consecutively executed statements for looping trace output, instead of the default of 20. Use 0 to get all the trace output from loops.

-s Suppress redundant trace output from simple assignment statements and string copy function calls. This option can hide a bug caused by use of the = operator in place of the == operator.

-t *n* Trace *n* variables per statement instead of the default of 10 (the maximum number is 20). The diagnostics section explains when to use this option.

–P Preprocess the input before tracing it. The user can also use the –D, –I, and –U cc(1) options.

–p *string*
Change the trace print function from the default of `printf`. For example, `fprintf(stderr,` would send the trace to the standard error output.

–r *f* Use file *f* in place of the `runtime.c` trace function package. This replacement lets the user change the entire print function, instead of just the name and leading arguments (see the –p option).

–V Prints version information on the standard error.

–Q*arg* If *arg* is y, identification information about `ctrace` will be added to the output files. This can be useful for software administration. Giving n for *arg* exlicitly asks for no such information, which is the default behavior.

EXAMPLE

If the file `lc.c` contains this C program:

```
#include <stdio.h>
main()  /* count lines in input */
{
    int c, nl;

    nl = 0;
    while ((c = getchar()) != EOF)
            if (c = '\n')
                    ++nl;
    printf("%d\n", nl);
}
```

these commands and test data are entered:

```
cc lc.c
a.out
1
(cntl-d)
```

the program will be compiled and executed. The output of the program will be the number 2, which is incorrect because there is only one line in the test data. The error in this program is common, but subtle. If the user invokes `ctrace` with these commands:

```
ctrace lc.c >temp.c
cc temp.c
a.out
```

the output will be:

```
 2 main()
 6     nl = 0;
       /* nl == 0 */
 7     while ((c = getchar()) != EOF)
```

The program is now waiting for input. If the user enters the same test data as before, the output will be:

```
        /* c == 49 or '1' */
8            if (c = '\n')
             /* c == 10 or '\n' */
9                 ++nl;
                  /* nl == 1 */
7       while ((c = getchar()) != EOF)
        /* c == 10 or '\n' */
8            if (c = '\n')
             /* c == 10 or '\n' */
9                 ++nl;
                  /* nl == 2 */
7       while ((c = getchar()) != EOF)
```

If an end-of-file character (cntl-d) is entered, the final output will be:

```
        /* c == -1 */
10      printf("%d\n", nl);
        /* nl == 2 */2
         return
```

Note the information printed out at the end of the trace line for the `nl` variable following line 10. Also note the `return` comment added by `ctrace` at the end of the trace output. This shows the implicit return at the terminating brace in the function.

The trace output shows that variable `c` is assigned the value '1' in line 7, but in line 8 it has the value '\n'. Once user attention is drawn to this `if` statement, he or she will probably realize that the assignment operator (=) was used in place of the equality operator (==). This error can easily be missed during code reading.

EXECUTION-TIME TRACE CONTROL

The default operation for `ctrace` is to trace the entire program file, unless the `-f` or `-v` options are used to trace specific functions. The default operation does not give the user statement-by-statement control of the tracing, nor does it let the user turn the tracing off and on when executing the traced program.

The user can do both of these by adding `ctroff()` and `ctron()` function calls to the program to turn the tracing off and on, respectively, at execution time. Thus, complex criteria can be arbitrarily coded for trace control with `if` statements, and this code can even be conditionally included because `ctrace` defines the `CTRACE` preprocessor variable. For example:

```
#ifdef CTRACE
     if (c == '!' && i > 1000)
          ctron();
#endif
```

These functions can also be called from sdb(1) if they are compiled with the `-g` option. For example, to trace all but lines 7 to 10 in the main function, enter:

```
sdb a.out
main:7b ctroff()
main:11b ctron()
r
```

The trace can be turned off and on by setting static variable `tr_ct_` to 0 and 1, respectively. This on/off option is useful if a user is using a debugger that can not call these functions directly.

FILES

`/usr/ccs/lib/ctrace/runtime.c` run-time trace package

SEE ALSO

`sdb`(1), `ctype`(3C), `fclose`(3S), `printf`(3S), `string`(3C).
`bfs`(1), `tail`(1) in the *User's Reference Manual.*

DIAGNOSTICS

This section contains diagnostic messages from both `ctrace` and `cc`(1), since the traced code often gets some `cc` warning messages. The user can get `cc` error messages in some rare cases, all of which can be avoided.

ctrace Diagnostics

`warning: some variables are not traced in this statement`
: Only 10 variables are traced in a statement to prevent the C compiler "out of tree space; simplify expression" error. Use the `-t` option to increase this number.

`warning: statement too long to trace`
: This statement is over 400 characters long. Make sure that tabs are used to indent the code, not spaces.

`cannot handle preprocessor code, use -P option`
: This is usually caused by `#ifdef/#endif` preprocessor statements in the middle of a C statement, or by a semicolon at the end of a `#define` preprocessor statement.

`'if ... else if' sequence too long`
: Split the sequence by removing an `else` from the middle.

`possible syntax error, try -P option`
: Use the `-P` option to preprocess the `ctrace` input, along with any appropriate `-D`, `-I`, and `-U` preprocessor options.

NOTES

Defining a function with the same name as a system function may cause a syntax error if the number of arguments is changed. Just use a different name.

`ctrace` assumes that `BADMAG` is a preprocessor macro, and that `EOF` and `NULL` are #defined constants. Declaring any of these to be variables, e.g., "`int EOF;`", will cause a syntax error.

Pointer values are always treated as pointers to character strings.

`ctrace` does not know about the components of aggregates like structures, unions, and arrays. It cannot choose a format to print all the components of an aggregate when an assignment is made to the entire aggregate. `ctrace` may choose to print the address of an aggregate or use the wrong format (e.g., `3.149050e-311` for a structure with two integer members) when printing the value of an aggregate.

The loop trace output elimination is done separately for each file of a multi-file program. Separate output elimination can result in functions called from a loop still being traced, or the elimination of trace output from one function in a file until another in the same file is called.

NAME

`cxref` – generate C program cross-reference

SYNOPSIS

`cxref` [*options*] *files*

DESCRIPTION

The `cxref` command analyzes a collection of C files and builds a cross-reference table. `cxref` uses a special version of `cc` to include `#define`'d information in its symbol table. It generates a list of all symbols (auto, static, and global) in each individual file, or, with the `-c` option, in combination. The table includes four fields: NAME, FILE, FUNCTION, and LINE. The line numbers appearing in the LINE field also show reference marks as appropriate. The reference marks include:

assignment	=
declaration	–
definition	*

If no reference marks appear, you can assume a general reference.

OPTIONS

`cxref` interprets the `-D`, `-I`, `-U` options in the same manner that `cc` does. In addition, `cxref` interprets the following options:

`-c` Combine the source files into a single report. Without the `-c` option, `cxref` generates a separate report for each file on the command line.

`-d` Disables printing declarations, making the report easier to read.

`-l` Does not print local variables. Prints only global and file scope statistics.

`-o` *file* Direct output to *file*.

`-s` Operates silently; does not print input file names.

`-t` Format listing for 80-column width.

`-w`*num* Width option that formats output no wider than *num* (decimal) columns. This option will default to 80 if *num* is not specified or is less than 51.

`-C` Runs only the first pass of `cxref`, creating a `.cx` file that can later be passed to `cxref`. This is similar to the `-c` option of `cc` or `lint`.

`-F` Prints the full path of the referenced file names.

`-L`*cols* Modifies the number of columns in the LINE field. If you do not specify a number, `cxref` defaults to five columns.

`-V` Prints version information on the standard error.

`-W`*name,file, function, line*
Changes the default width of at least one field. The default widths are:

Field	Characters
NAME	15
FILE	13
FUNCTION	15
LINE	20 (4 per column)

FILES

TMPDIR/`tcx.*`	temporary files
TMPDIR/`cx.*`	temporary files
LIBDIR/`xref`	accessed by `cxref`
LIBDIR	usually `/usr/ccs/lib`
TMPDIR	usually `/usr/tmp` but can be redefined by setting the environment variable `TMPDIR` [see `tempnam` in `tmpnam`(3S)].

EXAMPLE

`a.c`

```
1      main()
2      {
3              int i;
4              extern char c;
5
6              i=65;
7              c=(char)i;
8      }
```

Resulting cross-reference table:

```
NAME   FILE         FUNCTION   LINE
c      a.c          ---        4-     7=
i      a.c          main       3*     6=    7
main   a.c          ---        2*
u3b2   predefined   ---        0*
unix   predefined   ---        0*
```

SEE ALSO

cc(1), `lint`(1).

DIAGNOSTICS

Error messages usually mean you cannot compile the files.

NAME

delta – make a delta (change) to an SCCS file

SYNOPSIS

delta [-r*SID*] [-s] [-n] [-g*list*] [-m[*mrlist*]] [-y[*comment*]] [-p] *files*

DESCRIPTION

delta is used to permanently introduce into the named SCCS file changes that were made to the file retrieved by get -e (called the g-file or generated file).

delta makes a delta to each named SCCS file. If a directory is named, **delta** behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with s.) and unreadable files are silently ignored. If a name of – is given, the standard input is read (see the NOTES section); each line of the standard input is taken to be the name of an SCCS file to be processed.

delta may issue prompts on the standard output depending on certain keyletters specified and flags [see admin(1)] that may be present in the SCCS file (see -m and -y keyletters below).

Keyletter arguments apply independently to each named file.

-r*SID* Uniquely identifies which delta is to be made to the SCCS file. The use of this keyletter is necessary only if two or more outstanding gets for editing (get -e) on the same SCCS file were done by the same person (login name). The SID value specified with the -r keyletter can be either the SID specified on the get command line or the SID to be made as reported by the get command [see get(1)]. A diagnostic results if the specified SID is ambiguous, or, if necessary and omitted on the command line.

-s Suppresses the issue, on the standard output, of the created delta's SID, as well as the number of lines inserted, deleted and unchanged in the SCCS file.

-n Specifies retention of the edited g-file (normally removed at completion of delta processing).

-g*list* Specify a *list* [see get(1) for the definition of *list*] of deltas that are to be ignored when the file is accessed at the change level (SID) created by this delta.

-m[mrlist] If the SCCS file has the v flag set [see admin(1)] then a Modification Request (MR) number must be supplied as the reason for creating the new delta. If -m is not used and the standard input is a terminal, the prompt MRs? is issued on the standard output before the standard input is read; if the standard input is not a terminal, no prompt is issued. The MRs? prompt always precedes the comments? prompt (see -y keyletter). MRs in a list are separated by blanks and/or tab characters. An unescaped new-line character terminates the MR list. Note that if the v flag has a value [see admin(1)], it is taken to be the name of a program (or shell procedure) that will validate the correctness of the MR numbers. If a non-zero exit status is returned from the MR number validation program, `delta` terminates. (It is assumed that the MR numbers were not all valid.)

−y[comment] Arbitrary text used to describe the reason for making the delta. A null string is considered a valid *comment*. If −y is not specified and the standard input is a terminal, the prompt `comments?` is issued on the standard output before the standard input is read; if the standard input is not a terminal, no prompt is issued. An unescaped new-line character terminates the comment text.

−p Causes `delta` to print (on the standard output) the SCCS file differences before and after the delta is applied in a `diff`(1) format.

FILES

g-file	Existed before the execution of `delta`; removed after completion of `delta`.
p-file	Existed before the execution of `delta`; may exist after completion of `delta`.
q-file	Created during the execution of `delta`; removed after completion of `delta`.
x-file	Created during the execution of `delta`; renamed to SCCS file after completion of `delta`.
z-file	Created during the execution of `delta`; removed during the execution of `delta`.
d-file	Created during the execution of `delta`; removed after completion of `delta`.
`bdiff`	Program to compute differences between the "gotten" file and the g-file.

SEE ALSO

`admin`(1), `cdc`(1), `get`(1), `help`(1), `prs`(1), `rmdel`(1), `sccsfile`(4).
`bdiff`(1) in the *User's Reference Manual.*

DIAGNOSTICS

Use `help`(1) for explanations.

NOTES

A `get` of many SCCS files, followed by a `delta` of those files, should be avoided when the `get` generates a large amount of data. Instead, multiple `get/delta` sequences should be used.

If the standard input (−) is specified on the `delta` command line, the −m (if necessary) and −y keyletters must also be present. Omission of these keyletters causes an error.

Comments are limited to text strings of at most 1024 characters. Line lengths greater than 1000 characters cause undefined results.

NAME

`dis` – object code disassembler

SYNOPSIS

`dis` [–o] [–V] [–L] [–s] [–d *sec*] [–D *sec*] [–F *function*] [–t *sec*] [–l *string*] *file* ...

DESCRIPTION

The `dis` command produces an assembly language listing of *file*, which may be an object file or an archive of object files. The listing includes assembly statements and an octal or hexadecimal representation of the binary that produced those statements.

The following *options* are interpreted by the disassembler and may be specified in any order.

–d *sec* Disassemble the named section as data, printing the offset of the data from the beginning of the section.

–D *sec* Disassemble the named section as data, printing the actual address of the data.

–F *function* Disassemble only the named function in each object file specified on the command line. The –F option may be specified multiple times on the command line.

–L Lookup source labels for subsequent printing. This option works only if the file was compiled with additional debugging information [e.g., the –g option of cc].

–l *string* Disassemble the archive file specified by *string*. For example, one would issue the command `dis -l x -l z` to disassemble `libx.a` and `libz.a`, which are assumed to be in *LIBDIR*.

–o Print numbers in octal. The default is hexadecimal.

–s Perform symbolic disassembly where possible. Symbolic disassembly output will appear on the line following the instruction. Symbol names will be printed using C syntax.

–t *sec* Disassemble the named section as text.

–V Print, on standard error, the version number of the disassembler being executed.

If the –d, –D or –t options are specified, only those named sections from each user-supplied file name will be disassembled. Otherwise, all sections containing text will be disassembled.

On output, a number enclosed in brackets at the beginning of a line, such as [5], indicates that the break-pointable line number starts with the following instruction. These line numbers will be printed only if the file was compiled with additional debugging information [e.g., the –g option of cc]. An expression such as <40> in the operand field or in the symbolic disassembly, following a relative displacement for control transfer instructions, is the computed address within the section to which control will be transferred. A function name will appear in the first column, followed by ( ) if the object file contains a symbol table.

FILES

LIBDIR usually `/usr/ccs/lib`

SEE ALSO

`as`(1), `cc`(1), `ld`(1), `a.out`(4).

DIAGNOSTICS

The self-explanatory diagnostics indicate errors in the command line or problems encountered with the specified files.

NOTES

Since the `-da` option did not adhere to the command syntax rules, it has been replaced by `-D`.

At this time, symbolic disassembly does not take advantage of additional information available if the file is compiled with the `-g` option.

NAME

dump – dump selected parts of an object file

SYNOPSIS

dump [*options*] *files*

DESCRIPTION

The dump command dumps selected parts of each of its object *file* arguments.

This command will accept both object files and archives of object files. It processes each file argument according to one or more of the following options:

-a Dump the archive header of each member of an archive.

-C Dump decoded C++ symbol table names.

-c Dump the string table(s).

-D Dump debugging information.

-f Dump each file header.

-g Dump the global symbols in the symbol table of an archive.

-h Dump the section headers.

-L Dump dynamic linking information and static shared library information, if available.

-l Dump line number information.

-o Dump each program execution header.

-r Dump relocation information.

-s Dump section contents in hexadecimal.

-T *index* or -T *index1*, *index2*
Dump only the indexed symbol table entry defined by *index* or a range of entries defined by *index1*, *index2*.

-t Dump symbol table entries.

-u When reading a COFF object file, dump translates the file to ELF internally (this translation does not affect the file contents). This option controls how much translation occurs from COFF values to ELF. Normally (without -u), the COFF values are preserved as much as possible, showing the actual bytes in the file. If -u is used, dump updates the values and completes the internal translation, giving a consistent ELF view of the contents. Although the bytes displayed under this option might not match the file itself, they show how the file would look if it were converted to ELF. (See cof2elf(1) for more information.)

-V Print version information.

The following modifiers are used in conjunction with the options listed above to modify their capabilities.

−d *number* or −d *number1*, *number2*
: Dump the section number indicated by *number* or the range of sections starting at *number1* and ending at *number2*. This modifier can be used with −h, −s, and −r. When −d is used with −h or −s, the argument is treated as the number of a section or range of sections. When −d is used with −r, the argument is treated as the number of the section or range of sections to which the relocation applies. For example, to print out all relocation entries associated with the .text section, specify the number of the section as the argument to −d. If .text is section number 2 in the file, dump −r −d 2 will print all associated entries. To print out a specific relocation section use dump −s −n *name* for raw data output, or dump −sv −n *name* for interpreted output.

−n *name*
: Dump information pertaining only to the named entity. This modifier can be used with −h, −s, −r, and −t. When −n is used with −h or −s, the argument will be treated as the name of a section. When −n is used with −t or −r, the argument will be treated as the name of a symbol. For example, dump −t −n .text will dump the symbol table entry associated with the symbol whose name is .text, where dump −h −n .text will dump the section header information for the .text section.

−p
: Suppress printing of the headings.

−v
: Dump information in symbolic representation rather than numeric. This modifier can be used with −a (date, user id, group id), −f (class, data, type, machine, version, flags), −h (type, flags), −o (type, flags), −r (name, type), −s (interpret section contents wherever possible), −t (type, bind), and −L (value). When −v is used with −s, all sections that can be interpreted, such as the string table or symbol table, will be interpreted. For example, dump −sv −n .symtab *files* will produce the same formatted output as dump −tv *files*, but dump −s −n .symtab *files* will print raw data in hexadecimal. Without additional modifiers, dump −sv *files* will dump all sections in the files interpreting all those that it can and dumping the rest (such as .text or .data) as raw data.

The dump command attempts to format the information it dumps in a meaningful way, printing certain information in character, hexadecimal, octal or decimal representation as appropriate.

SEE ALSO

a.out(4), ar(4).

NAME

get – get a version of an SCCS file

SYNOPSIS

get [-a*seq-no.*] [-c*cutoff*] [-i*list*] [-r*SID*] [-w*string*] [-x*list*] [-l[p]] [-b] [-e] [-g] [-k] [-m] [-n] [-p] [-s] [-t] *file*...

DESCRIPTION

get generates an ASCII text file from each named SCCS file according to the specifications given by its keyletter arguments, which begin with -. The arguments may be specified in any order, but all keyletter arguments apply to all named SCCS files. If a directory is named, get behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with s.) and unreadable files are silently ignored. If a name of - is given, the standard input is read; each line of the standard input is taken to be the name of an SCCS file to be processed.

The generated text is normally written into a file called the g-file whose name is derived from the SCCS file name by simply removing the leading "s." (see also the FILES section below).

Each of the keyletter arguments is explained below as though only one SCCS file is to be processed, but the effects of any keyletter argument apply independently to each named file.

-r*SID* The SCCS identification string (SID) of the version (delta) of an SCCS file to be retrieved. Table 1 below shows, for the most useful cases, what version of an SCCS file is retrieved (as well as the SID of the version to be eventually created by delta(1) if the -e keyletter is also used), as a function of the SID specified.

-c*cutoff* Cutoff date-time, in the form:

YY[*MM*[*DD*[*HH*[*MM*[*SS*]]]]]

No changes (deltas) to the SCCS file that were created after the specified *cutoff* date-time are included in the generated ASCII text file. Units omitted from the date-time default to their maximum possible values; that is, -c7502 is equivalent to -c750228235959. Any number of non-numeric characters may separate the two-digit pieces of the *cutoff* date-time. This feature allows one to specify a *cutoff* date in the form:

-c"77/2/2 9:22:25".

-i*list* A *list* of deltas to be included (forced to be applied) in the creation of the generated file. The *list* has the following syntax:

<list> ::= *<range>* | *<list>* , *<range>*
<range> ::= *SID* | *SID* – *SID*

SID, the SCCS Identification of a delta, may be in any form shown in the "SID Specified" column of Table 1.

-x*list* A *list* of deltas to be excluded in the creation of the generated file. See the -i keyletter for the *list* format.

-e Indicates that the get is for the purpose of editing or making a change (delta) to the SCCS file via a subsequent use of delta(1). The -e keyletter used in a get for a particular version (SID) of the SCCS file prevents further gets for editing on the same SID until delta is executed or the j (joint edit) flag is set in the SCCS file [see admin(1)]. Concurrent use of get -e for different SIDs is always allowed.

If the g-file generated by get with an -e keyletter is accidentally ruined in the process of editing it, it may be regenerated by re-executing the get command with the -k keyletter in place of the -e keyletter.

SCCS file protection specified via the ceiling, floor, and authorized user list stored in the SCCS file [see admin(1)] are enforced when the -e keyletter is used.

-b Used with the -e keyletter to indicate that the new delta should have an SID in a new branch as shown in Table 1. This keyletter is ignored if the b flag is not present in the file [see admin(1)] or if the retrieved delta is not a leaf delta. (A leaf delta is one that has no successors on the SCCS file tree.) A branch delta may always be created from a non-leaf delta. Partial SIDs are interpreted as shown in the "SID Retrieved" column of Table 1.

-k Suppresses replacement of identification keywords (see below) in the retrieved text by their value. The -k keyletter is implied by the -e keyletter.

-l[p] Causes a delta summary to be written into an l-file. If -lp is used, then an l-file is not created; the delta summary is written on the standard output instead. See IDENTIFICATION KEYWORDS for detailed information on the l-file.

-p Causes the text retrieved from the SCCS file to be written on the standard output. No g-file is created. All output that normally goes to the standard output goes to file descriptor 2 instead, unless the -s keyletter is used, in which case it disappears.

-s Suppresses all output normally written on the standard output. However, fatal error messages (which always go to file descriptor 2) remain unaffected.

-m Causes each text line retrieved from the SCCS file to be preceded by the SID of the delta that inserted the text line in the SCCS file. The format is: SID, followed by a horizontal tab, followed by the text line.

-n Causes each generated text line to be preceded with the %M% identification keyword value (see below). The format is: %M% value, followed by a horizontal tab, followed by the text line. When both the -m and -n keyletters are used, the format is: %M%

value, followed by a horizontal tab, followed by the `-m` keyletter generated format.

- `-g` Suppresses the actual retrieval of text from the SCCS file. It is primarily used to generate an l-file, or to verify the existence of a particular SID.
- `-t` Used to access the most recently created delta in a given release (e.g., `-r1`), or release and level (e.g., `-r1.2`).
- `-w` *string* Substitute *string* for all occurrences of `%W%` when getting the file. Substitution occurs prior to keyword expansion.
- `-a`*seq-no.* The delta sequence number of the SCCS file delta (version) to be retrieved. This keyletter is used by the `comb` command; it is not a generally useful keyletter. If both the `-r` and `-a` keyletters are specified, only the `-a` keyletter is used. Care should be taken when using the `-a` keyletter in conjunction with the `-e` keyletter, as the SID of the delta to be created may not be what one expects. The `-r` keyletter can be used with the `-a` and `-e` keyletters to control the naming of the SID of the delta to be created.

For each file processed, `get` responds (on the standard output) with the SID being accessed and with the number of lines retrieved from the SCCS file.

If the `-e` keyletter is used, the SID of the delta to be made appears after the SID accessed and before the number of lines generated. If there is more than one named file or if a directory or standard input is named, each file name is printed (preceded by a new-line) before it is processed. If the `-i` keyletter is used, included deltas are listed following the notation "`Included`"; if the `-x` keyletter is used, excluded deltas are listed following the notation "`Excluded`".

TABLE 1. Determination of SCCS Identification String

SID* Specified	–b Keyletter Used†	Other Conditions	SID Retrieved	SID of Delta to be Created
none‡	no	R defaults to mR	mR.mL	mR.(mL+1)
none‡	yes	R defaults to mR	mR.mL	mR.mL.(mB+1).1
R	no	R > mR	mR.mL	R.1***
R	no	R = mR	mR.mL	mR.(mL+1)
R	yes	R > mR	mR.mL	mR.mL.(mB+1).1
R	yes	R = mR	mR.mL	mR.mL.(mB+1).1
R	–	R < mR and R does *not* exist	hR.mL**	hR.mL.(mB+1).1
R	–	Trunk succ.# in release > R and R exists	R.mL	R.mL.(mB+1).1
R.L	no	No trunk succ.	R.L	R.(L+1)
R.L	yes	No trunk succ.	R.L	R.L.(mB+1).1
R.L	–	Trunk succ. in release ≥ R	R.L	R.L.(mB+1).1
R.L.B	no	No branch succ.	R.L.B.mS	R.L.B.(mS+1)
R.L.B	yes	No branch succ.	R.L.B.mS	R.L.(mB+1).1
R.L.B.S	no	No branch succ.	R.L.B.S	R.L.B.(S+1)
R.L.B.S	yes	No branch succ.	R.L.B.S	R.L.(mB+1).1
R.L.B.S	–	Branch succ.	R.L.B.S	R.L.(mB+1).1

* "R", "L", "B", and "S" are the "release", "level", "branch", and "sequence" components of the SID, respectively; "m" means "maximum". Thus, for example, "R.mL" means "the maximum level number within release R"; "R.L.(mB+1).1" means "the first sequence number on the new branch (i.e., maximum branch number plus one) of level L within release R". Note that if the SID specified is of the form "R.L", "R.L.B", or "R.L.B.S", each of the specified components must exist.

** "hR" is the highest existing release that is lower than the specified, nonexistent, release R.

*** This is used to force creation of the first delta in a new release.

\# Successor.

† The –b keyletter is effective only if the b flag [see admin(1)] is present in the file. An entry of – means "irrelevant".

‡ This case applies if the d (default SID) flag is not present in the file. If the d flag is present in the file, then the SID obtained from the d flag is interpreted as if it had been specified on the command line. Thus, one of the other cases in this table applies.

IDENTIFICATION KEYWORDS

Identifying information is inserted into the text retrieved from the SCCS file by replacing identification keywords with their value wherever they occur. The following keywords may be used in the text stored in an SCCS file:

Keyword	Value
%M%	Module name: either the value of the m flag in the file [see admin(1)], or if absent, the name of the SCCS file with the leading s. removed.
%I%	SCCS identification (SID) (%R%.%L%.%B%.%S%) of the retrieved text.
%R%	Release.
%L%	Level.
%B%	Branch.
%S%	Sequence.
%D%	Current date (*YY/MM/DD*).
%H%	Current date (*MM/DD/YY*).
%T%	Current time (*HH:MM:SS*).
%E%	Date newest applied delta was created (*YY/MM/DD*).
%G%	Date newest applied delta was created (*MM/DD/YY*).
%U%	Time newest applied delta was created (*HH:MM:SS*).
%Y%	Module type: value of the t flag in the SCCS file [see admin(1)].
%F%	SCCS file name.
%P%	Fully qualified SCCS file name.
%Q%	The value of the q flag in the file [see admin(1)].
%C%	Current line number. This keyword is intended for identifying messages output by the program such as "this should not have happened" type errors. It is not intended to be used on every line to provide sequence numbers.
%Z%	The four-character string @(#) recognizable by the what command.
%W%	A shorthand notation for constructing what strings for UNIX System program files. %W% = %Z%%M%<tab>%I%
%A%	Another shorthand notation for constructing what strings for non-UNIX System program files: %A% = %Z%%Y% %M% %I%%Z%

Several auxiliary files may be created by get. These files are known generically as the g-file, l-file, p-file, and z-file. The letter before the hyphen is called the tag. An auxiliary file name is formed from the SCCS file name: the last component of all SCCS file names must be of the form s.*module-name*, the auxiliary files are named by replacing the leading s with the tag. The g-file is an exception to this scheme: the g-file is named by removing the s. prefix. For example, s.xyz.c, the auxiliary file names would be xyz.c, l.xyz.c, p.xyz.c, and z.xyz.c, respectively.

The g-file, which contains the generated text, is created in the current directory (unless the -p keyletter is used). A g-file is created in all cases, whether or not any lines of text were generated by the get. It is owned by the real user. If the -k keyletter is used or implied, its mode is 644; otherwise its mode is 444. Only the real user need have write permission in the current directory.

The l-file contains a table showing which deltas were applied in generating the retrieved text. The l-file is created in the current directory if the -l keyletter is used; its mode is 444 and it is owned by the real user. Only the real user need have write permission in the current directory.

Lines in the l-file have the following format:

a. A blank character if the delta was applied; * otherwise.
b. A blank character if the delta was applied or was not applied and ignored; * if the delta was not applied and was not ignored.
c. A code indicating a "special" reason why the delta was or was not applied: "I" (included), "X" (excluded), or "C" (cut off by a -c keyletter).
d. Blank.
e. SCCS identification (SID).
f. Tab character.
g. Date and time (in the form *YY/MM/DD HH:MM:SS*) of creation.
h. Blank.
i. Login name of person who created **delta**.

The comments and MR data follow on subsequent lines, indented one horizontal tab character. A blank line terminates each entry.

The p-file is used to pass information resulting from a get with an **-e** keyletter along to **delta**. Its contents are also used to prevent a subsequent execution of get with an **-e** keyletter for the same SID until **delta** is executed or the joint edit flag, j, [see admin(1)] is set in the SCCS file. The p-file is created in the directory containing the SCCS file and the effective user must have write permission in that directory. Its mode is 644 and it is owned by the effective user. The format of the p-file is: the gotten SID, followed by a blank, followed by the SID that the new delta will have when it is made, followed by a blank, followed by the login name of the real user, followed by a blank, followed by the date-time the get was executed, followed by a blank and the -i keyletter argument if it was present, followed by a blank and the -x keyletter argument if it was present, followed by a new-line. There can be an arbitrary number of lines in the p-file at any time; no two lines can have the same new delta SID.

The z-file serves as a lock-out mechanism against simultaneous updates. Its contents are the binary (2 bytes) process ID of the command (i.e., get) that created it. The z-file is created in the directory containing the SCCS file for the duration of get. The same protection restrictions as those for the p-file apply for the z-file. The z-file is created with mode 444.

FILES

g-file	Created by the execution of get.
p-file	[see **delta**(1)]
q-file	[see **delta**(1)]
z-file	[see **delta**(1)]
bdiff	Program to compute differences between the "gotten" file and the g-file.

SEE ALSO

admin(1), delta(1), help(1), prs(1), what(1).
bdiff(1) in the *User's Reference Manual*.

DIAGNOSTICS

Use help(1) for explanations.

NOTES

If the effective user has write permission (either explicitly or implicitly) in the directory containing the SCCS files, but the real user does not, then only one file may be named when the **-e** keyletter is used.

NAME

`help` – ask for help with message numbers or SCCS commands

SYNOPSIS

`help` [*args*]

DESCRIPTION

help finds information to explain a message from a command or explain the use of a SCCS command. Zero or more arguments may be supplied. If no arguments are given, **help** will prompt for one.

The arguments may be either information within the parentheses following a message or SCCS command names.

The response of the program will be the explanatory information related to the argument, if there is any.

When all else fails, try "help stuck".

FILES

LIBDIR/`help`	directory containing files of message text.
LIBDIR/`help/helploc`	file containing locations of help files not in *LIBDIR*/`help`.
LIBDIR	usually `/usr/ccs/lib`

NAME

`install` – install commands

SYNOPSIS

`/etc/install` [`-c` *dira*] [`-f` *dirb*] [`-i`] [`-n` *dirc*] [`-m` *mode*] [`-u` *user*] [`-g` *group*] [`-o`] [`-s`] *file* [*dirx* ...]

DESCRIPTION

The `install` command is most commonly used in "makefiles" [see `make`(1)] to install a *file* (updated target file) in a specific place within a file system. Each *file* is installed by copying it into the appropriate directory, thereby retaining the mode and owner of the original command. The program prints messages telling the user exactly what files it is replacing or creating and where they are going.

If no options or directories (*dirx* ...) are given, `install` will search a set of default directories (`/bin`, `/usr/bin`, `/etc`, `/lib`, and `/usr/lib`, in that order) for a file with the same name as *file*. When the first occurrence is found, `install` issues a message saying that it is overwriting that file with *file*, and proceeds to do so. If the file is not found, the program states this and exits without further action.

If one or more directories (*dirx* ...) are specified after *file*, those directories will be searched before the directories specified in the default list.

The meanings of the options are:

`-c` *dira* Installs a new command (*file*) in the directory specified by *dira*, only if it is not found. If it is found, `install` issues a message saying that the file already exists, and exits without overwriting it. May be used alone or with the `-s` option.

`-f` *dirb* Forces *file* to be installed in given directory, whether or not one already exists. If the file being installed does not already exist, the mode and owner of the new file will be set to `755` and `bin`, respectively. If the file already exists, the mode and owner will be that of the already existing file. May be used alone or with the `-o` or `-s` options.

`-i` Ignores default directory list, searching only through the given directories (*dirx* ...). May be used alone or with any other options except `-c` and `-f`.

`-n` *dirc* If *file* is not found in any of the searched directories, it is put in the directory specified in *dirc*. The mode and owner of the new file will be set to `755` and `bin`, respectively. May be used alone or with any other options except `-c` and `-f`.

`-m` *mode* The mode of the new file is set to *mode*.

`-u` *user* The owner of the new file is set to *user*.

−g *group* The group id of the new file is set to *group*. Only available to the superuser.

−o If *file* is found, this option saves the "found" file by copying it to OLD*file* in the directory in which it was found. This option is useful when installing a frequently used file such as `/bin/sh`, where the existing file cannot be removed. May be used alone or with any other options except **−c**.

−s Suppresses printing of messages other than error messages. May be used alone or with any other options.

SEE ALSO

make(1).

NAME

ld – link editor for object files

SYNOPSIS

ld [*options*] *files* ...

DESCRIPTION

The ld command combines relocatable object files, performs relocation, and resolves external symbols. Relocatable object files given as arguments are combined to produce an executable object file, or, if the -r option is specified, relocatable object files are combined to produce one relocatable object file. The output of ld is left in a.out by default.

If any argument is a library, it is searched exactly once at the point it is encountered in the argument list. Only those routines defining an unresolved external reference are loaded. The archive library symbol table [see ar(4)] is searched sequentially with as many passes as are necessary to resolve external references that can be satisfied by library members. Thus, the ordering of members in the library is functionally unimportant, unless there exist multiple library members defining the same external symbol.

The following options are recognized by ld:

-a Produce an executable object file; give errors for undefined references. This is the default behavior. -a may not be used with the -r option.

-e *epsym*
Set the entry point address for the output file to be that of the symbol *epsym*.

-l*x* Search a library, lib*x*.a, the conventional name for archive libraries. A library is searched when its name is encountered, so the placement of -l is significant.

-m Produce a memory map or listing of the input/output sections on the standard output.

-o *outfile*
Produce an output object file named *outfile*. The name of the default object file is a.out.

-r Combine relocatable object files to produce one relocatable object file. ld will not complain about unresolved references. This option cannot be used with -a.

-s Strip symbolic information from the output file. The debug and line sections and their associated relocation entries will be removed. Except for relocatable files, the symbol table and string table sections will also be removed from the output object file.

-t Turn off the warning about multiply defined symbols that are not the same size.

-u *symname*
Enter *symname* as an undefined symbol in the symbol table. This is useful for loading entirely from an archive library, since initially the symbol table is empty and an unresolved reference is needed to force the loading of the

first routine. The placement of this option on the command line is significant; it must be placed before the library that will define the symbol.

`-L` *path*
: Add *path* to the library search directories. `ld` searches for libraries first in any directories specified with `-L` options, then in the standard directories. This option is effective only if it precedes the `-l` option on the command line.

`-M` *mapfile*
: Read *mapfile* as a text file of directives to `ld`. Because these directives change the shape of the output file created by `ld`, use of this option is strongly discouraged.

`-Q[y|n]`
: Under `-Qy`, an `ident` string is added to the `.comment` section of the output file to identify the version of the link editor used to create the file. This will result in multiple `ld idents` when there have been multiple linking steps, such as when using `ld -r`. This is identical with the default action of the `cc` command. `-Qn` suppresses version.

`-V` Output a message giving information about the version of `ld` being used.

`-X` Generate a standard UNIX System file header within the "optional header" field in the output file.

`-YP,` *dirlist*
: Change the default directories used for finding libraries. *dirlist* is a colon-separated path list.

The environment variable `LD_LIBRARY_PATH` may be used to specify library search directories. In the most general case, it will contain two directory lists separated by a semicolon:

dirlist1`;`*dirlist2*

If `ld` is called with any number of occurences of `-L`, as in

`ld` ... `-L`*path1* ...`-L`*pathn* ...

then the search path ordering is

dirlist1 path1 ... pathn dirlist2 LIBPATH

FILES

`lib`*x*.a	libraries
`a.out`	output file
LIBPATH	usually `/usr/ccs/lib:/lib:/usr/lib`

SEE ALSO

`as`(1), `cc`(1), `exec`(2), `exit`(2), `end`(3C), `a.out`(4), `ar`(4).
The "C Compilation System" chapter and the "Mapfile Option" appendix in the *Programmer's Guide: ANSI C and Programming Support Tools.*

NOTES

Through its options, the link editor gives users great flexibility; however, those who use the **-M** *mapfile* option must assume some added responsibilities. Use of this feature is *strongly* discouraged.

NAME

lex – generate programs for simple lexical tasks

SYNOPSIS

lex [-ctvn -V -Q[y|n]] [*file*]

DESCRIPTION

The lex command generates programs to be used in simple lexical analysis of text.

The input *files* (standard input default) contain strings and expressions to be searched for and C text to be executed when these strings are found.

lex generates a file named lex.yy.c. When lex.yy.c is compiled and linked with the lex library, it copies the input to the output except when a string specified in the file is found. When a specified string is found, then the corresponding program text is executed. The actual string matched is left in yytext, an external character array. Matching is done in order of the patterns in the *file*. The patterns may contain square brackets to indicate character classes, as in [abx-z] to indicate a, b, x, y, and z; and the operators *, +, and ? mean, respectively, any non-negative number of, any positive number of, and either zero or one occurrence of, the previous character or character class. Thus, [a-zA-Z]+ matches a string of letters. The character . is the class of all ASCII characters except new-line. Parentheses for grouping and vertical bar for alternation are also supported. The notation *r*{*d*,*e*} in a rule indicates between *d* and *e* instances of regular expression *r*. It has higher precedence than | , but lower than *, ?, +, and concatenation. The character ^ at the beginning of an expression permits a successful match only immediately after a new-line, and the character $ at the end of an expression requires a trailing new-line. The character / in an expression indicates trailing context; only the part of the expression up to the slash is returned in yytext, but the remainder of the expression must follow in the input stream. An operator character may be used as an ordinary symbol if it is within " symbols or preceded by \.

Three macros are expected: input() to read a character; unput(*c*) to replace a character read; and output(*c*) to place an output character. They are defined in terms of the standard streams, but you can override them. The program generated is named yylex(), and the lex library contains a main() that calls it. The action REJECT on the right side of the rule causes this match to be rejected and the next suitable match executed; the function yymore() accumulates additional characters into the same yytext; and the function yyless(*n*) pushes back yyleng – n characters into the input stream. (yyleng is an external int variable giving the length of yytext.) The macros input and output use files yyin and yyout to read from and write to, defaulted to stdin and stdout, respectively.

Any line beginning with a blank is assumed to contain only C text and is copied; if it precedes %%, it is copied into the external definition area of the lex.yy.c file. All rules should follow a %%, as in yacc. Lines preceding %% that begin with a non-blank character define the string on the left to be the remainder of the line; it can be called out later by surrounding it with {}. In this section, C code (and preprocessor statements) can also be included between %{ and %}. Note that curly brackets do not imply parentheses; only string substitution is done.

EXAMPLE

```
D       [0-9]
%{
void
skipcommnts(void)
{
        for(;;)
        {
                while(input()!='*')
                        ;
                if(input()=='/')
                        return;
                else

                        unput(yytext[yyleng-1]);
        }
}
%}
%%
if      printf("IF statement\n");
[a-z]+ printf("tag, value %s\n",yytext);
0{D}+   printf("octal number %s\n",yytext);
{D}+    printf("decimal number %s\n",yytext);
"++"    printf("unary op\n");
"+"     printf("binary op\n");
"\n"    ;/*no action */
"/*"      skipcommnts();
%%
```

The external names generated by `lex` all begin with the prefix yy or YY.

The flags must appear before any files.

–c Indicates C actions and is the default.

–t Causes the `lex.yy.c` program to be written instead to standard output.

–v Provides a two-line summary of statistics.

–n Will not print out the –v summary.

–V Print out version information on standard error.

–Q[y|n] Print out version information to output file `lex.yy.c` by using –Qy. The –Qn option does not print out version information and is the default.

Multiple files are treated as a single file. If no files are specified, standard input is used.

Certain default table sizes are too small for some users. The table sizes for the resulting finite state machine can be set in the definitions section:

`%p` *n*	number of positions is *n* (default 2500)
`%n` *n*	number of states is *n* (500)
`%e` *n*	number of parse tree nodes is *n* (1000)
`%a` *n*	number of transitions is *n* (2000)
`%k` *n*	number of packed character classes is *n* (2500)
`%o` *n*	size of output array is *n* (3000)

The use of one or more of the above automatically implies the **–v** option, unless the –n option is used.

SEE ALSO

yacc(1).
The "`lex`" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools.*

NAME

lint – a C program checker

SYNOPSIS

`lint [`*options*`]` *files*

DESCRIPTION

lint detects features of C program files which are likely to be bugs, non-portable, or wasteful. It also checks type usage more strictly than the compiler. lint issues error and warning messages. Among the things it detects are unreachable statements, loops not entered at the top, automatic variables declared and not used, and logical expressions whose value is constant. lint checks for functions that return values in some places and not in others, functions called with varying numbers or types of arguments, and functions whose values are not used or whose values are used but none returned.

Arguments whose names end with .c are taken to be C source files. Arguments whose names end with .ln are taken to be the result of an earlier invocation of lint with either the –c or the –o option used. The .ln files are analogous to .o (object) files that are produced by the cc(1) command when given a .c file as input. Files with other suffixes are warned about and ignored.

lint takes all the .c, .ln, and llib–l*x*.ln (specified by –l*x*) files and processes them in their command line order. By default, lint appends the standard C lint library (llib–lc.ln) to the end of the list of files. When the –c option is used, the .ln and the llib–l*x*.ln files are ignored. When the –c option is not used, the second pass of lint checks the .ln and the llib–l*x*.ln list of files for mutual compatibility.

Any number of lint options may be used, in any order, intermixed with filename arguments. The following options are used to suppress certain kinds of complaints:

–a Suppress complaints about assignments of long values to variables that are not long.

–b Suppress complaints about break statements that cannot be reached.

–h Do not apply heuristic tests that attempt to intuit bugs, improve style, and reduce waste.

–m Suppress complaints about external symbols that could be declared static.

–u Suppress complaints about functions and external variables used and not defined, or defined and not used. (This option is suitable for running lint on a subset of files of a larger program).

–v Suppress complaints about unused arguments in functions.

–x Do not report variables referred to by external declarations but never used.

The following arguments alter lint's behavior:

–I*dir* Search for included header files in the directory *dir* before searching the current directory and/or the standard place.

-l*x* Include the lint library `llib-l`*x*`.ln`. For example, you can include a lint version of the math library `llib-lm.ln` by inserting `-lm` on the command line. This argument does not suppress the default use of `llib-lc.ln`. These lint libraries must be in the assumed directory. This option can be used to reference local lint libraries and is useful in the development of multi-file projects.

-L*dir* Search for lint libraries in *dir* before searching the standard place.

-n Do not check compatibility against the standard C lint library.

-p Attempt to check portability to other dialects of C. Along with stricter checking, this option causes all non-external names to be truncated to eight characters and all external names to be truncated to six characters and one case.

-s Produce one-line diagnostics only. `lint` occasionally buffers messages to produce a compound report.

-k Alter the behavior of /*LINTED [*message*]*/ directives. Normally, `lint` will suppress warning messages for the code following these directives. Instead of suppressing the messages, `lint` prints an additional message containing the comment inside the directive.

-y Specify that the file being linted will be treated as if the /*LINTLIBRARY*/ directive had been used. A lint library is normally created by using the /*LINTLIBRARY*/ directive.

-F Print pathnames of files. `lint` normally prints the filename without the path.

-c Cause `lint` to produce a `.ln` file for every `.c` file on the command line. These `.ln` files are the product of `lint`'s first pass only, and are not checked for inter-function compatibility.

-o*x* Cause `lint` to create a lint library with the name `llib-l`*x*`.ln`. The -c option nullifies any use of the -o option. The lint library produced is the input that is given to `lint`'s second pass. The -o option simply causes this file to be saved in the named lint library. To produce a `llib-l`*x*`.ln` without extraneous messages, use of the -x option is suggested. The -v option is useful if the source file(s) for the lint library are just external interfaces.

Some of the above settings are also available through the use of "lint comments" (see below).

-V Write to standard error the product name and release.

-W*file* Write a .ln file to *file*, for use by cflow(1).

-R*file* Write a .ln file to *file*, for use by cxref(1).

lint recognizes many cc(1) command line options, including -D, -U, -g, -O, -Xt, -Xa, and -Xc, although -g and -O are ignored. Unrecognized options are warned about and ignored. The predefined macro lint is defined to allow certain questionable code to be altered or removed for lint. Thus, the symbol lint should be thought of as a reserved word for all code that is planned to be checked by lint.

Certain conventional comments in the C source will change the behavior of lint:

/*ARGSUSED*n**/
: makes lint check only the first *n* arguments for usage; a missing *n* is taken to be 0 (this option acts like the -v option for the next function).

/*CONSTCOND*/ or /*CONSTANTCOND*/ or /*CONSTANTCONDITION*/
: suppresses complaints about constant operands for the next expression.

/*EMPTY*/
: suppresses complaints about a null statement consequent on an if statement. This directive should be placed after the test expression, and before the semicolon. This directive is supplied to support empty if statements when a valid else statement follows. It suppresses messages on an empty else consequent.

/*FALLTHRU*/ or /*FALLTHROUGH*/
: suppresses complaints about fall through to a case or default labelled statement. This directive should be placed immediately preceding the label.

/*LINTLIBRARY*/
: at the beginning of a file shuts off complaints about unused functions and function arguments in this file. This is equivalent to using the -v and -x options.

/*LINTED [*message*]*/
: suppresses any intra-file warning except those dealing with unused variables or functions. This directive should be placed on the line immediately preceding where the lint warning occurred. The -k option alters the way in which lint handles this directive. Instead of suppressing messages, lint will print an additional message, if any, contained in the comment. This directive is useful in conjunction with the -s option for post-lint filtering.

/*NOTREACHED*/
: at appropriate points stops comments about unreachable code. [This comment is typically placed just after calls to functions like exit(2)].

/*PRINTFLIKE*n**/
: makes `lint` check the first *(n-1)* arguments as usual. The *nth* argument is interpreted as a `printf` format string that is used to check the remaining arguments.

/*PROTOLIB*n**/
: causes `lint` to treat function declaration prototypes as function definitions if *n* is non-zero. This directive can only be used in conjunction with the
/* LINTLIBRARY */ directive. If *n* is zero, function prototypes will be treated normally.

/*SCANFLIKE*n**/
: makes `lint` check the first *(n-1)* arguments as usual. The *nth* argument is interpreted as a `scanf` format string that is used to check the remaining arguments.

/*VARARGS*n**/
: suppresses the usual checking for variable numbers of arguments in the following function declaration. The data types of the first *n* arguments are checked; a missing *n* is taken to be 0. The use of the ellipsis terminator (...) in the definition is suggested in new or updated code.

`lint` produces its first output on a per-source-file basis. Complaints regarding included files are collected and printed after all source files have been processed, if **-s** is not specified. Finally, if the **-c** option is not used, information gathered from all input files is collected and checked for consistency. At this point, if it is not clear whether a complaint stems from a given source file or from one of its included files, the source filename will be printed followed by a question mark.

The behavior of the **-c** and the **-o** options allows for incremental use of `lint` on a set of C source files. Generally, one invokes `lint` once for each source file with the **-c** option. Each of these invocations produces a `.ln` file that corresponds to the `.c` file, and prints all messages that are about just that source file. After all the source files have been separately run through `lint`, it is invoked once more (without the **-c** option), listing all the `.ln` files with the needed `-l`*x* options. This will print all the inter-file inconsistencies. This scheme works well with **make**; it allows **make** to be used to `lint` only the source files that have been modified since the last time the set of source files were `linted`.

FILES

LIBDIR	the directory where the lint libraries specified by the `-l`*x* option must exist
LIBDIR/`lint[12]`	first and second passes
LIBDIR/`llib-lc.ln`	declarations for C Library functions (binary format; source is in *LIBDIR*/`llib-lc`)
LIBPATH/`llib-lm.ln`	declarations for Math Library functions (binary format; source is in *LIBDIR*/llib-lm)

TMPDIR/*lint*	temporaries
TMPDIR	usually /usr/tmp but can be redefined by setting the environment variable TMPDIR [see tempnam in tmpnam(3S)].
LIBDIR	usually /ccs/lib
LIBPATH	usually /usr/ccs/lib:/lib:/usr/lib

SEE ALSO

cc(1), make(1).

See the ''lint'' chapter in the *C Programmer's Guide: ANSI C and Programming Support Tools.*

NAME

`lorder` – find ordering relation for an object library

SYNOPSIS

`lorder` *file* ...

DESCRIPTION

The input is one or more object or library archive *files* [see `ar`(1)]. The standard output is a list of pairs of object file or archive member names; the first file of the pair refers to external identifiers defined in the second. The output may be processed by `tsort`(1) to find an ordering of a library suitable for one-pass access by `ld`. Note that the link editor `ld` is capable of multiple passes over an archive in the portable archive format [see `ar`(4)] and does not require that `lorder` be used when building an archive. The usage of the `lorder` command may, however, allow for a more efficient access of the archive during the link edit process.

The following example builds a new library from existing `.o` files.

```
ar -cr library 'lorder *.o | tsort'
```

FILES

TMPDIR/`*symref`	temporary files
TMPDIR/`*symdef`	temporary files
TMPDIR	usually `/var/tmp` but can be redefined by setting the environment variable `TMPDIR` [see `tempnam()` in `tmpnam`(3S)].

SEE ALSO

`ar`(1), `ld`(1), `tsort`(1), `tempnam`(3S), `tmpname`(3S), `ar`(4).

NOTES

`lorder` will accept as input any object or archive file, regardless of its suffix, provided there is more than one input file. If there is but a single input file, its suffix must be `.o`.

NAME

lprof – display line-by-line execution count profile data

SYNOPSIS

lprof [-p] [-s] [-x] [-I *incdir*] [-r *srcfile*] [-c *cntfile*] [-o *prog*] [-V]

lprof -m *file1*.cnt *file2*.cnt *filen*.cnt [-T] -d *destfile*.cnt

DESCRIPTION

lprof reports the execution characteristics of a program on a (source) line by line basis. This is useful as a means to determine which and how often portions of the code were executed.

lprof interprets a profile file (*prog*.cnt by default) produced by the profiled program *prog* (a.out by default). *prog* creates a profile file if it has been loaded with the -ql option of cc. The profile information is computed for functions in a source file if the -ql option was used when the source file was compiled.

By default, lprof prints a listing of source files (the names of which are stored in the symbol table of the executable file), with each line preceded by its line number (in the source file) and the number of times the line was executed.

The following options may appear singly or be combined in any order:

-p
: Print listing, each line preceded by the line number and the number of times it was executed (default). This option can be used together with the -s option to print both the source listing and summary information.

-s
: Print summary information of percentage of lines of code executed per function.

-x
: Instead of printing the execution count numbers for each line, print each line preceded by its line number and a [U] if the line was not executed. If the line was executed, print only the line number.

-I *incdir*
: Look for source or header files in the directory *incdir* in addition to the current directory and the standard place for #include files (usually /usr/include). The user can specify more than one directory by using multiple -I options.

-r *srcfile*
: Instead of printing all source files, print only those files named in -r options (to be used with the -p option only). The user can specify multiple files with a single -r option.

-c *cntfile*
: Use the file *cntfile* instead of *prog*.cnt as the input profile file.

-o *prog*
: Use the name of the program *prog* instead of the name used when creating the profile file. Because the program name stored in the profile file contains the relative path, this option is necessary if the executable file or profile file has been moved.

-V Print, on standard error, the version number of `lprof`.

Merging Data Files

`lprof` can also be used to merge profile files. The -m option must be accompanied by the -d option:

-m *file1*.cnt *file2*.cnt *filen*.cnt -d *destfile*.cnt
: Merge the data files *file1*.cnt through *filen*.cnt by summing the execution counts per line, so that data from several runs can be accumulated. The result is written to *destfile*.cnt. The data files must contain profiling data for the same *prog* (see the -T option below).

-T Time stamp override. Normally, the time stamps of the executable files being profiled are checked, and data files will not be merged if the time stamps do not match. If -T is specified, this check is skipped.

CONTROLLING THE RUN-TIME PROFILING ENVIRONMENT

The environment variable PROFOPTS provides run-time control over profiling. When a profiled program (or shared object) is about to terminate, it examines the value of PROFOPTS to determine how the profiling data are to be handled. A terminating shared object will honor every PROFOPTS option except `file=`*filename*.

The environment variable PROFOPTS is a comma-separated list of options interpreted by the program being profiled. If PROFOPTS is not defined in the environment, then the default action is taken: The profiling data are saved in a file (with the default name, *prog*.cnt) in the current directory. If PROFOPTS is set to the null string, no profiling data are saved. The following are the available options:

msg=[y|n]
: If msg=y is specified, a message stating that profile data are being saved is printed to `stderr`. If msg=n is specified, only the profiling error messages are printed. The default is msg=y.

merge=[y|n]
: If merge=y is specified, the data files will be merged after successive runs. If merge=n is specified, the data files are not merged after successive runs, and the data file is overwritten after each execution. The merge will fail if the program has been recompiled, and the data file will be left in TMPDIR. The default is merge=n.

pid=[y|n]
: If pid=y is specified, the name of the data file will include the process ID of the profiled program. Inclusion of the process ID allows for the creation of different data files for programs calling `fork`. If pid=n is specified, the default name is used. The default is pid=n. For `lprof` to generate its profiling report, the -c option must be specified with `lprof` otherwise the default will fail.

dir=*dirname*
: The data file is placed in the directory *dirname* if this option is specified. Otherwise, the data file is created in the directory that is current at the end of execution.

`file=`*filename*
: *filename* is used as the name of the data file in *dir* created by the profiled program if this option is specified. Otherwise, the default name is used. For `lprof` to generate its profiling report, the `-c` option must be specified with `lprof` if the file option has been used at execution time; otherwise the default will fail.

FILES

prog`.cnt` profile data
TMPDIR usually `/usr/tmp` but can be redefined by setting the environment variable `TMPDIR` [see `tempnam` in `tmpnam`(3S)].

SEE ALSO

`cc`(1), `prof`(1), `fork`(2), `tmpnam`(3S).
The "`lprof`" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools.*

NOTES

For the `-m` option, if *destfile*`.cnt` exists, its previous contents are destroyed.

Optimized code cannot be profiled; if both optimization and line profiling are requested, profiling has precedence.

Different parts of one line of a source file may be executed different numbers of times (e.g., the `for` loop below); the count corresponds to the first part of the line.

For example, in the following `for` loop

```
                main()
1    [2]        {
                    int j;

1    [5]            for (j = 0; j < 5; j++)
5    [6]            sub(j);

1    [8]        }
                sub(a)
                int a;
5    [12]           {
5    [13]           printf("a is %d\n", a);
5    [14]           }
```

line 5 consists of three parts. The line count listed, however, is for the initialization part, that is, `j = 0`.

NAME

m4 – macro processor

SYNOPSIS

m4 [*options*] [*files*]

DESCRIPTION

The m4 command is a macro processor intended as a front end for C, assembler, and other languages. Each of the argument files is processed in order; if there are no files, or if a file name is –, the standard input is read. The processed text is written on the standard output.

The options and their effects are as follows:

–e Operate interactively. Interrupts are ignored and the output is unbuffered.

–s Enable line sync output for the C preprocessor (#line ...)

–B*int* Change the size of the push-back and argument collection buffers from the default of 4,096.

–H*int* Change the size of the symbol table hash array from the default of 199. The size should be prime.

–S*int* Change the size of the call stack from the default of 100 slots. Macros take three slots, and non-macro arguments take one.

–T*int* Change the size of the token buffer from the default of 512 bytes.

To be effective, the above flags must appear before any file names and before any –D or –U flags:

–D*name*[=*val*]
Defines *name* to *val* or to null in *val*'s absence.

–U*name*
undefines *name*.

Macro calls have the form:

name(*arg1*,*arg2*, ..., *argn*)

The (must immediately follow the name of the macro. If the name of a defined macro is not followed by a (, it is deemed to be a call of that macro with no arguments. Potential macro names consist of alphanumeric characters and underscore (_), where the first character is not a digit.

Leading unquoted blanks, tabs, and new-lines are ignored while collecting arguments. Left and right single quotes are used to quote strings. The value of a quoted string is the string stripped of the quotes.

When a macro name is recognized, its arguments are collected by searching for a matching right parenthesis. If fewer arguments are supplied than are in the macro definition, the trailing arguments are taken to be null. Macro evaluation proceeds normally during the collection of the arguments, and any commas or right parentheses that happen to turn up within the value of a nested call are as effective as those in the original input text. After argument collection, the value of the macro is pushed back onto the input stream and rescanned.

m4 makes available the following built-in macros. These macros may be redefined, but once this is done the original meaning is lost. Their values are null unless otherwise stated.

`define` the second argument is installed as the value of the macro whose name is the first argument. Each occurrence of **$*n*** in the replacement text, where *n* is a digit, is replaced by the *n*-th argument. Argument 0 is the name of the macro; missing arguments are replaced by the null string; **$#** is replaced by the number of arguments; `$*` is replaced by a list of all the arguments separated by commas; `$@` is like `$*`, but each argument is quoted (with the current quotes).

`undefine` removes the definition of the macro named in its argument.

`defn` returns the quoted definition of its argument(s). It is useful for renaming macros, especially built-ins.

`pushdef` like `define`, but saves any previous definition.

`popdef` removes current definition of its argument(s), exposing the previous one, if any.

`ifdef` if the first argument is defined, the value is the second argument, otherwise the third. If there is no third argument, the value is null. The word `unix` is predefined.

`shift` returns all but its first argument. The other arguments are quoted and pushed back with commas in between. The quoting nullifies the effect of the extra scan that will subsequently be performed.

`changequote`
change quote symbols to the first and second arguments. The symbols may be up to five characters long. `changequote` without arguments restores the original values (i.e., ` ').

`changecom` change left and right comment markers from the default **#** and new-line. With no arguments, the comment mechanism is effectively disabled. With one argument, the left marker becomes the argument and the right marker becomes new-line. With two arguments, both markers are affected. Comment markers may be up to five characters long.

`divert` **m4** maintains 10 output streams, numbered 0-9. The final output is the concatenation of the streams in numerical order; initially stream 0 is the current stream. The `divert` macro changes the current output stream to its (digit-string) argument. Output diverted to a stream other than 0 through 9 is discarded.

`undivert` causes immediate output of text from diversions named as arguments, or all diversions if no argument. Text may be undiverted into another diversion. Undiverting discards the diverted text.

`divnum`	returns the value of the current output stream.
`dnl`	reads and discards characters up to and including the next new-line.
`ifelse`	has three or more arguments. If the first argument is the same string as the second, then the value is the third argument. If not, and if there are more than four arguments, the process is repeated with arguments 4, 5, 6 and 7. Otherwise, the value is either the fourth string, or, if it is not present, null.
`incr`	returns the value of its argument incremented by 1. The value of the argument is calculated by interpreting an initial digit-string as a decimal number.
`decr`	returns the value of its argument decremented by 1.
`eval`	evaluates its argument as an arithmetic expression, using 32-bit arithmetic. Operators include `+`, `-`, `*`, `/`, `%`, `**` (exponentiation), bit-wise `&`, `|`, `^`, and `~`; relationals; parentheses. Octal and hex numbers may be specified as in C. The second argument specifies the radix for the result; the default is 10. The third argument may be used to specify the minimum number of digits in the result.
`len`	returns the number of characters in its argument.
`index`	returns the position in its first argument where the second argument begins (zero origin), or −1 if the second argument does not occur.
`substr`	returns a substring of its first argument. The second argument is a zero origin number selecting the first character; the third argument indicates the length of the substring. A missing third argument is taken to be large enough to extend to the end of the first string.
`translit`	transliterates the characters in its first argument from the set given by the second argument to the set given by the third. No abbreviations are permitted.
`include`	returns the contents of the file named in the argument.
`sinclude`	is identical to `include`, except that it says nothing if the file is inaccessible.
`syscmd`	executes the UNIX System command given in the first argument. No value is returned.
`sysval`	is the return code from the last call to `syscmd`.
`maketemp`	fills in a string of `XXXXX` in its argument with the current process ID.
`m4exit`	causes immediate exit from `m4`. Argument 1, if given, is the exit code; the default is 0.
`m4wrap`	argument 1 will be pushed back at final EOF; example: `` m4wrap(`cleanup()') ``

`errprint`	prints its argument on the diagnostic output file.
`dumpdef`	prints current names and definitions, for the named items, or for all if no arguments are given.
`traceon`	with no arguments, turns on tracing for all macros (including built-ins). Otherwise, turns on tracing for named macros.
`traceoff`	turns off trace globally and for any macros specified. Macros specifically traced by `traceon` can be untraced only by specific calls to `traceoff`.

SEE ALSO

as(1), cc(1).

NAME

make – maintain, update, and regenerate groups of programs

SYNOPSIS

make [-f *makefile*] [-eiknpqrst] [*names*]

DESCRIPTION

make allows the programmer to maintain, update, and regenerate groups of computer programs. make executes commands in *makefile* to update one or more target *names* (*names* are typically programs). If the -f option is not present, then makefile, Makefile, and the Source Code Control System (SCCS) files s.makefile, and s.Makefile are tried in order. If *makefile* is -, the standard input is taken. More than one -f *makefile* argument pair may appear.

make updates a target only if its dependents are newer than the target. All prerequisite files of a target are added recursively to the list of targets. Missing files are deemed to be outdated.

The following list of four directives can be included in *makefile* to extend the options provided by make. They are used in *makefile* as if they were targets:

.DEFAULT: If a file must be made but there are no explicit commands or relevant built-in rules, the commands associated with the name .DEFAULT are used if it exists.

.IGNORE: Same effect as the -i option.

.PRECIOUS: Dependents of the .PRECIOUS entry will not be removed when quit or interrupt are hit.

.SILENT: Same effect as the -s option.

The options for make are listed below:

-e Environment variables override assignments within makefiles.

-f *makefile* Description filename (*makefile* is assumed to be the name of a description file).

-i Ignore error codes returned by invoked commands.

-k Abandon work on the current entry if it fails, but continue on other branches that do not depend on that entry.

-n No execute mode. Print commands, but do not execute them. Even command lines beginning with an @ are printed.

-p Print out the complete set of macro definitions and target descriptions.

-q Question. make returns a zero or non-zero status code depending on whether or not the target file has been updated.

-r Do not use the built-in rules.

-s Silent mode. Do not print command lines before executing.

-t Touch the target files (causing them to be updated) rather than issue the usual commands.

Creating the makefile

The makefile invoked with the `-f` option is a carefully structured file of explicit instructions for updating and regenerating programs, and contains a sequence of entries that specify dependencies. The first line of an entry is a blank-separated, non-null list of targets, then a `:`, then a (possibly null) list of prerequisite files or dependencies. Text following a `;` and all following lines that begin with a tab are shell commands to be executed to update the target. The first non-empty line that does not begin with a tab or # begins a new dependency or macro definition. Shell commands may be continued across lines with a backslash-new-line (\ new-line) sequence. Everything printed by make (except the initial tab) is passed directly to the shell as is. Thus,

```
echo a\
b
```

will produce

```
ab
```

exactly the same as the shell would.

Sharp (#) and new-line surround comments including contained \ new-line sequences.

The following makefile says that `pgm` depends on two files `a.o` and `b.o`, and that they in turn depend on their corresponding source files (`a.c` and `b.c`) and a common file `incl.h`:

```
pgm: a.o b.o
     cc a.o b.o -o pgm
a.o: incl.h a.c
     cc -c a.c
b.o: incl.h b.c
     cc -c b.c
```

Command lines are executed one at a time, each by its own shell. The `SHELL` environment variable can be used to specify which shell `make` should use to execute commands. The default is `/bin/sh`. The first one or two characters in a command can be the following: `@`, `-`, `@-`, or `-@`. If `@` is present, printing of the command is suppressed. If `-` is present, `make` ignores an error. A line is printed when it is executed unless the `-s` option is present, or the entry `.SILENT:` is included in *makefile*, or unless the initial character sequence contains a `@`. The `-n` option specifies printing without execution; however, if the command line has the string `$(MAKE)` in it, the line is always executed (see the discussion of the `MAKEFLAGS` macro in the "Environment" section below). The `-t` (touch) option updates the modified date of a file without executing any commands.

Commands returning non-zero status normally terminate `make`. If the `-i` option is present, if the entry `.IGNORE:` is included in *makefile*, or if the initial character sequence of the command contains `-`, the error is ignored. If the `-k` option is present, work is abandoned on the current entry, but continues on other branches that do not depend on that entry.

Interrupt and quit cause the target to be deleted unless the target is a dependent of the directive `.PRECIOUS`.

Environment

The environment is read by **make**. All variables are assumed to be macro definitions and are processed as such. The environment variables are processed before any makefile and after the internal rules; thus, macro assignments in a makefile override environment variables. The **-e** option causes the environment to override the macro assignments in a makefile. Suffixes and their associated rules in the makefile will override any identical suffixes in the built-in rules.

The `MAKEFLAGS` environment variable is processed by **make** as containing any legal input option (except **-f** and **-p**) defined for the command line. Further, upon invocation, **make** "invents" the variable if it is not in the environment, puts the current options into it, and passes it on to invocations of commands. Thus, `MAKEFLAGS` always contains the current input options. This feature proves very useful for "super-makes". In fact, as noted above, when the **-n** option is used, the command `$(MAKE)` is executed anyway; hence, one can perform a `make -n` recursively on a whole software system to see what would have been executed. This result is possible because the **-n** is put in `MAKEFLAGS` and passed to further invocations of `$(MAKE)`. This usage is one way of debugging all of the makefiles for a software project without actually doing anything.

Include Files

If the string `include` appears as the first seven letters of a line in a *makefile*, and is followed by a blank or a tab, the rest of the line is assumed to be a filename and will be read by the current invocation, after substituting for any macros.

Macros

Entries of the form *string1* = *string2* are macro definitions. *string2* is defined as all characters up to a comment character or an unescaped new-line. Subsequent appearances of $(*string1*[:*subst1*=[*subst2*]]) are replaced by *string2*. The parentheses are optional if a single-character macro name is used and there is no substitute sequence. The optional :*subst1*=*subst2* is a substitute sequence. If it is specified, all non-overlapping occurrences of *subst1* in the named macro are replaced by *subst2*. Strings (for the purposes of this type of substitution) are delimited by blanks, tabs, new-line characters, and beginnings of lines. An example of the use of the substitute sequence is shown in the "Libraries" section below.

Internal Macros

There are five internally maintained macros that are useful for writing rules for building targets.

`$*` The macro `$*` stands for the filename part of the current dependent with the suffix deleted. It is evaluated only for inference rules.

`$@` The `$@` macro stands for the full target name of the current target. It is evaluated only for explicitly named dependencies.

`$<` The `$<` macro is only evaluated for inference rules or the `.DEFAULT` rule. It is the module that is outdated with respect to the target (the "manufactured" dependent file name). Thus, in the `.c.o` rule, the `$<` macro would evaluate to the `.c` file. An example for making optimized `.o` files from `.c` files is:

```
.c.o:
        cc -c -O $*.c
```

or:

```
.c.o:
        cc -c -O $<
```

`$?` The `$?` macro is evaluated when explicit rules from the makefile are evaluated. It is the list of prerequisites that are outdated with respect to the target, and essentially those modules that must be rebuilt.

`$%` The `$%` macro is only evaluated when the target is an archive library member of the form `lib(file.o)`. In this case, `$@` evaluates to `lib` and `$%` evaluates to the library member, `file.o`.

Four of the five macros can have alternative forms. When an upper case `D` or `F` is appended to any of the four macros, the meaning is changed to "directory part" for `D` and "file part" for `F`. Thus, `$(@D)` refers to the directory part of the string `$@`. If there is no directory part, `./` is generated. The only macro excluded from this alternative form is `$?`.

Suffixes

Certain names (for instance, those ending with `.o`) have inferable prerequisites such as `.c`, `.s`, etc. If no update commands for such a file appear in *makefile*, and if an inferable prerequisite exists, that prerequisite is compiled to make the target. In this case, **make** has inference rules that allow building files from other files by examining the suffixes and determining an appropriate inference rule to use. The current default inference rules are:

```
.c      .c~       .f     .f~    .s     .s~    .sh    .sh~   .C     .C~
.c.a    .c.o      .c~.a  .c~.c  .c~.o  .f.a   .f.o   .f~.a  .f~.f  .f~.o
.h~.h   .l.c      .l.o   .l~.c  .l~.l  .l~.o  .s.a   .s.o   .s~.a  .s~.o
.s~.s   .sh~.sh   .y.c   .y.o   .y~.c  .y~.o  .y~.y  .C.a   .C.o   .C~.a
.C~.C   .C~.o     .L.C   .L.o   .L~.C  .L~.L  .L~.o  .Y.C   .Y.o   .Y~.C
.Y~.o   .Y~.Y
```

The internal rules for **make** are contained in the source file `rules.c` for the **make** program. These rules can be locally modified. To print out the rules compiled into the **make** on any machine in a form suitable for recompilation, the following command is used:

```
make -pf - 2>/dev/null </dev/null
```

A tilde in the above rules refers to an SCCS file [see `sccsfile`(4)]. Thus, the rule `.c~.o` would transform an SCCS C source file into an object file (`.o`). Because the `s.` of the SCCS files is a prefix, it is incompatible with the **make** suffix point of view. Hence, the tilde is a way of changing any file reference into an SCCS file reference.

A rule with only one suffix (for example, `.c:`) is the definition of how to build *x* from *x*`.c`. In effect, the other suffix is null. This feature is useful for building targets from only one source file, for example, shell procedures and simple C programs.

Additional suffixes are given as the dependency list for `.SUFFIXES`. Order is significant: the first possible name for which both a file and a rule exist is inferred as a prerequisite. The default list is:

```
.SUFFIXES: .o .c .c~ .y .y~ .l .l~ .s .s~ .sh .sh~ .h .h~ .f .f~ .C
.C~ .Y .Y~ .L .L~
```

Here again, the above command for printing the internal rules will display the list of suffixes implemented on the current machine. Multiple suffix lists accumulate; `.SUFFIXES:` with no dependencies clears the list of suffixes.

Inference Rules

The first example can be done more briefly.

```
pgm: a.o b.o
     cc a.o b.o -o pgm
a.o b.o: incl.h
```

This abbreviation is possible because **make** has a set of internal rules for building files. The user may add rules to this list by simply putting them in the *makefile*.

Certain macros are used by the default inference rules to permit the inclusion of optional matter in any resulting commands. For example, CFLAGS, LFLAGS, and YFLAGS are used for compiler options to cc(1), lex(1), and yacc(1), respectively. Again, the previous method for examining the current rules is recommended.

The inference of prerequisites can be controlled. The rule to create a file with suffix `.o` from a file with suffix `.c` is specified as an entry with `.c.o:` as the target and no dependents. Shell commands associated with the target define the rule for making a `.o` file from a `.c` file. Any target that has no slashes in it and starts with a dot is identified as a rule and not a true target.

Libraries

If a target or dependency name contains parentheses, it is assumed to be an archive library, the string within parentheses referring to a member within the library. Thus, `lib(file.o)` and `$(LIB)(file.o)` both refer to an archive library that contains `file.o`. (This example assumes the LIB macro has been previously defined.) The expression `$(LIB)(file1.o file2.o)` is not legal. Rules pertaining to archive libraries have the form `.`*XX*`.a` where the *XX* is the suffix from which the archive member is to be made. An unfortunate by-product of the current implementation requires the *XX* to be different from the suffix of the archive member. Thus, one cannot have `lib(file.o)` depend upon `file.o` explicitly. The most common use of the archive interface follows. Here, we assume the source files are all C type source:

```
lib: lib(file1.o) lib(file2.o) lib(file3.o)
     @echo lib is now up-to-date
.c.a:
     $(CC) -c $(CFLAGS) $<
     $(AR) $(ARFLAGS) $@ $*.o
     rm -f $*.o
```

In fact, the `.c.a` rule listed above is built into **make** and is unnecessary in this example. A more interesting, but more limited example of an archive library maintenance construction follows:

```
lib: lib(file1.o) lib(file2.o) lib(file3.o)
     $(CC) -c $(CFLAGS) $(?:.o=.c)
     $(AR) $(ARFLAGS) lib $?
     rm $?
     @echo lib is now up-to-date
.c.a:;
```

Here the substitution mode of the macro expansions is used. The `$?` list is defined to be the set of object filenames (inside `lib`) whose C source files are outdated. The substitution mode translates the `.o` to `.c`. (Unfortunately, one cannot as yet transform to `.c~`; however, this transformation may become possible in the future.) Also note the disabling of the `.c.a:` rule, which would have created each object file, one by one. This particular construct speeds up archive library maintenance considerably. This type of construct becomes very cumbersome if the archive library contains a mix of assembly programs and C programs.

FILES

`[Mm]akefile` and `s.[Mm]akefile`
`/bin/sh`

SEE ALSO

cc(1), `lex`(1), yacc(1), `printf`(3S), `sccsfile`(4).

cd(1), sh(1) in the *User's Reference Manual.*

See the "make" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools.*

NOTES

Some commands return non-zero status inappropriately; use `-i` or the `-` command line prefix to overcome the difficulty.

Filenames with the characters `= : @` will not work. Commands that are directly executed by the shell, notably cd(1), are ineffectual across new-lines in **make**. The syntax `lib(file1.o file2.o file3.o)` is illegal. You cannot build `lib(file.o)` from `file.o`.

NAME

mcs – manipulate the comment section of an object file.

SYNOPSIS

mcs [–a *string*] [–c] [–d] [–n *name*] [–p] [–V] *file* ...

DESCRIPTION

The mcs command is used to manipulate a section, by default the .comment section, in an ELF object file. It is used to add to, delete, print, and compress the contents of a section in an ELF object file, and only print the contents of a section in a COFF object file. mcs must be given one or more of the options described below. It applies each of the options in order to each file.

The following options are available.

–a *string*
: Append *string* to the comment section of the ELF object files. If *string* contains embedded blanks, it must be enclosed in quotation marks.

–c
: Compress the contents of the comment section of the ELF object files. All duplicate entries are removed. The ordering of the remaining entries is not disturbed.

–d
: Delete the contents of the comment section from the ELF object files. The section header for the comment section is also removed.

–n *name*
: Specify the name of the comment section to access if other than .comment. By default, mcs deals with the section named .comment. This option can be used to specify another section.

–p
: Print the contents of the comment section on the standard output. Each section printed is tagged by the name of the file from which it was extracted, using the format *filename*[*member_name*]: for archive files; and *filename*: for other files.

–V
: Print, on standard error, the version number of mcs.

If the input file is an archive [see ar(4)], the archive is treated as a set of individual files. For example, if the –a option is specified, the string is appended to the comment section of each ELF object file in the archive; if the archive member is not an ELF object file, then it is left unchanged.

If mcs is executed on an archive file the archive symbol table will be removed, unless only the –p option has been specified. The archive symbol table must be restored by executing the ar command with the –s option before the archive can be linked by the ld command. mcs will produce appropriate warning messages when this situation arises.

EXAMPLES

```
mcs -p file               # Print file's comment section

mcs -a string file        # Append string to file's comment section
```

FILES

*TMPDIR/mcs**	temporary files
TMPDIR	usually /usr/tmp but can be redefined by setting the environment variable TMPDIR [see tempnam() in tmpnam(3S)].

SEE ALSO

ar(1), as(1), cc(1), ld(1), tmpnam(3S), a.out(4), ar(4).
See the "Object Files" chapter in *Programmer's Guide: ANSI C and Programming Support Tools.*

NOTES

mcs cannot add to, delete or compress the contents of a section that is contained within a segment.

NAME

montbl – create monetary database

SYNOPSIS

montbl [–o *outfile*] *infile*

DESCRIPTION

The montbl command takes as input a specification file, *infile*, that describes the formatting conventions for numeric quantities (monetary and otherwise) for a specific locale.

–o *outfile* Write the output on *outfile*; otherwise, write the output on a file named LC_MONETARY.

The output of montbl is suitable for use by the localeconv() function (see localeconv(3C)). Before *outfile* can be used by localeconv(), it must be installed in the /usr/lib/locale/*locale* directory with the name LC_MONETARY by someone who is super-user or a member of group bin. *locale* is the locale whose numeric formatting conventions are described in *infile*. This file must be readable by user, group, and other; no other permissions should be set. To use formatting conventions for numeric quantities described in this file, set the LC_MONETARY environment variable appropriately (see environ(5) or setlocale(3C)).

Once installed, this file will be used by the localeconv() function to initialize a structure of type struct lconv. For a description of each field in this structure, see localeconv(3C).

```
struct     lconv     {
     char *decimal_point;  /* "." */
     char *thousands_sep;  /* "" (zero length string) */
     char *grouping;       /* "" */
     char *int_curr_symbol;     /* "" */
     char *currency_symbol;     /* "" */
     char *mon_decimal_point; /* "" */
     char *mon_thousands_sep; /* "" */
     char *mon_grouping;   /* "" */
     char *positive_sign;  /* "" */
     char *negative_sign;  /* "" */
     char int_frac_digits; /* CHAR_MAX */
     char frac_digits;          /* CHAR_MAX */
     char p_cs_precedes;   /* CHAR_MAX */
     char p_sep_by_space;  /* CHAR_MAX */
     char n_cs_precedes;   /* CHAR_MAX */
     char n_sep_by_space;  /* CHAR_MAX */
     char p_sign_posn;          /* CHAR_MAX */
     char n_sign_posn;          /* CHAR_MAX */
};
```

The specification file contains the value each struct lconv member should be set to, except for the first two members, *decimal_point* and *thousands_sep* which are set by the LC_NUMERIC category to setlocale(3C). Each member's value is given on a separate line and in the order listed in the struct lconv definition above.

Lines starting with a # are taken to be comments and are ignored. All other lines are assumed to describe their corresponding structure member. A blank line describes the null string for structure members that are pointers to strings. A character in a string may be in octal or hex representation. For example, \141 or \x61 could be used to represent the letter 'a'.

Given below is an example of what the specification file for Italy would look like:

```
# Italy
3
ITL.
L.

.
\3

-
0
0
1
0
1
0
1
1
```

Note that the first non-comment line in the specification file describes the *grouping* field.

FILES

/lib/locale/*locale*/LC_MONETARY
: LC_MONETARY database for *locale*

/usr/lib/locale/C/montbl_C
: input file used to construct LC_MONETARY in the default locale.

SEE ALSO

localeconv(3C), setlocale(3C) in the *Programmer's Reference Manual.*

NAME

nm – print name list of an object file

SYNOPSIS

nm [-oxhvnefurplVT] *files*

DESCRIPTION

The nm command displays the symbol table of each ELF or COFF object file, specified by *file(s)*. The file may be a relocatable or absolute ELF or COFF object file; or it may be an archive of relocatable or absolute ELF or COFF object files. For each symbol, the following information will be printed:

Index — The index of the symbol. (The index appears in brackets.)

Value — The value of the symbol is one of the following: a section offset for defined symbols in a relocatable file; alignment constraints for symbols whose section index is SHN_COMMON; a virtual address in executable and dynamic library files.

Size — The size in bytes of the associated object.

Type — A symbol is of one of the following types: NOTYPE (no type was specified), OBJECT (a data object such as an array or variable), FUNC (a function or other executable code), SECTION (a section symbol), or FILE (name of the source file).

Bind — The symbol's binding attributes. LOCAL symbols have a scope limited to the object file containing their definition; GLOBAL symbols are visible to all object files being combined; and WEAK symbols are essentially global symbols with a lower precedence than GLOBAL.

Other — A field reserved for future use, currently containing 0.

Shndx — Except for three special values, this is the section header table index in relation to which the symbol is defined. The following special values exist: ABS indicates the symbol's value will not change through relocation; COMMON indicates an unallocated block and the value provides alignment constraints; and UNDEF indicates an undefined symbol.

Name — The name of the symbol.

The output of nm may be controlled using the following options:

-o — Print the value and size of a symbol in octal instead of decimal.

-x — Print the value and size of a symbol in hexadecimal instead of decimal.

-h — Do not display the output heading data.

-v — Sort external symbols by value before they are printed.

-n — Sort external symbols by name before they are printed.

-e — See NOTES below.

-f — See NOTES below.

-u — Print undefined symbols only.

−r Prepend the name of the object file or archive to each output line.

−p Produce easily parsable, terse output. Each symbol name is preceded by its value (blanks if undefined) and one of the letters U (undefined), N (symbol has no type), D (data object symbol), T (text symbol), S (section symbol), or F (file symbol). If the symbol's binding attribute is LOCAL, the key letter is lower case; if the symbol's binding attribute is WEAK, the key letter is upper case; if the −l modifier is specified, the upper case key letter is followed by a *; if the symbol's binding attribute is GLOBAL, the key letter is upper case.

−l Distinguish between WEAK and GLOBAL symbols by appending a * to the key letter for WEAK symbols.

−V Print the version of the nm command executing on the standard error output.

−T See NOTES below.

Options may be used in any order, either singly or in combination, and may appear anywhere in the command line. When conflicting options are specified (such as nm −v −n) the first is taken and the second ignored with a warning message to the user.

SEE ALSO

as(1), cc(1), dump(1), ld(1), a.out(4), ar(4).

NOTES

The following options are obsolete because of changes to the object file format and will be deleted in a future release.

−e Print only external and static symbols. The symbol table now contains only static and external symbols. Automatic symbols no longer appear in the symbol table. They do appear in the debugging information produced by cc −g, which may be examined using dump(1).

−f Produce full output. Redundant symbols (such as .text, .data, etc). which existed previously do not exist and producing full output will be identical to the default output.

−T By default, nm prints the entire name of the symbols listed. Since symbol names have been moved to the last column, the problem of overflow is removed and it is no longer necessary to truncate the symbol name.

NAME

prof – display profile data

SYNOPSIS

prof [-t | c | a | n] [-o | x] [-g | l] [-z] [-h] [-s] [-m *mdata*] -V [*prog*]

DESCRIPTION

The prof command interprets a profile file produced by the monitor function. The symbol table in the object file *prog* (a.out by default) is read and correlated with a profile file (mon.out by default). For each external text symbol the percentage of time spent executing between the address of that symbol and the address of the next is printed, together with the number of times that function was called and the average number of milliseconds per call.

The mutually exclusive options -t, -c, -a, and -n determine the type of sorting of the output lines:

-t Sort by decreasing percentage of total time (default).

-c Sort by decreasing number of calls.

-a Sort by increasing symbol address.

-n Sort lexically by symbol name.

The mutually exclusive options -o and -x specify the printing of the address of each symbol monitored:

-o Print each symbol address (in octal) along with the symbol name.

-x Print each symbol address (in hexadecimal) along with the symbol name.

The mutually exclusive options -g and -l control the type of symbols to be reported. The -l option must be used with care; it applies the time spent in a static function to the preceding (in memory) global function, instead of giving the static function a separate entry in the report. If all static functions are properly located (see example below), this feature can be very useful. If not, the resulting report may be misleading.

Assume that A and B are global functions and only A calls static function S. If S is located immediately after A in the source code (that is, if S is properly located), then, with the -l option, the amount of time spent in A can easily be determined, including the time spent in S. If, however, both A and B call S, then, if the -l option is used, the report will be misleading; the time spent during B's call to S will be attributed to A, making it appear as if more time had been spent in A than really had. In this case, function S cannot be properly located.

-g Include static (non-global) functions.

-l Do not include static (non-global) functions (default).

The following options may be used in any combination:

-z Include all symbols in the profile range, even if associated with zero number of calls and zero time.

−h Suppress the heading normally printed on the report. (This is useful if the report is to be processed further.)

−s Print a summary of several of the monitoring parameters and statistics on the standard error output.

−m *mdata* Use file *mdata* instead of mon.out as the input profile file.

−V Print prof version information on the standard error output.

A program creates a profile file if it has been link edited with the −p option of cc. This option to the cc command arranges for calls to monitor at the beginning and end of execution. The call to monitor at the end of execution causes the system to write a profile file. The number of calls to a function is tallied if the −p option was used when the file containing the function was compiled.

The name of the file created by a profiled program is controlled by the environmental variable PROFDIR. If PROFDIR is not set, mon.out is produced in the directory current when the program terminates. If PROFDIR=*string*, *string*/*pid*.*progname* is produced, where *progname* consists of argv[0] with any path prefix removed, and *pid* is the process ID of the program. If PROFDIR is set, but null, no profiling output are produced.

A single function may be split into subfunctions for profiling by means of the MARK macro [see prof(5)].

FILES

mon.out default profile file
a.out default namelist (object) file

SEE ALSO

cc(1), lprof(1), exit(2), profil(2), monitor(3C), prof(5).
The "lprof" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

NOTES

The times reported in successive identical runs may show variances because of varying cache-hit ratios that result from sharing the cache with other processes. Even if a program seems to be the only one using the machine, hidden background or asynchronous processes may blur the data. In rare cases, the clock ticks initiating recording of the program counter may "beat" with loops in a program, grossly distorting measurements. Call counts are always recorded precisely, however.

Only programs that call exit or return from main are guaranteed to produce a profile file, unless a final call to monitor is explicitly coded.

The times for static functions are attributed to the preceding external text symbol if the −g option is not used. However, the call counts for the preceding function are still correct; that is, the static function call counts are not added to the call counts of the external function.

If more than one of the options −t, −c, −a, and −n is specified, the last option specified is used and the user is warned.

NAME

prs – print an SCCS file

SYNOPSIS

prs [-d[*dataspec*]] [-r[*SID*]] [-e] [-l] [-c[*date-time*]] [-a] *files*

DESCRIPTION

prs prints, on the standard output, parts or all of an SCCS file [see sccsfile(4)] in a user-supplied format. If a directory is named, prs prints the files in that directory, except the non-SCCS files (last component of the path name does not begin with s.) and unreadable files. If a name of – is given, the standard input is read; each line of the standard input is taken to be the name of an SCCS file or directory to be processed. prs silently ignores non-SCCS files and unreadable files.

Arguments to prs, which may appear in any order, consist of keyletter arguments and file names.

The keyletter arguments apply independently to each named file:

-d[*dataspec*] Specifies the output data specification. The *dataspec* is a string consisting of SCCS file data keywords (see the DATA KEYWORDS section) interspersed with optional user-supplied text.

-r[*SID*] Specifies the SCCS identification (SID) string of a delta for which information is desired. The default is the top delta.

-e Requests information for all deltas created earlier than and including the delta designated via the -r keyletter or the date given by the -c option.

-l Requests information for all deltas created later than and including the delta designated via the -r keyletter or the date given by the -c option.

-c[*date-time*] The cutoff date-time in the form:

YY[*MM*[*DD*[*HH*[*MM*[*SS*]]]]]

Units omitted from the date-time default to their maximum possible values; for example, -c7502 is equivalent to -c750228235959. Any number of non-numeric characters may separate the fields of the cutoff date; for example, "-c77/2/2 9:22:25".

-a Requests printing of information for both removed, i.e., delta type = R, [see rmdel(1)] and existing, i.e., delta type = D, deltas. If the -a keyletter is not specified, information for existing deltas only is provided.

DATA KEYWORDS

Data keywords specify those parts of an SCCS file that are to be retrieved and output. All parts of an SCCS file [see sccsfile(4)] have an associated data keyword. There is no limit on the number of times a data keyword may appear in a *dataspec*.

The information printed by **prs** consists of: (1) the user-supplied text; and (2) appropriate values (extracted from the SCCS file) substituted for the recognized data keywords in the order of appearance in the *dataspec*. The format of a data keyword value is either "Simple" (S), in which keyword substitution is direct, or "Multi-line" (M), in which keyword substitution is followed by a carriage return.

User-supplied text is any text other than recognized data keywords. A tab is specified by \t and carriage return/new-line is specified by \n. The default data keywords are:

`":Dt:\t:DL:\nMRs:\n:MR:COMMENTS:\n:C:"`

Keyword	Data Item	File Section	Value	Format
:Dt:	Delta information	Delta Table	See below*	S
:DL:	Delta line statistics	"	:Li:/:Ld:/:Lu:	S
:Li:	Lines inserted by Delta	"	*nnnnn*	S
:Ld:	Lines deleted by Delta	"	*nnnnn*	S
:Lu:	Lines unchanged by Delta	"	*nnnnn*	S
:DT:	Delta type	"	D *or* R	S
:I:	SCCS ID string (SID)	"	:R:.:L:.:B:.:S:	S
:R:	Release number	"	*nnnn*	S
:L:	Level number	"	*nnnn*	S
:B:	Branch number	"	*nnnn*	S
:S:	Sequence number	"	*nnnn*	S
:D:	Date Delta created	"	:Dy:/:Dm:/:Dd:	S
:Dy:	Year Delta created	"	*nn*	S
:Dm:	Month Delta created	"	*nn*	S
:Dd:	Day Delta created	"	*nn*	S
:T:	Time Delta created	"	:Th:::Tm:::Ts:	S
:Th:	Hour Delta created	"	*nn*	S
:Tm:	Minutes Delta created	"	*nn*	S
:Ts:	Seconds Delta created	"	*nn*	S
:P:	Programmer who created Delta	"	*logname*	S
:DS:	Delta sequence number	"	*nnnn*	S
:DP:	Predecessor Delta seq-no.	"	*nnnn*	S
:DI:	Seq-no. of deltas incl., excl., ignored	"	:Dn:/:Dx:/:Dg:	S
:Dn:	Deltas included (seq #)	"	:DS: :DS: ...	S
:Dx:	Deltas excluded (seq #)	"	:DS: :DS: ...	S
:Dg:	Deltas ignored (seq #)	"	:DS: :DS: ...	S
:MR:	MR numbers for delta	"	*text*	M
:C:	Comments for delta	"	*text*	M
:UN:	User names	User Names	*text*	M
:FL:	Flag list	Flags	*text*	M

Keyword	Data Item	File Section	Value	Format
:Y:	Module type flag	"	*text*	S
:MF:	MR validation flag	"	yes or no	S
:MP:	MR validation pgm name	"	*text*	S
:KF:	Keyword error/warning flag	"	yes or no	S
:KV:	Keyword validation string	"	*text*	S
:BF:	Branch flag	"	yes or no	S
:J:	Joint edit flag	"	yes or no	S
:LK:	Locked releases	"	:R: ...	S
:Q:	User-defined keyword	"	*text*	S
:M:	Module name	"	*text*	S
:FB:	Floor boundary	"	:R:	S
:CB:	Ceiling boundary	"	:R:	S
:Ds:	Default SID	"	:I:	S
:ND:	Null delta flag	"	yes or no	S
:FD:	File descriptive text	Comments	*text*	M
:BD:	Body	Body	*text*	M
:GB:	Gotten body	"	*text*	M
:W:	A form of what(1) string	N/A	:Z::M:\t:I:	S
:A:	A form of what(1) string	N/A	:Z::Y: :M: :I::Z:	S
:Z:	what(1) string delimiter	N/A	@(#)	S
:F:	SCCS file name	N/A	*text*	S
:PN:	SCCS file path name	N/A	*text*	S

* :Dt: = :DT: :I: :D: :T: :P: :DS: :DP:

EXAMPLES

The command

```
prs -d"Users and/or user IDs for :F: are:\n:UN:" s.file
```

may produce on the standard output:

```
Users and/or user IDs for s.file are:
xyz
131
abc
```

The command

```
prs -d"Newest delta for pgm :M:: :I: Created :D: By :P:" -r
s.file
```

may produce on the standard output:

```
Newest delta for pgm main.c: 3.7 Created 77/12/1 By cas
```

The default case:

```
prs s.file
```

produces on the standard output:

```
D 1.1 77/12/1 00:00:00 cas 1 000000/00000/00000
MRs:
bl78-12345
bl79-54321
COMMENTS:
this is the comment line for s.file initial delta
```

for each delta table entry of the "D" type. The only keyletter argument allowed to be used with the "special case" is the -a keyletter.

FILES

/usr/tmp/pr?????

SEE ALSO

admin(1), delta(1), get(1), help(1), sccsfile(4).

DIAGNOSTICS

Use help(1) for explanations.

NAME

regcmp – regular expression compile

SYNOPSIS

regcmp [–] *file*...

DESCRIPTION

The regcmp command performs a function similar to regcmp and, in most cases, precludes the need for calling regcmp from C programs. Bypassing regcmp saves on both execution time and program size. The command regcmp compiles the regular expressions in *file* and places the output in *file*.i. If the – option is used, the output is placed in *file*.c. The format of entries in *file* is a name (C variable) followed by one or more blanks followed by one or more regular expressions enclosed in double quotes. The output of regcmp is C source code. Compiled regular expressions are represented as extern char vectors. *file*.i files may thus be #included in C programs, or *file*.c files may be compiled and later loaded. In the C program that uses the regcmp output, regex(abc, line) applies the regular expression named abc to line. Diagnostics are self-explanatory.

EXAMPLES

```
name     "([A-Za-z][A-Za-z0-9_]*)$0"

telno    "\({0,1}([2-9][01][1-9])$0\){0,1} *"
         "([2-9][0-9]{2})$1[ -]{0,1}"
         "([0-9]{4})$2"
```

The three arguments to telno shown above must all be entered on one line.

In the C program that uses the regcmp output,

```
regex(telno, line, area, exch, rest)
```

applies the regular expression named telno to line.

SEE ALSO

regcmp(3G).

NAME

`rmdel` – remove a delta from an SCCS file

SYNOPSIS

`rmdel -r`*SID files*

DESCRIPTION

rmdel removes the delta specified by the *SID* (SCCS identification string) from each named SCCS file. The delta to be removed must be the newest (most recent) delta in its branch in the delta chain of each named SCCS file. In addition, the delta specified must not be that of a version being edited for the purpose of making a delta; that is, if a p-file exists for the named SCCS file [see `get`(1)], the delta specified must not appear in any entry of the p-file.

The `-r` option specifies the *SID* level of the delta to be removed.

If a directory is named, **rmdel** behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with **s.**) and unreadable files are silently ignored. If a name of – is given, the standard input is read; each line of the standard input is taken to be the name of an SCCS file to be processed; non-SCCS files and unreadable files are silently ignored.

The rules governing the removal of a delta are as follows: if you make a delta and have appropriate file permissions, you can remove it; if you own the file and directory in which a new delta file resides, you can remove the delta.

FILES

x.file	[See **delta**(1)]
z.file	[See **delta**(1)]

SEE ALSO

delta(1), **get**(1), **help**(1), **prs**(1), **sccsfile**(4).

DIAGNOSTICS

Use **help**(1) for explanations.

NAME

sact – print current SCCS file editing activity

SYNOPSIS

`sact` *files*

DESCRIPTION

`sact` informs the user of any impending deltas to a named SCCS file. This situation occurs when `get` with the **–e** option has been previously executed without a subsequent execution of `delta`. If a directory is named on the command line, `sact` behaves as though each file in the directory were specified as a named file, except that non-SCCS files and unreadable files are silently ignored. If a name of – is given, the standard input is read with each line being taken as the name of an SCCS file to be processed.

The output for each named file consists of five fields separated by spaces.

Field 1	specifies the SID of a delta that currently exists in the SCCS file to which changes will be made to make the new delta.
Field 2	specifies the SID for the new delta to be created.
Field 3	contains the logname of the user who will make the delta (i.e., executed a `get` for editing).
Field 4	contains the date that `get` **–e** was executed.
Field 5	contains the time that `get` **–e** was executed.

SEE ALSO

`delta`(1), `diff`(1), `get`(1), `help`(1), `unget`(1).

DIAGNOSTICS

Use `help`(1) for explanations.

NAME

`sccsdiff` – compare two versions of an SCCS file

SYNOPSIS

sccsdiff -r*SID1* **-r***SID2* [**-p**] [**-s***n*] *files*

DESCRIPTION

`sccsdiff` compares two versions of an SCCS file and generates the differences between the two versions. Any number of SCCS files may be specified, but arguments apply to all files.

-r*SID1* -r*SID2*	*SID1* and *SID2* specify the deltas of an SCCS file that are to be compared. Versions are passed to `bdiff` in the order given.
-p	pipe output for each file through `pr`.
-s*n*	*n* is the file segment size that `bdiff` will pass to `diff`. This option is useful when `diff` fails due to a high system load.

FILES

`/usr/tmp/get?????` temporary files

SEE ALSO

`get`(1), `help`(1).

`diff`(1), `bdiff`(1), `pr`(1) in the *User's Reference Manual*.

NAME

sdb – symbolic debugger

SYNOPSIS

sdb [**-e**] [**-s** *signo*] [**-V**] [**-W**] [**-w**] [*objfile* [*corfile* [*directory-list*]]]

DESCRIPTION

sdb is the symbolic debugger for C and assembly programs. **sdb** may be used to examine executable program files and core files. It may also be used to examine live processes in a controlled execution environment.

The *objfile* argument is the name of an executable program file. To take full advantage of the symbolic capabilities of **sdb**, this file should be compiled with the **-g** (debug) option. If it has not been compiled with the **-g** option, the symbolic capabilities of **sdb** will be limited, but the file can still be examined and the program debugged.

The *corfile* argument is the name of a core image file. A core image file is produced by the abnormal termination of *objfile* or by the use of **gcore**. A core image file contains a copy of the segments of a program. The default for *corfile* is **core**. A core image file need not be present to use **sdb**. Using a hyphen (–) instead of *corfile* forces **sdb** to ignore an existing core image file.

The *directory-list* argument is a colon-separated list of directories that is used by **sdb** to locate source files used to build *objfile*. If no directory list is specified, **sdb** will look in the current directory.

The following options are recognized by **sdb**:

-e Ignore symbolic information and treat nonsymbolic addresses as file offsets.

-s *signo*
Where *signo* is a decimal number that corresponds to a signal number [see **signal**(2)], do not stop live processes under control of **sdb** that receive the signal. This option may be used more than once on the **sdb** command line.

-V Print version information. If no *objfile* argument is specified on the command line, **sdb** will exit after printing the version information.

-W Suppress warnings about *corfile* being older than *objfile* or about source files that are older than *objfile*.

-w Allow user to write to *objfile* or *corfile*.

sdb recognizes a current line and a current file. When **sdb** is examining an executable program file without a core file, the current line and current file are initially set to the line and file containing the first line of **main**. If *corfile* exists, then current line and current file are initially set to the line and file containing the source statement where the process terminated. The current line and current file change automatically as a live process executes. They may also be changed with the source file examination commands.

Names of variables are written as in C. Variables local to a procedure may be accessed using the form *procedure*:*variable*. If no procedure name is given, the procedure containing the current line is used by default.

Structure members may be referred to as *variable*.*member*, pointers to structure members as *variable*->*member*, and array elements as *variable*[*number*]. Pointers may also be dereferenced by using the form *pointer*[*number*]. Combinations of these forms may also be used. The form *number*->*member* may be used where *number* is the address of a pointer, and *number*.*member* where *number* is interpreted as the address of a structure instance. The template of the structure type used in this case will be the last structure type referenced. When sdb displays the value of a structure, it does so by displaying the value of all elements of the structure. The address of a structure is displayed by displaying the address of the structure instance rather than the addresses of individual elements.

Elements of a multidimensional array may be referred to as *variable* [*number*][*number*]..., or as *variable* [*number*,*number*,...]. In place of *number*, the form *number*;*number* may be used to indicate a range of values, * may be used to indicate all legitimate values for that subscript, or subscripts may be omitted entirely if they are the last subscripts and the full range of values is desired. If no subscripts are specified, sdb will display the value of all elements of the array.

A particular instance of a variable on the stack is referred to as *procedure*:*variable*,*number*. The *number* is the occurrence of the specified procedure on the stack, with the topmost occurrence being 1. The default procedure is the one containing the current line.

Addresses may be used in sdb commands as well. Addresses are specified by decimal, octal, or hexadecimal numbers.

Line numbers in the source program are specified by the form *filename*:*number* or *procedure*:*number*. In either case, the *number* is relative to the beginning of the file and corresponds to the line number used by text editors or the output of pr. A number used by itself implies a line in the current file.

While a live process is running under sdb, all addresses and identifiers refer to the live process. When sdb is not examining a live process, the addresses and identifiers refer to *objfile* or *corfile*.

Commands

The commands for examining data in the program are:

t
: Prints a stack trace of the terminated or halted program. The function invoked most recently is at the top of the stack. For C programs, the stack ends with `_start`, which is the startup routine that invokes `main`.

T
: Prints the top line of the stack trace.

variable/*clm*
: Print the value of *variable* according to length *l* and format *m*. The numeric count *c* indicates that a region of memory, beginning at the address implied by *variable*, is to be displayed. The length specifiers are:

`b`	one byte
`h`	two bytes (half word)
`l`	four bytes (long word)

Legal values for *m* are:

`c`	character
`d`	signed decimal
`u`	unsigned decimal
`o`	octal
`x`	hexadecimal
`f`	32-bit single precision floating point
`g`	64-bit double precision floating point
`s`	Assumes that *variable* is a string pointer and prints characters starting at the address pointed to by the variable.
`a`	Prints characters starting at the variable's address. Do not use this with register variables.
`p`	pointer to procedure
`i`	Disassembles machine-language instruction with addresses printed numerically and symbolically.
`I`	Disassembles machine-language instruction with addresses printed numerically only.

Length specifiers are effective with formats `c`, `d`, `u`, `o`, `x`. The length specifier determines the output length of the value to be displayed. This value may be truncated. The count specifier *c* displays that many units of memory, starting at the address of the *variable*. The number of bytes in the unit of memory is determined by *l* or by the size associated with the variable. If the specifiers *c*, *l*, and *m* are omitted, **sdb** uses defaults. If a count specifier is used with the **s** or **a** command, then that many characters are printed. Otherwise, successive characters are printed until either a null byte is reached or 128 characters are printed. The last variable may be redisplayed with the `./` command.

For a limited form of pattern matching, use the **sh** metacharacters `*` and `?` within procedure and variable names. (**sdb** does not accept these metacharacters in file names, as the function name in a line number when setting a breakpoint, in the function call command, or as the argument to the **e** command.) If no procedure name is supplied, **sdb** matches both local and global variables. If the procedure name is specified, then **sdb** matches only local variables. To match global variables only, use :*pattern*. To print all variables, use `*:*`.

linenumber?*lm*
variable:?*lm*

Prints the value at the address from the executable or text space given by *linenumber* or *variable* (procedure name), according to the format *lm*. The default format is `i`.

variable=*lm*
linenumber=*lm*
number=*lm*

Prints the address of *variable* or *linenumber*, or the value of *number*. *l* specifies length and *m* specifies the format. If no format is specified, then **sdb** uses `lx` (four-byte hex). *m* allows you to convert between decimal, octal, and hexadecimal.

variable!*value*

Sets *variable* to the given *value*. The value may be a number, a character constant, or a variable. The value must be well-defined; structures are allowed only if assigning to another structure variable of the same type. Character constants are denoted ´*character*. Numbers are viewed as integers unless a decimal point or exponent is used. In this case, they are treated as having the type `double`. Registers, except the floating point registers, are viewed as integers. Register names are identical to those used by the assembler (for example, %*regname* where *regname* is the name of a register). If the address of a variable is given, it is regarded as the address of a variable of type `int`. C conventions are used in any type conversions necessary to perform the indicated assignment.

x Prints the machine registers and the current machine-language instruction.

X Prints the current machine-language instruction.

The commands for examining source files are:

e
e *procedure*
e *filename*
e *directory*/

e, without arguments, prints the name of the current file. The second form sets the current file to the file containing the procedure. The third form sets the current file to *filename*. The current line is set to the first line in the named procedure or file. Source files are assumed to be in the directories in the directory list. The fourth form adds *directory* to the end of the directory list.

/*regular expression*/

Searches forward from the current line for a line containing a string matching *regular expression*, as in **ed**. The trailing / may be omitted, except when associated with a breakpoint.

?*regular expression*?

Searches backward from the current line for a line containing a string matching *regular expression*, as in **ed**. The trailing ? may be omitted, except when associated with a breakpoint.

p Prints the current line.

z Prints the current line and the following nine lines. Sets the current line to the last line printed.

w Prints the 10 lines (the window) around the current line.

number
Specifies the current line. Prints the new current line.

count+
Advances the current line by *count* lines. Prints the new current line.

count–
Resets the current line by *count* lines back. Prints the new current line.

The commands for controlling the execution of the source program are:

count r *args*
count R
Runs the program with the given arguments. The r command with no arguments reuses the previous arguments to the program. The R command runs the program with no arguments. An argument beginning with < or > redirects the standard input or output, respectively. Full sh syntax is accepted. If *count* is given, it specifies the number of breakpoints to be ignored.

linenumber c *count*
linenumber C *count*
Continues execution. sdb stops when it encounters *count* breakpoints. The signal that stopped the program is reactivated with the C command and ignored with the c command. If a line number is specified, then a temporary breakpoint is placed at the line and execution continues. The breakpoint is deleted when the command finishes.

linenumber g *count*
Continues with execution resumed at the given line. If *count* is given, it specifies the number of breakpoints to be ignored.

s *count*
S *count*
s single steps the program through *count* lines or if no *count* is given, then the program runs for one line. s will step from one function into a called function. S also steps a program, but it will not step into a called function. It steps over the function called.

i *count*
I *count*
Single steps by *count* machine-language instructions. The signal that caused the program to stop is reactivated with the I command and ignored with the i command.

variable$m *count*
address:m *count*

Single steps (as with s) until the specified location is modified with a new value. If *count* is omitted, it is, in effect, infinity. *Variable* must be accessible from the current procedure. This command can be very slow.

level v

Toggles verbose mode. This is for use when single stepping with S, s, or m. If *level* is omitted, then just the current source file and/or function name is printed when either changes. If *level* is 1 or greater, each C source line is printed before it executes. If *level* is 2 or greater, each assembler statement is also printed. A v turns verbose mode off.

k Kills the program being debugged.

procedure(*arg1,arg2,...*)
procedure(*arg1,arg2,...*)/*m*

Executes the named procedure with the given arguments. Arguments can be register names, integer, character, or string constants, or names of variables accessible from the current procedure. The second form causes the value returned by the procedure to be printed according to format *m*. If no format is given, it defaults to d.

linenumber b *commands*

Sets a breakpoint at the given line. If a procedure name without a line number is given (e.g., *proc*:), a breakpoint is placed at the first line in the procedure even if it was not compiled with the -g option. If no *linenumber* is given, a breakpoint is placed at the current line. If no *commands* are given, execution stops at the breakpoint and control is returned to sdb. Otherwise the *commands* are executed when the breakpoint is encountered. Multiple commands are specified by separating them with semicolons. Nested associated commands are not permitted; setting breakpoints within the associated environments is permitted.

B Prints a list of the currently active breakpoints.

linenumber d

Deletes a breakpoint at the given line. If no *linenumber* is given, then the breakpoints are deleted interactively. Each breakpoint location is printed and a line is read from the standard input. If the line begins with a y or d, then the breakpoint is deleted.

D Deletes all breakpoints.

l Prints the last executed line.

linenumber a

Announces a line number. If *linenumber* is of the form *proc*:*number*, the command effectively does a *linenumber*:b l;c. If *linenumber* is of the form *proc*:, the command effectively does a *proc*:b T;c.

Miscellaneous commands:

#*rest-of-line*
The *rest-of-line* represents comments that are ignored by `sdb`.

!*command*
The *command* is interpreted by `sh`.

`new-line`
If the previous command printed a source line, then advance the current line by one line and print the new current line. If the previous command displayed a memory location, then display the next memory location. If the previous command disassembled an instruction, then disassemble the next instruction.

`end-of-file character`
Scrolls the next 10 lines of instructions, source, or data depending on which was printed last. The end-of-file character is usually `control-d`.

< *filename*
Read commands from *filename* until the end of file is reached, and then continue to accept commands from standard input. Commands are echoed, preceded by two asterisks, just before being executed. This command may not be nested; < may not appear as a command in a file.

`M` Prints the address maps.

" *string* "
Prints the given string. The C escape sequences of the form *character*, *octaldigits*, or \\x*hexdigits* are recognized, where *character* is a nonnumeric character. The trailing quote may be omitted.

`q` Exits the debugger.

`V` Prints version stamping information.

SEE ALSO

`cc`(1), `signal`(2), `a.out`(4), `core`(4).
`ed`(1), `gcore`(1), `sh`(1) in the *User's Reference Manual*.
The "`sdb`" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

NOTES

The *objfile* argument is accessed directly for debugging information while the process is created via the `PATH` variable.

NAME

`size` – print section sizes in bytes of object files

SYNOPSIS

`size [ -F -f -n -o -V -x]` *files*

DESCRIPTION

The `size` command produces segment or section size information in bytes for each loaded section in ELF or COFF object files. `size` prints out the size of the text, data, and bss (uninitialized data) segments (or sections) and their total.

`size` processes ELF and COFF object files entered on the command line. If an archive file is input to the `size` command, the information for each object file in the archive is displayed.

When calculating segment information, the `size` command prints out the total file size of the non-writable segments, the total file size of the writable segments, and the total memory size of the writable segments minus the total file size of the writable segments.

If it cannot calculate segment information, `size` calculates section information. When calculating section information, it prints out the total size of sections that are allocatable, non-writable, and not NOBITS, the total size of the sections that are allocatable, writable, and not NOBITS, and the total size of the writable sections of type NOBITS. (NOBITS sections do not actually take up space in the *file*.)

If `size` cannot calculate either segment or section information, it prints an error message and stops processing the file.

`-F` Prints out the size of each loadable segment, the permission flags of the segment, then the total of the loadable segment sizes. If there is no segment data, `size` prints an error message and stops processing the file.

`-f` Prints out the size of each allocatable section, the name of the section, and the total of the section sizes. If there is no section data, `size` prints out an error message and stops processing the file.

`-n` Prints out non-loadable segment or non-allocatable section sizes. If segment data exists, `size` prints out the memory size of each loadable segment or file size of each non-loadable segment, the permission flags, and the total size of the segments. If there is no segment data, `size` prints out, for each allocatable and non-allocatable section, the memory size, the section name, and the total size of the sections. If there is no segment or section data, `size` prints an error message and stops processing.

`-o` Prints numbers in octal, not decimal.

`-V` Prints the version information for the `size` command on the standard error output.

`-x` Prints numbers in hexadecimal; not decimal.

EXAMPLES

The examples below are typical `size` output.

`size` *file*	`2724 + 88 + 0 = 2812`
`size -f` *file*	`26(.text) + 5(.init) + 5(.fini) = 36`
`size -F` *file*	`2724(r-x) + 88(rwx) + 0(rwx) = 2812`

SEE ALSO

`as(1)`, `cc(1)`, `ld(1)`, `a.out(4)`, `ar(4)`.

NOTES

Since the size of bss sections is not known until link-edit time, the `size` command will not give the true total size of pre-linked objects.

NAME

strip – strip symbol table, debugging and line number information from an object file.

SYNOPSIS

strip [-blrVx] *file* ...

DESCRIPTION

The strip command strips the symbol table, debugging information, and line number information from ELF object files; COFF object files can no longer be stripped. Once this stripping process has been done, no symbolic debugging access will be available for that file; therefore, this command is normally run only on production modules that have been debugged and tested.

If strip is executed on a common archive file [see ar(4)] in addition to processing the members, strip will remove the archive symbol table. The archive symbol table must be restored by executing the ar(1) command with the –s option before the archive can be linked by the ld(1) command. strip will produce appropriate warning messages when this situation arises.

The amount of information stripped from the ELF object file can be controlled by using any of the following options:

–b Same effect as the default behavior. This option is obsolete and will be removed in the next release.

–l Strip line number information only; do not strip the symbol table or debugging information.

–r Same effect as the default behavior. This option is obsolete and will be removed in the next release.

–V Print, on standard error, the version number of strip.

–x Do not strip the symbol table; debugging and line number information may be stripped.

strip is used to reduce the file storage overhead taken by the object file.

FILES

TMPDIR/strp*	temporary files
TMPDIR	usually /usr/tmp but can be redefined by setting the environment variable TMPDIR [see tempnam() in tmpnam(3S)].

SEE ALSO

ar(1), as(1), cc(1), ld(1), tmpnam(3S), a.out(4), ar(4).

NOTES

The symbol table section will not be removed if it is contained within a segment, or the file is either a relocatable or dynamic shared object.

The line number and debugging sections will not be removed if they are contained within a segment, or their associated relocation section is contained within a segment.

NAME

`tsort` – topological sort

SYNOPSIS

`tsort` [*file*]

DESCRIPTION

The `tsort` command produces on the standard output a totally ordered list of items consistent with a partial ordering of items mentioned in the input *file*. If no *file* is specified, the standard input is understood.

The input consists of pairs of items (nonempty strings) separated by blanks. Pairs of different items indicate ordering. Pairs of identical items indicate presence, but not ordering.

SEE ALSO

`lorder`(1).

DIAGNOSTICS

`Odd data`: there is an odd number of fields in the input file.

NAME

unget – undo a previous get of an SCCS file

SYNOPSIS

`unget [-rSID] [-s] [-n]` *files*

DESCRIPTION

unget undoes the effect of a get -e done prior to creating the intended new delta. If a directory is named, unget behaves as though each file in the directory were specified as a named file, except that non-SCCS files and unreadable files are silently ignored. If a name of – is given, the standard input is read with each line being taken as the name of an SCCS file to be processed.

Keyletter arguments apply independently to each named file.

-r*SID* Uniquely identifies which delta is no longer intended. (This would have been specified by get as the "new delta"). The use of this keyletter is necessary only if two or more outstanding gets for editing on the same SCCS file were done by the same person (login name). A diagnostic results if the specified *SID* is ambiguous, or if it is necessary and omitted on the command line.

-s Suppresses the printout, on the standard output, of the intended delta's *SID*.

-n Causes the retention of the gotten file, which would normally be removed from the current directory.

unget must be performed by the same user who performed the original get -e.

FILES

p-file [see **delta**(1)]

q-file [see **delta**(1)]

z-file [see **delta**(1)]

SEE ALSO

delta(1), **get**(1), **help**(1), **sact**(1).

DIAGNOSTICS

Use **help**(1) for explanations.

NAME

`val` – validate an SCCS file

SYNOPSIS

`val -`

`val` [`-s`] [`-r`*SID*] [`-m`*name*] [`-y`*type*] *files*

DESCRIPTION

`val` determines if the specified *file* is an SCCS file meeting the characteristics specified by the optional argument list. Arguments to `val` may appear in any order. The arguments consist of keyletter arguments, which begin with a –, and named files.

`val` has a special argument, –, which causes reading of the standard input until an end-of-file condition is detected. Each line read is independently processed as if it were a command line argument list.

`val` generates diagnostic messages on the standard output for each command line and file processed, and also returns a single 8-bit code on exit as described below.

The keyletter arguments are defined as follows. The effects of any keyletter argument apply independently to each named file on the command line.

`-s` The presence of this argument silences the diagnostic message normally generated on the standard output for any error that is detected while processing each named file on a given command line.

`-r`*SID* The argument value *SID* (SCCS identification string) is an SCCS delta number. A check is made to determine if the *SID* is ambiguous (e. g., `-r1` is ambiguous because it physically does not exist but implies 1.1, 1.2, etc., which may exist) or invalid (e. g., `r1.0` or `r1.1.0` are invalid because neither can exist as a valid delta number). If the *SID* is valid and not ambiguous, a check is made to determine if it actually exists.

`-m`*name* The argument value *name* is compared with the SCCS `%M%` keyword in *file*.

`-y`*type* The argument value *type* is compared with the SCCS `%Y%` keyword in *file*.

The 8-bit code returned by `val` is a disjunction of the possible errors; it can be interpreted as a bit string where (moving from left to right) set bits are interpreted as follows:

bit 0 = missing file argument
bit 1 = unknown or duplicate keyletter argument
bit 2 = corrupted SCCS file
bit 3 = cannot open file or file not SCCS
bit 4 = *SID* is invalid or ambiguous
bit 5 = *SID* does not exist
bit 6 = `%Y%`, `-y` mismatch
bit 7 = `%M%`, `-m` mismatch

`val` can process two or more files on a given command line and in turn can process multiple command lines (when reading the standard input). In these cases an aggregate code is returned: a logical OR of the codes generated for each command line and file processed.

SEE ALSO

`admin`(1), `delta`(1), `get`(1), `help`(1, `prs`(1).

DIAGNOSTICS

Use `help`(1) for explanations.

NOTES

`val` can process up to 50 files on a single command line.

NAME

vc – version control

SYNOPSIS

`vc [-a] [-t] [-c`*char*`] [-s]` [*keyword=value ... keyword=value*]

DESCRIPTION

This command is obsolete and will be removed in the next release.

The **vc** command copies lines from the standard input to the standard output under control of its arguments and of "control statements" encountered in the standard input. In the process of performing the copy operation, user-declared *keyword*s may be replaced by their string *value* when they appear in plain text and/or control statements.

The copying of lines from the standard input to the standard output is conditional, based on tests (in control statements) of keyword values specified in control statements or as **vc** command arguments.

A control statement is a single line beginning with a control character, except as modified by the `-t` keyletter (see below). The default control character is colon (`:`), except as modified by the `-c` keyletter (see below). Input lines beginning with a backslash (\) followed by a control character are not control lines and are copied to the standard output with the backslash removed. Lines beginning with a backslash followed by a non-control character are copied in their entirety.

A keyword is composed of 9 or less alphanumerics; the first must be alphabetic. A value is any ASCII string that can be created with **ed**; a numeric value is an unsigned string of digits. Keyword values may not contain blanks or tabs.

Replacement of keywords by values is done whenever a keyword surrounded by control characters is encountered on a version control statement. The **-a** keyletter (see below) forces replacement of keywords in all lines of text. An uninterpreted control character may be included in a value by preceding it with \. If a literal \ is desired, then it too must be preceded by \.

The following options are valid:

-a Forces replacement of keywords surrounded by control characters with their assigned value in all text lines and not just in **vc** statements.

`-t` All characters from the beginning of a line up to and including the first tab character are ignored for the purpose of detecting a control statement. If a control statement is found, all characters up to and including the tab are discarded.

-cchar Specifies a control character to be used in place of the "`:`" default.

-s Silences warning messages (not error) that are normally printed on the diagnostic output.

vc recognizes the following version control statements:

`:dcl` *keyword*[, ..., *keyword*]
Declare keywords. All keywords must be declared.

:**asg** *keyword=value*

Assign values to keywords. An **asg** statement overrides the assignment for the corresponding keyword on the **vc** command line and all previous **asg** statements for that keyword. Keywords that are declared but are not assigned values have null values.

:`if` *condition*

. . .

:**end**

Skip lines of the standard input. If the condition is true, all lines between the `if` statement and the matching **end** statement are copied to the standard output. If the condition is false, all intervening lines are discarded, including control statements. Note that intervening `if` statements and matching **end** statements are recognized solely for the purpose of maintaining the proper `if`-**end** matching.

The syntax of a condition is:

<cond>	::=	["not"] *<or>*
<or>	::=	*<and>* | *<and>* "|" *<or>*
<and>	::=	*<exp>* | *<exp>* "&" *<and>*
<exp>	::=	"(" *<or>* ")" | *<value>* *<op>* *<value>*
<op>	::=	"=" | "!=" | "<" | ">"
<value>	::=	*<arbitrary ASCII string>* | *<numeric string>*

The available operators and their meanings are:

=	equal
!=	not equal
&	and
|	or
>	greater than
<	less than
( )	used for logical groupings
not	may only occur immediately after the `if`, and when present, inverts the value of the entire condition

The > and < operate only on unsigned integer values (e.g., `: 012 > 12` is false). All other operators take strings as arguments (e.g., `: 012 != 12` is true).

The precedence of the operators (from highest to lowest) is:

= != > < all of equal precedence
&
|

Parentheses may be used to alter the order of precedence.

Values must be separated from operators or parentheses by at least one blank or tab.

: : *text*

Replace keywords on lines that are copied to the standard output. The two leading control characters are removed, and keywords surrounded by control characters in text are replaced by their value before the line is copied to the output file. This action is independent of the -a keyletter.

:on
:off Turn on or off keyword replacement on all lines.

:ctl *char*

Change the control character to *char*.

:msg *message*

Print *message* on the diagnostic output.

:err *message*

Print *message* followed by:

```
ERROR: err statement on line ... (915)
```

on the diagnostic output. vc halts execution, and returns an exit code of 1.

SEE ALSO

help(1).
ed(1) in the *User's Reference Manual.*

NAME

what – print identification strings

SYNOPSIS

`what [-s]` *files*

DESCRIPTION

what searches the given files for all occurrences of the pattern that the **get** command substitutes for `%Z%` (this is `@(#)` at this printing) and prints out what follows until the first ", >, new-line, \, or null character. For example, if the C program in file `f.c` contains

`#ident "@(#)`*identification information*`"`

and `f.c` is compiled to yield `f.o` and `a.out`, then the command

```
what f.c f.o a.out
```

prints

`f.c:`
identification information

`f.o:`
identification information

`a.out:`
identification information

what is intended to be used in conjunction with the **get** command, which automatically inserts identifying information, but it can also be used where the information is inserted manually. Only one option exists:

-s Quit after finding the first occurrence of pattern in each file.

SEE ALSO

get(1), **help**(1), **mcs**(1).

DIAGNOSTICS

Exit status is 0 if any matches are found, otherwise 1. See **help**(1) for explanations.

NAME

yacc – yet another compiler-compiler

SYNOPSIS

`yacc [-vVdlt] [-Q[y|n]]` *file*

DESCRIPTION

The **yacc** command converts a context-free grammar into a set of tables for a simple automaton that executes an LALR(1) parsing algorithm. The grammar may be ambiguous; specified precedence rules are used to break ambiguities.

The output file, `y.tab.c`, must be compiled by the C compiler to produce a program **yyparse**. This program must be loaded with the lexical analyzer program, **yylex**, as well as **main** and **yyerror**, an error handling routine. These routines must be supplied by the user; the **lex**(1) command is useful for creating lexical analyzers usable by **yacc**.

`-v` Prepares the file `y.output`, which contains a description of the parsing tables and a report on conflicts generated by ambiguities in the grammar.

`-d` Generates the file `y.tab.h` with the `#define` statements that associate the **yacc**-assigned "token codes" with the user-declared "token names." This association allows source files other than `y.tab.c` to access the token codes.

`-l` Specifies that the code produced in `y.tab.c` will not contain any `#line` constructs. This option should only be used after the grammar and the associated actions are fully debugged.

`-Q[y|n]` The `-Qy` option puts the version stamping information in `y.tab.c`. This allows you to know what version of **yacc** built the file. The `-Qn` option (the default) writes no version information.

`-t` Compiles runtime debugging code by default. Runtime debugging code is always generated in `y.tab.c` under conditional compilation control. By default, this code is not included when `y.tab.c` is compiled. Whether or not the `-t` option is used, the runtime debugging code is under the control of **YYDEBUG**, a preprocessor symbol. If **YYDEBUG** has a non-zero value, then the debugging code is included. If its value is zero, then the code will not be included. The size and execution time of a program produced without the runtime debugging code will be smaller and slightly faster.

`-V` Prints on the standard error output the version information for **yacc**.

FILES

`y.output`	
`y.tab.c`	
`y.tab.h`	defines for token names
`yacc.tmp`,	
`yacc.debug`, `yacc.acts`	temporary files

LIBDIR/yaccpar	parser prototype for C programs
LIBDIR	usually /usr/ccs/lib

SEE ALSO

lex(1).
The "yacc" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

DIAGNOSTICS

The number of reduce-reduce and shift-reduce conflicts is reported on the standard error output; a more detailed report is found in the y.output file. Similarly, if some rules are not reachable from the start symbol, this instance is also reported.

NOTES

Because file names are fixed, at most one yacc process can be active in a given directory at a given time.

SYSTEM CALLS (2)

NAME

`intro` – introduction to system calls and error numbers

SYNOPSIS

`#include <errno.h>`

DESCRIPTION

This section describes all of the system calls. Most of these calls have one or more error returns. An error condition is indicated by an otherwise impossible returned value. This is almost always −1 or the NULL pointer; the individual descriptions specify the details. An error number is also made available in the external variable *errno*. *errno* is not cleared on successful calls, so it should be tested only after an error has been indicated.

Each system call description attempts to list all possible error numbers. The following is a complete list of the error numbers and their names as defined in `<errno.h>`.

1 EPERM Not owner
: Typically this error indicates an attempt to modify a file in some way forbidden except to its owner or super-user. It is also returned for attempts by ordinary users to do things allowed only to the super-user.

2 ENOENT No such file or directory
: This error occurs when a file name is specified and the file should exist but doesn't, or when one of the directories in a path name does not exist.

3 ESRCH No such process
: No process can be found corresponding to that specified by *pid* in `kill`(2) or `ptrace`(2).

4 EINTR Interrupted system call
: An asynchronous signal (such as interrupt or quit), which the user has elected to catch, occurred during a system call. If execution is resumed after processing the signal, it will appear as if the interrupted system call returned this error condition.

5 EIO I/O error
: Some physical I/O error has occurred. This error may in some cases occur on a call following the one to which it actually applies.

6 ENXIO No such device or address
: I/O on a special file refers to a subdevice which does not exist, or beyond the limits of the device. It may also occur when, for example, a tape drive is not on-line or no disk pack is loaded on a drive.

7 E2BIG Arg list too long
: An argument list longer than 5,120 bytes is presented to a member of the `exec`(2) family.

8 ENOEXEC Exec format error
: A request is made to execute a file which, although it has the appropriate permissions, does not start with a valid magic number [see `a.out`(4)].

9 EBADF Bad file number
: Either a file descriptor refers to no open file, or a `read`(2) [respectively, `write`(2)] request is made to a file which is open only for writing (respectively, reading).

10 ECHILD No child processes
: A `wait` was executed by a process that had no existing or unwaited-for child processes.

11 EAGAIN No more processes
: A `fork` failed because the system's process table is full or the user is not allowed to create any more processes. Or a system call failed because of insufficient memory or swap space.

12 ENOMEM Not enough space
: During an `exec`(2), `brk`(2), or `sbrk`(2), a program asks for more space than the system is able to supply. This may not be a temporary condition; the maximum space size is a system parameter. The error may also occur if the arrangement of text, data, and stack segments requires too many segmentation registers, or if there is not enough swap space during a `fork`(2). If this error occurs on a resource associated with Remote File Sharing (RFS), it indicates a memory depletion wich may be temporary, dependent on system activity at the time the call was invoked.

13 EACCES Permission denied
: An attempt was made to access a file in a way forbidden by the protection system.

14 EFAULT Bad address
: The system encountered a hardware fault in attempting to use an argument of a system call.

15 ENOTBLK Block device required
: A non-block file was mentioned where a block device was required, e.g., in `mount`(2).

16 EBUSY Device or resource busy
: An attempt was made to mount a device that was already mounted or an attempt was made to dismount a device on which there is an active file (open file, current directory, mounted-on file, active text segment). It will also occur if an attempt is made to enable accounting when it is already enabled. The device or resource is currently unavailable.

17 EEXIST File exists
: An existing file was mentioned in an inappropriate context, e.g., `link`(2).

18 EXDEV Cross-device link
: A link to a file on another device was attempted.

19 ENODEV No such device
: An attempt was made to apply an inappropriate system call to a device; e.g., read a write-only device.

20 ENOTDIR Not a directory
A non-directory was specified where a directory is required, for example in a path prefix or as an argument to `chdir`(2).

21 EISDIR Is a directory
An attempt was made to write on a directory.

22 EINVAL Invalid argument
Some invalid argument (e.g., dismounting a non-mounted device; mentioning an undefined signal in `signal`(2) or `kill`(2); reading or writing a file for which `lseek`(2) has generated a negative pointer). Also set by the math functions described in the (3M) entries of this manual.

23 ENFILE File table overflow
The system file table is full, and temporarily no more *opens* can be accepted.

24 EMFILE Too many open files
No process may have more than NOFILES (default 20) descriptors open at a time.

25 ENOTTY Not a character device (or) Not a typewriter
An attempt was made to `ioctl`(2) a file that is not a special character device.

26 ETXTBSY Text file busy
An attempt was made to execute a pure-procedure program that is currently open for writing. Also an attempt to open for writing or to remove a pure-procedure program that is being executed.

27 EFBIG File too large
The size of a file exceeded the maximum file size or ULIMIT [see `ulimit`(2)].

28 ENOSPC No space left on device
During a `write`(2) to an ordinary file, there is no free space left on the device. In `fcntl`(2), the setting or removing of record locks on a file cannot be accomplished because there are no more record entries left on the system.

29 ESPIPE Illegal seek
An `lseek`(2) was issued to a pipe.

30 EROFS Read-only file system
An attempt to modify a file or directory was made on a device mounted read-only.

31 EMLINK Too many links
An attempt to make more than the maximum number of links (1000) to a file.

32 EPIPE Broken pipe
A write on a pipe for which there is no process to read the data. This condition normally generates a signal; the error is returned if the signal is ignored.

33 EDOM Math argument
The argument of a function in the math package (3M) is out of the domain of the function.

34 ERANGE Result too large
The value of a function in the math package (3M) is not representable within machine precision.

35 ENOMSG No message of desired type
An attempt was made to receive a message of a type that does not exist on the specified message queue [see `msgop`(2)].

36 EIDRM Identifier removed
This error is returned to processes that resume execution due to the removal of an identifier from the file system's name space [see `msgctl`(2), `semctl`(2), and `shmctl`(2)].

37-44 Reserved numbers

45 EDEADLK Deadlock
A deadlock situation was detected and avoided. This error pertains to file and record locking.

46 ENOLCK No lock
In `fcntl`(2) the setting or removing of record locks on a file cannot be accomplished because there are no more record entries left on the system.

60 ENOSTR Not a stream
A `putmsg`(2) or `getmsg`(2) system call was attempted on a file descriptor that is not a STREAMS device.

62 ETIME Stream ioctl timeout
The timer set for a STREAMS `ioctl`(2) call has expired. The cause of this error is device specific and could indicate either a hardware or software failure, or perhaps a timeout value that is too short for the specific operation. The status of the `ioctl`(2) operation is indeterminate.

63 ENOSR No stream resources
Insufficient STREAMS memory resources are available to perform a STREAMS related system call. This is a non-recoverable error and requires the system to be reconfigured with additional STREAMS memory resources.

64 ENONET Machine is not on the network
This error is Remote File Sharing (RFS) specific. It occurs when users try to advertise, unadvertise, mount, or unmount remote resources while the machine has not done the proper startup to connect to the network.

65 ENOPKG No package
This error occurs when users attempt to use a system call from a package which has not been installed.

66 EREMOTE Resource is remote
This error is RFS specific. It occurs when users try to advertise a resource which is not on the local machine, or try to mount/unmount a device (or pathname) that is on a remote machine.

67 ENOLINK Virtual circuit is gone
This error is RFS specific. It occurs when the link (virtual circuit) connecting to a remote machine is gone.

68 EADV Advertise error
This error is RFS specific. It occurs when users try to advertise a resource which has been advertised already, or try to stop the RFS while there are resources still advertised, or try to force unmount a resource when it is still advertised.

69 ESRMNT Srmount error
This error is RFS specific. It occurs when users try to stop RFS while there are resources still mounted by remote machines.

70 ECOMM Communication error
This error is RFS specific. It occurs when trying to send messages to remote machines but no virtual circuit can be found.

71 EPROTO Protocol error
Some protocol error occurred. This error is device specific, but is generally not related to a hardware failure.

74 EMULTIHOP Multihop attempted
This error is RFS specific. It occurs when users try to access remote resources which are not directly accessible.

77 EBADMSG Bad message
During a `read`(2), `getmsg`(2), or `ioctl`(2) I_RECVFD system call to a STREAMS device, something has come to the head of the queue that can't be processed. That something depends on the system call:
`read`(2) - control information or a passed file descriptor.
`getmsg`(2) - passed file descriptor.
`ioctl`(2) - control or data information.

83 ELIBACC Cannot access a needed shared library
Trying to **exec**(2) an `a.out` that requires a shared library (to be linked in) and the shared library doesn't exist or the user doesn't have permission to use it.

84 ELIBBAD Accessing a corrupted shared library
Trying to **exec**(2) an `a.out` that requires a shared library (to be linked in) and **exec**(2) could not load the shared library. The shared library is probably corrupted.

85 ELIBSCN .lib section in `a.out` corrupted
Trying to **exec**(2) an `a.out` that requires a shared library (to be linked in) and there was erroneous data in the .lib section of the `a.out`. The .lib section tells **exec**(2) what shared libraries are needed. The `a.out` is probably corrupted.

86 ELIBMAX Attempting to link in more shared libraries than system limit
Trying to **exec**(2) an `a.out` that requires more shared libraries (to be linked in) than is allowed on the current configuration of the system. See the *System Administrator's Guide.*

87 ELIBEXEC Cannot exec a shared library directly
Trying to **exec**(2) a shared library directly. This is not allowed.

DEFINITIONS

Process ID Each active process in the system is uniquely identified by a positive integer called a process ID. The range of this ID is from 1 to 30,000.

Parent Process ID A new process is created by a currently active process [see `fork`(2)]. The parent process ID of a process is the process ID of its creator.

Process Group ID Each active process is a member of a process group that is identified by a positive integer called the process group ID. This ID is the process ID of the group leader. This grouping permits the signaling of related processes [see `kill`(2)].

Tty Group ID Each active process can be a member of a terminal group that is identified by a positive integer called the tty group ID. This grouping is used to terminate a group of related processes upon termination of one of the processes in the group [see `exit`(2) and `signal`(2)].

Real User ID and Real Group ID Each user allowed on the system is identified by a positive integer (0 to 65535) called a real user ID.

Each user is also a member of a group. The group is identified by a positive integer called the real group ID.

An active process has a real user ID and real group ID that are set to the real user ID and real group ID, respectively, of the user responsible for the creation of the process.

Effective User ID and Effective Group ID An active process has an effective user ID and an effective group ID that are used to determine file access permissions (see below). The effective user ID and effective group ID are equal to the process's real user ID and real group ID respectively, unless the process or one of its ancestors evolved from a file that had the set-user-ID bit or set-group ID bit set [see **exec**(2)].

Super-user A process is recognized as a *super-user* process and is granted special privileges, such as immunity from file permissions, if its effective user ID is 0.

Special Processes The processes with a process ID of 0 and a process ID of 1 are special processes and are referred to as *proc0* and *proc1*.

proc0 is the scheduler. *proc1* is the initialization process (*init*). *proc1* is the ancestor of every other process in the system and is used to control the process structure.

File Descriptor A file descriptor is a small integer used to do I/O on a file. The value of a file descriptor is from 0 to (NOFILES - 1). A process may have no more than NOFILES file descriptors open simultaneously. A file descriptor is returned by system calls such as open(2), or pipe(2). The file descriptor is used as an argument by calls such as read(2), write(2), ioctl(2), and close(2).

File Name Names consisting of 1 to 14 characters may be used to name an ordinary file, special file or directory.

These characters may be selected from the set of all character values excluding \0 (null) and the ASCII code for / (slash).

Note that it is generally unwise to use *, ?, [, or] as part of file names because of the special meaning attached to these characters by the shell [see sh(1)]. Although permitted, the use of unprintable characters in file names should be avoided.

Path Name and Path Prefix A path name is a null-terminated character string starting with an optional slash (/), followed by zero or more directory names separated by slashes, optionally followed by a file name.

If a path name begins with a slash, the path search begins at the *root* directory. Otherwise, the search begins from the current working directory.

A slash by itself names the root directory.

Unless specifically stated otherwise, the null path name is treated as if it named a non-existent file.

Directory Directory entries are called links. By convention, a directory contains at least two links, . and .., referred to as *dot* and *dot-dot* respectively. Dot refers to the directory itself and dot-dot refers to its parent directory.

Root Directory and Current Working Directory Each process has associated with it a concept of a root directory and a current working directory for the purpose of resolving path name searches. The root directory of a process need not be the root directory of the root file system.

File Access Permissions Read, write, and execute/search permissions on a file are granted to a process if one or more of the following are true:

> The effective user ID of the process is super-user.
>
> The effective user ID of the process matches the user ID of the owner of the file and the appropriate access bit of the "owner" portion (0700) of the file mode is set.

The effective user ID of the process does not match the user ID of the owner of the file, and the effective group ID of the process matches the group of the file and the appropriate access bit of the "group" portion (0070) of the file mode is set.

The effective user ID of the process does not match the user ID of the owner of the file, and the effective group ID of the process does not match the group ID of the file, and the appropriate access bit of the "other" portion (0007) of the file mode is set.

Otherwise, the corresponding permissions are denied.

Message Queue Identifier A message queue identifier (msqid) is a unique positive integer created by a `msgget(2)` system call. Each msqid has a message queue and a data structure associated with it. The data structure is referred to as `msqid_ds` and contains the following members:

```
struct ipc_perm msg_perm;
struct msg *msg_first;
struct msg *msg_last;
ushort msg_cbytes;
ushort msg_qnum;
ushort msg_qbytes;
ushort msg_lspid;
ushort msg_lrpid;
time_t msg_stime;
time_t msg_rtime;
time_t msg_ctime;
```

`msg_perm` is an ipc_perm structure that specifies the message operation permission (see below). This structure includes the following members:

```
ushort cuid;      /* creator user id */
ushort cgid;      /* creator group id */
ushort uid;       /* user id */
ushort gid;       /* group id */
ushort mode;      /* r/w permission */
ushort seq;       /* slot usage sequence # */
key_t  key;       /* key */
```

`msg *msg_first`
: is a pointer to the first message on the queue.

`msg *msg_last`
: is a pointer to the last message on the queue.

`msg_cbytes`
: is the current number of bytes on the queue.

`msg_qnum`
: is the number of messages currently on the queue.

`msg_qbytes`
: is the maximum number of bytes allowed on the queue.

`msg_lspid`
: is the process id of the last process that performed a **msgsnd** operation.

`msg_lrpid`
: is the process id of the last process that performed a **msgrcv** operation.

`msg_stime`
: is the time of the last **msgsnd** operation.

`msg_rtime`
: is the time of the last **msgrcv** operation.

`msg_ctime`
: is the time of the last `msgctl(2)` operation that changed a member of the above structure.

Message Operation Permissions In the **msgop**(2) and `msgctl(2)` system call descriptions, the permission required for an operation is given as "{token}", where "token" is the type of permission needed, interpreted as follows:

00400	Read by user
00200	Write by user
00040	Read by group
00020	Write by group
00004	Read by others
00002	Write by others

Read and write permissions on a msqid are granted to a process if one or more of the following are true:

The effective user ID of the process is super-user.

The effective user ID of the process matches `msg_perm.cuid` or `msg_perm.uid` in the data structure associated with *msqid* and the appropriate bit of the "user" portion (0600) of `msg_perm.mode` is set.

The effective group ID of the process matches `msg_perm.cgid` or `msg_perm.gid` and the appropriate bit of the "group" portion (060) of `msg_perm.mode` is set.

The appropriate bit of the "other" portion (006) of `msg_perm.mode` is set.

Otherwise, the corresponding permissions are denied.

Semaphore Identifier A semaphore identifier (semid) is a unique positive integer created by a `semget(2)` system call. Each semid has a set of semaphores and a data structure associated with it. The data structure is referred to as `semid_ds` and contains the following members:

```
struct ipc_perm sem_perm;/* operation permission struct */
struct sem *sem_base;    /* ptr to first semaphore in set */
ushort sem_nsems;        /* number of sems in set */
time_t sem_otime;        /* last operation time */
```

```
time_t sem_ctime;          /* last change time */
                           /* Times measured in secs since */
                           /* 00:00:00 GMT, Jan. 1, 1970 */
```

sem_perm is an ipc_perm structure that specifies the semaphore operation permission (see below). This structure includes the following members:

```
ushort uid;      /* user id */
ushort gid;      /* group id */
ushort cuid;     /* creator user id */
ushort cgid;     /* creator group id */
ushort mode;     /* r/a permission */
ushort seq;      /* slot usage sequence number */
key_t  key;      /* key */
```

sem_nsems
is equal to the number of semaphores in the set. Each semaphore in the set is referenced by a positive integer referred to as a *sem_num*. *sem_num* values run sequentially from 0 to the value of sem_nsems minus 1.

sem_otime
is the time of the last **semop**(2) operation.

sem_ctime
is the time of the last **semctl**(2) operation that changed a member of the above structure.

A semaphore is a data structure called *sem* that contains the following members:

```
ushort semval;    /* semaphore value */
short  sempid;    /* pid of last operation  */
ushort semncnt;   /* # awaiting semval > cval */
ushort semzcnt;   /* # awaiting semval = 0 */
```

semval
is a non-negative integer which is the actual value of the semphore.

sempid
is equal to the process ID of the last process that performed a semaphore operation on this semaphore.

semncnt
is a count of the number of processes that are currently suspended awaiting this semaphore's semval to become greater than its current value.

semzcnt
is a count of the number of processes that are currently suspended awaiting this semaphore's semval to become zero.

Semaphore Operation Permissions In the semop(2) and semctl(2) system call descriptions, the permission required for an operation is given as "{token}", where "token" is the type of permission needed interpreted as follows:

00400	Read by user
00200	Alter by user
00040	Read by group
00020	Alter by group
00004	Read by others
00002	Alter by others

Read and alter permissions on a semid are granted to a process if one or more of the following are true:

The effective user ID of the process is super-user.

The effective user ID of the process matches sem_perm.cuid or sem_perm.uid in the data structure associated with *semid* and the appropriate bit of the "user" portion (0600) of sem_perm.mode is set.

The effective group ID of the process matches sem_perm.cgid or sem_perm.gid and the appropriate bit of the "group" portion (060) of sem_perm.mode is set.

The appropriate bit of the "other" portion (006) of sem_perm.mode is set.

Otherwise, the corresponding permissions are denied.

Shared Memory Identifier A shared memory identifier (shmid) is a unique positive integer created by a shmget(2) system call. Each shmid has a segment of memory (referred to as a shared memory segment) and a data structure associated with it. (Note that these shared memory segments must be explicitly removed by the user after the last reference to them is removed.) The data structure is referred to as shmid_ds and contains the following members:

```
struct ipc_perm shm_perm;/* operation permission struct */
int     shm_segsz;       /* size of segment */
struct region *shm_reg;  /*ptr to region structure */
char    pad[4];          /* for swap compatibility */
ushort  shm_lpid;        /* pid of last operation */
ushort  shm_cpid;        /* creator pid */
ushort  shm_nattch;      /* number of current attaches */
ushort  shm_cnattch;     /* used only for shminfo */
time_t  shm_atime;       /* last attach time */
time_t  shm_dtime;       /* last detach time */
time_t  shm_ctime;       /* last change time */
                         /* Times measured in secs since */
                         /* 00:00:00 GMT, Jan. 1, 1970 */
```

shm_perm is an ipc_perm structure that specifies the shared memory operation permission (see below). This structure includes the following members:

```
ushort cuid;     /* creator user id */
ushort cgid;     /* creator group id */
ushort uid;      /* user id */
ushort gid;      /* group id */
ushort mode;     /* r/w permission */
ushort seq;      /* slot usage sequence # */
key_t  key;      /* key */
```

`shm_segsz` specifies the size of the shared memory segment in bytes.

`shm_cpid` is the process id of the process that created the shared memory identifier.

`shm_lpid` is the process id of the last process that performed a `shmop`(2) operation.

`shm_nattch` is the number of processes that currently have this segment attached.

`shm_atime` is the time of the last `shmat` operation.

`shm_dtime` is the time of the last `shmdt` operation.

`shm_ctime` is the time of the last `shmctl`(2) operation that changed one of the members of the above structure.

Shared Memory Operation Permissions In the `shmop`(2) and `shmctl`(2) system call descriptions, the permission required for an operation is given as "{token}", where "token" is the type of permission needed interpreted as follows:

00400	Read by user
00200	Write by user
00040	Read by group
00020	Write by group
00004	Read by others
00002	Write by others

Read and write permissions on a shmid are granted to a process if one or more of the following are true:

The effective user ID of the process is super-user.

The effective user ID of the process matches `shm_perm.cuid` or `shm_perm.uid` in the data structure associated with *shmid* and the appropriate bit of the "user" portion (0600) of `shm_perm.mode` is set.

The effective group ID of the process matches `shm_perm.cgid` or `shm_perm.gid` and the appropriate bit of the "group" portion (060) of `shm_perm.mode` is set.

The appropriate bit of the "other" portion (06) of `shm_perm.mode` is set.

Otherwise, the corresponding permissions are denied.

STREAMS A set of kernel mechanisms that support the development of network services and data communication *drivers*. It defines interface standards for character input/output within the kernel and between the kernel and user level processes. The STREAMS mechanism is composed of utility routines, kernel facilities and a set of data structures.

Stream A stream is a full-duplex data path within the kernel between a user process and driver routines. The primary components are a *stream head,* a *driver* and zero or more *modules* between the *stream head* and *driver.* A *stream* is analogous to a Shell pipeline except that data flow and processing are bidirectional.

Stream Head In a *stream,* the *stream head* is the end of the *stream* that provides the interface between the *stream* and a user process. The principle functions of the *stream head* are processing STREAMS-related system calls, and passing data and information between a user process and the *stream.*

Driver In a *stream,* the *driver* provides the interface between peripheral hardware and the *stream.* A *driver* can also be a pseudo-*driver,* such as a *multiplexor* or log *driver* [see log(7)], which is not associated with a hardware device.

Module A module is an entity containing processing routines for input and output data. It always exists in the middle of a *stream,* between the stream's head and a *driver.* A *module* is the STREAMS counterpart to the commands in a shell pipeline except that a module contains a pair of functions which allow independent bidirectional (*downstream* and *upstream*) data flow and processing.

Downstream In a *stream,* the direction from *stream head* to *driver.*

Upstream In a *stream,* the direction from *driver* to *stream head.*

Message In a *stream,* one or more blocks of data or information, with associated STREAMS control structures. *Messages* can be of several defined types, which identify the *message* contents. *Messages* are the only means of transferring data and communicating within a *stream.*

Message Queue In a *stream,* a linked list of *messages* awaiting processing by a *module* or *driver.*

Read Queue In a *stream,* the *message queue* in a *module* or *driver* containing *messages* moving *upstream.*

Write Queue In a *stream,* the *message queue* in a *module* or *driver* containing *messages* moving *downstream.*

Multiplexor A multiplexor is a driver that allows *streams* associated with several user processes to be connected to a single *driver*, or several *drivers* to be connected to a single user process. STREAMS does not provide a general multiplexing *driver*, but does provide the facilities for constructing them, and for connecting multiplexed configurations of *streams*.

SEE ALSO

`intro`(3).

NAME

access – determine accessibility of a file

SYNOPSIS

```
int access (path, amode)
char *path;
int amode;
```

DESCRIPTION

path points to a path name naming a file. **access** checks the named file for accessibility according to the bit pattern contained in *amode*, using the real user ID in place of the effective user ID and the real group ID in place of the effective group ID. The bit pattern contained in *amode* is constructed as follows:

04	read
02	write
01	execute (search)
00	check existence of file

Access to the file is denied if one or more of the following are true:

[ENOTDIR]	A component of the path prefix is not a directory.
[ENOENT]	Read, write, or execute (search) permission is requested for a null path name.
[ENOENT]	The named file does not exist.
[EACCES]	Search permission is denied on a component of the path prefix.
[EROFS]	Write access is requested for a file on a read-only file system.
[ETXTBSY]	Write access is requested for a pure procedure (shared text) file that is being executed.
[EACCES]	Permission bits of the file mode do not permit the requested access.
[EFAULT]	*path* points outside the allocated address space for the process.
[EINTR]	A signal was caught during the **access** system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

The owner of a file has permission checked with respect to the "owner" read, write, and execute mode bits. Members of the file's group other than the owner have permissions checked with respect to the "group" mode bits, and all others have permissions checked with respect to the "other" mode bits.

SEE ALSO

chmod(2), stat(2).

DIAGNOSTICS

If the requested access is permitted, a value of 0 is returned. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

NAME

acct – enable or disable process accounting

SYNOPSIS

```
int acct (path)
char *path;
```

DESCRIPTION

acct is used to enable or disable the system process accounting routine. If the routine is enabled, an accounting record will be written on an accounting file for each process that terminates. Termination can be caused by one of two things: an exit call or a signal [see exit(2) and signal(2)]. The effective user ID of the calling process must be superuser to use this call.

path points to a pathname naming the accounting file. The accounting file format is given in acct(4).

The accounting routine is enabled if *path* is non-zero and no errors occur during the system call. It is disabled if *path* is zero and no errors occur during the system call.

acct will fail if one or more of the following are true:

[EPERM]	The effective user of the calling process is not superuser.
[EBUSY]	An attempt is being made to enable accounting when it is already enabled.
[ENOTDIR]	A component of the path prefix is not a directory.
[ENOENT]	One or more components of the accounting file pathname do not exist.
[EACCES]	The file named by *path* is not an ordinary file.
[EROFS]	The named file resides on a read-only file system.
[EFAULT]	*path* points to an illegal address.

SEE ALSO

exit(2), signal(2), acct(4).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

alarm – set a process alarm clock

SYNOPSIS

```
unsigned alarm (sec)
unsigned sec;
```

DESCRIPTION

alarm instructs the alarm clock of the calling process to send the signal SIGALRM to the calling process after the number of real time seconds specified by *sec* have elapsed [see **signal**(2)].

Alarm requests are not stacked; successive calls reset the alarm clock of the calling process.

If *sec* is 0, any previously made alarm request is canceled.

SEE ALSO

pause(2), **signal**(2), **sigpause**(2), **sigset**(2).

DIAGNOSTICS

alarm returns the amount of time previously remaining in the alarm clock of the calling process.

NAME

brk, sbrk – change data segment space allocation

SYNOPSIS

```
int brk (endds)
char *endds;
char *sbrk (incr)
int incr;
```

DESCRIPTION

brk and sbrk are used to change dynamically the amount of space allocated for the calling process's data segment [see exec(2)]. The change is made by resetting the process's break value and allocating the appropriate amount of space. The break value is the address of the first location beyond the end of the data segment. The amount of allocated space increases as the break value increases. Newly allocated space is set to zero. If, however, the same memory space is reallocated to the same process its contents are undefined.

brk sets the break value to *endds* and changes the allocated space accordingly.

sbrk adds *incr* bytes to the break value and changes the allocated space accordingly. *incr* can be negative, in which case the amount of allocated space is decreased.

brk and sbrk will fail without making any change in the allocated space if one or more of the following are true:

[ENOMEM] Such a change would result in more space being allocated than is allowed by the system-imposed maximum process size [see ulimit(2)].

[EAGAIN] Total amount of system memory available for a read during physical IO is temporarily insufficient [see shmop(2)]. This may occur even though the space requested was less than the system-imposed maximum process size [see ulimit(2)].

SEE ALSO

exec(2), shmop(2), ulimit(2), end(3C).

DIAGNOSTICS

Upon successful completion, brk returns a value of 0 and sbrk returns the old break value. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

chdir – change working directory

SYNOPSIS

```
int chdir (path)
char *path;
```

DESCRIPTION

path points to the path name of a directory. `chdir` causes the named directory to become the current working directory, the starting point for path searches for path names not beginning with /.

`chdir` will fail and the current working directory will be unchanged if one or more of the following are true:

[ENOTDIR]	A component of the path name is not a directory.
[ENOENT]	The named directory does not exist.
[EACCES]	Search permission is denied for any component of the path name.
[EFAULT]	*path* points outside the allocated address space of the process.
[EINTR]	A signal was caught during the `chdir` system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

SEE ALSO

chroot(2).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

chmod – change mode of file

SYNOPSIS

```
int chmod (path, mode)
char *path;
int mode;
```

DESCRIPTION

path points to a path name naming a file. chmod sets the access permission portion of the named file's mode according to the bit pattern contained in *mode*.

Access permission bits are interpreted as follows:

04000	Set user ID on execution.
020#0	Set group ID on execution if # is 7, 5, 3, or 1 Enable mandatory file/record locking if # is 6, 4, 2, or 0
01000	Save text image after execution.
00400	Read by owner.
00200	Write by owner.
00100	Execute (search if a directory) by owner.
00070	Read, write, execute (search) by group.
00007	Read, write, execute (search) by others.

The effective user ID of the process must match the owner of the file or be super-user to change the mode of a file.

If the effective user ID of the process is not super-user and the file is not a directory, mode bit 01000 (save text image on execution) is cleared.

If the effective user ID of the process is not super-user and the effective group ID of the process does not match the group ID of the file, mode bit 02000 (set group ID on execution) is cleared.

If a 410 executable file has the sticky bit (mode bit 01000) set, the operating system will not delete the program text from the swap area when the last user process terminates. If a 413 executable file has the sticky bit set, the operating system will not delete the program text from memory when the last user process terminates. In either case, if the sticky bit is set the text will already be available (either in a swap area or in memory) when the next user of the file executes it, thus making execution faster.

If the executing process is not owned by the super-user, chmod will mask the sticky-bit but will not return an error.

If a directory is writable and has the sticky bit set, files within that directory can be removed only if one or more of the following is true [see unlink(2)]:

the user owns the file
the user owns the directory
the file is writable by the user
the user is the super-user

If the mode bit 02000 (set group ID on execution) is set and the mode bit 00010 (execute or search by group) is not set, mandatory file/record locking will exist on a regular file. This may effect future calls to open(2), creat(2), read(2), and write(2) on this file.

chmod will fail and the file mode will be unchanged if one or more of the following are true:

[ENOTDIR]	A component of the path prefix is not a directory.
[ENOENT]	The named file does not exist.
[EACCES]	Search permission is denied on a component of the path prefix.
[EPERM]	The effective user ID does not match the owner of the file and the effective user ID is not super-user.
[EROFS]	The named file resides on a read-only file system.
[EFAULT]	*path* points outside the allocated address space of the process.
[EINTR]	A signal was caught during the chmod system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

SEE ALSO

chown(2), creat(2), fcntl(2), mknod(2), open(2), read(2), write(2).
chmod(1) in the *User's Reference Manual*.

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

chown – change owner and group of a file

SYNOPSIS

```
int chown (path, owner, group)
char *path;
int owner, group;
```

DESCRIPTION

path points to a path name naming a file. The owner ID and group ID of the named file are set to the numeric values contained in *owner* and *group* respectively.

Only processes with effective user ID equal to the file owner or super-user may change the ownership of a file.

If chown is invoked by other than the super-user, the set-user-ID and set-group-ID bits of the file mode, 04000 and 02000 respectively, will be cleared.

chown will fail and the owner and group of the named file will remain unchanged if one or more of the following are true:

[ENOTDIR]	A component of the path prefix is not a directory.
[ENOENT]	The named file does not exist.
[EACCES]	Search permission is denied on a component of the path prefix.
[EPERM]	The effective user ID does not match the owner of the file and the effective user ID is not super-user.
[EROFS]	The named file resides on a read-only file system.
[EFAULT]	*path* points outside the allocated address space of the process.
[EINTR]	A signal was caught during the chown system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

SEE ALSO

chmod(2).
chown(1) in the *User's Reference Manual.*

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

chroot – change root directory

SYNOPSIS

```
int chroot (path)
char *path;
```

DESCRIPTION

path points to a path name naming a directory. chroot causes the named directory to become the root directory, the starting point for path searches for path names beginning with /. The user's working directory is unaffected by the chroot system call.

The effective user ID of the process must be super-user to change the root directory.

The .. entry in the root directory is interpreted to mean the root directory itself. Thus, .. cannot be used to access files outside the subtree rooted at the root directory.

chroot will fail and the root directory will remain unchanged if one or more of the following are true:

[ENOTDIR]	Any component of the path name is not a directory.
[ENOENT]	The named directory does not exist.
[EPERM]	The effective user ID is not super-user.
[EFAULT]	*path* points outside the allocated address space of the process.
[EINTR]	A signal was caught during the chroot system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

SEE ALSO

chdir(2).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

close – close a file descriptor

SYNOPSIS

```
int close (fildes)
int fildes;
```

DESCRIPTION

fildes is a file descriptor obtained from a creat, open, dup, fcntl, or pipe system call. close closes the file descriptor indicated by *fildes*. All outstanding record locks owned by the process (on the file indicated by *fildes*) are removed.

If a STREAMS [see intro(2)] file is closed, and the calling process had previously registered to receive a SIGPOLL signal [see signal(2) and sigset(2)] for events associated with that file [see I_SETSIG in streamio(7)], the calling process will be unregistered for events associated with the file. The last close for a *stream* causes the *stream* associated with *fildes* to be dismantled. If O_NDELAY is not set and there have been no signals posted for the *stream*, close waits up to 15 seconds, for each module and driver, for any output to drain before dismantling the *stream*. If the O_NDELAY flag is set or if there are any pending signals, close does not wait for output to drain, and dismantles the *stream* immediately.

The named file is closed unless one or more of the following are true:

[EBADF] *fildes* is not a valid open file descriptor.

[EINTR] A signal was caught during the close system call.

[ENOLINK] *fildes* is on a remote machine and the link to that machine is no longer active.

SEE ALSO

creat(2), dup(2), exec(2), fcntl(2), intro(2), open(2), pipe(2), signal(2), sigset(2).
streamio(7) in the *System Administrator's Reference Manual.*

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

creat – create a new file or rewrite an existing one

SYNOPSIS

```
int creat (path, mode)
char *path;
int mode;
```

DESCRIPTION

creat creates a new ordinary file or prepares to rewrite an existing file named by the path name pointed to by *path*.

If the file exists, the length is truncated to 0 and the mode and owner are unchanged. Otherwise, the file's owner ID is set to the effective user ID, of the process the group ID of the process is set to the effective group ID, of the process and the low-order 12 bits of the file mode are set to the value of *mode* modified as follows:

> All bits set in the process's file mode creation mask are cleared [see **umask**(2)].
>
> The "save text image after execution bit" of the mode is cleared [see **chmod**(2)].

Upon successful completion, a write-only file descriptor is returned and the file is open for writing, even if the mode does not permit writing. The file pointer is set to the beginning of the file. The file descriptor is set to remain open across exec system calls [see fcntl(2)]. No process may have more than 20 files open simultaneously. A new file may be created with a mode that forbids writing.

creat fails if one or more of the following are true:

[ENOTDIR]	A component of the path prefix is not a directory.
[ENOENT]	A component of the path prefix does not exist.
[EACCES]	Search permission is denied on a component of the path prefix.
[ENOENT]	The path name is null.
[EACCES]	The file does not exist and the directory in which the file is to be created does not permit writing.
[EROFS]	The named file resides or would reside on a read-only file system.
[ETXTBSY]	The file is a pure procedure (shared text) file that is being executed.
[EACCES]	The file exists and write permission is denied.
[EISDIR]	The named file is an existing directory.
[EMFILE]	NOFILES file descriptors are currently open.
[EFAULT]	*path* points outside the allocated address space of the process.
[ENFILE]	The system file table is full.

[EAGAIN] The file exists, mandatory file/record locking is set, and there are outstanding record locks on the file [see chmod(2)].

[EINTR] A signal was caught during the `creat` system call.

[ENOLINK] *path* points to a remote machine and the link to that machine is no longer active.

[EMULTIHOP] Components of *path* require hopping to multiple remote machines.

[ENOSPC] The file system is out of inodes.

SEE ALSO

`chmod`(2), `close`(2), `dup`(2), `fcntl`(2), `lseek`(2), `open`(2), `read`(2), `umask`(2), `write`(2).

DIAGNOSTICS

Upon successful completion, a non-negative integer, namely the file descriptor, is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

dup – duplicate an open file descriptor

SYNOPSIS

```
int dup (fildes)
int fildes;
```

DESCRIPTION

fildes is a file descriptor obtained from a creat, open, dup, fcntl, or pipe system call. dup returns a new file descriptor having the following in common with the original:

Same open file (or pipe).

Same file pointer (i.e., both file descriptors share one file pointer).

Same access mode (read, write or read/write).

The new file descriptor is set to remain open across exec system calls [see fcntl(2)].

The file descriptor returned is the lowest one available.

dup will fail if one or more of the following are true:

[EBADF] *fildes* is not a valid open file descriptor.

[EINTR] A signal was caught during the dup system call.

[EMFILE] NOFILES file descriptors are currently open.

[ENOLINK] *fildes* is on a remote machine and the link to that machine is no longer active.

SEE ALSO

close(2), creat(2), exec(2), fcntl(2), open(2), pipe(2), lockf(3C).

DIAGNOSTICS

Upon successful completion a non-negative integer, namely the file descriptor, is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

exec: execl, execv, execle, execve, execlp, execvp – execute a file

SYNOPSIS

```
int execl (path, arg0, arg1, ..., argn, (char *)0)
char *path, *arg0, *arg1, ..., *argn;

int execv (path, argv)
char *path, *argv[ ];

int execle (path, arg0, arg1, ..., argn, (char *)0, envp)
char *path, *arg0, *arg1, ..., *argn, *envp[ ];

int execve (path, argv, envp)
char *path, *argv[ ], *envp[ ];

int execlp (file, arg0, arg1, ..., argn, (char *)0)
char *file, *arg0, *arg1, ..., *argn;

int execvp (file, argv)
char *file, *argv[ ];
```

DESCRIPTION

exec in all its forms transforms the calling process into a new process. The new process is constructed from an ordinary, executable file called the *new process file*. This file consists of a header [see a.out(4)], a text segment, and a data segment. The data segment contains an initialized portion and an uninitialized portion (bss). There can be no return from a successful exec because the calling process is overlaid by the new process.

When a C program is executed, it is called as follows:

```
main (argc, argv, envp)
int argc;
char **argv, **envp;
```

where *argc* is the argument count, *argv* is an array of character pointers to the arguments themselves, and *envp* is an array of character pointers to the environment strings. As indicated, *argc* is conventionally at least one and the first member of the array points to a string containing the name of the file.

path points to a path name that identifies the new process file.

file points to the new process file. The path prefix for this file is obtained by a search of the directories passed as the *environment* line "PATH =" [see environ(5)]. The environment is supplied by the shell [see sh(1)].

arg0, arg1, ... , argn are pointers to null-terminated character strings. These strings constitute the argument list available to the new process. By convention, at least *arg0* must be present and point to a string that is the same as *path* (or its last component).

argv is an array of character pointers to null-terminated strings. These strings constitute the argument list available to the new process. By convention, *argv* must have at least one member, and it must point to a string that is the same as *path* (or its last component). *argv* is terminated by a null pointer.

envp is an array of character pointers to null-terminated strings. These strings constitute the environment for the new process. *envp* is terminated by a null pointer. For **execl** and **execv**, the C run-time start-off routine places a pointer to the environment of the calling process in the global cell:

```
extern char **environ;
```

and it is used to pass the environment of the calling process to the new process.

File descriptors open in the calling process remain open in the new process, except for those whose close-on-exec flag is set; see `fcntl`(2). For those file descriptors that remain open, the file pointer is unchanged.

Signals set to terminate the calling process will be set to terminate the new process. Signals set to be ignored by the calling process will be set to be ignored by the new process. Signals set to be caught by the calling process will be set to terminate new process; see `signal`(2).

For signals set by **sigset**(2), **exec** will ensure that the new process has the same system signal action for each signal type whose action is SIG_DFL, SIG_IGN, or SIG_HOLD as the calling process. However, if the action is to catch the signal, then the action will be reset to SIG_DFL, and any pending signal for this type will be held.

If the set-user-ID mode bit of the new process file is set [see **chmod**(2)], **exec** sets the effective user ID of the new process to the owner ID of the new process file. Similarly, if the set-group-ID mode bit of the new process file is set, the effective group ID of the new process is set to the group ID of the new process file. The real user ID and real group ID of the new process remain the same as those of the calling process. However, if the effective user-ID is `root` or Super-user, the set-user-ID and set-group-ID bits will be honored when the process is being controlled by `ptrace`(2).

The shared memory segments attached to the calling process will not be attached to the new process [see **shmop**(2)].

Profiling is disabled for the new process; see `profil`(2).

The new process also inherits the following attributes from the calling process:

nice value [see `nice`(2)]
process ID
parent process ID
process group ID
semadj values [see **semop**(2)]
tty group ID [see `exit`(2) and `signal`(2)]
trace flag [see `ptrace`(2) request 0]
time left until an alarm clock signal [see `alarm`(2)]
current working directory
root directory
file mode creation mask [see `umask`(2)]
file size limit [see `ulimit`(2)]

utime, stime, cutime, and stime [see times(2)]
file-locks [see fcntl(2) and lockf(3C)]

exec will fail and return to the calling process if one or more of the following are true:

[ENOENT]	One or more components of the new process path name of the file do not exist.
[ENOTDIR]	A component of the new process path of the file prefix is not a directory.
[EACCES]	Search permission is denied for a directory listed in the new process file's path prefix.
[EACCES]	The new process file is not an ordinary file.
[EACCES]	The new process file mode denies execution permission.
[ENOEXEC]	The exec is not an execlp or execvp, and the new process file has the appropriate access permission but an invalid magic number in its header.
[ETXTBSY]	The new process file is a pure procedure (shared text) file that is currently open for writing by some process.
[ENOMEM]	The new process requires more memory than is allowed by the system-imposed maximum MAXMEM.
[E2BIG]	The number of bytes in the new process's argument list is greater than the system-imposed limit of 5120 bytes.
[EFAULT]	Required hardware is not present.
[EFAULT]	An a.out that was compiled with the MAU or 32B flag is running on a machine without a MAU or 32B.
[EFAULT]	*path*, *argv*, or *envp* point to an illegal address.
[EAGAIN]	Not enough memory.
[ELIBACC]	Required shared library does not have execute permission.
[ELIBEXEC]	Trying to exec a shared library directly.
[EINTR]	A signal was caught during the exec system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

SEE ALSO

alarm(2), exit(2), fcntl(2), fork(2), nice(2), ptrace(2), semop(2), signal(2), sigset(2), times(2), ulimit(2), umask(2), lockf(3C), a.out(4), environ(5).
sh(1) in the *User's Reference Manual.*

DIAGNOSTICS

If exec returns to the calling process an error has occurred; the return value will be −1 and *errno* will be set to indicate the error.

NAME

exit, _exit – terminate process

SYNOPSIS

```
void exit (status)
int status;
void _exit (status)
int status;
```

DESCRIPTION

exit terminates the calling process with the following consequences:

All of the file descriptors open in the calling process are closed.

If the parent process of the calling process is executing a wait, it is notified of the calling process's termination and the low order eight bits (i.e., bits 0377) of *status* are made available to it [see wait(2)].

If the parent process of the calling process is not executing a wait, the calling process is transformed into a zombie process. A zombie process is a process that only occupies a slot in the process table. It has no other space allocated either in user or kernel space. The process table slot that it occupies is partially overlaid with time accounting information (see <sys/proc.h>) to be used by times.

The parent process ID of all of the calling processes' existing child processes and zombie processes is set to 1. This means the initialization process [see intro(2)] inherits each of these processes.

Each attached shared memory segment is detached and the value of shm_nattach in the data structure associated with its shared memory identifier is decremented by 1.

For each semaphore for which the calling process has set a semadj value [see semop(2)], that semadj value is added to the semval of the specified semaphore.

If the process has a process, text, or data lock, an unlock is performed [see plock(2)].

An accounting record is written on the accounting file if the system's accounting routine is enabled [see acct(2)].

If the process ID, tty group ID, and process group ID of the calling process are equal, the SIGHUP signal is sent to each process that has a process group ID equal to that of the calling process.

A death of child signal is sent to the parent.

The C function exit may cause cleanup actions before the process exits. The function _exit circumvents all cleanup.

SEE ALSO

acct(2), intro(2), plock(2), semop(2), signal(2), sigset(2), wait(2).

DIAGNOSTICS

None. There can be no return from an exit system call.

NAME

`fcntl` – file control

SYNOPSIS

```
#include <fcntl.h>

int fcntl (fildes, cmd, arg)
int fildes, cmd, arg;
```

DESCRIPTION

`fcntl` provides for control over open files. *fildes* is an open file descriptor [see `intro`(2)].

The data type, value and use of *arg* are specific to the value of *cmd*. *cmd* specifies the operation to be performed by `fcntl` and may be one of the following:

F_DUPFD
: Return a new file descriptor as follows:

  Lowest numbered available file descriptor greater than or equal to *arg*.

  Same open file (or pipe) as the original file.

  Same file pointer as the original file (i.e., both file descriptors share one file pointer).

  Same access mode (read, write or read/write).

  Same file status flags (i.e., both file descriptors share the same file status flags).

  The close-on-exec flag (see F_GETFD) associated with the new file descriptor is set to remain open across **exec**(2) system calls.

F_GETFD
: Get the close-on-exec flag associated with *fildes*. If the low-order bit is 0, the file will remain open across **exec**. Otherwise, the file will be closed upon execution of **exec**.

F_SETFD
: Set the close-on-exec flag associated with *fildes* to the low-order bit of *arg* (0 or 1 as above).

F_GETFL
: Get *fildes* status flags.

F_SETFL
: Set *fildes* status flags to *arg*. Only certain flags can be set [see `fcntl`(5)].

F_GETLK
: Get the first lock which blocks the lock description given by the variable of type *struct flock* pointed to by *arg*. The information retrieved overwrites the information passed to `fcntl` in the *flock* structure. If no lock is found that would prevent this lock from being created, then the structure is passed back unchanged except for the lock type which will be set to F_UNLCK.

F_SETLK
: Set or clear a file segment lock according to the variable of type *struct flock* pointed to by *arg* [see `fcntl`(5)]. The *cmd* F_SETLK is used to establish read (F_RDLCK) and write (F_WRLCK) locks, as well as remove either type of lock (F_UNLCK). If a read or write lock cannot be set, `fcntl` will return immediately with an error value of −1.

F_SETLKW — This *cmd* is the same as F_SETLK except that if a read or write lock is blocked by other locks, `fcntl` will block until the segment is free to be locked.

A read lock prevents any process from write locking the protected area. More than one read lock may exist for a given segment of a file at a given time. The file descriptor on which a read lock is being placed must have been opened with read access.

A write lock prevents any process from read locking or write locking the protected area. Only one write lock may exist for a given segment of a file at a given time. The file descriptor on which a write lock is being placed must have been opened with write access.

The *flock* structure describes the type (*l_type*), starting offset (*l_whence*), relative offset (*l_start*), size (*l_len*), process id (*l_pid*), and RFS system id (*l_sysid*) of the segment of the file to be affected. The process id and system id fields are used only with the F_GETLK *cmd* to return the values for a blocking lock. Locks may start and extend beyond the current end of a file, but may not be negative relative to the beginning of the file. A lock may be set to always extend to the end of file by setting *l_len* to zero (0). If such a lock also has *l_whence* and *l_start* set to zero (0), the whole file will be locked. Changing or unlocking a segment from the middle of a larger locked segment leaves two smaller segments for either end. Locking a segment that is already locked by the calling process causes the old lock type to be removed and the new lock type to take effect. All locks associated with a file for a given process are removed when a file descriptor for that file is closed by that process or the process holding that file descriptor terminates. Locks are not inherited by a child process in a `fork`(2) system call.

When mandatory file and record locking is active on a file [see `chmod`(2)], `read`(2) and `write`(2) system calls issued on the file will be affected by the record locks in effect.

`fcntl` will fail if one or more of the following are true:

[EBADF] — *fildes* is not a valid open file descriptor.

[EBADF] — *cmd* is F_SETLK or F_SETLKW , the type of lock (*l_type*) is a read lock (F_RDLCK) and *fildes* is not a valid open file descriptor open for reading.

[EBADF] — *cmd* is F_SETLK or F_SETLKW , the type of lock (*l_type*) is a write lock (F_WRLCK) and *fildes* is not a valid open file descriptor open for writing.

[EMFILE] — *cmd* is F_DUPFD and the number of file descriptors currently open in the calling process is the configured value for the maximum number of open file descriptors allowed each user.

[EINVAL] — *cmd* is F_DUPFD and *arg* is either negative, or greater than or equal to the configured value for the maximum number of open file descriptors allowed each user.

[EINVAL]	*cmd* is not a valid value.
[EINVAL]	*cmd* is F_GETLK, F_SETLK, or F_SETLKW and *arg* or the data it points to is not valid.
[EACCES]	*cmd* is F_SETLK, the type of lock (*l_type*) is a read (F_RDLCK) lock and the segment of a file to be locked is already write locked by another process or the type is a write (F_WRLCK) lock and the segment of a file to be locked is already read or write locked by another process.
[ENOLCK]	*cmd* is F_SETLK or F_SETLKW, the type of lock is a read or write lock, and there are no more record locks available (too many file segments locked) because the system maximum has been exceeded.
[EDEADLK]	*cmd* is F_SETLKW, the lock is blocked by some lock from another process, and if `fcntl` blocked the calling process waiting for that lock to become free, this would cause a deadlock.
[EFAULT]	*cmd* is F_GETLK, F_SETLK or F_SETLKW and the value pointed to by *arg* resulted in an address outside the program address space.
[EINTR]	A signal was caught during the `fcntl` system call.
[ENOLINK]	*fildes* is on a remote machine and the link to that machine is no longer active.

SEE ALSO

`fcntl`(5).
`close`(2), `creat`(2), dup(2), exec(2), `fork`(2), open(2), `pipe`(2).

DIAGNOSTICS

Upon successful completion, the value returned depends on *cmd* as follows:

F_DUPFD	A new file descriptor.
F_GETFD	Value of flag (only the low-order bit is defined).
F_SETFD	Value other than −1.
F_GETFL	Value of file status flags.
F_SETFL	Value other than −1.
F_GETLK	Value other than −1.
F_SETLK	Value other than −1.
F_SETLKW	Value other than −1.

Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NOTES

Because, in the future, the variable *errno* will be set to EAGAIN rather than EACCES when a section of a file is already locked by another process, portable application programs should expect and test for either value.

NAME

fork – create a new process

SYNOPSIS

```
int fork ()
```

DESCRIPTION

fork causes creation of a new process. The new process (child process) is an exact copy of the calling process (parent process). This means the child process inherits the following attributes from the parent process:

environment
close-on-exec flag [see exec(2)]
signal handling settings (i.e., SIG_DFL, SIG_IGN, SIG_HOLD, function address)
set-user-ID mode bit
set-group-ID mode bit
profiling on/off status
nice value [see nice(2)]
all attached shared memory segments [see shmop(2)]
process group ID
tty group ID [see exit(2)]
current working directory
root directory
file mode creation mask [see umask(2)]
file size limit [see ulimit(2)]

The child process differs from the parent process in the following ways:

The child process has a unique process ID.

The child process has a different parent process ID (i.e., the process ID of the parent process).

The child process has its own copy of the parent's file descriptors. Each of the child's file descriptors shares a common file pointer with the corresponding file descriptor of the parent.

All semadj values are cleared [see semop(2)].

Process locks, text locks and data locks are not inherited by the child [see plock(2)].

The child process's utime, stime, cutime, and cstime are set to 0. The time left until an alarm clock signal is reset to 0.

fork will fail and no child process will be created if one or more of the following are true:

[EAGAIN]	The system-imposed limit on the total number of processes under execution would be exceeded.
[EAGAIN]	The system-imposed limit on the total number of processes under execution by a single user would be exceeded.

[EAGAIN] Total amount of system memory available when reading via raw IO is temporarily insufficient.

SEE ALSO

`exec`(2), `nice`(2), `plock`(2), `ptrace`(2), `semop`(2), `shmop`(2), `signal`(2), `sigset`(2), `times`(2), `ulimit`(2), `umask`(2), `wait`(2).

DIAGNOSTICS

Upon successful completion, `fork` returns a value of 0 to the child process and returns the process ID of the child process to the parent process. Otherwise, a value of −1 is returned to the parent process, no child process is created, and *errno* is set to indicate the error.

NAME

getdents – read directory entries and put in a file system independent format

SYNOPSIS

```
#include <sys/dirent.h>

int getdents (fildes, buf, nbyte)
int fildes;
char *buf;
unsigned nbyte;
```

DESCRIPTION

fildes is a file descriptor obtained from an open(2) or dup(2) system call.

getdents attempts to read *nbyte* bytes from the directory associated with *fildes* and to format them as file system independent directory entries in the buffer pointed to by *buf*. Since the file system independent directory entries are of variable length, in most cases the actual number of bytes returned will be strictly less than *nbyte*.

The file system independent directory entry is specified by the dirent structure.

On devices capable of seeking, getdents starts at a position in the file given by the file pointer associated with *fildes*. Upon return from getdents, the file pointer is incremented to point to the next directory entry.

This system call was developed in order to implement the readdir routine [for a description see directory(3C)], and should not be used for other purposes.

getdents will fail if one or more of the following are true:

[EBADF]	*fildes* is not a valid file descriptor open for reading.
[EFAULT]	*buf* points outside the allocated address space.
[EINVAL]	*nbyte* is not large enough for one directory entry.
[ENOENT]	The current file pointer for the directory is not located at a valid entry.
[ENOLINK]	*fildes* points to a remote machine and the link to that machine is no longer active.
[ENOTDIR]	*fildes* is not a directory.
[EIO]	An I/O error occurred while accessing the file system.

SEE ALSO

directory(3C).

DIAGNOSTICS

Upon successful completion a non-negative integer is returned indicating the number of bytes actually read. A value of 0 indicates the end of the directory has been reached. If the system call failed, a −1 is returned and *errno* is set to indicate the error.

NAME

getmsg – get next message off a stream

SYNOPSIS

```
#include <stropts.h>

int getmsg(fd, ctlptr, dataptr, flags)
int fd;
struct strbuf *ctlptr;
struct strbuf *dataptr;
int *flags;
```

DESCRIPTION

getmsg retrieves the contents of a message [see intro(2)] located at the *stream head* read queue from a STREAMS file, and places the contents into user specified buffer(s). The message must contain either a data part, a control part or both. The data and control parts of the message are placed into separate buffers, as described below. The semantics of each part is defined by the STREAMS module that generated the message.

fd specifies a file descriptor referencing an open *stream*. *ctlptr* and *dataptr* each point to a *strbuf* structure which contains the following members:

```
int maxlen;      /* maximum buffer length */
int len;   /* length of data        */
char *buf; /* ptr to buffer    */
```

where *buf* points to a buffer in which the data or control information is to be placed, and *maxlen* indicates the maximum number of bytes this buffer can hold. On return, *len* contains the number of bytes of data or control information actually received, or is 0 if there is a zero-length control or data part, or is -1 if no data or control information is present in the message. *flags* may be set to the values 0 or RS_HIPRI and is used as described below.

ctlptr is used to hold the control part from the message and *dataptr* is used to hold the data part from the message. If *ctlptr* (or *dataptr*) is NULL or the *maxlen* field is -1, the control (or data) part of the message is not processed and is left on the *stream head* read queue and *len* is set to -1. If the *maxlen* field is set to 0 and there is a zero-length control (or data) part, that zero-length part is removed from the read queue and *len* is set to 0. If the *maxlen* field is set to 0 and there are more than zero bytes of control (or data) information, that information is left on the read queue and *len* is set to 0. If the *maxlen* field in *ctlptr* or *dataptr* is less than, respectively, the control or data part of the message, *maxlen* bytes are retrieved. In this case, the remainder of the message is left on the *stream head* read queue and a non-zero return value is provided, as described below under DIAGNOSTICS. If information is retrieved from a *priority* message, *flags* is set to RS_HIPRI on return.

By default, getmsg processes the first priority or non-priority message available on the *stream head* read queue. However, a user may choose to retrieve only priority messages by setting *flags* to RS_HIPRI. In this case, getmsg will only process the next message if it is a priority message.

If O_NDELAY has not been set, getmsg blocks until a message, of the type(s) specified by *flags* (priority or either), is available on the *stream head* read queue. If O_NDELAY has been set and a message of the specified type(s) is not present on the read queue, getmsg fails and sets *errno* to EAGAIN.

If a hangup occurs on the *stream* from which messages are to be retrieved, getmsg will continue to operate normally, as described above, until the *stream head* read queue is empty. Thereafter, it will return 0 in the *len* fields of *ctlptr* and *dataptr*.

getmsg fails if one or more of the following are true:

[EAGAIN] The O_NDELAY flag is set, and no messages are available.

[EBADF] *fd* is not a valid file descriptor open for reading.

[EBADMSG] Queued message to be read is not valid for getmsg.

[EFAULT] *ctlptr*, *dataptr*, or *flags* points to a location outside the allocated address space.

[EINTR] A signal was caught during the getmsg system call.

[EINVAL] An illegal value was specified in *flags*, or the *stream* referenced by *fd* is linked under a multiplexor.

[ENOSTR] A *stream* is not associated with *fd*.

A getmsg can also fail if a STREAMS error message had been received at the *stream head* before the call to getmsg. The error returned is the value contained in the STREAMS error message.

SEE ALSO

intro(2), read(2), poll(2), putmsg(2), write(2).
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DIAGNOSTICS

Upon successful completion, a non-negative value is returned. A value of 0 indicates that a full message was read successfully. A return value of MORECTL indicates that more control information is waiting for retrieval. A return value of MOREDATA indicates that more data is waiting for retrieval. A return value of MORECTL | MOREDATA indicates that both types of information remain. Subsequent getmsg calls will retrieve the remainder of the message.

NAME

getpid, getpgrp, getppid – get process, process group, and parent process IDs

SYNOPSIS

```
int getpid ()

int getpgrp ()

int getppid ()
```

DESCRIPTION

getpid returns the process ID of the calling process.

getpgrp returns the process group ID of the calling process.

getppid returns the parent process ID of the calling process.

SEE ALSO

exec(2), fork(2), intro(2), setpgrp(2), signal(2).

NAME

`getuid`, `geteuid`, `getgid`, `getegid` – get real user, effective user, real group, and effective group IDs

SYNOPSIS

```
unsigned short getuid ()

unsigned short geteuid ()

unsigned short getgid ()

unsigned short getegid ()
```

DESCRIPTION

`getuid` returns the real user ID of the calling process.

`geteuid` returns the effective user ID of the calling process.

`getgid` returns the real group ID of the calling process.

`getegid` returns the effective group ID of the calling process.

SEE ALSO

`intro`(2), `setuid`(2).

NAME

`ioctl` – control device

SYNOPSIS

```
int ioctl (fildes, request, arg)
int fildes, request;
```

DESCRIPTION

`ioctl` performs a variety of control functions on devices and STREAMS. For non-STREAMS files, the functions performed by this call are *device-specific* control functions. The arguments *request* and *arg* are passed to the file designated by *fildes* and are interpreted by the device driver. This control is infrequently used on non-STREAMS devices, with the basic input/output functions performed through the `read`(2) and `write`(2) system calls.

For STREAMS files, specific functions are performed by the `ioctl` call as described in `streamio`(7).

fildes is an open file descriptor that refers to a device. *request* selects the control function to be performed and will depend on the device being addressed. *arg* represents additional information that is needed by this specific device to perform the requested function. The data type of *arg* depends upon the particular control request, but it is either an integer or a pointer to a device-specific data structure.

In addition to device-specific and STREAMS functions, generic functions are provided by more than one device driver, for example, the general terminal interface [see `termio`(7)].

`ioctl` will fail for any type of file if one or more of the following are true:

[EACCES] Future error.

[EBADF] *fildes* is not a valid open file descriptor.

[ENOTTY] *fildes* is not associated with a device driver that accepts control functions.

[EINTR] A signal was caught during the `ioctl` system call.

`ioctl` will also fail if the device driver detects an error. In this case, the error is passed through `ioctl` without change to the caller. A particular driver might not have all of the following error cases. Other requests to device drivers will fail if one or more of the following are true:

[EFAULT] *request* requires a data transfer to or from a buffer pointed to by *arg*, but some part of the buffer is outside the process's allocated space.

[EINVAL] *request* or *arg* is not valid for this device.

[EIO] Some physical I/O error has occurred.

[ENXIO] The *request* and *arg* are valid for this device driver, but the service requested can not be performed on this particular subdevice.

[ENOLINK] *fildes* is on a remote machine and the link to that machine is no longer active.

STREAMS errors are described in `streamio`(7).

SEE ALSO

`streamio`(7), `termio`(7) in the *System Administrator's Reference Manual.*

DIAGNOSTICS

Upon successful completion, the value returned depends upon the device control function, but must be a non-negative integer. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

NAME

`kill` – send a signal to a process or a group of processes

SYNOPSIS

```
int kill (pid, sig)
int pid, sig;
```

DESCRIPTION

`kill` sends a signal to a process or a group of processes. The process or group of processes to which the signal is to be sent is specified by *pid*. The signal that is to be sent is specified by *sig* and is either one from the list given in `signal`(2), or 0. If *sig* is 0 (the null signal), error checking is performed but no signal is actually sent. This can be used to check the validity of *pid*.

The real or effective user ID of the sending process must match the effective or saved effective ID [from `exec`(2)] user ID of the receiving process, unless the effective user ID of the sending process is super-user.

The processes with a process ID of 0 and a process ID of 1 are special processes [see `intro`(2)] and will be referred to below as *proc0* and *proc1*, respectively.

If *pid* is greater than zero, *sig* will be sent to the process whose process ID is equal to *pid*. *pid* may equal 1.

If *pid* is 0, *sig* will be sent to all processes excluding *proc0* and *proc1* whose process group ID is equal to the process group ID of the sender.

If *pid* is −1 and the effective user ID of the sender is not super-user, *sig* will be sent to all processes excluding *proc0* and *proc1* whose real user ID is equal to the effective user ID of the sender.

If *pid* is −1 and the effective user ID of the sender is super-user, *sig* will be sent to all processes excluding *proc0* and *proc1*.

If *pid* is negative but not −1, *sig* will be sent to all processes whose process group ID is equal to the absolute value of *pid*.

`kill` will fail and no signal will be sent if one or more of the following are true:

[EINVAL]	*sig* is not a valid signal number.
[EINVAL]	*sig* is SIGKILL and *pid* is 1 (proc1).
[ESRCH]	No process can be found corresponding to that specified by *pid*.
[EPERM]	The user ID of the sending process is not super-user, and its real or effective user ID does not match the real or effective user ID of the receiving process.

SEE ALSO

`getpid`(2), `setpgrp`(2), `signal`(2), `sigset`(2).
`kill`(1) in the *User's Reference Manual*.

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

`link` – link to a file

SYNOPSIS

```
int link (path1, path2)
char *path1, *path2;
```

DESCRIPTION

path1 points to a path name naming an existing file. *path2* points to a path name naming the new directory entry to be created. `link` creates a new link (directory entry) for the existing file.

`link` will fail and no link will be created if one or more of the following are true:

[ENOTDIR]	A component of either path prefix is not a directory.
[ENOENT]	A component of either path prefix does not exist.
[EACCES]	A component of either path prefix denies search permission.
[ENOENT]	The file named by *path1* does not exist.
[EEXIST]	The link named by *path2* exists.
[EPERM]	The file named by *path1* is a directory and the effective user ID is not super-user.
[EXDEV]	The link named by *path2* and the file named by *path1* are on different logical devices (file systems).
[ENOENT]	*path2* points to a null path name.
[EACCES]	The requested link requires writing in a directory with a mode that denies write permission.
[EROFS]	The requested link requires writing in a directory on a read-only file system.
[EFAULT]	*path* points outside the allocated address space of the process.
[EMLINK]	The maximum number of links to a file would be exceeded.
[EINTR]	A signal was caught during the `link` system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

SEE ALSO

`unlink`(2).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

`lseek` – move read/write file pointer

SYNOPSIS

```
long lseek (fildes, offset, whence)
int fildes;
long offset;
int whence;
```

DESCRIPTION

fildes is a file descriptor returned from a `creat`, `open`, `dup`, or `fcntl` system call. `lseek` sets the file pointer associated with *fildes* as follows:

If *whence* is 0, the pointer is set to *offset* bytes.

If *whence* is 1, the pointer is set to its current location plus *offset*.

If *whence* is 2, the pointer is set to the size of the file plus *offset*.

Upon successful completion, the resulting pointer location, as measured in bytes from the beginning of the file, is returned. Note that if *fildes* is a remote file descriptor and *offset* is negative, `lseek` will return the file pointer even if it is negative.

`lseek` will fail and the file pointer will remain unchanged if one or more of the following are true:

[EBADF] *fildes* is not an open file descriptor.

[ESPIPE] *fildes* is associated with a pipe or fifo.

[EINVAL and SIGSYS signal]
Whence is not 0, 1, or 2.

[EINVAL] *fildes* is not a remote file descriptor, and the resulting file pointer would be negative.

Some devices are incapable of seeking. The value of the file pointer associated with such a device is undefined.

SEE ALSO

`creat`(2), `dup`(2), `fcntl`(2), `open`(2).

DIAGNOSTICS

Upon successful completion, a non-negative integer indicating the file pointer value is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

`mkdir` – make a directory

SYNOPSIS

```
int mkdir (path, mode)
char *path;
int mode;
```

DESCRIPTION

The routine `mkdir` creates a new directory with the name *path*. The mode of the new directory is initialized from the *mode*. The protection part of the *mode* argument is modified by the process's mode mask [see **umask**(2)].

The directory's owner ID is set to the process's effective user ID. The directory's group ID is set to the process's effective group ID. The newly created directory is empty with the possible exception of entries for "." and "..". `mkdir` will fail and no directory will be created if one or more of the following are true:

[ENOTDIR]	A component of the path prefix is not a directory.
[ENOENT]	A component of the path prefix does not exist.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.
[EACCES]	Either a component of the path prefix denies search permission or write permission is denied on the parent directory of the directory to be created.
[ENOENT]	The path is longer than the maximum allowed.
[EEXIST]	The named file already exists.
[EROFS]	The path prefix resides on a read-only file system.
[EFAULT]	*path* points outside the allocated address space of the process.
[EMLINK]	The maximum number of links to the parent directory would be exceeded.
[EIO]	An I/O error has occurred while accessing the file system.

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned, and *errno* is set to indicate the error.

NAME

mknod – make a directory, or a special or ordinary file

SYNOPSIS

```
int mknod (path, mode, dev)
char *path;
int mode, dev;
```

DESCRIPTION

mknod creates a new file named by the path name pointed to by *path*. The mode of the new file is initialized from *mode*. Where the value of *mode* is interpreted as follows:

0170000 file type; one of the following:

0010000 fifo special
0020000 character special
0040000 directory
0060000 block special
0100000 or 0000000 ordinary file

0004000 set user ID on execution
00020#0 set group ID on execution if # is 7, 5, 3, or 1
enable mandatory file/record locking if # is 6, 4, 2, or 0
0001000 save text image after execution
0000777 access permissions; constructed from the following:

0000400 read by owner
0000200 write by owner
0000100 execute (search on directory) by owner
0000070 read, write, execute (search) by group
0000007 read, write, execute (search) by others

The owner ID of the file is set to the effective user ID of the process. The group ID of the file is set to the effective group ID of the process.

Values of *mode* other than those above are undefined and should not be used. The low-order 9 bits of *mode* are modified by the process's file mode creation mask: all bits set in the process's file mode creation mask are cleared [see umask(2)]. If *mode* indicates a block or character special file, *dev* is a configuration-dependent specification of a character or block I/O device. If *mode* does not indicate a block special or character special device, *dev* is ignored.

mknod may be invoked only by the super-user for file types other than FIFO special.

mknod will fail and the new file will not be created if one or more of the following are true:

[EPERM] The effective user ID of the process is not super-user.

[ENOTDIR] A component of the path prefix is not a directory.

[ENOENT]	A component of the path prefix does not exist.
[EROFS]	The directory in which the file is to be created is located on a read-only file system.
[EEXIST]	The named file exists.
[EFAULT]	*path* points outside the allocated address space of the process.
[ENOSPC]	No space is available.
[EINTR]	A signal was caught during the mknod system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

SEE ALSO

chmod(2), exec(2), umask(2), fs(4).
mkdir(1) in the *User's Reference Manual*.

DIAGNOSTICS

Upon successful completion a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NOTES

If mknod is used to create a device in a remote directory (Remote File Sharing), the major and minor device numbers are interpreted by the server.

NAME

mount – mount a file system

SYNOPSIS

```
#include <sys/types.h>
#include <sys/mount.h>

int mount (spec, dir, mflag, fstyp, dataptr, datalen)
char *spec, *dir;
int mflag, fstyp;
char *dataptr;
int datalen;
```

DESCRIPTION

mount requests that a removable file system contained on the block special file identified by *spec* be mounted on the directory identified by *dir*. *spec* and *dir* are pointers to path names. *fstyp* is the file system type number. The sysfs(2) system call can be used to determine the file system type number. Note that if both the MS_DATA and MS_FSS flag bits of *mflag* are off, the file system type will default to the root file system type. Only if either flag is on will fstyp be used to indicate the file system type.

If the MS_DATA flag is set in *mflag* the system expects the *dataptr* and *datalen* arguments to be present. Together they describe a block of file-system specific data at address *dataptr* of length *datalen*. This is interpreted by file-system specific code within the operating system and its format depends upon the file system type. A particular file system type may not require this data, in which case *dataptr* and *datalen* should both be zero. Note that MS_FSS is obsolete and will be ignored if MS_DATA is also set, but if MS_FSS is set and MS_DATA is not, *dataptr* and *datalen* are both assumed to be zero.

Upon successful completion, references to the file *dir* will refer to the root directory on the mounted file system.

The low-order bit of *mflag* is used to control write permission on the mounted file system; if 1, writing is forbidden, otherwise writing is permitted according to individual file accessibility.

mount may be invoked only by the super-user. It is intended for use only by the mount(1M) utility.

mount will fail if one or more of the following are true:

[EPERM]	The effective user ID is not super-user.
[ENOENT]	Any of the named files does not exist.
[ENOTDIR]	A component of a path prefix is not a directory.
[EREMOTE]	*spec* is remote and cannot be mounted.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

[ENOTBLK]	*spec* is not a block special device.
[ENXIO]	The device associated with *spec* does not exist.
[ENOTDIR]	*dir* is not a directory.
[EFAULT]	*spec* or *dir* points outside the allocated address space of the process.
[EBUSY]	*dir* is currently mounted on, is someone's current working directory, or is otherwise busy.
[EBUSY]	The device associated with *spec* is currently mounted.
[EBUSY]	There are no more mount table entries.
[EROFS]	*spec* is write protected and *mflag* requests write permission.
[ENOSPC]	The file system state in the super-block is not FsOKAY and *mflag* requests write permission.
[EINVAL]	The super block has an invalid magic number or the `fstyp` is invalid or *mflag* is not valid.

SEE ALSO

`sysfs`(2), `umount`(2).
`mount`(1M), `fs`(4) in the *System Administrator's Reference Manual.*

DIAGNOSTICS

Upon successful completion a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

msgctl – message control operations

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>

int msgctl (msqid, cmd, buf)
int msqid, cmd;
struct msqid_ds *buf;
```

DESCRIPTION

msgctl provides a variety of message control operations as specified by *cmd*. The following *cmd*s are available:

IPC_STAT — Place the current value of each member of the data structure associated with *msqid* into the structure pointed to by *buf*. The contents of this structure are defined in intro(2). {READ}

IPC_SET — Set the value of the following members of the data structure associated with *msqid* to the corresponding value found in the structure pointed to by *buf*:

```
msg_perm.uid
msg_perm.gid
msg_perm.mode /* only low 9 bits */
msg_qbytes
```

This *cmd* can only be executed by a process that has an effective user ID equal to either that of super user, or to the value of msg_perm.cuid or msg_perm.uid in the data structure associated with *msqid*. Only super user can raise the value of msg_qbytes.

IPC_RMID — Remove the message queue identifier specified by *msqid* from the system and destroy the message queue and data structure associated with it. This *cmd* can only be executed by a process that has an effective user ID equal to either that of super user, or to the value of msg_perm.cuid or msg_perm.uid in the data structure associated with *msqid*.

msgctl will fail if one or more of the following are true:

[EINVAL] — *msqid* is not a valid message queue identifier.

[EINVAL] — *cmd* is not a valid command.

[EACCES] — *cmd* is equal to IPC_STAT and {READ} operation permission is denied to the calling process [see intro(2)].

[EPERM] — *cmd* is equal to IPC_RMID or IPC_SET. The effective user ID of the calling process is not equal to that of super user, or to the value of msg_perm.cuid or msg_perm.uid in the data structure associated with *msqid*.

[EPERM] *cmd* is equal to `IPC_SET`, an attempt is being made to increase to the value of `msg_qbytes`, and the effective user ID of the calling process is not equal to that of super user.

[EFAULT] *buf* points to an illegal address.

SEE ALSO

`intro`(2), `msgget`(2), `msgop`(2).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

msgget – get message queue

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>

int msgget (key, msgflg)
key_t key;
int msgflg;
```

DESCRIPTION

msgget returns the message queue identifier associated with *key*.

A message queue identifier and associated message queue and data structure [see intro(2)] are created for *key* if one of the following are true:

> *key* is equal to IPC_PRIVATE.
>
> *key* does not already have a message queue identifier associated with it, and (*msgflg* & IPC_CREAT) is "true".

Upon creation, the data structure associated with the new message queue identifier is initialized as follows:

> msg_perm.cuid, msg_perm.uid, msg_perm.cgid, and msg_perm.gid are set equal to the effective user ID and effective group ID, respectively, of the calling process.
>
> The low-order 9 bits of msg_perm.mode are set equal to the low-order 9 bits of *msgflg*.
>
> msg_qnum, msg_lspid, msg_lrpid, msg_stime, and msg_rtime are set equal to 0.
>
> msg_ctime is set equal to the current time.
>
> msg_qbytes is set equal to the system limit.

msgget will fail if one or more of the following are true:

[EACCES] A message queue identifier exists for *key*, but operation permission [see intro(2)] as specified by the low-order 9 bits of *msgflg* would not be granted.

[ENOENT] A message queue identifier does not exist for *key* and (*msgflg* & IPC_CREAT) is "false".

[ENOSPC] A message queue identifier is to be created but the system-imposed limit on the maximum number of allowed message queue identifiers system wide would be exceeded.

[EEXIST] A message queue identifier exists for *key* but ((*msgflg* & IPC_CREAT) & (*msgflg* & IPC_EXCL)) is "true".

SEE ALSO

intro(2), msgctl(2), msgop(2).

DIAGNOSTICS

Upon successful completion, a non-negative integer, namely a message queue identifier, is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

msgop – message operations

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>

int msgsnd (msqid, msgp, msgsz, msgflg)
int msqid;
struct msgbuf *msgp;
int msgsz, msgflg;

int msgrcv (msqid, msgp, msgsz, msgtyp, msgflg)
int msqid;
struct msgbuf *msgp;
int msgsz;
long msgtyp;
int msgflg;
```

DESCRIPTION

msgsnd is used to send a message to the queue associated with the message queue identifier specified by *msqid*. {WRITE} *msgp* points to a structure containing the message. This structure is composed of the following members:

```
long   mtype;      /* message type */
char   mtext[];    /* message text */
```

mtype is a positive integer that can be used by the receiving process for message selection (see msgrcv below). *mtext* is any text of length *msgsz* bytes. *msgsz* can range from 0 to a system-imposed maximum.

msgflg specifies the action to be taken if one or more of the following are true:

The number of bytes already on the queue is equal to msg_qbytes [see intro(2)].

The total number of messages on all queues system-wide is equal to the system-imposed limit.

These actions are as follows:

If (*msgflg* & IPC_NOWAIT) is "true", the message will not be sent and the calling process will return immediately.

If (*msgflg* & IPC_NOWAIT) is "false", the calling process will suspend execution until one of the following occurs:

The condition responsible for the suspension no longer exists, in which case the message is sent.

msqid is removed from the system [see msgctl(2)]. When this occurs, *errno* is set equal to EIDRM, and a value of −1 is returned.

The calling process receives a signal that is to be caught. In this case the message is not sent and the calling process resumes execution in the manner prescribed in signal(2).

msgsnd will fail and no message will be sent if one or more of the following are true:

[EINVAL] *msqid* is not a valid message queue identifier.

[EACCES] Operation permission is denied to the calling process [see intro(2)].

[EINVAL] *mtype* is less than 1.

[EAGAIN] The message cannot be sent for one of the reasons cited above and (*msgflg* & IPC_NOWAIT) is "true".

[EINVAL] *msgsz* is less than zero or greater than the system-imposed limit.

[EFAULT] *msgp* points to an illegal address.

Upon successful completion, the following actions are taken with respect to the data structure associated with *msqid* [see intro (2)].

msg_qnum is incremented by 1.

msg_lspid is set equal to the process ID of the calling process.

msg_stime is set equal to the current time.

msgrcv reads a message from the queue associated with the message queue identifier specified by *msqid* and places it in the structure pointed to by *msgp*. {READ} This structure is composed of the following members:

```
long   mtype;      /* message type */
char   mtext[];    /* message text */
```

mtype is the received message's type as specified by the sending process. *mtext* is the text of the message. *msgsz* specifies the size in bytes of *mtext*. The received message is truncated to *msgsz* bytes if it is larger than *msgsz* and (*msgflg* & MSG_NOERROR) is "true". The truncated part of the message is lost and no indication of the truncation is given to the calling process.

msgtyp specifies the type of message requested as follows:

If *msgtyp* is equal to 0, the first message on the queue is received.

If *msgtyp* is greater than 0, the first message of type *msgtyp* is received.

If *msgtyp* is less than 0, the first message of the lowest type that is less than or equal to the absolute value of *msgtyp* is received.

msgflg specifies the action to be taken if a message of the desired type is not on the queue. These are as follows:

If (*msgflg* & IPC_NOWAIT) is "true", the calling process will return immediately with a return value of −1 and *errno* set to ENOMSG.

If (*msgflg* & IPC_NOWAIT) is "false", the calling process will suspend execution until one of the following occurs:

A message of the desired type is placed on the queue.

msqid is removed from the system. When this occurs, *errno* is set equal to EIDRM, and a value of −1 is returned.

The calling process receives a signal that is to be caught. In this case a message is not received and the calling process resumes execution in the manner prescribed in `signal(2)`.

`msgrcv` will fail and no message will be received if one or more of the following are true:

[EINVAL] *msqid* is not a valid message queue identifier.

[EACCES] Operation permission is denied to the calling process.

[EINVAL] *msgsz* is less than 0.

[E2BIG] *mtext* is greater than *msgsz* and (*msgflg* & `MSG_NOERROR`) is "false".

[ENOMSG] The queue does not contain a message of the desired type and (*msgtyp* & `IPC_NOWAIT`) is "true".

[EFAULT] *msgp* points to an illegal address.

Upon successful completion, the following actions are taken with respect to the data structure associated with *msqid* [see `intro(2)`].

`msg_qnum` is decremented by 1.

`msg_lrpid` is set equal to the process ID of the calling process.

`msg_rtime` is set equal to the current time.

SEE ALSO

`intro(2)`, `msgctl(2)`, `msgget(2)`, `signal(2)`.

DIAGNOSTICS

If *msgsnd* or *msgrcv* return due to the receipt of a signal, a value of −1 is returned to the calling process and *errno* is set to EINTR. If they return due to removal of *msqid* from the system, a value of −1 is returned and *errno* is set to EIDRM.

Upon successful completion, the return value is as follows:

`msgsnd` returns a value of 0.

`msgrcv` returns a value equal to the number of bytes actually placed into *mtext*.

Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

`nice` – change priority of a process

SYNOPSIS

```
int nice (incr)
int incr;
```

DESCRIPTION

`nice` adds the value of *incr* to the nice value of the calling process. A process's `nicevalue` is a non-negative number for which a more positive value results in lower CPU priority.

A maximum nice value of 39 and a minimum nice value of 0 are imposed by the system. (The default nice value is 20.) Requests for values above or below these limits result in the nice value being set to the corresponding limit.

[EPERM] `nice` will fail and not change the nice value if *incr* is negative or greater than 39 and the effective user ID of the calling process is not super-user.

SEE ALSO

exec(2).
`nice(1)` in the *User's Reference Manual*.

DIAGNOSTICS

Upon successful completion, `nice` returns the new nice value minus 20. Otherwise, a value of –1 is returned and *errno* is set to indicate the error.

NAME

open – open for reading or writing

SYNOPSIS

```
#include <fcntl.h>
int open (path, oflag [, mode] )
char *path;
int oflag, mode;
```

DESCRIPTION

path points to a path name naming a file. open opens a file descriptor for the named file and sets the file status flags according to the value of *oflag*. For non-STREAMS [see `intro`(2)] files, *oflag* values are constructed by or-ing flags from the following list (only one of the first three flags below may be used):

`O_RDONLY` Open for reading only.

`O_WRONLY` Open for writing only.

`O_RDWR` Open for reading and writing.

`O_NDELAY` This flag may affect subsequent reads and writes [see `read`(2) and `write`(2)].

When opening a FIFO with O_RDONLY or O_WRONLY set:

If O_NDELAY is set:

> An open for reading-only will return without delay. An open for writing-only will return an error if no process currently has the file open for reading.

If O_NDELAY is clear:

> An open for reading-only will block until a process opens the file for writing. An open for writing-only will block until a process opens the file for reading.

When opening a file associated with a communication line:

If O_NDELAY is set:

> The open will return without waiting for carrier.

If O_NDELAY is clear:

> The open will block until carrier is present.

`O_APPEND` If set, the file pointer will be set to the end of the file prior to each write.

`O_SYNC` When opening a regular file, this flag affects subsequent writes. If set, each `write`(2) will wait for both the file data and file status to be physically updated.

`O_CREAT` If the file exists, this flag has no effect. Otherwise, the owner ID of the file is set to the effective user ID of the process, the group ID of the file is set to the effective group ID of the process, and the low-order 12 bits of the file mode are set to the value of *mode* modified as follows [see `creat`(2)]:

All bits set in the file mode creation mask of the process are cleared [see umask(2)].

The "save text image after execution bit" of the mode is cleared [see chmod(2)].

O_TRUNC If the file exists, its length is truncated to 0 and the mode and owner are unchanged.

O_EXCL If O_EXCL and O_CREAT are set, open will fail if the file exists.

When opening a STREAMS file, *oflag* may be constructed from O_NDELAY or-ed with either O_RDONLY, O_WRONLY or O_RDWR. Other flag values are not applicable to STREAMS devices and have no effect on them. The value of O_NDELAY affects the operation of STREAMS drivers and certain system calls [see read(2), getmsg(2), putmsg(2) and write(2)]. For drivers, the implementation of O_NDELAY is device-specific. Each STREAMS device driver may treat this option differently.

Certain flag values can be set following open as described in fcntl(2).

The file pointer used to mark the current position within the file is set to the beginning of the file.

The new file descriptor is set to remain open across exec system calls [see fcntl(2)].

The named file is opened unless one or more of the following are true:

[EACCES] A component of the path prefix denies search permission.

[EACCES] *oflag* permission is denied for the named file.

[EAGAIN] The file exists, mandatory file/record locking is set, and there are outstanding record locks on the file [see chmod (2)].

[EEXIST] O_CREAT and O_EXCL are set, and the named file exists.

[EFAULT] *path* points outside the allocated address space of the process.

[EINTR] A signal was caught during the open system call.

[EIO] A hangup or error occurred during a STREAMS open.

[EISDIR] The named file is a directory and *oflag* is write or read/write.

[EMFILE] NOFILES file descriptors are currently open.

[EMULTIHOP] Components of *path* require hopping to multiple remote machines.

[ENFILE] The system file table is full.

[ENOENT] O_CREAT is not set and the named file does not exist.

[ENOLINK] *path* points to a remote machine, and the link to that machine is no longer active.

[ENOMEM] The system is unable to allocate a send descriptor.

[ENOSPC]	O_CREAT and O_EXCL are set, and the file system is out of inodes.
[ENOSR]	Unable to allocate a *stream*.
[ENOTDIR]	A component of the path prefix is not a directory.
[ENXIO]	The named file is a character special or block special file, and the device associated with this special file does not exist.
[ENXIO]	O_NDELAY is set, the named file is a FIFO, O_WRONLY is set, and no process has the file open for reading.
[ENXIO]	A STREAMS module or driver open routine failed.
[EROFS]	The named file resides on a read-only file system and *oflag* is write or read/write.
[ETXTBSY]	The file is a pure procedure (shared text) file that is being executed and *oflag* is write or read/write.

SEE ALSO

`chmod`(2), `close`(2), `creat`(2), `dup`(2), `fcntl`(2), `intro`(2), `lseek`(2), `read`(2), `getmsg`(2), `putmsg`(2), `umask`(2), `write`(2).

DIAGNOSTICS

Upon successful completion, the file descriptor is returned. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

NAME

pause – suspend process until signal

SYNOPSIS

`pause ()`

DESCRIPTION

pause suspends the calling process until it receives a signal. The signal must be one that is not currently set to be ignored by the calling process.

If the signal causes termination of the calling process, **pause** will not return.

If the signal is *caught* by the calling process and control is returned from the signal-catching function [see `signal`(2)], the calling process resumes execution from the point of suspension; with a return value of −1 from **pause** and *errno* set to EINTR.

SEE ALSO

`alarm`(2), `kill`(2), `signal`(2), `sigpause`(2), `wait`(2).

NAME

`pipe` – create an interprocess channel

SYNOPSIS

```
int pipe (fildes)
int fildes[2];
```

DESCRIPTION

`pipe` creates an I/O mechanism called a pipe and returns two file descriptors, *fildes*[0] and *fildes*[1]. *Fildes*[0] is opened for reading and *fildes*[1] is opened for writing.

Up to 5120 bytes of data are buffered by the pipe before the writing process is blocked. A read only file descriptor *fildes*[0] accesses the data written to *fildes*[1] on a first-in-first-out (FIFO) basis.

`pipe` will fail if:

[EMFILE]	NOFILES file descriptors are currently open.
[ENFILE]	The system file table is full.

SEE ALSO

`read`(2), `write`(2).
`sh`(1) in the *User's Reference Manual.*

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

`plock` – lock process, text, or data in memory

SYNOPSIS

```
#include <sys/lock.h>

int plock (op)
int op;
```

DESCRIPTION

`plock` allows the calling process to lock its text segment (text lock), its data segment (data lock), or both its text and data segments (process lock) into memory. Locked segments are immune to all routine swapping. `plock` also allows these segments to be unlocked. The effective user ID of the calling process must be super-user to use this call. *op* specifies the following:

`PROCLOCK` –	lock text and data segments into memory (process lock)
`TXTLOCK` –	lock text segment into memory (text lock)
`DATLOCK` –	lock data segment into memory (data lock)
`UNLOCK` –	remove locks

`plock` will fail and not perform the requested operation if one or more of the following are true:

[EPERM]	The effective user ID of the calling process is not super-user.
[EINVAL]	*op* is equal to `PROCLOCK` and a process lock, a text lock, or a data lock already exists on the calling process.
[EINVAL]	*op* is equal to `TXTLOCK` and a text lock, or a process lock already exists on the calling process.
[EINVAL]	*op* is equal to `DATLOCK` and a data lock, or a process lock already exists on the calling process.
[EINVAL]	*op* is equal to `UNLOCK` and no type of lock exists on the calling process.
[EAGAIN]	Not enough memory.

SEE ALSO

`exec`(2), `exit`(2), `fork`(2).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned to the calling process. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

poll – STREAMS input/output multiplexing

SYNOPSIS

```
#include <stropts.h>
#include <poll.h>

int poll(fds, nfds, timeout)
struct pollfd fds[];
unsigned long nfds;
int timeout;
```

DESCRIPTION

poll provides users with a mechanism for multiplexing input/output over a set of file descriptors that reference open *streams* [see intro(2)]. poll identifies those *streams* on which a user can send or receive messages, or on which certain events have occurred. A user can receive messages using read(2) or getmsg(2) and can send messages using write(2) and putmsg(2). Certain ioctl(2) calls, such as I_RECVFD and I_SENDFD [see streamio(7)], can also be used to receive and send messages.

fds specifies the file descriptors to be examined and the events of interest for each file descriptor. It is a pointer to an array with one element for each open file descriptor of interest. The array's elements are *pollfd* structures which contain the following members:

```
int fd;            /* file descriptor */
short events;          /* requested events */
short revents;         /* returned events */
```

where *fd* specifies an open file descriptor and *events* and *revents* are bitmasks constructed by or-ing any combination of the following event flags:

POLLIN — A non-priority or file descriptor passing message (see I_RECVFD) is present on the *stream head* read queue. This flag is set even if the message is of zero length. In *revents*, this flag is mutually exclusive with POLLPRI.

POLLPRI — A priority message is present on the *stream head* read queue. This flag is set even if the message is of zero length. In *revents*, this flag is mutually exclusive with POLLIN.

POLLOUT — The first downstream write queue in the *stream* is not full. Priority control messages can be sent (see putmsg) at any time.

POLLERR — An error message has arrived at the *stream head*. This flag is only valid in the *revents* bitmask; it is not used in the *events* field.

POLLHUP — A hangup has occurred on the *stream*. This event and POLLOUT are mutually exclusive; a *stream* can never be writable if a hangup has occurred. However, this event and POLLIN or POLLPRI are not mutually exclusive. This flag is only valid in the *revents* bitmask; it is not used in the *events* field.

POLLNVAL The specified *fd* value does not belong to an open *stream*. This flag is only valid in the *revents* field; it is not used in the *events* field.

For each element of the array pointed to by *fds*, `poll` examines the given file descriptor for the event(s) specified in *events*. The number of file descriptors to be examined is specified by *nfds*. If *nfds* exceeds NOFILES, the system limit of open files [see `ulimit`(2)], `poll` will fail.

If the value *fd* is less than zero, *events* is ignored and *revents* is set to 0 in that entry on return from `poll`.

The results of the `poll` query are stored in the *revents* field in the *pollfd* structure. Bits are set in the *revents* bitmask to indicate which of the requested events are true. If none are true, none of the specified bits is set in *revents* when the `poll` call returns. The event flags POLLHUP, POLLERR and POLLNVAL are always set in *revents* if the conditions they indicate are true; this occurs even though these flags were not present in *events*.

If none of the defined events have occurred on any selected file descriptor, `poll` waits at least *timeout* msec for an event to occur on any of the selected file descriptors. On a computer where millisecond timing accuracy is not available, *timeout* is rounded up to the nearest legal value available on that system. If the value *timeout* is 0, `poll` returns immediately. If the value of *timeout* is -1, `poll` blocks until a requested event occurs or until the call is interrupted. `poll` is not affected by the O_NDELAY flag.

`poll` fails if one or more of the following are true:

[EAGAIN] Allocation of internal data structures failed but request should be attempted again.

[EFAULT] Some argument points outside the allocated address space.

[EINTR] A signal was caught during the `poll` system call.

[EINVAL] The argument *nfds* is less than zero, or *nfds* is greater than NOFILES.

SEE ALSO

`intro`(2), `read`(2), `getmsg`(2), `putmsg`(2), `write`(2).
`streamio`(7) in the *System Administrator's Reference Manual.*
STREAMS Primer.
STREAMS Programmer's Guide.

DIAGNOSTICS

Upon successful completion, a non-negative value is returned. A positive value indicates the total number of file descriptors that has been selected (i.e., file descriptors for which the *revents* field is non-zero). A value of 0 indicates that the call timed out and no file descriptors have been selected. Upon failure, a value of -1 is returned and *errno* is set to indicate the error.

NAME

`profil` – execution time profile

SYNOPSIS

```
void profil (buff, bufsiz, offset, scale)
char *buff;
int bufsiz, offset, scale;
```

DESCRIPTION

buff points to an area of core whose length (in bytes) is given by *bufsiz*. After this call, the user's program counter (pc) is examined each clock tick. Then the value of *offset* is subtracted from it, and the remainder multiplied by *scale*. If the resulting number corresponds to an entry inside *buff*, that entry is incremented. An entry is defined as a series of bytes with length *sizeof(short)*.

The scale is interpreted as an unsigned, fixed-point fraction with binary point at the left: 0xffffffff (hex) gives a 1-1 mapping of pc's to words in *buff*; 0x7fffffff (hex) maps each pair of instruction words together. 02(octal) maps all instructions onto the beginning of *buff* (producing a non-interrupting core clock).

Profiling is turned off by giving a *scale* of 0 or 1. It is rendered ineffective by giving a *bufsiz* of 0. Profiling is turned off when an `exec` is executed, but remains on in child and parent both after a `fork`. Profiling will be turned off if an update in *buff* would cause a memory fault.

SEE ALSO

`prof`(1), `times`(2).

NAME

ptrace − process trace

SYNOPSIS

```
int ptrace (request, pid, addr, data)
int request, pid, addr, data;
```

DESCRIPTION

ptrace provides a means by which a parent process may control the execution of a child process. Its primary use is for the implementation of breakpoint debugging [see sdb(1)]. The child process behaves normally until it encounters a signal [see signal(2) for the list], at which time it enters a stopped state and its parent is notified via *wait*(2). When the child is in the stopped state, its parent can examine and modify its "core image" using ptrace. Also, the parent can cause the child either to terminate or continue, with the possibility of ignoring the signal that caused it to stop.

The *request* argument determines the precise action to be taken by ptrace and is one of the following:

0 This request must be issued by the child process if it is to be traced by its parent. It turns on the child's trace flag that stipulates that the child should be left in a stopped state upon receipt of a signal rather than the state specified by *func* [see signal(2)]. The *pid*, *addr*, and *data* arguments are ignored, and a return value is not defined for this request. Peculiar results will ensue if the parent does not expect to trace the child.

The remainder of the requests can only be used by the parent process. For each, *pid* is the process ID of the child. The child must be in a stopped state before these requests are made.

1, 2

With these requests, the word at location *addr* in the address space of the child is returned to the parent process. If I and D space are separated, request 1 returns a word from I space, and request 2 returns a word from D space. If I and D space are not separated, either request 1 or request 2 may be used with equal results. The *data* argument is ignored. These two requests will fail if *addr* is not the start address of a word, in which case a value of −1 is returned to the parent process and the parent's *errno* is set to EIO.

3 With this request, the word at location *addr* in the child's USER area in the system's address space (see <sys/user.h>) is returned to the parent process. The *data* argument is ignored. This request will fail if *addr* is not the start address of a word or is outside the USER area, in which case a value of −1 is returned to the parent process and the parent's *errno* is set to EIO.

4, 5

With these requests, the value given by the *data* argument is written into the address space of the child at location *addr*. If I and D space are separated, request 4 writes a word into I space, and request 5 writes a word into D space. If I and D space are not separated, either request 4 or request 5 may be used with equal results. Upon successful completion, the value written into the address space of the child is returned to the parent. These two requests will fail if *addr* is not the start address of a word. Upon failure a value of −1 is returned to the parent process and the parent's *errno* is set to EIO.

6 With this request, a few entries in the child's USER area can be written. *data* gives the value that is to be written and *addr* is the location of the entry. The few entries that can be written are:

the general registers

the condition codes of the Processor Status Word.

7 This request causes the child to resume execution. If the *data* argument is 0, all pending signals including the one that caused the child to stop are canceled before it resumes execution. If the *data* argument is a valid signal number, the child resumes execution as if it had incurred that signal, and any other pending signals are canceled. The *addr* argument must be equal to 1 for this request. Upon successful completion, the value of *data* is returned to the parent. This request will fail if *data* is not 0 or a valid signal number, in which case a value of −1 is returned to the parent process and the parent's *errno* is set to EIO.

8 This request causes the child to terminate with the same consequences as `exit`(2).

9 This request sets the trace bit in the Processor Status Word of the child and then executes the same steps as listed above for request 7. The trace bit causes an interrupt upon completion of one machine instruction. This effectively allows single stepping of the child.

To forestall possible fraud, `ptrace` inhibits the set-user-id facility on subsequent *exec*(2) calls. If a traced process calls **exec**, it will stop before executing the first instruction of the new image showing signal **SIGTRAP**. `ptrace` will in general fail if one or more of the following are true:

[EIO] *request* is an illegal number.

[ESRCH] *pid* identifies a child that does not exist or has not executed a `ptrace` with request 0.

SEE ALSO

`sdb`(1), **exec**(2), `signal`(2), `wait`(2).

NAME

putmsg – send a message on a stream

SYNOPSIS

```
#include <stropts.h>

int putmsg (fd, ctlptr, dataptr, flags)
int fd;
struct strbuf *ctlptr;
struct strbuf *dataptr;
int flags;
```

DESCRIPTION

putmsg creates a message [see intro(2)] from user specified buffer(s) and sends the message to a STREAMS file. The message may contain either a data part, a control part or both. The data and control parts to be sent are distinguished by placement in separate buffers, as described below. The semantics of each part is defined by the STREAMS module that receives the message.

fd specifies a file descriptor referencing an open *stream*. *ctlptr* and *dataptr* each point to a *strbuf* structure which contains the following members:

```
int maxlen;   /* not used */
int len;      /* length of data */
char *buf;    /* ptr to buffer */
```

ctlptr points to the structure describing the control part, if any, to be included in the message. The *buf* field in the *strbuf* structure points to the buffer where the control information resides, and the *len* field indicates the number of bytes to be sent. The *maxlen* field is not used in putmsg [see getmsg(2)]. In a similar manner, *dataptr* specifies the data, if any, to be included in the message. *flags* may be set to the values 0 or RS_HIPRI and is used as described below.

To send the data part of a message, *dataptr* must be non-NULL and the *len* field of *dataptr* must have a value of 0 or greater. To send the control part of a message, the corresponding values must be set for *ctlptr*. No data (control) part will be sent if either *dataptr* (*ctlptr*) is NULL or the *len* field of *dataptr* (*ctlptr*) is set to -1.

If a control part is specified, and *flags* is set to RS_HIPRI, a *priority* message is sent. If *flags* is set to 0, a non-priority message is sent. If no control part is specified, and *flags* is set to RS_HIPRI, putmsg fails and sets *errno* to EINVAL. If no control part and no data part are specified, and *flags* is set to 0, no message is sent, and 0 is returned.

For non-priority messages, putmsg will block if the *stream* write queue is full due to internal flow control conditions. For priority messages, putmsg does not block on this condition. For non-priority messages, putmsg does not block when the write queue is full and O_NDELAY is set. Instead, it fails and sets *errno* to EAGAIN.

putmsg also blocks, unless prevented by lack of internal resources, waiting for the availability of message blocks in the *stream*, regardless of priority or whether O_NDELAY has been specified. No partial message is sent.

putmsg fails if one or more of the following are true:

[EAGAIN] A non-priority message was specified, the O_NDELAY flag is set and the *stream* write queue is full due to internal flow control conditions.

[EBADF] *fd* is not a valid file descriptor open for writing.

[EFAULT] *ctlptr* or *dataptr* points outside the allocated address space.

[EINTR] A signal was caught during the putmsg system call.

[EINVAL] An undefined value was specified in *flags*, or *flags* is set to RS_HIPRI and no control part was supplied.

[EINVAL] The *stream* referenced by *fd* is linked below a multiplexor.

[ENOSR] Buffers could not be allocated for the message that was to be created due to insufficient STREAMS memory resources.

[ENOSTR] A *stream* is not associated with *fd*.

[ENXIO] A hangup condition was generated downstream for the specified *stream*.

[ERANGE] The size of the data part of the message does not fall within the range specified by the maximum and minimum packet sizes of the topmost *stream* module. This value is also returned if the control part of the message is larger than the maximum configured size of the control part of a message, or if the data part of a message is larger than the maximum configured size of the data part of a message.

A putmsg also fails if a STREAMS error message had been processed by the *stream* head before the call to putmsg. The error returned is the value contained in the STREAMS error message.

SEE ALSO

intro(2), read(2), getmsg(2), poll(2), write(2).
STREAMS Primer.
STREAMS Programmer's Guide.

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

NAME

read – read from file

SYNOPSIS

```
int read (fildes, buf, nbyte)
int fildes;
char *buf;
unsigned nbyte;
```

DESCRIPTION

fildes is a file descriptor obtained from a creat(2), open(2), dup(2), fcntl(2), or pipe(2) system call.

read attempts to read *nbyte* bytes from the file associated with *fildes* into the buffer pointed to by *buf*.

On devices capable of seeking, the read starts at a position in the file given by the file pointer associated with *fildes*. Upon return from read, the file pointer is incremented by the number of bytes actually read.

Devices that are incapable of seeking always read from the current position. The value of a file pointer associated with such a file is undefined.

Upon successful completion, read returns the number of bytes actually read and placed in the buffer; this number may be less than *nbyte* if the file is associated with a communication line [see ioctl(2) and termio(7)], or if the number of bytes left in the file is less than *nbyte* bytes. A value of 0 is returned when an end-of-file has been reached.

A read from a STREAMS [see intro(2)] file can operate in three different modes: "byte-stream" mode, "message-nondiscard" mode, and "message-discard" mode. The default is byte-stream mode. This can be changed using the I_SRDOPT ioctl request [see streamio(7)], and can be tested with the I_GRDOPT ioctl. In byte-stream mode, read will retrieve data from the *stream* until it has retrieved *nbyte* bytes, or until there is no more data to be retrieved. Byte-stream mode ignores message boundaries.

In STREAMS message-nondiscard mode, read retrieves data until it has read *nbyte* bytes, or until it reaches a message boundary. If the read does not retrieve all the data in a message, the remaining data are replaced on the *stream*, and can be retrieved by the next read or getmsg(2) call. Message-discard mode also retrieves data until it has retrieved *nbyte* bytes, or it reaches a message boundary. However, unread data remaining in a message after the read returns are discarded, and are not available for a subsequent read or getmsg.

When attempting to read from a regular file with mandatory file/record locking set [see chmod(2)], and there is a blocking (i.e. owned by another process) write lock on the segment of the file to be read:

> If O_NDELAY is set, the read will return a -1 and set errno to EAGAIN.
>
> If O_NDELAY is clear, the read will sleep until the blocking record lock is removed.

When attempting to read from an empty pipe (or FIFO):

If O_NDELAY is set, the read will return a 0.

If O_NDELAY is clear, the read will block until data is written to the file or the file is no longer open for writing.

When attempting to read a file associated with a tty that has no data currently available:

If O_NDELAY is set, the read will return a 0.

If O_NDELAY is clear, the read will block until data becomes available.

When attempting to read a file associated with a *stream* that has no data currently available:

If O_NDELAY is set, the read will return a -1 and set errno to EAGAIN.

If O_NDELAY is clear, the read will block until data becomes available.

When reading from a STREAMS file, handling of zero-byte messages is determined by the current read mode setting. In byte-stream mode, `read` accepts data until it has read *nbyte* bytes, or until there is no more data to read, or until a zero-byte message block is encountered. `read` then returns the number of bytes read, and places the zero-byte message back on the *stream* to be retrieved by the next `read` or `getmsg`. In the two other modes, a zero-byte message returns a value of 0 and the message is removed from the *stream*. When a zero-byte message is read as the first message on a *stream*, a value of 0 is returned regardless of the read mode.

A `read` from a STREAMS file can only process data messages. It cannot process any type of protocol message and will fail if a protocol message is encountered at the *stream head*.

`read` will fail if one or more of the following are true:

[EAGAIN]	Mandatory file/record locking was set, O_NDELAY was set, and there was a blocking record lock.
[EAGAIN]	Total amount of system memory available when reading via raw IO is temporarily insufficient.
[EAGAIN]	No message waiting to be read on a *stream* and O_NDELAY flag set.
[EBADF]	*fildes* is not a valid file descriptor open for reading.
[EBADMSG]	Message waiting to be read on a *stream* is not a data message.
[EDEADLK]	The read was going to go to sleep and cause a deadlock situation to occur.
[EFAULT]	*buf* points outside the allocated address space.
[EINTR]	A signal was caught during the `read` system call.
[EINVAL]	Attempted to read from a *stream* linked to a multiplexor.

[ENOLCK] The system record lock table was full, so the read could not go to sleep until the blocking record lock was removed.

[ENOLINK] *fildes* is on a remote machine and the link to that machine is no longer active.

A `read` from a STREAMS file will also fail if an error message is received at the *stream head*. In this case, *errno* is set to the value returned in the error message. If a hangup occurs on the *stream* being read, `read` will continue to operate normally until the *stream head* read queue is empty. Thereafter, it will return 0.

SEE ALSO

`creat`(2), `dup`(2), `fcntl`(2), `ioctl`(2),`intro`(2), `open`(2), `pipe`(2), `getmsg`(2).
`streamio`(7), `termio`(7) in the *System Administrator's Reference Manual*.

DIAGNOSTICS

Upon successful completion a non-negative integer is returned indicating the number of bytes actually read. Otherwise, a -1 is returned and *errno* is set to indicate the error.

NAME

`rmdir` – remove a directory

SYNOPSIS

```
int rmdir (path)
char *path;
```

DESCRIPTION

`rmdir` removes the directory named by the path name pointed to by *path*. The directory must not have any entries other than "." and "..".

The named directory is removed unless one or more of the following are true:

[EINVAL]	The current directory may not be removed.
[EINVAL]	The "." entry of a directory may not be removed.
[EEXIST]	The directory contains entries other than those for "." and "..".
[ENOTDIR]	A component of the path prefix is not a directory.
[ENOENT]	The named directory does not exist.
[EACCES]	Search permission is denied for a component of the path prefix.
[EACCES]	Write permission is denied on the directory containing the directory to be removed.
[EACCES]	The parent directory has the sticky bit set and the parent directory is not owned by the user and the directory is not owned by the user and the directory is not writable by the user and the user is not superuser
[EBUSY]	The directory to be removed is the mount point for a mounted file system.
[EROFS]	The directory entry to be removed is part of a read-only file system.
[EFAULT]	*path* points outside the process's allocated address space.
[EIO]	An I/O error occurred while accessing the file system.
[ENOLINK]	*path* points to a remote machine, and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

SEE ALSO

`mkdir`(2).
`rmdir`(1), `rm`(1), and `mkdir`(1) in the *User's Reference Manual*.

NAME

`semctl` – semaphore control operations

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/sem.h>

int semctl (semid, semnum, cmd, arg)
int semid, cmd;
int semnum;
union semun {
     int val;
     struct semid_ds *buf;
     ushort *array;
} arg;
```

DESCRIPTION

`semctl` provides a variety of semaphore control operations as specified by *cmd*.

The following *cmd*s are executed with respect to the semaphore specified by *semid* and *semnum*:

GETVAL Return the value of semval [see `intro`(2)]. {READ}

SETVAL Set the value of semval to *arg.val*. {ALTER} When this cmd is successfully executed, the semadj value corresponding to the specified semaphore in all processes is cleared.

GETPID Return the value of sempid. {READ}

GETNCNT Return the value of semncnt. {READ}

GETZCNT Return the value of semzcnt. {READ}

The following *cmd*s return and set, respectively, every semval in the set of semaphores.

GETALL Place semvals into array pointed to by *arg.array*. {READ}

SETALL Set semvals according to the array pointed to by *arg.array*. {ALTER} When this cmd is successfully executed the semadj values corresponding to each specified semaphore in all processes are cleared.

The following *cmd*s are also available:

IPC_STAT Place the current value of each member of the data structure associated with *semid* into the structure pointed to by *arg.buf*. The contents of this structure are defined in `intro`(2). {READ}

IPC_SET Set the value of the following members of the data structure associated with *semid* to the corresponding value found in the structure pointed to by *arg.buf*:

```
sem_perm.uid
sem_perm.gid
sem_perm.mode /* only low 9 bits */
```

This cmd can only be executed by a process that has an effective user ID equal to either that of super-user, or to the value of **sem_perm.cuid** or **sem_perm.uid** in the data structure associated with *semid*.

IPC_RMID — Remove the semaphore identifier specified by *semid* from the system and destroy the set of semaphores and data structure associated with it. This cmd can only be executed by a process that has an effective user ID equal to either that of super-user, or to the value of **sem_perm.cuid** or **sem_perm.uid** in the data structure associated with *semid*.

semctl fails if one or more of the following are true:

[EINVAL] *semid* is not a valid semaphore identifier.

[EINVAL] *semnum* is less than zero or greater than **sem_nsems**.

[EINVAL] *cmd* is not a valid command.

[EACCES] Operation permission is denied to the calling process [see intro(2)].

[ERANGE] *cmd* is **SETVAL** or **SETALL** and the value to which semval is to be set is greater than the system imposed maximum.

[EPERM] *cmd* is equal to **IPC_RMID** or **IPC_SET** and the effective user ID of the calling process is not equal to that of super-user, or to the value of **sem_perm.cuid** or **sem_perm.uid** in the data structure associated with *semid*.

[EFAULT] *arg.buf* points to an illegal address.

SEE ALSO

intro(2), **semget**(2), **semop**(2).

DIAGNOSTICS

Upon successful completion, the value returned depends on *cmd* as follows:

GETVAL	The value of semval.
GETPID	The value of sempid.
GETNCNT	The value of semncnt.
GETZCNT	The value of semzcnt.
All others	A value of 0.

Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

semget – get set of semaphores

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/sem.h>

key_t key;
int nsems, semflg;
```

DESCRIPTION

semget returns the semaphore identifier associated with *key*.

A semaphore identifier and associated data structure and set containing *nsems* semaphores [see intro(2)] are created for *key* if one of the following is true:

> *key* is equal to IPC_PRIVATE.
>
> *key* does not already have a semaphore identifier associated with it, and (*semflg* & IPC_CREAT) is "true".

Upon creation, the data structure associated with the new semaphore identifier is initialized as follows:

> sem_perm.cuid, sem_perm.uid, sem_perm.cgid, and sem_perm.gid are set equal to the effective user ID and effective group ID, respectively, of the calling process.
>
> The low-order 9 bits of sem_perm.mode are set equal to the low-order 9 bits of *semflg*.
>
> sem_nsems is set equal to the value of *nsems*.
>
> sem_otime is set equal to 0 and sem_ctime is set equal to the current time.

semget fails if one or more of the following are true:

[EINVAL] *nsems* is either less than or equal to zero or greater than the system-imposed limit.

[EACCES] A semaphore identifier exists for *key*, but operation permission [see intro(2)] as specified by the low-order 9 bits of *semflg* would not be granted.

[EINVAL] A semaphore identifier exists for *key*, but the number of semaphores in the set associated with it is less than *nsems*, and *nsems* is not equal to zero.

[ENOENT] A semaphore identifier does not exist for *key* and (*semflg* & IPC_CREAT) is "false".

[ENOSPC] A semaphore identifier is to be created but the system-imposed limit on the maximum number of allowed semaphore identifiers system wide would be exceeded.

[ENOSPC] A semaphore identifier is to be created but the system-imposed limit on the maximum number of allowed semaphores system wide would be exceeded.

[EEXIST] A semaphore identifier exists for *key* but ((*semflg* & IPC_CREAT) and (*semflg* & IPC_EXCL)) is "true".

SEE ALSO

intro(2), semctl(2), semop(2).

DIAGNOSTICS

Upon successful completion, a non-negative integer, namely a semaphore identifier, is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

semop – semaphore operations

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/sem.h>

int semop (semid, sops, nsops)
int semid;
struct sembuf **sops;
unsigned nsops;
```

DESCRIPTION

semop is used to automatically perform an array of semaphore operations on the set of semaphores associated with the semaphore identifier specified by *semid*. *sops* is a pointer to the array of semaphore-operation structures. *Nsops* is the number of such structures in the array. The contents of each structure includes the following members:

```
short   sem_num;    /* semaphore number */
short   sem_op;     /* semaphore operation */
short   sem_flg;    /* operation flags */
```

Each semaphore operation specified by *sem_op* is performed on the corresponding semaphore specified by *semid* and *sem_num*.

sem_op specifies one of three semaphore operations as follows:

If *sem_op* is a negative integer, one of the following will occur: {ALTER}

If semval [see `intro`(2)] is greater than or equal to the absolute value of *sem_op*, the absolute value of *sem_op* is subtracted from semval. Also, if (*sem_flg* & **SEM_UNDO**) is "true", the absolute value of *sem_op* is added to the calling process's semadj value [see `exit`(2)] for the specified semaphore.

If semval is less than the absolute value of *sem_op* and (*sem_flg* & **IPC_NOWAIT**) is "true", **semop** will return immediately.

If semval is less than the absolute value of *sem_op* and (*sem_flg* & **IPC_NOWAIT**) is "false", **semop** will increment the semncnt associated with the specified semaphore and suspend execution of the calling process until one of the following conditions occur.

semval becomes greater than or equal to the absolute value of *sem_op*. When this occurs, the value of semncnt associated with the specified semaphore is decremented, the absolute value of *sem_op* is subtracted from semval and, if (*sem_flg* & **SEM_UNDO**) is "true", the absolute value of *sem_op* is added to the calling process's semadj value for the specified semaphore.

The semid for which the calling process is awaiting action is removed from the system [see **semctl**(2)]. When this occurs, *errno* is set equal to EIDRM, and a value of −1 is returned.

The calling process receives a signal that is to be caught. When this occurs, the value of semncnt associated with the specified semaphore is decremented, and the calling process resumes execution in the manner prescribed in `signal`(2).

If *sem_op* is a positive integer, the value of *sem_op* is added to semval and, if (*sem_flg* & `SEM_UNDO`) is "true", the value of *sem_op* is subtracted from the calling process's semadj value for the specified semaphore. {ALTER}

If *sem_op* is zero, one of the following will occur: {READ}

If semval is zero, **semop** will return immediately.

If semval is not equal to zero and (*sem_flg* & `IPC_NOWAIT`) is "true", **semop** will return immediately.

If semval is not equal to zero and (*sem_flg* & `IPC_NOWAIT`) is "false", **semop** will increment the semzcnt associated with the specified semaphore and suspend execution of the calling process until one of the following occurs:

semval becomes zero, at which time the value of semzcnt associated with the specified semaphore is decremented.

The semid for which the calling process is awaiting action is removed from the system. When this occurs, *errno* is set equal to EIDRM, and a value of −1 is returned.

The calling process receives a signal that is to be caught. When this occurs, the value of semzcnt associated with the specified semaphore is decremented, and the calling process resumes execution in the manner prescribed in `signal`(2).

semop will fail if one or more of the following are true for any of the semaphore operations specified by *sops*:

[EINVAL]	*semid* is not a valid semaphore identifier.
[EFBIG]	*sem_num* is less than zero or greater than or equal to the number of semaphores in the set associated with *semid*.
[E2BIG]	*nsops* is greater than the system-imposed maximum.
[EACCES]	Operation permission is denied to the calling process [see `intro`(2)]
[EAGAIN]	The operation would result in suspension of the calling process but (*sem_flg* & `IPC_NOWAIT`) is "true".
[ENOSPC]	The limit on the number of individual processes requesting an `SEM_UNDO` would be exceeded.
[EINVAL]	The number of individual semaphores for which the calling process requests a `SEM_UNDO` would exceed the limit.

[ERANGE] An operation would cause a semval to overflow the system-imposed limit.

[ERANGE] An operation would cause a semadj value to overflow the system-imposed limit.

[EFAULT] *sops* points to an illegal address.

Upon successful completion, the value of sempid for each semaphore specified in the array pointed to by *sops* is set equal to the process ID of the calling process.

SEE ALSO

`exec`(2), `exit`(2), `fork`(2), `intro`(2), `semctl`(2), `semget`(2).

DIAGNOSTICS

If *semop* returns due to the receipt of a signal, a value of −1 is returned to the calling process and *errno* is set to EINTR. If it returns due to the removal of a *semid* from the system, a value of −1 is returned and *errno* is set to EIDRM.

Upon successful completion, a value of zero is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

setpgrp – set process group ID

SYNOPSIS

`int setpgrp ()`

DESCRIPTION

setpgrp sets the process group ID of the calling process to the process ID of the calling process and returns the new process group ID.

SEE ALSO

exec(2), fork(2), getpid(2), intro(2), kill(2), signal(2).

DIAGNOSTICS

setpgrp returns the value of the new process group ID.

NAME

`setuid`, `setgid` – set user and group IDs

SYNOPSIS

```
int setuid (uid)
int uid;

int setgid (gid)
int gid;
```

DESCRIPTION

`setuid` (`setgid`) is used to set the real user (group) ID and effective user (group) ID of the calling process.

If the effective user ID of the calling process is super-user, the real user (group) ID and effective user (group) ID are set to *uid* (*gid*).

If the effective user ID of the calling process is not super-user, but its real user (group) ID is equal to *uid* (*gid*), the effective user (group) ID is set to *uid* (*gid*).

If the effective user ID of the calling process is not super-user, but the saved set-user (group) ID from **exec**(2) is equal to *uid* (*gid*), the effective user (group) ID is set to *uid* (*gid*).

`setuid` (`setgid`) will fail if the real user (group) ID of the calling process is not equal to *uid* (*gid*) and its effective user ID is not super-user. [EPERM]

The *uid* is out of range. [EINVAL]

SEE ALSO

`getuid`(2), `intro`(2).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

shmctl – shared memory control operations

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>

int shmctl (shmid, cmd, buf)
int shmid, cmd;
struct shmid_ds *buf;
```

DESCRIPTION

`shmctl` provides a variety of shared memory control operations as specified by *cmd*. The following *cmd*s are available:

`IPC_STAT` Place the current value of each member of the data structure associated with *shmid* into the structure pointed to by *buf*. The contents of this structure are defined in `intro`(2). {READ}

`IPC_SET` Set the value of the following members of the data structure associated with *shmid* to the corresponding value found in the structure pointed to by *buf*:

```
shm_perm.uid
shm_perm.gid
shm_perm.mode /* only low 9 bits */
```

This *cmd* can only be executed by a process that has an effective user ID equal to that of super user, or to the value of `shm_perm.cuid` or `shm_perm.uid` in the data structure associated with *shmid*.

`IPC_RMID` Remove the shared memory identifier specified by *shmid* from the system and destroy the shared memory segment and data structure associated with it. This *cmd* can only be executed by a process that has an effective user ID equal to that of super user, or to the value of `shm_perm.cuid` or `shm_perm.uid` in the data structure associated with *shmid*.

`SHM_LOCK` Lock the shared memory segment specified by *shmid* in memory. This *cmd* can only be executed by a process that has an effective user ID equal to super user.

`SHM_UNLOCK` Unlock the shared memory segment specified by *shmid*. This *cmd* can only be executed by a process that has an effective user ID equal to super user.

`shmctl` will fail if one or more of the following are true:

[EINVAL] *shmid* is not a valid shared memory identifier.

[EINVAL] *cmd* is not a valid command.

[EACCES] *cmd* is equal to `IPC_STAT` and {READ} operation permission is denied to the calling process [see `intro`(2)].

[EPERM] *cmd* is equal to `IPC_RMID` or `IPC_SET` and the effective user ID of the calling process is not equal to that of super user, or to the value of `shm_perm.cuid` or `shm_perm.uid` in the data structure associated with *shmid*.

[EPERM] *cmd* is equal to `SHM_LOCK` or `SHM_UNLOCK` and the effective user ID of the calling process is not equal to that of super user.

[EFAULT] *buf* points to an illegal address.

[ENOMEM] *cmd* is equal to `SHM_LOCK` and there is not enough memory.

SEE ALSO

`shmget(2)`, `shmop(2)`.

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NOTES

The user must explicitly remove shared memory segments after the last reference to them has been removed.

NAME

shmget – get shared memory segment identifier

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>

key_t key;
int size, shmflg;
```

DESCRIPTION

shmget returns the shared memory identifier associated with *key*.

A shared memory identifier and associated data structure and shared memory segment of at least *size* bytes [see intro(2)] are created for *key* if one of the following are true:

key is equal to IPC_PRIVATE.

key does not already have a shared memory identifier associated with it, and (*shmflg* & IPC_CREAT) is "true".

Upon creation, the data structure associated with the new shared memory identifier is initialized as follows:

shm_perm.cuid, shm_perm.uid, shm_perm.cgid, and shm_perm.gid are set equal to the effective user ID and effective group ID, respectively, of the calling process.

The low-order 9 bits of shm_perm.mode are set equal to the low-order 9 bits of *shmflg*. shm_segsz is set equal to the value of *size*.

shm_lpid, shm_nattch shm_atime, and shm_dtime are set equal to 0.

shm_ctime is set equal to the current time.

shmget will fail if one or more of the following are true:

[EINVAL] *size* is less than the system-imposed minimum or greater than the system-imposed maximum.

[EACCES] A shared memory identifier exists for *key* but operation permission [see intro(2)] as specified by the low-order 9 bits of *shmflg* would not be granted.

[EINVAL] A shared memory identifier exists for *key* but the size of the segment associated with it is less than *size* and *size* is not equal to zero.

[ENOENT] A shared memory identifier does not exist for *key* and (*shmflg* & IPC_CREAT) is "false".

[ENOSPC] A shared memory identifier is to be created but the system-imposed limit on the maximum number of allowed shared memory identifiers system wide would be exceeded.

[ENOMEM] A shared memory identifier and associated shared memory segment are to be created but the amount of available memory is not sufficient to fill the request.

[EEXIST] A shared memory identifier exists for *key* but ((*shmflg* & IPC_CREAT) and (*shmflg* & IPC_EXCL)) is "true".

SEE ALSO

intro(2), shmctl(2), shmop(2).

DIAGNOSTICS

Upon successful completion, a non-negative integer, namely a shared memory identifier is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NOTES

The user must explicitly remove shared memory segments after the last reference to them has been removed.

NAME

shmop – shared memory operations

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>

char *shmat (shmid, shmaddr, shmflg)
int shmid;
char *shmaddr;
int shmflg;

int shmdt (shmaddr)
char *shmaddr;
```

DESCRIPTION

shmat attaches the shared memory segment associated with the shared memory identifier specified by *shmid* to the data segment of the calling process. The segment is attached at the address specified by one of the following criteria:

> If *shmaddr* is equal to zero, the segment is attached at the first available address as selected by the system.
>
> If *shmaddr* is not equal to zero and (*shmflg* & SHM_RND) is "true", the segment is attached at the address given by (*shmaddr* - (*shmaddr* modulus SHMLBA)).
>
> If *shmaddr* is not equal to zero and (*shmflg* & SHM_RND) is "false", the segment is attached at the address given by *shmaddr*.

shmdt detaches from the calling process's data segment the shared memory segment located at the address specified by *shmaddr.*

The segment is attached for reading if (*shmflg* & SHM_RDONLY) is "true" {READ}, otherwise it is attached for reading and writing {READ/WRITE}.

shmat will fail and not attach the shared memory segment if one or more of the following are true:

[EINVAL]	*shmid* is not a valid shared memory identifier.
[EACCES]	Operation permission is denied to the calling process [see intro(2)].
[ENOMEM]	The available data space is not large enough to accommodate the shared memory segment.
[EINVAL]	*shmaddr* is not equal to zero, and the value of (*shmaddr* - (*shmaddr* modulus SHMLBA)) is an illegal address.
[EINVAL]	*shmaddr* is not equal to zero, (*shmflg* & SHM_RND) is "false", and the value of *shmaddr* is an illegal address.
[EMFILE]	The number of shared memory segments attached to the calling process would exceed the system-imposed limit.

[EINVAL] *shmdt* will fail and not detach the shared memory segment if *shmaddr* is not the data segment start address of a shared memory segment.

SEE ALSO

exec(2), exit(2), fork(2), intro(2), shmctl(2), shmget(2).

DIAGNOSTICS

Upon successful completion, the return value is as follows:

shmat returns the data segment start address of the attached shared memory segment.

shmdt returns a value of 0.

Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

NOTES

The user must explicitly remove shared memory segments after the last reference to them has been removed.

NAME

`signal` – specify what to do upon receipt of a signal

SYNOPSIS

```
#include <signal.h>

void (*signal (sig, func))()
int sig;
void (*func)();
```

DESCRIPTION

`signal` allows the calling process to choose one of three ways in which it is possible to handle the receipt of a specific signal. *sig* specifies the signal and *func* specifies the choice.

sig can be assigned any one of the following except `SIGKILL`:

SIGHUP	01	hangup
SIGINT	02	interrupt
SIGQUIT	03[1]	quit
SIGILL	04[1]	illegal instruction (not reset when caught)
SIGTRAP	05[1]	trace trap (not reset when caught)
SIGIOT	06[1]	IOT instruction
SIGEMT	07[1]	EMT instruction
SIGFPE	08[1]	floating point exception
SIGKILL	09	kill (cannot be caught or ignored)
SIGBUS	10[1]	bus error
SIGSEGV	11[1]	segmentation violation
SIGSYS	12[1]	bad argument to system call
SIGPIPE	13	write on a pipe with no one to read it
SIGALRM	14	alarm clock
SIGTERM	15	software termination signal
SIGUSR1	16	user-defined signal 1
SIGUSR2	17	user-defined signal 2
SIGCLD	18[2]	death of a child
SIGPWR	19[2]	power fail
SIGPOLL	22[3]	selectable event pending

func is assigned one of three values: `SIG_DFL`, `SIG_IGN`, or a *function address*. `SIG_DFL`, and `SIG_IGN`, are defined in the include file *signal.h*. Each is a macro that expands to a constant expression of type pointer to function returning *void*, and has a unique value that matches no declarable function.

The actions prescribed by the values of *func* are as follows:

`SIG_DFL` – terminate process upon receipt of a signal
Upon receipt of the signal *sig*, the receiving process is to be terminated with all of the consequences outlined in `exit`(2). See NOTE [1] below.

`SIG_IGN` – ignore signal
The signal *sig* is to be ignored.

Note: the signal **SIGKILL** cannot be ignored.

function address – catch signal

Upon receipt of the signal *sig*, the receiving process is to execute the signal-catching function pointed to by *func*. The signal number *sig* will be passed as the only argument to the signal-catching function. Additional arguments are passed to the signal-catching function for hardware-generated signals. Before entering the signal-catching function, the value of *func* for the caught signal will be set to SIG_DFL unless the signal is SIGILL, SIGTRAP, or SIGPWR.

Upon return from the signal-catching function, the receiving process will resume execution at the point it was interrupted.

When a signal that is to be caught occurs during a read(2), a write(2), an open(2), or an ioctl(2) system call on a slow device (like a terminal; but not a file), during a pause(2) system call, or during a wait(2) system call that does not return immediately due to the existence of a previously stopped or zombie process, the signal catching function will be executed and then the interrupted system call may return a −1 to the calling process with *errno* set to EINTR.

signal will not catch an invalid function argument, *func*, and results are undefined when an attempt is made to execute the function at the bad address.

Note: The signal **SIGKILL** cannot be caught.

A call to signal cancels a pending signal *sig* except for a pending SIGKILL signal.

signal will fail if *sig* is an illegal signal number, including SIGKILL. [EINVAL]

NOTES

[1]

If SIG_DFL is assigned for these signals, in addition to the process being terminated, a "core image" will be constructed in the current working directory of the process, if the following conditions are met:

The effective user ID and the real user ID of the receiving process are equal.

An ordinary file named core exists and is writable or can be created. If the file must be created, it will have the following properties:

a mode of 0666 modified by the file creation mask [see *umask*(2)]

a file owner ID that is the same as the effective user ID of the receiving process.

a file group ID that is the same as the effective group ID of the receiving process

[2]

For the signals SIGCLD and SIGPWR, *func* is assigned one of three values: SIG_DFL, SIG_IGN, or a *function address*. The actions prescribed by these values are:

SIG_DFL - ignore signal
The signal is to be ignored.

SIG_IGN - ignore signal
The signal is to be ignored. Also, if *sig* is SIGCLD, the calling process's child processes will not create zombie processes when they terminate [see exit(2)].

function address - catch signal
If the signal is SIGPWR, the action to be taken is the same as that described above for *func* equal to *function address*. The same is true if the signal is SIGCLD with one exception: while the process is executing the signal-catching function, any received SIGCLD signals will be ignored. (This is the default action.)

In addition, SIGCLD affects the wait, and exit system calls as follows:

wait If the *func* value of SIGCLD is set to SIG_IGN and a wait is executed, the wait will block until all of the calling process's child processes terminate; it will then return a value of −1 with *errno* set to ECHILD.

exit If in the exiting process's parent process the *func* value of SIGCLD is set to SIG_IGN, the exiting process will not create a zombie process.

When processing a pipeline, the shell makes the last process in the pipeline the parent of the proceeding processes. A process that may be piped into in this manner (and thus become the parent of other processes) should take care not to set SIGCLD to be caught.

[3]
SIGPOLL is issued when a file descriptor corresponding to a STREAMS [see intro(2)] file has a "selectable" event pending. A process must specifically request that this signal be sent using the I_SETSIG ioctl call. Otherwise, the process will never receive SIGPOLL.

SEE ALSO

intro(2), kill(2), pause(2), ptrace(2), wait(2), setjmp(3C), sigset(2).
kill(1) in the *User's Reference Manual.*

DIAGNOSTICS

Upon successful completion, signal returns the previous value of *func* for the specified signal *sig*. Otherwise, a value of SIG_ERR is returned and *errno* is set to indicate the error. SIG_ERR is defined in the include file *signal.h.*

NAME

sigset, sighold, sigrelse, sigignore, sigpause – signal management

SYNOPSIS

```
#include <signal.h>

void (*sigset (sig, func))()
int sig;
void (*func)();

int sighold (sig)
int sig;

int sigrelse (sig)
int sig;

int sigignore (sig)
int sig;

int sigpause (sig)
int sig;
```

DESCRIPTION

These functions provide signal management for application processes. sigset specifies the system signal action to be taken upon receipt of signal *sig*. This action is either calling a process signal-catching handler *func* or performing a system-defined action.

sig can be assigned any one of the following values except SIGKILL. Machine or implementation dependent signals are not included (see NOTES below). Each value of *sig* is a macro, defined in <signal.h>, that expands to an integer constant expression.

SIGHUP	hangup
SIGINT	interrupt
SIGQUIT*	quit
SIGILL*	illegal instruction (not held when caught)
SIGTRAP*	trace trap (not held when caught)
SIGABRT*	abort
SIGFPE*	floating point exception
SIGKILL	kill (can not be caught or ignored)
SIGSYS*	bad argument to system call
SIGPIPE	write on a pipe with no one to read it
SIGALRM	alarm clock
SIGTERM	software termination signal
SIGUSR1	user-defined signal 1
SIGUSR2	user-defined signal 2
SIGCLD	death of a child (see NOTES below)
SIGPWR	power fail (see NOTES below)
SIGPOLL	selectable event pending (see NOTES below)

See below under SIG_DFL regarding asterisks (*) in the above list.

The following values for the system-defined actions of *func* are also defined in `<signal.h>`. Each is a macro that expands to a constant expression of type pointer to function returning *void* and has a unique value that matches no declarable function.

`SIG_DFL` – default system action

Upon receipt of the signal *sig*, the receiving process is to be terminated with all of the consequences outlined in `exit`(2). In addition a "core image" will be made in the current working directory of the receiving process if *sig* is one for which an asterisk appears in the above list *and* the following conditions are met:

The effective user ID and the real user ID of the receiving process are equal.

An ordinary file named `core` exists and is writable or can be created. If the file must be created, it will have the following properties:

a mode of 0666 modified by the file creation mask [see *umask*(2)]

a file owner ID that is the same as the effective user ID of the receiving process.

a file group ID that is the same as the effective group ID of the receiving process

`SIG_IGN` – ignore signal

Any pending signal *sig* is discarded and the system signal action is set to ignore future occurrences of this signal type.

`SIG_HOLD` – hold signal

The signal *sig* is to be held upon receipt. Any pending signal of this type remains held. Only one signal of each type is held.

Otherwise, *func* must be a pointer to a function, the signal-catching handler, that is to be called when signal *sig* occurs. In this case, `sigset` specifies that the process will call this function upon receipt of signal *sig*. Any pending signal of this type is released. This handler address is retained across calls to the other signal management functions listed here.

When a signal occurs, the signal number *sig* will be passed as the only argument to the signal-catching handler. Before calling the signal-catching handler, the system signal action will be set to SIG_HOLD . During normal return from the signal-catching handler, the system signal action is restored to *func* and any held signal of this type released. If a non-local goto (*longjmp*) is taken, then `sigrelse` must be called to restore the system signal action and release any held signal of this type.

In general, upon return from the signal-catching handler, the receiving process will resume execution at the point it was interrupted. However, when a signal is caught during a `read`(2), a `write`(2), an open(2), or an `ioctl`(2) system call during a `sigpause` system call, or during a `wait`(2) system call that does not return immediately due to the existence of a previously stopped or zombie process, the signal-catching handler will be executed and then the interrupted system call may return a −1 to the calling process with *errno* set to EINTR.

sighold and **sigrelse** are used to establish critical regions of code. **sighold** is analogous to raising the priority level and deferring or holding a signal until the priority is lowered by **sigrelse**. **sigrelse** restores the system signal action to that specified previously by **sigset**.

sigignore sets the action for signal *sig* to SIG_IGN (see above).

sigpause suspends the calling process until it receives a signal, the same as **pause**(2). However, if the signal *sig* had been received and held, it is released and the system signal action taken. This system call is useful for testing variables that are changed on the occurrence of a signal. The correct usage is to use **sighold** to block the signal first, then test the variables. If they have not changed, then call **sigpause** to wait for the signal. **sigset** will fail if one or more of the following are true:

[EINVAL] *sig* is an illegal signal number (including SIGKILL) or the default handling of *sig* cannot be changed.

[EINTR] A signal was caught during the system call **sigpause**.

DIAGNOSTICS

Upon successful completion, **sigset** returns the previous value of the system signal action for the specified signal *sig*. Otherwise, a value of SIG_ERR is returned and *errno* is set to indicate the error. SIG_ERR is defined in <*signal.h*>.

For the other functions, upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

SEE ALSO

kill(2), **pause**(2), **signal**(2), **wait**(2), **setjmp**(3C).

NOTES

Two signals that behave differently than the signals described above exist in this release of the system:

SIGCLD death of a child (reset when caught)
SIGPWR power fail (not reset when caught)

For these signals, *func* is assigned one of three values: SIG_DFL, SIG_IGN, or a *function address*. The actions prescribed by these values are as follows:

SIG_DFL - ignore signal
The signal is to be ignored.

SIG_IGN - ignore signal
The signal is to be ignored. Also, if *sig* is SIGCLD, the calling process's child processes will not create zombie processes when they terminate [see **exit**(2)].

function address - catch signal
If the signal is SIGPWR, the action to be taken is the same as that described above for *func* equal to *function address*. The same is true if the signal is SIGCLD with one exception: while the process is executing the signal-catching function, any received SIGCLD signals will be ignored. (This is the default action.)

The SIGCLD affects two other system calls [*wait*(2), and *exit*(2)] in the following ways:

`wait` If the *func* value of SIGCLD is set to SIG_IGN and a `wait` is executed, the `wait` will block until all of the calling process's child processes terminate; it will then return a value of −1 with *errno* set to ECHILD.

`exit` If in the exiting process's parent process the *func* value of SIGCLD is set to SIG_IGN, the exiting process will not create a zombie process.

When processing a pipeline, the shell makes the last process in the pipeline the parent of the proceeding processes. A process that may be piped into in this manner (and thus become the parent of other processes) should take care not to set SIGCLD to be caught.

SIGPOLL is issued when a file descriptor corresponding to a STREAMS [see `intro`(2)] file has a "selectable" event pending. A process must specifically request that this signal be sent using the I_SETSIG `ioctl`(2) call [see `streamio`(7)]. Otherwise, the process will never receive SIGPOLL.

For portability, applications should use only the symbolic names of signals rather than their values and use only the set of signals defined here. The action for the signal SIGKILL can not be changed from the default system action.

Specific implementations may have other implementation-defined signals. Also, additional implementation-defined arguments may be passed to the signal-catching handler for hardware-generated signals. For certain hardware-generated signals, it may not be possible to resume execution at the point of interruption.

The signal type SIGSEGV is reserved for the condition that occurs on an invalid access to a data object. If an implementation can detect this condition, this signal type should be used.

The other signal management functions, `signal`(2) and `pause`(2), should not be used in conjunction with these routines for a particular signal type.

NAME

stat, fstat – get file status

SYNOPSIS

```
#include <sys/types.h>
#include <sys/stat.h>

int stat (path, buf)
char *path;
struct stat *buf;

int fstat (fildes, buf)
int fildes;
struct stat *buf;
```

DESCRIPTION

path points to a path name naming a file. Read, write, or execute permission of the named file is not required, but all directories listed in the path name leading to the file must be searchable. stat obtains information about the named file.

Note that in a Remote File Sharing environment, the information returned by stat depends upon the user/group mapping set up between the local and remote computers. [See idload(1M)].

fstat obtains information about an open file known by the file descriptor *fildes*, obtained from a successful open, creat, dup, fcntl, or pipe system call.

buf is a pointer to a stat structure into which information is placed concerning the file.

The contents of the structure pointed to by *buf* include the following members:

```
ushort st_mode;   /* File mode [see mknod(2)] */
ino_t  st_ino;    /* Inode number */
dev_t  st_dev;    /* ID of device containing */
                  /* a directory entry for this file */
dev_t  st_rdev;   /* ID of device */
                  /* This entry is defined only for */
                  /* character or block special files */
short  st_nlink;  /* Number of links */
ushort st_uid;    /* User ID of the file's owner */
ushort st_gid;    /* Group ID of the file's group */
off_t  st_size;   /* File size in bytes */
time_t st_atime;  /* Time of last access */
time_t st_mtime;  /* Time of last data modification */
time_t st_ctime;  /* Time of last file status change */
                  /* Times measured in seconds since */
                  /* 00:00:00 GMT, Jan. 1, 1970 */
```

st_mode The mode of the file as described in the mknod(2) system call.

st_ino This field uniquely identifies the file in a given file system. The pair st_ino and st_dev uniquely identifies regular files.

st_dev This field uniquely identifies the file system that contains the file. Its value may be used as input to the ustat(2) system call to determine more information about this file system. No other meaning is associated with this value.

st_rdev This field should be used only by administrative commands. It is valid only for block special or character special files and only has meaning on the system where the file was configured.

st_nlink This field should be used only by administrative commands.

st_uid The user ID of the file's owner.

st_gid The group ID of the file's group.

st_size For regular files, this is the address of the end of the file. For pipes or fifos, this is the count of the data currently in the file. For block special or character special, this is not defined.

st_atime Time when file data was last accessed. Changed by the following system calls: creat(2), mknod(2), pipe(2), utime(2), and read(2).

st_mtime Time when data was last modified. Changed by the following system calls: creat(2), mknod(2), pipe(2), utime(2), and write(2).

st_ctime Time when file status was last changed. Changed by the following system calls: chmod(2), chown(2), creat(2), link(2), mknod(2), pipe(2), unlink(2), utime(2), and write(2).

stat will fail if one or more of the following are true:

[ENOTDIR] A component of the path prefix is not a directory.

[ENOENT] The named file does not exist.

[EACCES] Search permission is denied for a component of the path prefix.

[EFAULT] *buf* or *path* points to an invalid address.

[EINTR] A signal was caught during the stat system call.

[ENOLINK] *path* points to a remote machine and the link to that machine is no longer active.

[EMULTIHOP] Components of *path* require hopping to multiple remote machines.

fstat will fail if one or more of the following are true:

[EBADF] *fildes* is not a valid open file descriptor.

[EFAULT] *buf* points to an invalid address.

[ENOLINK] *fildes* points to a remote machine and the link to that machine is no longer active.

SEE ALSO

chmod(2), chown(2), creat(2), link(2), mknod(2), pipe(2), read(2), time(2), unlink(2), utime(2), write(2).

DIAGNOSTICS

Upon successful completion a value of 0 is returned. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

NAME

`statfs, fstatfs` – get file system information

SYNOPSIS

```
#include <sys/types.h>
#include <sys/statfs.h>

int statfs (path, buf, len, fstyp)
char *path;
struct statfs *buf;
int len, fstyp;

int fstatfs (fildes, buf, len, fstyp)
int fildes;
struct statfs *buf;
int len, fstyp;
```

DESCRIPTION

`statfs` returns a "generic superblock" describing a file system. It can be used to acquire information about mounted as well as unmounted file systems, and usage is slightly different in the two cases. In all cases, *buf* is a pointer to a structure (described below) which will be filled by the system call, and *len* is the number of bytes of information which the system should return in the structure. *len* must be no greater than `sizeof (struct statfs)` and ordinarily it will contain exactly that value; if it holds a smaller value the system will fill the structure with that number of bytes. (This allows future versions of the system to grow the structure without invalidating older binary programs.)

If the file system of interest is currently mounted, *path* should name a file which resides on that file system. In this case the file system type is known to the operating system and the `fstyp` argument must be zero. For an unmounted file system *path* must name the block special file containing it and `fstyp` must contain the (non-zero) file system type. In both cases read, write, or execute permission of the named file is not required, but all directories listed in the path name leading to the file must be searchable.

The `statfs` structure pointed to by *buf* includes the following members:

```
short   f_fstyp;   /* File system type */
short   f_bsize;   /* Block size */
short   f_frsize;  /* Fragment size */
long    f_blocks;  /* Total number of blocks */
long    f_bfree;   /* Count of free blocks */
long    f_files;   /* Total number of file nodes */
long    f_ffree;   /* Count of free file nodes */
char    f_fname[6];/* Volume name */
char    f_fpack[6];/* Pack name */
```

`fstatfs` is similar, except that the file named by *path* in `statfs` is instead identified by an open file descriptor *fildes* obtained from a successful `open`(2), `creat`(2), `dup`(2), `fcntl`(2), or `pipe`(2) system call.

statfs obsoletes `ustat`(2) and should be used in preference to it in new programs.

statfs and **fstatfs** will fail if one or more of the following are true:

[ENOTDIR]	A component of the path prefix is not a directory.
[ENOENT]	The named file does not exist.
[EACCES]	Search permission is denied for a component of the path prefix.
[EFAULT]	*buf* or *path* points to an invalid address.
[EBADF]	*fildes* is not a valid open file descriptor.
[EINVAL]	*fstyp* is an invalid file system type; *path* is not a block special file and **fstyp** is nonzero; *len* is negative or is greater than **sizeof (struct statfs)**.
[ENOLINK]	*path* points to a remote machine, and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

DIAGNOSTICS

Upon successful completion a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

SEE ALSO

`chmod`(2), `chown`(2), `creat`(2), `link`(2), `mknod`(2), `pipe`(2), `read`(2), `time`(2), `unlink`(2), `utime`(2), `write`(2), `fs`(4).

NAME

`stime` – set time

SYNOPSIS

```
int stime (tp)
long *tp;
```

DESCRIPTION

`stime` sets the system's idea of the time and date. *tp* points to the value of time as measured in seconds from 00:00:00 GMT January 1, 1970.

[EPERM] `stime` will fail if the effective user ID of the calling process is not super-user.

SEE ALSO

`time`(2).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and *errno* is set to indicate the error.

NAME

sync – update super block

SYNOPSIS

`void sync ( )`

DESCRIPTION

`sync` causes all information in memory that should be on disk to be written out. This includes modified super blocks, modified i-nodes, and delayed block I/O.

It should be used by programs which examine a file system, for example `fsck`, `df`, etc. It is mandatory before a re-boot.

The writing, although scheduled, is not necessarily complete upon return from `sync`.

NAME

`sysfs` – get file system type information

SYNOPSIS

```
#include <sys/fstyp.h>
#include <sys/fsid.h>

int sysfs (opcode, fsname)
int opcode;
char *fsname;

int sysfs (opcode, fs_index, buf)
int opcode;
int fs_index;
char *buf;

int sysfs (opcode)
int opcode;
```

DESCRIPTION

`sysfs` returns information about the file system types configured in the system. The number of arguments accepted by `sysfs` varies and depends on the *opcode*. The currently recognized *opcodes* and their functions are described below:

GETFSIND	translates *fsname*, a null-terminated file-system identifier, into a file-system type index.
GETFSTYP	translates *fs_index*, a file-system type index, into a null-terminated file-system identifier and writes it into the buffer pointed to by *buf*; this buffer must be at least of size `FSTYPSZ` as defined in *<sys/fstyp.h>*.
GETNFSTYP	returns the total number of file system types configured in the system.

`sysfs` will fail if one or more of the following are true:

[EINVAL]	*fsname* points to an invalid file-system identifier; *fs_index* is zero, or invalid; *opcode* is invalid.
[EFAULT]	*buf* or *fsname* point to an invalid user address.

DIAGNOSTICS

Upon successful completion, `sysfs` returns the file-system type index if the *opcode* is `GETFSIND`, a value of 0 if the *opcode* is `GETFSTYP`, or the number of file system types configured if the *opcode* is `GETNFSTYP`. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

NAME

`time` – get time

SYNOPSIS

```
#include <sys/types.h>

time_t time (tloc)
long *tloc;
```

DESCRIPTION

time returns the value of time in seconds since 00:00:00 GMT, January 1, 1970.

If *tloc* is non-zero, the return value is also stored in the location to which *tloc* points.

SEE ALSO

`stime`(2).

WARNING

time fails and its actions are undefined if *tloc* points to an illegal address.

DIAGNOSTICS

Upon successful completion, *time* returns the value of time. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

times – get process and child process times

SYNOPSIS

```
#include <sys/types.h>
#include <sys/times.h>

long times (buffer)
struct tms *buffer;
```

DESCRIPTION

times fills the structure pointed to by *buffer* with time-accounting information. The following are the contents of this structure:

```
struct tms {
        time_t tms_utime;
        time_t tms_stime;
        time_t tms_cutime;
        time_t tms_cstime;
};
```

This information comes from the calling process and each of its terminated child processes for which it has executed a wait. All times are reported in clock ticks per second. Clock ticks are a system-dependent parameter. The specific value for an implementation is defined by the variable HZ, found in the include file param.h.

tms_utime is the CPU time used while executing instructions in the user space of the calling process.

tms_stime is the CPU time used by the system on behalf of the calling process.

tms_cutime is the sum of the *tms_utime*s and *tms_cutime*s of the child processes.

tms_cstime is the sum of the *tms_stime*s and *tms_cstime*s of the child processes.

[EFAULT] times will fail if *buffer* points to an illegal address.

SEE ALSO

exec(2), fork(2), time(2), wait(2).

DIAGNOSTICS

Upon successful completion, times returns the elapsed real time, in clock ticks per second, from an arbitrary point in the past (e.g., system start-up time). This point does not change from one invocation of times to another. If times fails, a −1 is returned and *errno* is set to indicate the error.

NAME

uadmin – administrative control

SYNOPSIS

```
#include <sys/uadmin.h>

int uadmin (cmd, fcn, mdep)
int cmd, fcn, mdep;
```

DESCRIPTION

uadmin provides control for basic administrative functions. This system call is tightly coupled to the system administrative procedures and is not intended for general use. The argument *mdep* is provided for machine-dependent use and is not defined here.

As specified by *cmd*, the following commands are available:

A_SHUTDOWN — The system is shutdown. All user processes are killed, the buffer cache is flushed, and the root file system is unmounted. The action to be taken after the system has been shut down is specified by *fcn*. The functions are generic; the hardware capabilities vary on specific machines.

- AD_HALT — Halt the processor and turn off the power.
- AD_BOOT — Reboot the system, using /unix.
- AD_IBOOT — Interactive reboot; user is prompted for system name.

A_REBOOT — The system stops immediately without any further processing. The action to be taken next is specified by *fcn* as above.

A_REMOUNT — The root file system is mounted again after having been fixed. This should be used only during the startup process.

uadmin fails if any of the following are true:

[EPERM] — The effective user ID is not super-user.

DIAGNOSTICS

Upon successful completion, the value returned depends on *cmd* as follows:

A_SHUTDOWN	Never returns.
A_REBOOT	Never returns.
A_REMOUNT	0

Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

NAME

`ulimit` – get and set user limits

SYNOPSIS

```
long ulimit (cmd, newlimit)
int cmd;
long newlimit;
```

DESCRIPTION

This function provides for control over process limits. The *cmd* values available are:

1 Get the regular file size limit of the process. The limit is in units of 512-byte blocks and is inherited by child processes. Files of any size can be read.

2 Set the regular file size limit of the process to the value of *newlimit*. Any process may decrease this limit, but only a process with an effective user ID of super-user may increase the limit. `ulimit` fails and the limit is unchanged if a process with an effective user ID other than super-user attempts to increase its regular file size limit. [EPERM]

3 Get the maximum possible break value [see `brk`(2)].

4 Get the current value of the maximum number of open files per process configured in the system.

SEE ALSO

`brk`(2), `write`(2).

WARNING

`ulimit` is effective in limiting the growth of regular files. Pipes are currently limited to 5,120 bytes.

DIAGNOSTICS

Upon successful completion, a non-negative value is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

umask – set and get file creation mask

SYNOPSIS

```
int umask (cmask)
int cmask;
```

DESCRIPTION

umask sets the process's file mode creation mask to *cmask* and returns the previous value of the mask. Only the low-order 9 bits of *cmask* and the file mode creation mask are used.

SEE ALSO

chmod(2), creat(2), mknod(2), open(2).
mkdir(1), sh(1) in the *User's Reference Manual*.

DIAGNOSTICS

The previous value of the file mode creation mask is returned.

NAME

umount − unmount a file system

SYNOPSIS

```
int umount (file)
char *file;
```

DESCRIPTION

umount requests that a previously mounted file system contained on the block special device or directory identified by *file* be unmounted. *file* is a pointer to a path name. After unmounting the file system, the directory upon which the file system was mounted reverts to its ordinary interpretation.

umount may be invoked only by the super-user.

umount will fail if one or more of the following are true:

[EPERM]	The process's effective user ID is not super-user.
[EINVAL]	*file* does not exist.
[ENOTBLK]	*file* is not a block special device.
[EINVAL]	*file* is not mounted.
[EBUSY]	A file on *file* is busy.
[EFAULT]	*file* points to an illegal address.
[EREMOTE]	*file* is remote.
[ENOLINK]	*file* is on a remote machine, and the link to that machine is no longer active.
[EMULTIHOP]	Components of the path pointed to by *file* require hopping to multiple remote machines.

SEE ALSO

mount(2).

DIAGNOSTICS

Upon successful completion a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

uname – get name of current UNIX system

SYNOPSIS

```
#include <sys/utsname.h>

int uname (name)
struct utsname *name;
```

DESCRIPTION

uname stores information identifying the current UNIX system in the structure pointed to by *name*.

uname uses the structure defined in <sys/utsname.h> whose members are:

```
char sysname[9];
char nodename[9];
char release[9];
char version[9];
char machine[9];
```

uname returns a null-terminated character string naming the current UNIX system in the character array *sysname*. Similarly, *nodename* contains the name that the system is known by on a communications network. *release* and *version* further identify the operating system. *machine* contains a standard name that identifies the hardware that the UNIX system is running on.

[EFAULT] uname will fail if *name* points to an invalid address.

SEE ALSO

uname(1) in the *User's Reference Manual.*

DIAGNOSTICS

Upon successful completion, a non-negative value is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

`unlink` – remove directory entry

SYNOPSIS

```
int unlink (path)
char *path;
```

DESCRIPTION

`unlink` removes the directory entry named by the path name pointed to by *path*.

The named file is unlinked unless one or more of the following are true:

[ENOTDIR]	A component of the path prefix is not a directory.
[ENOENT]	The named file does not exist.
[EACCES]	Search permission is denied for a component of the path prefix.
[EACCES]	Write permission is denied on the directory containing the link to be removed.
[EACCES]	The parent directory has the sticky bit set and the file is not writable by the user and the user does not own the parent directory and the user does not own the file and the user is not superuser
[EPERM]	The named file is a directory and the effective user ID of the process is not super-user.
[EBUSY]	The entry to be unlinked is the mount point for a mounted file system.
[ETXTBSY]	The entry to be unlinked is the last link to a pure procedure (shared text) file that is being executed.
[EROFS]	The directory entry to be unlinked is part of a read-only file system.
[EFAULT]	*path* points outside the process's allocated address space.
[EINTR]	A signal was caught during the `unlink` system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

When all links to a file have been removed and no process has the file open, the space occupied by the file is freed and the file ceases to exist. If one or more processes have the file open when the last link is removed, the removal is postponed until all references to the file have been closed.

SEE ALSO

`close`(2), `link`(2), `open`(2).
`rm`(1) in the *User's Reference Manual.*

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

ustat – get file system statistics

SYNOPSIS

```
#include <sys/types.h>
#include <ustat.h>

int ustat (dev, buf)
dev_t dev;
struct ustat *buf;
```

DESCRIPTION

ustat returns information about a mounted file system. *dev* is a device number identifying a device containing a mounted file system. *buf* is a pointer to a ustat structure that includes the following elements:

```
daddr_t f_tfree;        /* Total free blocks */
ino_t   f_tinode;       /* Number of free inodes */
char    f_fname[6];     /* Filsys name */
char    f_fpack[6];     /* Filsys pack name */
```

ustat will fail if one or more of the following are true:

[EINVAL] *dev* is not the device number of a device containing a mounted file system.

[EFAULT] *buf* points outside the process's allocated address space.

[EINTR] A signal was caught during a ustat system call.

[ENOLINK] *dev* is on a remote machine and the link to that machine is no longer active.

[ECOMM] *dev* is on a remote machine and the link to that machine is no longer active.

SEE ALSO

stat(2), fs(4).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

utime – set file access and modification times

SYNOPSIS

```
#include <sys/types.h>
int utime (path, times)
char *path;
struct utimbuf *times;
```

DESCRIPTION

path points to a path name naming a file. utime sets the access and modification times of the named file.

If times is NULL, the access and modification times of the file are set to the current time. A process must be the owner of the file or have write permission to use utime in this manner.

If times is not NULL, times is interpreted as a pointer to a *utimbuf* structure and the access and modification times are set to the values contained in the designated structure. Only the owner of the file or the super-user may use utime this way.

The times in the following structure are measured in seconds since 00:00:00 GMT, Jan. 1, 1970.

```
struct utimbuf{
        time_t actime;    /* access time */
        time_t modtime;   /* modification time */
};
```

utime will fail if one or more of the following are true:

[ENOENT]	The named file does not exist.
[ENOTDIR]	A component of the path prefix is not a directory.
[EACCES]	Search permission is denied by a component of the path prefix.
[EPERM]	The effective user ID is not super-user and not the owner of the file and times is not NULL.
[EACCES]	The effective user ID is not super-user and not the owner of the file and times is NULL and write access is denied.
[EROFS]	The file system containing the file is mounted read-only.
[EFAULT]	*times* is not NULL and points outside the process's allocated address space.
[EFAULT]	*path* points outside the process's allocated address space.
[EINTR]	A signal was caught during the utime system call.
[ENOLINK]	*path* points to a remote machine and the link to that machine is no longer active.
[EMULTIHOP]	Components of *path* require hopping to multiple remote machines.

SEE ALSO

`stat`(2).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

NAME

`wait` – wait for child process to stop or terminate

SYNOPSIS

```
int wait (stat_loc)
int *stat_loc;
```

DESCRIPTION

`wait` suspends the calling process until until one of the immediate children terminates or until a child that is being traced stops, because it has hit a break point. The `wait` system call will return prematurely if a signal is received and if a child process stopped or terminated prior to the call on `wait`, return is immediate.

If *stat_loc* is non-zero, 16 bits of information called status are stored in the low order 16 bits of the location pointed to by *stat_loc*. *status* can be used to differentiate between stopped and terminated child processes and if the child process terminated, status identifies the cause of termination and passes useful information to the parent. This is accomplished in the following manner:

> If the child process stopped, the high order 8 bits of status will contain the number of the signal that caused the process to stop and the low order 8 bits will be set equal to 0177.
>
> If the child process terminated due to an `exit` call, the low order 8 bits of status will be zero and the high order 8 bits will contain the low order 8 bits of the argument that the child process passed to `exit` [see `exit`(2)].
>
> If the child process terminated due to a signal, the high order 8 bits of status will be zero and the low order 8 bits will contain the number of the signal that caused the termination. In addition, if the low order seventh bit (i.e., bit 200) is set, a "core image" will have been produced [see `signal`(2)].

If a parent process terminates without waiting for its child processes to terminate, the parent process ID of each child process is set to 1. This means the initialization process inherits the child processes [see `intro`(2)].

`wait` will fail and return immediately if one or more of the following are true:

[ECHILD] The calling process has no existing unwaited-for child processes.

SEE ALSO

`exec`(2), `exit`(2), `fork`(2), `intro`(2), `pause`(2), `ptrace`(2), `signal`(2).

NOTES

`wait` fails and its actions are undefined if *stat_loc* points to an invalid address.

See NOTES in `signal`(2).

DIAGNOSTICS

If `wait` returns due to the receipt of a signal, a value of −1 is returned to the calling process and *errno* is set to EINTR. If `wait` returns due to a stopped or terminated child process, the process ID of the child is returned to the calling process. Otherwise, a value of −1 is returned and *errno* is set to indicate the error.

NAME

write – write on a file

SYNOPSIS

```
int write (fildes, buf, nbyte)
int fildes;
char *buf;
unsigned nbyte;
```

DESCRIPTION

fildes is a file descriptor obtained from a creat(2), open(2), dup(2), fcntl(2), or pipe(2) system call.

write attempts to write *nbyte* bytes from the buffer pointed to by *buf* to the file associated with the *fildes*.

On devices capable of seeking, the actual writing of data proceeds from the position in the file indicated by the file pointer. Upon return from write, the file pointer is incremented by the number of bytes actually written.

On devices incapable of seeking, writing always takes place starting at the current position. The value of a file pointer associated with such a device is undefined.

If the O_APPEND flag of the file status flags is set, the file pointer will be set to the end of the file prior to each write.

For regular files, if the O_SYNC flag of the file status flags is set, the write will not return until both the file data and file status have been physically updated. This function is for special applications that require extra reliability at the cost of performance. For block special files, if O_SYNC is set, the write will not return until the data has been physically updated.

A write to a regular file will be blocked if mandatory file/record locking is set [see chmod(2)], and there is a record lock owned by another process on the segment of the file to be written. If O_NDELAY is not set, the write will sleep until the blocking record lock is removed.

For STREAMS [see intro(2)] files, the operation of write is determined by the values of the minimum and maximum *nbyte* range ("packet size") accepted by the *stream*. These values are contained in the topmost *stream* module. Unless the user pushes [see I_PUSH in streamio(7)] the topmost module, these values can not be set or tested from user level. If *nbyte* falls within the packet size range, *nbyte* bytes will be written. If *nbyte* does not fall within the range and the minimum packet size value is zero, write will break the buffer into maximum packet size segments prior to sending the data downstream (the last segment may contain less than the maximum packet size). If *nbyte* does not fall within the range and the minimum value is non-zero, write will fail with *errno* set to ERANGE. Writing a zero-length buffer (*nbyte* is zero) sends zero bytes with zero returned.

For STREAMS files, if O_NDELAY is not set and the *stream* can not accept data (the *stream* write queue is full due to internal flow control conditions), write will block until data can be accepted. O_NDELAY will prevent a process from blocking due to flow control conditions. If O_NDELAY is set and the *stream* can not accept data, write will fail. If O_NDELAY is set and part of the buffer has been written when a condition in which the *stream* can not accept additional data occurs, `write` will terminate and return the number of bytes written.

`write` will fail and the file pointer will remain unchanged if one or more of the following are true:

[EAGAIN] Mandatory file/record locking was set, O_NDELAY was set, and there was a blocking record lock.

[EAGAIN] Total amount of system memory available when reading via raw IO is temporarily insufficient.

[EAGAIN] Attempt to write to a *stream* that can not accept data with the O_NDELAY flag set.

[EBADF] *fildes* is not a valid file descriptor open for writing.

[EDEADLK] The write was going to go to sleep and cause a deadlock situation to occur.

[EFAULT] *buf* points outside the process's allocated address space.

[EFBIG] An attempt was made to write a file that exceeds the process's file size limit or the maximum file size [see *ulimit*(2)].

[EINTR] A signal was caught during the `write` system call.

[EINVAL] Attempt to write to a *stream* linked below a multiplexor.

[ENOLCK] The system record lock table was full, so the write could not go to sleep until the blocking record lock was removed.

[ENOLINK] *fildes* is on a remote machine and the link to that machine is no longer active.

[ENOSR] Attempt to write to a *stream* with insufficient STREAMS memory resources available in the system.

[ENOSPC] During a `write` to an ordinary file, there is no free space left on the device.

[ENXIO] A hangup occurred on the *stream* being written to.

[EPIPE and SIGPIPE signal] An attempt is made to write to a pipe that is not open for reading by any process.

[ERANGE] Attempt to write to a *stream* with *nbyte* outside specified minimum and maximum write range, and the minimum value is non-zero.

If a `write` requests that more bytes be written than there is room for (e.g., the `ulimit` [see `ulimit(2)`] or the physical end of a medium), only as many bytes as there is room for will be written. For example, suppose there is space for 20 bytes more in a file before reaching a limit. A write of 512-bytes will return 20. The next write of a non-zero number of bytes will give a failure return (except as noted below).

If the file being written is a pipe (or FIFO) and the O_NDELAY flag of the file flag word is set, then write to a full pipe (or FIFO) will return a count of 0. Otherwise (O_NDELAY clear), writes to a full pipe (or FIFO) will block until space becomes available.

A write to a STREAMS file can fail if an error message has been received at the stream head. In this case, *errno* is set to the value included in the error message.

SEE ALSO

`creat`(2), `dup`(2), `fcntl`(2), `intro`(2), `lseek`(2), `open`(2), `pipe`(2), `ulimit`(2).

DIAGNOSTICS

Upon successful completion the number of bytes actually written is returned. Otherwise, −1 is returned and *errno* is set to indicate the error.

SUBROUTINES (3)

NAME

intro – introduction to functions and libraries

DESCRIPTION

This section describes functions found in various libraries, other than those functions that directly invoke UNIX system primitives, which are described in Section 2 of this volume. Function declarations can be obtained from the #include files indicated on each page. Certain major collections are identified by a letter after the section number:

(3C) These functions, together with those of Section 2 and those marked (3S), constitute the standard C library, libc, which is automatically linked by the C compilation system. The standard C library is implemented as an archive, libc.a.

(3S) These functions constitute the "standard I/O package" [see stdio(3S)].

(3E) These functions constitute the ELF access library, libelf. This library is not automatically linked by the C compilation system. Specify -lelf on the cc command line to link with this library.

(3G) These functions constitute the general-purpose library, libgen. This library is not automatically linked by the C compilation system. Specify -lgen on the cc command line to link with this library.

(3M) These functions constitute the math library, libm. [See intro(3M) and math(5).] This library is not automatically linked by the C compilation system. Use the -lm option on the cc command line to link with the libm library.

(3X) Specialized libraries. The files in which these libraries are found are given on the appropriate pages.

DEFINITIONS

A character is any bit pattern able to fit into a byte on the machine. The null character is a character with value 0, conventionally represented in the C language as \0. A character array is a sequence of characters. A null-terminated character array (a *string*) is a sequence of characters, the last of which is the null character. The null string is a character array containing only the terminating null character. A NULL pointer is the value that is obtained by casting 0 into a pointer. C guarantees that this value will not match that of any legitimate pointer, so many functions that return pointers return NULL to indicate an error. The macro NULL is defined in stdio.h. Types of the form size_t are defined in the appropriate header files.

FILES

INCDIR	usually /usr/include
LIBDIR	usually /usr/ccs/lib
LIBDIR/libc.a	
LIBDIR/libgen.a	
LIBDIR/libm.a	

SEE ALSO

ar(1), cc(1), ld(1), lint(1), nm(1), intro(2), intro(3M), stdio(3S), math(5).
The "C Compilation System" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools.*

DIAGNOSTICS

Error handling varies, for functions that return floating-point values, according to compilation mode. Under the `-Xt` (default) option to `cc`, these functions return the conventional values `0`, ±`HUGE`, or `NaN` when the function is undefined for the given arguments or when the value is not representable. In the `-Xa` and `-Xc` compilation modes, ±`HUGE_VAL` is returned instead of ±`HUGE`. (`HUGE_VAL` and `HUGE` are defined in `math.h` to be infinity and the largest-magnitude single-precision number, respectively.)

NOTES

None of the functions, external variables, or macros should be redefined in the user's programs. Any other name may be redefined without affecting the behavior of other library functions, but such redefinition may conflict with a declaration in an included header file.

The header files in *INCDIR* provide function prototypes (function declarations including the types of arguments) for most of the functions listed in this manual. Function prototypes allow the compiler to check for correct usage of these functions in the user's program. The `lint` program checker may also be used and will report discrepancies even if the header files are not included with `#include` statements. Definitions for Sections 2, 3C, and 3S are checked automatically. Other definitions can be included by using the `-l` option to `lint`. (For example, `-lm` includes definitions for `libm`.) Use of `lint` is highly recommended.

Users should carefully note the difference between STREAMS and *stream*. STREAMS is a set of kernel mechanisms that support the development of network services and data communication drivers. It is composed of utility routines, kernel facilities, and a set of data structures. A *stream* is a file with its associated buffering. It is declared to be a pointer to a type `FILE` defined in `stdio.h`.

In detailed definitions of components, it is sometimes necessary to refer to symbolic names that are implementation-specific, but which are not necessarily expected to be accessible to an application program. Many of these symbolic names describe boundary conditions and system limits.

In this section, for readability, these implementation-specific values are given symbolic names. These names always appear enclosed in curly brackets to distinguish them from symbolic names of other implementation-specific constants that are accessible to application programs by header files. These names are not necessarily accessible to an application program through a header file, although they may be defined in the documentation for a particular system.

In general, a portable application program should not refer to these symbolic names in its code. For example, an application program would not be expected to test the length of an argument list given to a routine to determine if it was greater than `{ARG_MAX}`.

NAME

a64l, l64a – convert between long integer and base-64 ASCII string

SYNOPSIS

```
#include <stdlib.h>

long a64l (const char *s);

char *l64a (long l);
```

DESCRIPTION

These functions are used to maintain numbers stored in base-64 ASCII characters. These characters define a notation by which long integers can be represented by up to six characters; each character represents a "digit" in a radix-64 notation.

The characters used to represent "digits" are `.` for 0, `/` for 1, `0` through `9` for 2–11, `A` through `Z` for 12–37, and `a` through `z` for 38–63.

`a64l` takes a pointer to a null-terminated base-64 representation and returns a corresponding `long` value. If the string pointed to by `s` contains more than six characters, `a64l` will use the first six.

`a64l` scans the character string from left to right with the least significant digit on the left, decoding each character as a 6-bit radix-64 number.

`l64a` takes a `long` argument and returns a pointer to the corresponding base-64 representation. If the argument is 0, `l64a` returns a pointer to a null string.

NOTES

The value returned by `l64a` is a pointer into a static buffer, the contents of which are overwritten by each call.

NAME

abort – generate an abnormal termination signal

SYNOPSIS

```
#include <stdlib.h>

void abort (void);
```

DESCRIPTION

abort first closes all open files, stdio(3S) streams, and directory streams, if possible, then causes the signal SIGABRT to be sent to the calling process.

SEE ALSO

sdb(1), exit(2), kill(2), signal(2), stdio(3S).
sh(1) in the *User's Reference Manual.*

DIAGNOSTICS

If SIGABRT is neither caught nor ignored, and the current directory is writable, a core dump is produced and the message abort – core dumped is written by the shell [see sh(1)].

NAME

abs, labs – return integer absolute value

SYNOPSIS

```
#include <stdlib.h>

int abs (int val);

long labs (long lval);
```

DESCRIPTION

abs returns the absolute value of its int operand. labs returns the absolute value of its long operand.

SEE ALSO

floor(3M).

NOTES

In 2's-complement representation, the absolute value of the largest magnitude negative integral value is undefined.

NAME

addseverity – build a list of severity levels for an application for use with fmtmsg

SYNOPSIS

```
#include <fmtmsg.h>

int addseverity(int severity, const char *string);
```

DESCRIPTION

The addseverity function builds a list of severity levels for an application to be used with the message formatting facility, fmtmsg. *severity* is an integer value indicating the seriousness of the condition, and *string* is a pointer to a string describing the condition (string is not limited to a specific size).

If addseverity is called with an integer value that has not been previously defined, the function adds that new severity value and print string to the existing set of standard severity levels.

If addseverity is called with an integer value that has been previously defined, the function redefines that value with the new print string. Previously defined severity levels may be removed by supplying the NULL string. If addseverity is called with a negative number or an integer value of 0, 1, 2, 3, or 4, the function fails and returns −1. The values 0–4 are reserved for the standard severity levels and cannot be modified. Identifiers for the standard levels of severity are:

MM_HALT	indicates that the application has encountered a severe fault and is halting. Produces the print string HALT.
MM_ERROR	indicates that the application has detected a fault. Produces the print string ERROR.
MM_WARNING	indicates a condition that is out of the ordinary, that might be a problem, and should be watched. Produces the print string WARNING.
MM_INFO	provides information about a condition that is not in error. Produces the print string INFO.
MM_NOSEV	indicates that no severity level is supplied for the message.

Severity levels may also be defined at run time using the SEV_LEVEL environment variable [see fmtmsg(3C)].

EXAMPLES

When the function addseverity is used as follows:

```
addseverity(7,"ALERT")
```

the following call to fmtmsg:

```
fmtmsg(MM_PRINT, "UX:cat", 7, "invalid syntax", "refer to
manual", "UX:cat:001")
```

produces:

```
UX:cat: ALERT: invalid syntax
TO FIX: refer to manual   UX:cat:001
```

SEE ALSO

fmtmsg(3C), printf(3S).

DIAGNOSTICS

addseverity returns MM_OK on success or MM_NOTOK on failure.

NAME

atexit – add program termination routine

SYNOPSIS

```
#include <stdlib.h>

int atexit (void (*func)(void));
```

DESCRIPTION

atexit adds the function *func* to a list of functions to be called without arguments on normal termination of the program. Normal termination occurs by either a call to the exit system call or a return from main. At most 32 functions may be registered by atexit; the functions will be called in the reverse order of their registration.

atexit returns 0 if the registration succeeds, nonzero if it fails.

SEE ALSO

exit(2).

NAME

bsearch – binary search a sorted table

SYNOPSIS

```
#include <stdlib.h>

void *bsearch (const void *key, const void *base, size_t nel,
    size_t size, int (*compar)(const void *, const void *));
```

DESCRIPTION

bsearch is a binary search routine generalized from Knuth (6.2.1) Algorithm B. It returns a pointer into a table (an array) indicating where a datum may be found or a null pointer if the datum cannot be found. The table must be previously sorted in increasing order according to a comparison function pointed to by *compar*. *key* points to a datum instance to be sought in the table. *base* points to the element at the base of the table. *nel* is the number of elements in the table. *size* is the number of bytes in each element. The function pointed to by *compar* is called with two arguments that point to the elements being compared. The function must return an integer less than, equal to, or greater than 0 as accordingly the first argument is to be considered less than, equal to, or greater than the second.

EXAMPLE

The example below searches a table containing pointers to nodes consisting of a string and its length. The table is ordered alphabetically on the string in the node pointed to by each entry.

This program reads in strings and either finds the corresponding node and prints out the string and its length, or prints an error message.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

struct node {                   /* these are stored in the table */
      char *string;
      int length;
};
static struct node table[] =    /* table to be searched */
{
      { "asparagus", 10 },
      { "beans", 6 },
      { "tomato", 7 },
      { "watermelon", 11 },
};

main()
{
      struct node *node_ptr, node;
      /* routine to compare 2 nodes */
      static int node_compare(const void *, const void *);
      char str_space[20];   /* space to read string into */
```

```
        node.string = str_space;
        while (scanf("%20s", node.string) != EOF) {
             node_ptr = bsearch( &node,
                     table, sizeof(table)/sizeof(struct node),
                     sizeof(struct node), node_compare);
             if (node_ptr != NULL) {
                  (void) printf("string = %20s, length = %d\n",
                       node_ptr->string, node_ptr->length);
             } else {
                  (void)printf("not found: %20s\n", node.string);
             }
        }
        return(0);
   }

   /* routine to compare two nodes based on an  */
   /* alphabetical ordering of the string field */
   static int
   node_compare(const void *node1, const void *node2)
   {
        return (strcmp(
                  ((const struct node *)node1)->string,
                  ((const struct node *)node2)->string));
   }
```

SEE ALSO

hsearch(3C), lsearch(3C), qsort(3C), tsearch(3C).

DIAGNOSTICS

A null pointer is returned if the key cannot be found in the table.

NOTES

The pointers to the key and the element at the base of the table should be of type pointer-to-*element*.

The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

If the number of elements in the table is less than the size reserved for the table, *nel* should be the lower number.

NAME

clock – report CPU time used

SYNOPSIS

```
#include <time.h>

clock_t clock (void);
```

DESCRIPTION

clock returns the amount of CPU time (in microseconds) used since the first call to clock in the calling process. The time reported is the sum of the user and system times of the calling process and its terminated child processes for which it has executed the wait system call, the pclose function, or the system function.

Dividing the value returned by clock by the constant CLOCKS_PER_SEC, defined in the time.h header file, will give the time in seconds.

SEE ALSO

times(2), wait(2), popen(3S), system(3S).

NOTES

The value returned by clock is defined in microseconds for compatibility with systems that have CPU clocks with much higher resolution. Because of this, the value returned will wrap around after accumulating only 2147 seconds of CPU time (about 36 minutes). If the process time used is not available or cannot be represented, clock returns the value (clock_t)-1.

NAME

conv: toupper, tolower, _toupper, _tolower, toascii – translate characters

SYNOPSIS

```
#include <ctype.h>

int toupper (int c);

int tolower (int c);

int _toupper (int c);

int _tolower (int c);

int toascii (int c);
```

DESCRIPTION

toupper and tolower have as their domain the range of the function getc: all values represented in an unsigned char and the value of the macro EOF as defined in stdio.h. If the argument of toupper represents a lower-case letter, the result is the corresponding upper-case letter. If the argument of tolower represents an upper-case letter, the result is the corresponding lower-case letter. All other arguments in the domain are returned unchanged.

The macros _toupper and _tolower accomplish the same things as toupper and tolower, respectively, but have restricted domains and are faster. _toupper requires a lower-case letter as its argument; its result is the corresponding upper-case letter. _tolower requires an upper-case letter as its argument; its result is the corresponding lower-case letter. Arguments outside the domain cause undefined results.

toascii yields its argument with all bits turned off that are not part of a standard 7-bit ASCII character; it is intended for compatibility with other systems.

toupper, tolower, _toupper, and _tolower are affected by LC_CTYPE. In the C locale, or in a locale where shift information is not defined, these functions determine the case of characters according to the rules of the ASCII-coded character set. Characters outside the ASCII range of characters are returned unchanged.

SEE ALSO

ctype(3C), getc(3S), setlocale(3C), environ(5).

NAME

crypt, setkey, encrypt – generate encryption

SYNOPSIS

```
#include <crypt.h>

char *crypt (const char *key, const char *salt);

void setkey (const char *key);

void encrypt (char *block, int edflag);
```

DESCRIPTION

crypt is the password encryption function. It is based on a one-way encryption algorithm with variations intended (among other things) to frustrate use of hardware implementations of a key search.

key is the input string to encrypt, for instance, a user's typed password. Only the first eight characters are used; the rest are ignored. *salt* is a two-character string chosen from the set a-zA-Z0-9./; this string is used to perturb the hashing algorithm in one of 4096 different ways, after which the input string is used as the key to encrypt repeatedly a constant string. The returned value points to the encrypted input string. The first two characters of the return value are the *salt* itself.

The setkey and encrypt functions provide (rather primitive) access to the actual hashing algorithm. The argument of setkey is a character array of length 64 containing only the characters with numerical value 0 and 1. This string is divided into groups of 8, the low-order bit in each group is ignored; this gives a 56-bit key that is set into the machine. This is the key that will be used with the hashing algorithm to encrypt the string *block* with the encrypt function.

The *block* argument of encrypt is a character array of length 64 containing only the characters with numerical value 0 and 1. The argument array is modified in place to a similar array representing the bits of the argument after having been subjected to the hashing algorithm using the key set by setkey. The argument *edflag*, indicating decryption rather than encryption, is ignored; use encrypt in libcrypt [see crypt(3X)] for decryption.

SEE ALSO

getpass(3C), crypt(3X), passwd(4).
login(1), passwd(1) in the *User's Reference Manual.*

NOTES

The return value for crypt points to static data that are overwritten by each call.

NAME

ctermid – generate file name for terminal

SYNOPSIS

```
#include <stdio.h>

char *ctermid (char *s);
```

DESCRIPTION

ctermid generates the path name of the controlling terminal for the current process, and stores it in a string.

If *s* is a NULL pointer, the string is stored in an internal static area, the contents of which are overwritten at the next call to ctermid, and the address of which is returned. Otherwise, *s* is assumed to point to a character array of at least L_ctermid elements; the path name is placed in this array and the value of *s* is returned. The constant L_ctermid is defined in the stdio.h header file.

SEE ALSO

ttyname(3C).

NOTES

The difference between ctermid and ttyname(3C) is that ttyname must be handed a file descriptor and returns the actual name of the terminal associated with that file descriptor, while ctermid returns a string (/dev/tty) that will refer to the terminal if used as a file name. Thus ttyname is useful only if the process already has at least one file open to a terminal.

NAME

ctime, localtime, gmtime, asctime, tzset – convert date and time to string

SYNOPSIS

```
#include <time.h>

char *ctime (const time_t *clock);

struct tm *localtime (const time_t *clock);

struct tm *gmtime (const time_t *clock);

char *asctime (const struct tm *tm);

extern time_t timezone, altzone;

extern int daylight;

extern char *tzname[2];

void tzset (void);
```

DESCRIPTION

ctime, localtime, and gmtime accept arguments of type time_t, pointed to by clock, representing the time in seconds since 00:00:00 UTC, January 1, 1970. ctime returns a pointer to a 26-character string as shown below. Time zone and daylight savings corrections are made before the string is generated. The fields are constant in width:

```
Fri Sep 13 00:00:00 1986\n\0
```

localtime and gmtime return pointers to tm structures, described below. localtime corrects for the main time zone and possible alternate ("daylight savings") time zone; gmtime converts directly to Coordinated Universal Time (UTC), which is the time the UNIX system uses internally.

asctime converts a tm structure to a 26-character string, as shown in the above example, and returns a pointer to the string.

Declarations of all the functions and externals, and the tm structure, are in the time.h header file. The structure declaration is:

```
struct     tm {
     int  tm_sec;    /* seconds after the minute — [0, 61] */
                          /* for leap seconds */
     int  tm_min;    /* minutes after the hour — [0, 59] */
     int  tm_hour;   /* hour since midnight — [0, 23] */
     int  tm_mday;   /* day of the month — [1, 31] */
     int  tm_mon;    /* months since January — [0, 11] */
     int  tm_year;   /* years since 1900 */
     int  tm_wday;   /* days since Sunday — [0, 6] */
     int  tm_yday;   /* days since January 1 — [0, 365] */
     int  tm_isdst;  /* flag for alternate daylight */
                          /* savings time */
};
```

The value of tm_isdst is positive if daylight savings time is in effect, zero if daylight savings time is not in effect, and negative if the information is not available. (Previously, the value of tm_isdst was defined as non-zero if daylight savings time was in effect.)

The external time_t variable altzone contains the difference, in seconds, between Coordinated Universal Time and the alternate time zone. The external variable timezone contains the difference, in seconds, between UTC and local standard time. The external variable daylight indicates whether time should reflect daylight savings time. Both timezone and altzone default to 0 (UTC). The external variable daylight is non-zero if an alternate time zone exists. The time zone names are contained in the external variable tzname, which by default is set to:

```
char *tzname[2] = { "GMT", "   " };
```

These functions know about the peculiarities of this conversion for various time periods for the U.S. (specifically, the years 1974, 1975, and 1987). They will handle the new daylight savings time starting with the first Sunday in April, 1987.

tzset uses the contents of the environment variable TZ to override the value of the different external variables. The function tzset is called by asctime and may also be called by the user. See environ(5) for a description of the TZ environment variable.

tzset scans the contents of the environment variable and assigns the different fields to the respective variable. For example, the most complete setting for New Jersey in 1986 could be

```
EST5EDT4,116/2:00:00,298/2:00:00
```

or simply

```
EST5EDT
```

An example of a southern hemisphere setting such as the Cook Islands could be

```
KDT9:30KST10:00,63/5:00,302/20:00
```

In the longer version of the New Jersey example of TZ, tzname[*0*] is EST, timezone will be set to 5*60*60, tzname[*1*] is EDT, altzone will be set to 4*60*60, the starting date of the alternate time zone is the 117th day at 2 AM, the ending date of the alternate time zone is the 299th day at 2 AM (using zero-based Julian days), and daylight will be set positive. Starting and ending times are relative to the alternate time zone. If the alternate time zone start and end dates and the time are not provided, the days for the United States that year will be used and the time will be 2 AM. If the start and end dates are provided but the time is not provided, the time will be 2 AM. The effects of tzset are thus to change the values of the external variables timezone, altzone, daylight, and tzname. ctime, localtime, mktime, and strftime will also update these external variables as if they had called tzset at the time specified by the time_t or struct tm value that they are converting.

Note that in most installations, TZ is set to the correct value by default when the user logs on, via the local /etc/profile file [see profile(4) and timezone(4)].

FILES

/usr/lib/locale/*language*/LC_TIME – file containing locale specific date and time information

SEE ALSO

time(2), **getenv**(3C), **mktime**(3C), **putenv**(3C), **printf**(3S), **setlocale**(3C), **strftime**(3C), **cftime**(4), **profile**(4), **timezone**(4), **environ**(5).

NOTES

The return values for **ctime**, **localtime**, and **gmtime** point to static data whose content is overwritten by each call.

Setting the time during the interval of change from timezone to altzone or vice versa can produce unpredictable results. The system administrator must change the Julian start and end days annually.

NAME

ctype: isdigit, isxdigit, islower, isupper, isalpha, isalnum, isspace, iscntrl, ispunct, isprint, isgraph, isascii – character handling

SYNOPSIS

```
#include <ctype.h>

int isalpha(int c);

int isupper(int c);

int islower(int c);

int isdigit(int c);

int isxdigit(int c);

int isalnum(int c);

int isspace(int c);

int ispunct(int c);

int isprint(int c);

int isgraph(int c);

int iscntrl(int c);

int isascii(int c);
```

DESCRIPTION

These macros classify character-coded integer values. Each is a predicate returning non-zero for true, zero for false. The behavior of these macros, except isascii, is affected by the current locale [see setlocale(3C)]. To modify the behavior, change the LC_TYPE category in setlocale, that is, setlocale (LC_CTYPE, *newlocale*). In the C locale, or in a locale where character type information is not defined, characters are classified according to the rules of the US-ASCII 7-bit coded character set.

The macro isascii is defined on all integer values; the rest are defined only where the argument is an int, the value of which is representable as an unsigned char, or EOF, which is defined by the stdio.h header file and represents end-of-file.

isalpha — tests for any character for which isupper or islower is true, or any character that is one of an implementation-defined set of characters for which none of iscntrl, isdigit, ispunct, or isspace is true. In the C locale, isalpha returns true only for the characters for which isupper or islower is true.

isupper — tests for any character that is an upper-case letter or is one of an implementation-defined set of characters for which none of iscntrl, isdigit, ispunct, isspace, or islower is true. In the C locale, isupper returns true only for the characters defined as upper-case ASCII characters.

islower tests for any character that is a lower-case letter or is one of an implementation-defined set of characters for which none of **iscntrl**, **isdigit**, **ispunct**, **isspace**, or **isupper** is true. In the C locale, **islower** returns true only for the characters defined as lower-case ASCII characters.

isdigit tests for any decimal-digit character.

isxdigit tests for any hexadecimal-digit character ([0-9], [A-F] or [a-f]).

isalnum tests for any character for which **isalpha** or **isdigit** is true (letter or digit).

isspace tests for any space, tab, carriage-return, newline, vertical-tab or form-feed (standard white-space characters) or for one of an implementation-defined set of characters for which **isalnum** is false. In the C locale, **isspace** returns true only for the standard white-space characters.

ispunct tests for any printing character which is neither a space nor a character for which **isalnum** is true.

isprint tests for any printing character, including space (" ").

isgraph tests for any printing character, except space.

iscntrl tests for any "control character" as defined by the character set.

isascii tests for any ASCII character, code between 0 and 0177 inclusive.

All the character classification macros and the conversion functions and macros use a table lookup.

Functions exist for all the above-defined macros. To get the function form, the macro name must be undefined (e.g., **#undef isdigit**).

FILES

/usr/lib/locale/*locale*/LC_CTYPE

SEE ALSO

chrtbl(1M), **setlocale**(3C), **stdio**(3S), **ascii**(5), **environ**(5).

DIAGNOSTICS

If the argument to any of the character handling macros is not in the domain of the function, the result is undefined.

NAME

cuserid – get character login name of the user

SYNOPSIS

```
#include <stdio.h>

char *cuserid (char *s);
```

DESCRIPTION

cuserid generates a character-string representation of the login name that the owner of the current process is logged in under. If *s* is a NULL pointer, this representation is generated in an internal static area, the address of which is returned. Otherwise, *s* is assumed to point to an array of at least L_cuserid characters; the representation is left in this array. The constant L_cuserid is defined in the stdio.h header file.

SEE ALSO

getlogin(3C), getpwent(3C).

DIAGNOSTICS

If the login name cannot be found, cuserid returns a NULL pointer; if *s* is not a NULL pointer, a null character `\0´ will be placed at *s*[0].

NAME

`dial` – establish an out-going terminal line connection

SYNOPSIS

```
#include <dial.h>

int dial (CALL call);

void undial (int fd);
```

DESCRIPTION

`dial` returns a file-descriptor for a terminal line open for read/write. The argument to `dial` is a `CALL` structure (defined in the `dial.h` header file).

When finished with the terminal line, the calling program must invoke `undial` to release the semaphore that has been set during the allocation of the terminal device.

The definition of `CALL` in the `dial.h` header file is:

```
typedef struct {
struct termio *attr;  /* pointer to termio attribute struct */
int        baud;      /* transmission data rate */
int        speed;     /* 212A modem: low=300, high=1200 */
char       *line;     /* device name for out-going line */
char       *telno;    /* pointer to tel-no digits string */
int        modem;     /* specify modem control for direct lines */
char       *device;   /* unused */
int        dev_len;   /* unused */
} CALL;
```

The `CALL` element `speed` is intended only for use with an outgoing dialed call, in which case its value should be either 300 or 1200 to identify the 113A modem, or the high- or low-speed setting on the 212A modem. Note that the 113A modem or the low-speed setting of the 212A modem will transmit at any rate between 0 and 300 bits per second. However, the high-speed setting of the 212A modem transmits and receives at 1200 bits per second only. The `CALL` element `baud` is for the desired transmission baud rate. For example, one might set `baud` to 110 and `speed` to 300 (or 1200). However, if `speed` is set to 1200, `baud` must be set to high (1200).

If the desired terminal line is a direct line, a string pointer to its device-name should be placed in the `line` element in the `CALL` structure. Legal values for such terminal device names are kept in the `Devices` file. In this case, the value of the `baud` element should be set to -1. This value will cause `dial` to determine the correct value from the `Devices` file.

The `telno` element is for a pointer to a character string representing the telephone number to be dialed. Such numbers may consist only of these characters:

0-9	dial 0-9
*	dial *
#	dial #
=	wait for secondary dial tone
–	delay for approximately 4 seconds

The CALL element modem is used to specify modem control for direct lines. This element should be non-zero if modem control is required. The CALL element attr is a pointer to a termio structure, as defined in the termio.h header file. A NULL value for this pointer element may be passed to the dial function, but if such a structure is included, the elements specified in it will be set for the outgoing terminal line before the connection is established. This setting is often important for certain attributes such as parity and baud-rate.

The CALL elements device and dev_len are no longer used. They are retained in the CALL structure for compatibility reasons.

FILES

/etc/uucp/Devices
/etc/uucp/Systems
/var/spool/uucp/LCK..*tty-device*

SEE ALSO

alarm(2), read(2), write(2).

termio(7) in the *System Administrator's Reference Manual*.

uucp(1C) in the *User's Reference Manual*.

DIAGNOSTICS

On failure, a negative value indicating the reason for the failure will be returned. Mnemonics for these negative indices as listed here are defined in the dial.h header file.

```
INTRPT     -1      /* interrupt occurred */
D_HUNG     -2      /* dialer hung (no return from write) */
NO_ANS     -3      /* no answer within 10 seconds */
ILL_BD     -4      /* illegal baud-rate */
A_PROB     -5      /* acu problem (open() failure) */
L_PROB     -6      /* line problem (open() failure) */
NO_Ldv     -7      /* can't open Devices file */
DV_NT_A    -8      /* requested device not available */
DV_NT_K    -9      /* requested device not known */
NO_BD_A    -10     /* no device available at requested baud */
NO_BD_K    -11     /* no device known at requested baud */
DV_NT_E    -12     /* requested speed does not match */
BAD_SYS    -13     /* system not in Systems file*/
```

NOTES

Including the dial.h header file automatically includes the termio.h header file.

An alarm(2) system call for 3600 seconds is made (and caught) within the dial module for the purpose of "touching" the LCK.. file and constitutes the device allocation semaphore for the terminal device. Otherwise, uucp(1C) may simply delete the LCK.. entry on its 90-minute clean-up rounds. The alarm may go off while the user program is in a read(2) or write(2) system call, causing an apparent error return. If the user program expects to be around for an hour or more, error returns from reads should be checked for (errno==EINTR), and the read possibly reissued.

NAME

difftime – computes the difference between two calendar times

SYNOPSIS

```
#include <time.h>

double difftime (time_t time1, time_t time0);
```

DESCRIPTION

difftime computes the difference between two calendar times. difftime returns the difference *(time1-time0)* expressed in seconds as a double. This function is provided because there are no general arithmetic properties defined for type time_t.

SEE ALSO

ctime(3C).

NAME

directory: opendir, readdir, telldir, seekdir, rewinddir, closedir – directory operations

SYNOPSIS

```
#include <dirent.h>

DIR *opendir (const char *filename);

struct dirent *readdir (DIR *dirp);

long telldir (DIR *dirp);

void seekdir (DIR *dirp, long loc);

void rewinddir (DIR *dirp);

int closedir (DIR *dirp);
```

DESCRIPTION

opendir opens the directory named by *filename* and associates a directory stream with it. opendir returns a pointer to be used to identify the directory stream in subsequent operations. The directory stream is positioned at the first entry. A null pointer is returned if *filename* cannot be accessed or is not a directory, or if it cannot malloc(3C) enough memory to hold a DIR structure or a buffer for the directory entries.

readdir returns a pointer to the next active directory entry and positions the directory stream at the next entry. No inactive entries are returned. It returns NULL upon reaching the end of the directory or upon detecting an invalid location in the directory. readdir buffers several directory entries per actual read operation; readdir marks for update the st_atime field of the directory each time the directory is actually read.

telldir returns the current location associated with the named directory stream.

seekdir sets the position of the next readdir operation on the directory stream. The new position reverts to the position associated with the directory stream at the time the telldir operation that provides *loc* was performed. Values returned by telldir are valid only if the directory has not changed because of compaction or expansion. This situation is not a problem with System V, but it may be a problem with some file system types.

rewinddir resets the position of the named directory stream to the beginning of the directory. It also causes the directory stream to refer to the current state of the corresponding directory, as a call to opendir would.

closedir closes the named directory stream and frees the DIR structure.

The following errors can occur as a result of these operations.

opendir returns NULL on failure and sets errno to one of the following values:

ENOTDIR	A component of *filename* is not a directory.
EACCES	A component of *filename* denies search permission.

EACCES	Read permission is denied on the specified directory.
EMFILE	The maximum number of file descriptors are currently open.
ENFILE	The system file table is full.
EFAULT	*filename* points outside the allocated address space.
ENOENT	A component of *filename* does not exist or is a null pathname.

readdir returns NULL on failure and sets errno to one of the following values:

ENOENT	The current file pointer for the directory is not located at a valid entry.
EBADF	The file descriptor determined by the DIR stream is no longer valid. This result occurs if the DIR stream has been closed.

telldir, seekdir, and closedir return −1 on failure and set errno to the following value:

EBADF	The file descriptor determined by the DIR stream is no longer valid. This results if the DIR stream has been closed.

EXAMPLE

Here is a sample program that prints the names of all the files in the current directory:

```
#include <stdio.h>
#include <dirent.h>

main()
{
        DIR *dirp;
        struct dirent *direntp;

        dirp = opendir( "." );
        while ( (direntp = readdir( dirp )) != NULL )
              (void)printf( "%s\n", direntp->d_name );
        closedir( dirp );
        return (0);
}
```

SEE ALSO

getdents(2), dirent(4).

NOTES

rewinddir is implemented as a macro, so its function address cannot be taken.

NAME

div, ldiv – compute the quotient and remainder

SYNOPSIS

```
#include <stdlib.h>

div_t div (int numer, int denom);

ldiv_t ldiv (long int numer, long int denom);
```

DESCRIPTION

div computes the quotient and remainder of the division of the numerator *numer* by the denominator *denom*. This function provides a well-defined semantics for the signed integral division and remainder operations, unlike the implementation-defined semantics of the built-in operations. The sign of the resulting quotient is that of the algebraic quotient, and, if the division is inexact, the magnitude of the resulting quotient is the largest integer less than the magnitude of the algebraic quotient. If the result cannot be represented, the behavior is undefined; otherwise, *quotient* * *denom* + *remainder* will equal *numer*.

div returns a structure of type div_t, comprising both the quotient and remainder:

```
typedef struct div_t {
     int  quot; /*quotient*/
     int  rem;  /*remainder*/
} div_t;
```

ldiv is similar to div, except that the arguments and the members of the returned structure (which has type ldiv_t) all have type long int.

NAME

`drand48, erand48, lrand48, nrand48, mrand48, jrand48, srand48, seed48, lcong48` – generate uniformly distributed pseudo-random numbers

SYNOPSIS

```
#include <stdlib.h>

double drand48 (void);

double erand48 (unsigned short xsubi[3]);

long lrand48 (void);

long nrand48 (unsigned short xsubi[3]);

long mrand48 (void);

long jrand48 (unsigned short xsubi[3]);

void srand48 (long seedval);

unsigned short *seed48 (unsigned short seed16v[3]);

void lcong48 (unsigned short param[7]);
```

DESCRIPTION

This family of functions generates pseudo-random numbers using the well-known linear congruential algorithm and 48-bit integer arithmetic.

Functions `drand48` and `erand48` return non-negative double-precision floating-point values uniformly distributed over the interval [0.0, 1.0).

Functions `lrand48` and `nrand48` return non-negative long integers uniformly distributed over the interval $[0, 2^{31})$.

Functions `mrand48` and `jrand48` return signed long integers uniformly distributed over the interval $[-2^{31}, 2^{31})$.

Functions `srand48`, `seed48`, and `lcong48` are initialization entry points, one of which should be invoked before either `drand48`, `lrand48`, or `mrand48` is called. (Although it is not recommended practice, constant default initializer values will be supplied automatically if `drand48`, `lrand48`, or `mrand48` is called without a prior call to an initialization entry point.) Functions `erand48`, `nrand48`, and `jrand48` do not require an initialization entry point to be called first.

All the routines work by generating a sequence of 48-bit integer values, X_i, according to the linear congruential formula

$$X_{n+1} = (aX_n + c)_{\text{mod } m} \qquad n \geq 0.$$

The parameter $m = 2^{48}$; hence 48-bit integer arithmetic is performed. Unless `lcong48` has been invoked, the multiplier value a and the addend value c are given by

$$a = 5DEECE66D_{16} = 273673163155_8$$
$$c = B_{16} = 13_8.$$

The value returned by any of the functions `drand48`, `erand48`, `lrand48`, `nrand48`, `mrand48`, or `jrand48` is computed by first generating the next 48-bit X_i in the sequence. Then the appropriate number of bits, according to the type of data item to be returned, are copied from the high-order (leftmost) bits of X_i and transformed into the returned value.

The functions drand48, lrand48, and mrand48 store the last 48-bit X_i generated in an internal buffer. X_i must be initialized prior to being invoked. The functions erand48, nrand48, and jrand48 require the calling program to provide storage for the successive X_i values in the array specified as an argument when the functions are invoked. These routines do not have to be initialized; the calling program must place the desired initial value of X_i into the array and pass it as an argument. By using different arguments, functions erand48, nrand48, and jrand48 allow separate modules of a large program to generate several *independent* streams of pseudo-random numbers, i.e., the sequence of numbers in each stream will *not* depend upon how many times the routines have been called to generate numbers for the other streams.

The initializer function srand48 sets the high-order 32 bits of X_i to the 32 bits contained in its argument. The low-order 16 bits of X_i are set to the arbitrary value $330E_{16}$.

The initializer function seed48 sets the value of X_i to the 48-bit value specified in the argument array. In addition, the previous value of X_i is copied into a 48-bit internal buffer, used only by seed48, and a pointer to this buffer is the value returned by seed48. This returned pointer, which can just be ignored if not needed, is useful if a program is to be restarted from a given point at some future time — use the pointer to get at and store the last X_i value, and then use this value to reinitialize via seed48 when the program is restarted.

The initialization function lcong48 allows the user to specify the initial X_i, the multiplier value *a*, and the addend value *c*. Argument array elements *param[0-2]* specify X_i, *param[3-5]* specify the multiplier *a*, and *param[6]* specifies the 16-bit addend *c*. After lcong48 has been called, a subsequent call to either srand48 or seed48 will restore the "standard" multiplier and addend values, *a* and *c*, specified on the previous page.

SEE ALSO

rand(3C).

NAME

dup2 − duplicate an open file descriptor

SYNOPSIS

```
#include <unistd.h>

int dup2 (int fildes, int fildes2);
```

DESCRIPTION

fildes is a file descriptor referring to an open file, and *fildes2* is a non-negative integer less than {OPEN_MAX} (the maximum number of open files). dup2 causes *fildes2* to refer to the same file as *fildes*. If *fildes2* already referred to an open file, not *fildes*, it is closed first. If *fildes2* refers to *fildes*, or if *fildes* is not a valid open file descriptor, *fildes2* will not be closed first.

dup2 will fail if one or more of the following are true:

EBADF	*fildes* is not a valid open file descriptor.
EBADF	*fildes2* is negative or greater than or equal to {OPEN_MAX}.
EINTR	a signal was caught during the dup2 call.
%[EMFILE	{OPEN_MAX} file descriptors are currently open.

SEE ALSO

creat(2), close(2), exec(2), fcntl(2), open(2), pipe(2), lockf(3C), limits(4).

DIAGNOSTICS

Upon successful completion a non-negative integer, namely, the file descriptor, is returned. Otherwise, a value of −1 is returned and errno is set to indicate the error.

NAME

ecvt, fcvt, gcvt – convert floating-point number to string

SYNOPSIS

```
#include <stdlib.h>

char *ecvt (double value, int ndigit, int *decpt, int *sign);

char *fcvt (double value, int ndigit, int *decpt, int *sign);

char *gcvt (double value, int ndigit, char *buf);
```

DESCRIPTION

ecvt converts *value* to a null-terminated string of *ndigit* digits and returns a pointer thereto. The high-order digit is non-zero, unless the value is zero. The low-order digit is rounded. The position of the decimal point relative to the beginning of the string is stored indirectly through *decpt* (negative means to the left of the returned digits). The decimal point is not included in the returned string. If the sign of the result is negative, the word pointed to by *sign* is non-zero, otherwise it is zero.

fcvt is identical to ecvt, except that the correct digit has been rounded for printf %f output of the number of digits specified by *ndigit*.

gcvt converts the *value* to a null-terminated string in the array pointed to by *buf* and returns *buf*. It attempts to produce *ndigit* significant digits in %f format if possible, otherwise %e format (scientific notation), ready for printing. A minus sign, if there is one, or a decimal point will be included as part of the returned string. Trailing zeros are suppressed.

SEE ALSO

printf(3S).

NOTES

The values returned by ecvt and fcvt point to a single static data array whose content is overwritten by each call.

NAME

end, etext, edata – last locations in program

SYNOPSIS

```
extern etext;

extern edata;

extern end;
```

DESCRIPTION

These names refer neither to routines nor to locations with interesting contents; only their addresses are meaningful.

etext The address of etext is the first address above the program text.

edata The address of edata is the first address above the initialized data region.

end The address of end is the first address above the uninitialized data region.

SEE ALSO

cc(1), brk(2), malloc(3C), stdio(3S).

NOTE

When execution begins, the program break (the first location beyond the data) coincides with end, but the program break may be reset by the routines brk, malloc, the standard input/output library [see stdio(3S)], by the profile (-p) option of cc, and so on. Thus, the current value of the program break should be determined by sbrk ((char *)0) [see brk(2)].

NAME

fclose, fflush – close or flush a stream

SYNOPSIS

```
#include <stdio.h>

int fclose (FILE *stream);

int fflush (FILE *stream);
```

DESCRIPTION

fclose causes any buffered data waiting to be written for the named *stream* [see intro(3)] to be written out, and the *stream* to be closed. If the underlying file pointer is not already at end of file, and the file is one capable of seeking, the file pointer is adjusted so that the next operation on the open file pointer deals with the byte after the last one read from or written to the file being closed.

fclose is performed automatically for all open files upon calling exit.

If *stream* points to an output stream or an update stream on which the most recent operation was not input, fflush causes any buffered data waiting to be written for the named *stream* to be written to that file. Any unread data buffered in *stream* is discarded. The *stream* remains open. If *stream* is open for reading, the underlying file pointer is not already at end of file, and the file is one capable of seeking, the file pointer is adjusted so that the next operation on the open file pointer deals with the byte after the last one read from or written to the stream.

When calling fflush, if *stream* is a null pointer, all files open for writing are flushed.

SEE ALSO

close(2), exit(2), intro(3), fopen(3S), setbuf(3S), stdio(3S).

DIAGNOSTICS

Upon successful completion these functions return a value of zero. Otherwise EOF is returned.

NAME

ferror, feof, clearerr, fileno – stream status inquiries

SYNOPSIS

```
#include <stdio.h>

int ferror (FILE *stream);

int feof (FILE *stream);

void clearerr (FILE *stream);

int fileno (FILE *stream);
```

DESCRIPTION

ferror returns non-zero when an error has previously occurred reading from or writing to the named *stream* [see intro(3)], otherwise zero.

feof returns non-zero when EOF has previously been detected reading the named input *stream*, otherwise zero.

clearerr resets the error indicator and EOF indicator to zero on the named *stream*.

fileno returns the integer file descriptor associated with the named *stream*; see open(2).

SEE ALSO

open(2), fopen(3S), stdio(3S).

NAME

`ffs` – find first set bit

SYNOPSIS

```
#include <string.h>

int ffs(const int i);
```

DESCRIPTION

ffs finds the first bit set in the argument passed it and returns the index of that bit. Bits are numbered starting at 1 from the low order bit. A return value of zero indicates that the value passed is zero.

NAME

fmtmsg – display a message on stderr or system console

SYNOPSIS

```
#include <fmtmsg.h>

int fmtmsg(long classification, const char *label, int severity,
    const char *text, const char *action, const char *tag);
```

DESCRIPTION

Based on a message's classification component, fmtmsg writes a formatted message to stderr, to the console, or to both.

fmtmsg can be used instead of the traditional printf interface to display messages to stderr. fmtmsg provides a simple interface for producing language-independent applications.

A formatted message consists of up to five standard components as defined below. The component, *classification,* is not part of the standard message displayed to the user, but rather defines the source of the message and directs the display of the formatted message.

classification
: Contains identifiers from the following groups of major classifications and subclassifications. Any one identifier from a subclass may be used in combination by ORing the values together with a single identifier from a different subclass. Two or more identifiers from the same subclass should not be used together, with the exception of identifiers from the display subclass. (Both display subclass identifiers may be used so that messages can be displayed to both stderr and the system console).

"Major classifications" identify the source of the condition. Identifiers are: MM_HARD (hardware), MM_SOFT (software), and MM_FIRM (firmware).

"Message source subclassifications" identify the type of software in which the problem is spotted. Identifiers are: MM_APPL (application), MM_UTIL (utility), and MM_OPSYS (operating system).

"Display subclassifications" indicate where the message is to be displayed. Identifiers are: MM_PRINT to display the message on the standard error stream, MM_CONSOLE to display the message on the system console. Neither, either, or both identifiers may be used.

"Status subclassifications" indicate whether the application will recover from the condition. Identifiers are: MM_RECOVER (recoverable) and MM_NRECOV (non-recoverable).

An additional identifier, MM_NULLMC, indicates that no classification component is supplied for the message.

label Identifies the source of the message. The format of this component is two fields separated by a colon. The first field is up to 10 characters long; the second is up to 14 characters. Suggested usage is that *label* identifies the package in which the application resides as well as the program or application name. For example, the *label* UX:cat indicates the UNIX System V package and the cat application.

severity
Indicates the seriousness of the condition. Identifiers for the standard levels of *severity* are:

MM_HALT indicates that the application has encountered a severe fault and is halting. Produces the print string HALT.

MM_ERROR indicates that the application has detected a fault. Produces the print string ERROR.

MM_WARNING indicates a condition out of the ordinary that might be a problem and should be watched. Produces the print string WARNING.

MM_INFO provides information about a condition that is not in error. Produces the print string INFO.

MM_NOSEV indicates that no severity level is supplied for the message.

Other severity levels may be added by using the **addseverity** routine.

text Describes the condition that produced the message. The *text* string is not limited to a specific size.

action Describes the first step to be taken in the error recovery process. fmtmsg precedes each action string with the prefix: TO FIX:. The *action* string is not limited to a specific size.

tag An identifier which references on-line documentation for the message. Suggested usage is that *tag* includes the *label* and a unique identifying number. A sample *tag* is UX:cat:146.

Environment Variables

There are two environment variables that control the behavior of fmtmsg: MSGVERB and SEV_LEVEL.

MSGVERB tells fmtmsg which message components it is to select when writing messages to stderr. The value of MSGVERB is a colon-separated list of optional keywords. MSGVERB can be set as follows:

MSGVERB=[*keyword*[:*keyword*[:...]]]
export MSGVERB

Valid *keywords* are: label, severity, text, action, and tag. If MSGVERB contains a keyword for a component and the component's value is not the component's null value, fmtmsg includes that component in the message when writing the message to stderr. If MSGVERB does not include a keyword for a message component, that component is not included in the display of the message. The keywords may appear in any order. If MSGVERB is not defined, if its value is the null-string, if its value is not of the correct format, or if it contains keywords other than the valid ones listed above, fmtmsg selects all components.

The first time fmtmsg is called, it examines the MSGVERB environment variable to see which message components it is to select when generating a message to write to the standard error stream, stderr. The values accepted on the initial call are saved for future calls.

MSGVERB affects only which components are selected for display to the standard error stream. All message components are included in console messages.

SEV_LEVEL defines severity levels and associates print strings with them for use by fmtmsg. The standard severity levels shown below cannot be modified. Additional severity levels can also be defined, redefined, and removed using addseverity [see addseverity(3C)]. If the same severity level is defined by both SEV_LEVEL and addseverity, the definition by addseverity is controlling.

0	(no severity is used)
1	HALT
2	ERROR
3	WARNING
4	INFO

SEV_LEVEL can be set as follows:

SEV_LEVEL=[*description*[:*description*[:...]]]
export SEV_LEVEL

description is a comma-separated list containing three fields:

description=severity_keyword,level,printstring

severity_keyword is a character string that is used as the keyword on the -s *severity* option to the fmtmsg command. (This field is not used by the fmtmsg function.)

level is a character string that evaluates to a positive integer (other than 0, 1, 2, 3, or 4, which are reserved for the standard severity levels). If the keyword *severity_keyword* is used, *level* is the severity value passed on to the fmtmsg function.

printstring is the character string used by fmtmsg in the standard message format whenever the severity value *level* is used.

If a *description* in the colon list is not a three-field comma list, or, if the second field of a comma list does not evaluate to a positive integer, that *description* in the colon list is ignored.

The first time fmtmsg is called, it examines the SEV_LEVEL environment variable, if defined, to see whether the environment expands the levels of severity beyond the five standard levels and those defined using addseverity. The values accepted on the initial call are saved for future calls.

Use in Applications

One or more message components may be systematically omitted from messages generated by an application by using the null value of the argument for that component.

The table below indicates the null values and identifiers for fmtmsg arguments.

Argument	Type	Null-Value	Identifier
label	char*	(char*) NULL	MM_NULLLBL
severity	int	0	MM_NULLSEV
class	long	0L	MM_NULLMC
text	char*	(char*) NULL	MM_NULLTXT
action	char*	(char*) NULL	MM_NULLACT
tag	char*	(char*) NULL	MM_NULLTAG

Another means of systematically omitting a component is by omitting the component keyword(s) when defining the MSGVERB environment variable (see the "Environment Variables" section).

EXAMPLES

Example 1:

The following example of fmtmsg:

```
fmtmsg(MM_PRINT, "UX:cat", MM_ERROR, "invalid syntax", "refer
to manual", "UX:cat:001")
```

produces a complete message in the standard message format:

```
UX:cat: ERROR: invalid syntax
TO FIX: refer to manual   UX:cat:001
```

Example 2:

When the environment variable MSGVERB is set as follows:

```
MSGVERB=severity:text:action
```

and the Example 1 is used, fmtmsg produces:

```
ERROR: invalid syntax
TO FIX: refer to manual
```

Example 3:

When the environment variable SEV_LEVEL is set as follows:

```
SEV_LEVEL=note,5,NOTE
```

the following call to fmtmsg:

```
fmtmsg(MM_UTIL | MM_PRINT, "UX:cat", 5, "invalid syntax",
"refer to manual", "UX:cat:001")
```

produces:

```
UX:cat: NOTE: invalid syntax
        TO FIX: refer to manual   UX:cat:001
```

SEE ALSO

addseverity(3C), printf(3S).

DIAGNOSTICS

The exit codes for `fmtmsg` are the following:

`MM_OK`	The function succeeded.
`MM_NOTOK`	The function failed completely.
`MM_NOMSG`	The function was unable to generate a message on the standard error stream, but otherwise succeeded.
`MM_NOCON`	The function was unable to generate a console message, but otherwise succeeded.

NAME

fopen, freopen, fdopen – open a stream

SYNOPSIS

```
#include <stdio.h>

FILE *fopen (const char *filename, const char *type);

FILE *freopen (const char *filename, const char *type, FILE
    *stream);

FILE *fdopen (int fildes, const char *type);
```

DESCRIPTION

fopen opens the file named by *filename* and associates a *stream* with it. fopen returns a pointer to the FILE structure associated with the *stream*.

filename points to a character string that contains the name of the file to be opened.

type is a character string beginning with one of the following sequences:

"r" or "rb" open for reading

"w" or "wb" truncate to zero length or create for writing

"a" or "ab" append; open for writing at end of file, or create for writing

"r+", "r+b" or "rb+"
open for update (reading and writing)

"w+", "w+b" or "wb+"
truncate or create for update

"a+", "a+b" or "ab+"
append; open or create for update at end-of-file

The "b" is ignored in the above *types*. The "b" exists to distinguish binary files from text files. However, there is no distinction between these types of files on a UNIX system.

freopen substitutes the named file in place of the open *stream*. A flush is first attempted, and then the original *stream* is closed, regardless of whether the open ultimately succeeds. Failure to flush or close *stream* successfully is ignored. freopen returns a pointer to the FILE structure associated with *stream*.

freopen is typically used to attach the preopened *streams* associated with stdin, stdout, and stderr to other files. stderr is by default unbuffered, but the use of freopen will cause it to become buffered or line-buffered.

fdopen associates a *stream* with a file descriptor. File descriptors are obtained from open, dup, creat, or pipe, which open files but do not return pointers to a FILE structure *stream*. Streams are necessary input for almost all of the Section 3S library routines. The *type* of *stream* must agree with the mode of the open file. The file position indicator associated with *stream* is set to the position indicated by the file offset associated with *fildes*.

When a file is opened for update, both input and output may be done on the resulting *stream*. However, output may not be directly followed by input without an intervening `fflush`, `fseek`, `fsetpos`, or `rewind`, and input may not be directly followed by output without an intervening `fseek`, `fsetpos`, or `rewind`, or an input operation that encounters end-of-file.

When a file is opened for append (i.e., when *type* is `"a"`, `"ab"`, `"a+"`, or `"ab+"`), it is impossible to overwrite information already in the file. `fseek` may be used to reposition the file pointer to any position in the file, but when output is written to the file, the current file pointer is disregarded. All output is written at the end of the file and causes the file pointer to be repositioned at the end of the output. If two separate processes open the same file for append, each process may write freely to the file without fear of destroying output being written by the other. The output from the two processes will be intermixed in the file in the order in which it is written.

When opened, a *stream* is fully buffered if and only if it can be determined not to refer to an interactive device. The error and end-of-file indicators are cleared for the *stream*.

SEE ALSO

`close`(2), `creat`(2), `dup`(2), `open`(2), `pipe`(2), `write`(2), `fclose`(3S), `fseek`(3S), `setbuf`(3S), `stdio`(3S).

DIAGNOSTICS

The functions `fopen` and `freopen` return a null pointer if *path* cannot be accessed, or if *type* is invalid, or if the file cannot be opened.

The function `fdopen` returns a null pointer if *fildes* is not an open file descriptor, or if *type* is invalid, or if the file cannot be opened.

The functions `fopen` or `fdopen` may fail and not set `errno` if there are no free `stdio` streams.

File descriptors used by `fdopen` must be less than 255.

NAME

fpgetround, fpsetround, fpgetmask, fpsetmask, fpgetsticky, fpsetsticky – IEEE floating-point environment control

SYNOPSIS

```
#include <ieeefp.h>

fp_rnd fpgetround (void);

fp_rnd fpsetround (fp_rnd rnd_dir);

fp_except fpgetmask (void);

fp_except fpsetmask (fp_except mask);

fp_except fpgetsticky (void);

fp_except fpsetsticky (fp_except sticky);
```

DESCRIPTION

There are five floating-point exceptions: divide-by-zero, overflow, underflow, imprecise (inexact) result, and invalid operation. When a floating-point exception occurs, the corresponding sticky bit is set (1), and if the mask bit is enabled (1), the trap takes place. These routines let the user change the behavior on occurrence of any of these exceptions, as well as change the rounding mode for floating-point operations.

```
FP_X_INV     /* invalid operation exception */
FP_X_OFL     /* overflow exception */
FP_X_UFL     /* underflow exception */
FP_X_DZ      /* divide-by-zero exception */
FP_X_IMP     /* imprecise (loss of precision) */
FP_RN        /* round to nearest representative number */
FP_RP        /* round to plus infinity */
FP_RM        /* round to minus infinity */
FP_RZ        /* round to zero (truncate) */
```

`fpgetround` returns the current rounding mode.

`fpsetround` sets the rounding mode and returns the previous rounding mode.

`fpgetmask` returns the current exception masks.

`fpsetmask` sets the exception masks and returns the previous setting.

`fpgetsticky` returns the current exception sticky flags.

`fpsetsticky` sets (clears) the exception sticky flags and returns the previous setting.

The default environment is rounding mode set to nearest (`FP_RN`) and all traps disabled.

Individual bits may be examined using the constants defined in `ieeefp.h`.

SEE ALSO

`isnan`(3C).

NOTES

fpsetsticky modifies all sticky flags. **fpsetmask** changes all mask bits. **fpsetmask** clears the sticky bit corresponding to any exception being enabled.

C requires truncation (round to zero) for floating point to integral conversions. The current rounding mode has no effect on these conversions.

One must clear the sticky bit to recover from the trap and to proceed. If the sticky bit is not cleared before the next trap occurs, a wrong exception type may be signaled.

NAME

fread, fwrite – binary input/output

SYNOPSIS

```
#include <stdio.h>

size_t fread (void *ptr, size_t size, size_t nitems, FILE *stream);

size_t fwrite (const void *ptr, size_t size, size_t nitems, FILE
    *stream);
```

DESCRIPTION

`fread` reads into an array pointed to by *ptr* up to *nitems* items of data from *stream*, where an item of data is a sequence of bytes (not necessarily terminated by a null byte) of length *size*. `fread` stops reading bytes if an end-of-file or error condition is encountered while reading *stream*, or if *nitems* items have been read. `fread` increments the data pointer in *stream* to point to the byte following the last byte read if there is one. `fread` does not change the contents of *stream*. `fread` returns the number of items read.

`fwrite` writes to the named output *stream* at most *nitems* items of data from the array pointed to by *ptr*, where an item of data is a sequence of bytes (not necessarily terminated by a null byte) of length *size*. `fwrite` stops writing when it has written *nitems* items of data or if an error condition is encountered on *stream*. `fwrite` does not change the contents of the array pointed to by *ptr*. `fwrite` increments the data-pointer in *stream* by the number of bytes written. `fwrite` returns the number of items written.

If *size* or *nitems* is zero, then `fread` and `fwrite` return a value of 0 and do not effect the state of *stream*.

The `ferror` or `feof` routines must be used to distinguish between an error condition and end-of-file condition.

SEE ALSO

`exit`(2), `lseek`(2), `read`(2), `write`(2), `abort`(3C), `fclose`(3S), `fopen`(3S), `getc`(3S), `gets`(3S), `printf`(3S), `putc`(3S), `puts`(3S), `scanf`(3S), `stdio`(3S).

DIAGNOSTICS

If an error occurs, the error indicator for *stream* is set.

NAME

`frexp`, `ldexp`, `logb`, `modf`, `modff`, `nextafter`, `scalb` – manipulate parts of floating-point numbers

SYNOPSIS

```
#include <math.h>

double frexp (double value, int *eptr);

double ldexp (double value, int exp);

double logb (double value);

double nextafter (double value1, double value2);

double scalb (double value, double exp);

double modf (double value, double *iptr);

float modff (float value, float *iptr);
```

DESCRIPTION

Every non-zero number can be written uniquely as $x * 2^n$, where the "mantissa" (fraction) x is in the range $0.5 \leq |x| < 1.0$, and the "exponent" n is an integer. `frexp` returns the mantissa of a double *value*, and stores the exponent indirectly in the location pointed to by *eptr*. If *value* is zero, both results returned by `frexp` are zero.

`ldexp` and `scalb` return the quantity $value * 2^{exp}$. The only difference between the two is that `scalb` of a signaling NaN will result in the invalid operation exception being raised.

`logb` returns the unbiased exponent of its floating-point argument as a double-precision floating-point value.

`modf` and `modff` (single-precision version) return the signed fractional part of *value* and store the integral part indirectly in the location pointed to by *iptr*.

`nextafter` returns the next representable double-precision floating-point value following *value1* in the direction of *value2*. Thus, if *value2* is less than *value1*, `nextafter` returns the largest representable floating-point number less than *value1*.

SEE ALSO

cc(1), `intro`(3M).

DIAGNOSTICS

If `ldexp` would cause overflow, ±`HUGE` (defined in `math.h`) is returned (according to the sign of *value*), and `errno` is set to `ERANGE`. If `ldexp` would cause underflow, zero is returned and `errno` is set to `ERANGE`. If the input *value* to `ldexp` is NaN or infinity, that input is returned and `errno` is set to `EDOM`. The same error conditions apply to `scalb` except that a signaling NaN as input will result in the raising of the invalid operation exception.

`logb` of NaN returns that NaN, `logb` of infinity returns positive infinity, and `logb` of zero returns negative infinity and results in the raising of the divide by zero exception. In each of these conditions `errno` is set to `EDOM`.

If input *value1* to **nextafter** is positive or negative infinity, that input is returned and **errno** is set to **EDOM**. The overflow and inexact exceptions are signalled when input *value1* is finite, but **nextafter**(*value1*, *value2*) is not. The underflow and inexact exceptions are signalled when **nextafter**(*value1*, *value2*) lies strictly between $\pm 2^{-1022}$. In both cases **errno** is set to **ERANGE**.

When the program is compiled with the **cc** options **-Xc** or **-Xa**, **HUGE_VAL** is returned instead of **HUGE**.

NAME

`fseek`, `rewind`, `ftell` – reposition a file pointer in a stream

SYNOPSIS

```
#include <stdio.h>

int fseek (FILE *stream, long offset, int ptrname);

void rewind (FILE *stream);

long ftell (FILE *stream);
```

DESCRIPTION

`fseek` sets the position of the next input or output operation on the *stream* [see `intro`(3)]. The new position is at the signed distance *offset* bytes from the beginning, from the current position, or from the end of the file, according to a *ptrname* value of `SEEK_SET`, `SEEK_CUR`, or `SEEK_END` (defined in `stdio.h`) as follows:

`SEEK_SET` set position equal to *offset* bytes.

`SEEK_CUR` set position to current location plus *offset*.

`SEEK_END` set position to `EOF` plus *offset*.

`fseek` allows the file position indicator to be set beyond the end of the existing data in the file. If data is later written at this point, subsequent reads of data in the gap will return zero until data is actually written into the gap. `fseek`, by itself, does not extend the size of the file.

`rewind (stream)` is equivalent to:

```
(void) fseek (stream, 0L, SEEK_SET);
```

except that `rewind` also clears the error indicator on *stream*.

`fseek` and `rewind` clear the `EOF` indicator and undo any effects of `ungetc` on *stream*. After `fseek` or `rewind`, the next operation on a file opened for update may be either input or output.

If *stream* is writable and buffered data has not been written to the underlying file, `fseek` and `rewind` cause the unwritten data to be written to the file.

`ftell` returns the offset of the current byte relative to the beginning of the file associated with the named *stream*.

SEE ALSO

`lseek`(2), `write`(2), `fopen`(3S), `popen`(3S), `stdio`(3S), `ungetc`(3S).

DIAGNOSTICS

`fseek` returns −1 for improper seeks, otherwise zero. An improper seek can be, for example, an `fseek` done on a file that has not been opened via `fopen`; in particular, `fseek` may not be used on a terminal or on a file opened via `popen`. After a stream is closed, no further operations are defined on that stream.

NOTES

Although on the UNIX system an offset returned by `ftell` is measured in bytes, and it is permissible to seek to positions relative to that offset, portability to non-UNIX systems requires that an offset be used by `fseek` directly. Arithmetic may not meaningfully be performed on such an offset, which is not necessarily measured in bytes.

NAME

fsetpos, fgetpos – reposition a file pointer in a stream

SYNOPSIS

```
#include <stdio.h>

int fsetpos (FILE *stream, const fpos_t *pos);

int fgetpos (FILE *stream, fpos_t *pos);
```

DESCRIPTION

fsetpos sets the position of the next input or output operation on the *stream* according to the value of the object pointed to by *pos*. The object pointed to by *pos* must be a value returned by an earlier call to fgetpos on the same stream.

fsetpos clears the end-of-file indicator for the stream and undoes any effects of the ungetc function on the same stream. After fsetpos, the next operation on a file opened for update may be either input or output.

fgetpos stores the current value of the file position indicator for *stream* in the object pointed to by *pos*. The value stored contains information usable by fsetpos for repositioning the stream to its position at the time of the call to fgetpos.

If successful, both fsetpos and fgetpos return zero. Otherwise, they both return nonzero.

SEE ALSO

fseek(3S), lseek(2) ungetc(3S).

NAME

ftw − walk a file tree

SYNOPSIS

```
#include <ftw.h>

int ftw (const char *path, int (*fn) (const char *, const struct
stat *, int), int depth);
```

DESCRIPTION

ftw recursively descends the directory hierarchy rooted in *path*. For each object in the hierarchy, ftw calls the user-defined function *fn*, passing it a pointer to a null-terminated character string containing the name of the object, a pointer to a stat structure (see stat(2)) containing information about the object, and an integer. Possible values of the integer, defined in the <ftw.h> header file, are:

FTW_F The object is a file.

FTW_D The object is a directory.

FTW_DNR The object is a directory that cannot be read. Descendants of the directory will not be processed.

FTW_NS stat failed on the object because of lack of appropriate permission or the object is a symbolic link that points to a non-existent file. The stat buffer passed to *fn* is undefined.

ftw visits a directory before visiting any of its descendants.

The tree traversal continues until the tree is exhausted, an invocation of *fn* returns a nonzero value, or some error is detected within ftw (such as an I/O error). If the tree is exhausted, ftw returns zero. If *fn* returns a nonzero value, ftw stops its tree traversal and returns whatever value was returned by *fn*. If ftw detects an error other than EACCES, it returns −1, and sets the error type in *errno*.

ftw uses one file descriptor for each level in the tree. The *depth* argument limits the number of file descriptors so used. If *depth* is zero or negative, the effect is the same as if it were 1. *depth* must not be greater than the number of file descriptors currently available for use. ftw will run more quickly if *depth* is at least as large as the number of levels in the tree. When ftw returns it closes any file descriptors which it has opened. It does not close any file descriptors which may have been opened by *fn*.

SEE ALSO

stat(2), malloc(3C).

NOTES

Because ftw is recursive, it is possible for it to terminate with a memory fault when applied to very deep file structures.

ftw uses malloc(3C) to allocate dynamic storage during its operation. If ftw is forcibly terminated, such as by longjmp being executed by *fn* or an interrupt routine, ftw will not have a chance to free that storage, so it will remain permanently allocated. A safe way to handle interrupts is to store the fact that an interrupt has occurred, and arrange to have *fn* return a nonzero value at its next invocation.

NAME

getc, getchar, fgetc, getw – get character or word from a stream

SYNOPSIS

```
#include <stdio.h>

int getc (FILE *stream);

int getchar (void);

int fgetc (FILE *stream);

int getw (FILE *stream);
```

DESCRIPTION

getc returns the next character (i.e., byte) from the named input *stream* [see intro(3)] as an unsigned char converted to an int. It also moves the file pointer, if defined, ahead one character in *stream*. getchar is defined as getc(stdin). getc and getchar are macros.

fgetc behaves like getc, but is a function rather than a macro. fgetc runs more slowly than getc, but it takes less space per invocation and its name can be passed as an argument to a function.

getw returns the next word (i.e., integer) from the named input *stream*. getw increments the associated file pointer, if defined, to point to the next word. The size of a word is the size of an integer and varies from machine to machine. getw assumes no special alignment in the file.

SEE ALSO

fclose(3S), ferror(3S), fopen(3S), fread(3S), gets(3S), putc(3S), scanf(3S), stdio(3S), ungetc(3S).

DIAGNOSTICS

These functions return the constant EOF at end-of-file or upon an error and set the EOF or error indicator of *stream*, respectively. Because EOF is a valid integer, ferror should be used to detect getw errors.

NOTES

If the integer value returned by getc, getchar, or fgetc is stored into a character variable and then compared against the integer constant EOF, the comparison may never succeed, because sign-extension of a character on widening to integer is implementation dependent.

The macro version of getc evaluates a *stream* argument more than once and may treat side effects incorrectly. In particular, getc(*f++) does not work sensibly. Use fgetc instead.

Because of possible differences in word length and byte ordering, files written using putw are implementation dependent, and may not be read using getw on a different processor.

Functions exist for all the above-defined macros. To get the function form, the macro name must be undefined (e.g., #undef getc).

NAME

getcwd – get pathname of current working directory

SYNOPSIS

```
#include <unistd.h>

char *getcwd (char *buf, int size);
```

DESCRIPTION

getcwd returns a pointer to the current directory pathname. The value of *size* must be at least one greater than the length of the pathname to be returned.

If *buf* is not NULL, the pathname will be stored in the space pointed to by *buf*.

If *buf* is a NULL pointer, getcwd will obtain *size* bytes of space using malloc(3C). In this case, the pointer returned by getcwd may be used as the argument in a subsequent call to free.

getcwd will fail if one or more of the following are true:

EACCES A parent directory cannot be read to get its name.

EINVAL *size* is equal to 0.

ERANGE *size* is less than 0 or is greater than 0 and less than the length of the pathname plus 1.

EXAMPLE

Here is a program that prints the current working directory.

```
#include <unistd.h>
#include <stdio.h>

main()
{
      char *cwd;
      if ((cwd = getcwd(NULL, 64)) == NULL)
      {
            perror("pwd");
            exit(2);
      }
      (void)printf("%s\n", cwd);
      return(0);
}
```

SEE ALSO

malloc(3C)

DIAGNOSTICS

Returns NULL with *errno* set if *size* is not large enough, or if an error occurs in a lower-level function.

NAME

getenv – return value for environment name

SYNOPSIS

```
#include <stdlib.h>

char *getenv (const char *name);
```

DESCRIPTION

getenv searches the environment list [see environ(5)] for a string of the form *name=value* and, if the string is present, returns a pointer to the *value* in the current environment. Otherwise, it returns a null pointer.

SEE ALSO

exec(2), putenv(3C), environ(5).

NAME

getgrent, getgrgid, getgrnam, setgrent, endgrent, fgetgrent – get group file entry

SYNOPSIS

```
#include <grp.h>

struct group *getgrent (void);

struct group *getgrgid (gid_t gid);

struct group *getgrnam (const char *name);

void setgrent (void);

void endgrent (void);

struct group *fgetgrent (FILE  *f);
```

DESCRIPTION

getgrent, getgrgid, and getgrnam each return pointers to an object containing the broken-out fields of a line in the /etc/group file. Each line contains a "group" structure, defined in the grp.h header file with the following members:

```
char   *gr_name;   /* the name of the group */
char   *gr_passwd; /* the encrypted group password */
gid_t gr_gid;      /* the numerical group ID */
char   **gr_mem;   /* vector of pointers to member names */
```

When first called, getgrent returns a pointer to the first group structure in the file; thereafter, it returns a pointer to the next group structure in the file; so, successive calls may be used to search the entire file. getgrgid searches from the beginning of the file until a numerical group id matching *gid* is found and returns a pointer to the particular structure in which it was found.

getgrnam searches from the beginning of the file until a group name matching *name* is found and returns a pointer to the particular structure in which it was found. If an end-of-file or an error is encountered on reading, these functions return a null pointer.

A call to setgrent has the effect of rewinding the group file to allow repeated searches. endgrent may be called to close the group file when processing is complete.

fgetgrent returns a pointer to the next group structure in the stream *f*, which matches the format of /etc/group.

FILES

/etc/group

SEE ALSO

getlogin(3C), getpwent(3C).
group(4) in the *System Administrator's Reference Manual*.

DIAGNOSTICS

`getgrent`, `getgrgid`, `getgrnam`, and `fgetgrent` return a null pointer on `EOF` or error.

NOTES

All information is contained in a static area, so it must be copied if it is to be saved.

NAME

getlogin – get login name

SYNOPSIS

```
#include &lt;stdlib.h>

char *getlogin (void);
```

DESCRIPTION

getlogin returns a pointer to the login name as found in /etc/utmp. It may be used in conjunction with getpwnam to locate the correct password file entry when the same user ID is shared by several login names.

If getlogin is called within a process that is not attached to a terminal, it returns a NULL pointer. The correct procedure for determining the login name is to call cuserid, or to call getlogin and if it fails to call getpwuid.

FILES

/etc/utmp

SEE ALSO

cuserid(3S), getgrent(3C), getpwent(3C), utmp(4).

DIAGNOSTICS

Returns the NULL pointer if the login name is not found.

NOTES

The return values point to static data whose content is overwritten by each call.

NAME

getmntent, getmntany – get mnttab file entry

SYNOPSIS

```
#include <stdio.h>
#include <sys/mnttab.h>

int getmntent (FILE *fp, struct mnttab *mp);

int getmntany (FILE *fp, struct mnttab *mp, struct mnttab *mpref);
```

DESCRIPTION

getmntent and getmntany each fill in the structure pointed to by *mp* with the broken-out fields of a line in the /etc/mnttab file. Each line in the file contains a mnttab structure, declared in the sys/mnttab.h header file:

```
struct mnttab {
        char *mnt_special;
        char *mnt_mountp;
        char *mnt_fstype;
        char *mnt_mntopts;
        char *mnt_time;
};
```

The fields have meanings described in mnttab(4).

getmntent returns a pointer to the next mnttab structure in the file; so successive calls can be used to search the entire file. getmntany searches the file referenced by *fp* until a match is found between a line in the file and *mpref*. *mpref* matches the line if all non-null entries in *mpref* match the corresponding fields in the file. Note that these routines do not open, close, or rewind the file.

FILES

/etc/mnttab

SEE ALSO

mnttab(4).

DIAGNOSTICS

If the next entry is successfully read by getmntent or a match is found with getmntany, 0 is returned. If an end-of-file is encountered on reading, these functions return −1. If an error is encountered, a value greater than 0 is returned. The possible error values are:

MNT_TOOLONG	A line in the file exceeded the internal buffer size of MNT_LINE_MAX.
MNT_TOOMANY	A line in the file contains too many fields.
MNT_TOOFEW	A line in the file contains too few fields.

NOTES

The members of the mnttab structure point to information contained in a static area, so it must be copied if it is to be saved.

NAME

getopt – get option letter from argument vector

SYNOPSIS

```
#include <stdlib.h>

int getopt (int argc, char * const *argv, const char *optstring);

extern char *optarg;

extern int optind, opterr, optopt;
```

DESCRIPTION

getopt returns the next option letter in *argv* that matches a letter in *optstring*. It supports all the rules of the command syntax standard [see intro(1)]. Since all new commands are intended to adhere to the command syntax standard, they should use getopts(1), getopt(3C), or getsubopts(3C) to parse positional parameters and check for options that are legal for that command.

optstring must contain the option letters the command using getopt will recognize; if a letter is followed by a colon, the option is expected to have an argument, or group of arguments, which may be separated from it by white space. *optarg* is set to point to the start of the option argument on return from getopt.

getopt places in *optind* the *argv* index of the next argument to be processed. *optind* is external and is initialized to 1 before the first call to getopt. When all options have been processed (i.e., up to the first non-option argument), getopt returns EOF. The special option "--" (two hyphens) may be used to delimit the end of the options; when it is encountered, EOF is returned and "--" is skipped. This is useful in delimiting non-option arguments that begin with "-" (hyphen).

EXAMPLE

The following code fragment shows how one might process the arguments for a command that can take the mutually exclusive options a and b, and the option o, which requires an argument:

```
#include <stdlib.h>
#include <stdio.h>

main (int argc, char **argv)
{
        int c;
        extern char *optarg;
        extern int optind;
        int aflg = 0;
        int bflg = 0;
        int errflg = 0;
        char *ofile = NULL;

        while ((c = getopt(argc, argv, "abo:")) != EOF)
                switch (c) {
                case 'a':
                        if (bflg)
                                errflg++;
```

```
                    else
                        aflg++;
                    break;
                case 'b':
                    if (aflg)
                        errflg++;
                    else
                        bflg++;
                    break;
                case 'o':
                    ofile = optarg;
                    (void)printf("ofile = %s\n", ofile);
                    break;
                case '?':
                    errflg++;
                }
        if (errflg) {
            (void)fprintf(stderr,
                "usage: cmd [-a|-b] [-o<file>] files...\n");
            exit (2);
        }
        for ( ; optind < argc; optind++)
            (void)printf("%s\n", argv[optind]);
        return 0;
}
```

SEE ALSO

getsubopt(3C).
getopts(1), intro(1) in the *User's Reference Manual.*

DIAGNOSTICS

getopt prints an error message on the standard error and returns a "?" (question mark) when it encounters an option letter not included in *optstring* or no argument after an option that expects one. This error message may be disabled by setting opterr to 0. The value of the character that caused the error is in optopt.

NOTES

The library routine getopt does not fully check for mandatory arguments. That is, given an option string a:b and the input –a –b, getopt assumes that –b is the mandatory argument to the option –a and not that –a is missing a mandatory argument.

It is a violation of the command syntax standard [see intro(1)] for options with arguments to be grouped with other options, as in cmd –aboxxx file, where a and b are options, o is an option that requires an argument, and xxx is the argument to o. Although this syntax is permitted in the current implementation, it should not be used because it may not be supported in future releases. The correct syntax is cmd –ab –oxxx file.

NAME

getpass – read a password

SYNOPSIS

```
#include <stdlib.h>

char *getpass (const char *prompt);
```

DESCRIPTION

getpass reads up to a newline or EOF from the file /dev/tty, after prompting on the standard error output with the null-terminated string *prompt* and disabling echoing. A pointer is returned to a null-terminated string of at most 8 characters. If /dev/tty cannot be opened, a null pointer is returned. An interrupt will terminate input and send an interrupt signal to the calling program before returning.

FILES

/dev/tty

NOTE

The return value points to static data whose content is overwritten by each call.

NAME

getpw – get name from UID

SYNOPSIS

```
#include <stdlib.h>

int getpw (uid_t uid, char *buf);
```

DESCRIPTION

getpw searches the password file for a user id number that equals *uid*, copies the line of the password file in which *uid* was found into the array pointed to by *buf*, and returns 0. getpw returns non-zero if *uid* cannot be found.

This routine is included only for compatibility with prior systems and should not be used; see getpwent(3C) for routines to use instead.

FILES

/etc/passwd

SEE ALSO

getpwent(3C).
passwd(4) in the *System Administrator's Reference Manual.*

DIAGNOSTICS

getpw returns non-zero on error.

NAME

getpwent, getpwuid, getpwnam, setpwent, endpwent, fgetpwent – manipulate password file entry

SYNOPSIS

```
#include <pwd.h>

struct passwd *getpwent (void);

struct passwd *getpwuid (uid_t uid);

struct passwd *getpwnam (const char *name);

void setpwent (void);

void endpwent (void);

struct passwd *fgetpwent (FILE *f);
```

DESCRIPTION

getpwent, getpwuid, and getpwnam each returns a pointer to an object with the following structure containing the broken-out fields of a line in the /etc/passwd file. Each line in the file contains a passwd structure, declared in the pwd.h header file:

```
struct passwd {
      char *pw_name;
      char *pw_passwd;
      uid_t pw_uid;
      gid_t pw_gid;
      char *pw_age;
      char *pw_comment;
      char *pw_gecos;
      char *pw_dir;
      char *pw_shell;
};
```

getpwent when first called returns a pointer to the first passwd structure in the file; thereafter, it returns a pointer to the next passwd structure in the file; so successive calls can be used to search the entire file. getpwuid searches from the beginning of the file until a numerical user id matching *uid* is found and returns a pointer to the particular structure in which it was found. getpwnam searches from the beginning of the file until a login name matching *name* is found, and returns a pointer to the particular structure in which it was found. If an end-of-file or an error is encountered on reading, these functions return a null pointer.

A call to setpwent has the effect of rewinding the password file to allow repeated searches. endpwent may be called to close the password file when processing is complete.

fgetpwent returns a pointer to the next passwd structure in the stream *f*, which matches the format of /etc/passwd.

FILES

/etc/passwd

SEE ALSO

getlogin(3C), getgrent(3C).
passwd(4) in the *System Administrator's Reference Manual.*

DIAGNOSTICS

getpwent, getpwnid, getpwnam, and fgetpwent return a null pointer on EOF or error.

NOTES

All information is contained in a static area, so it must be copied if it is to be saved.

NAME

`gets`, `fgets` – get a string from a stream

SYNOPSIS

```
#include <stdio.h>

char *gets (char *s);

char *fgets (char *s, int n, FILE *stream);
```

DESCRIPTION

`gets` reads characters from the standard input stream [see `intro`(3)], `stdin`, into the array pointed to by *s*, until a newline character is read or an end-of-file condition is encountered. The newline character is discarded and the string is terminated with a null character.

`fgets` reads characters from the *stream* into the array pointed to by *s*, until $n-1$ characters are read, or a newline character is read and transferred to *s*, or an end-of-file condition is encountered. The string is then terminated with a null character.

When using `gets`, if the length of an input line exceeds the size of *s*, indeterminate behavior may result. For this reason, it is strongly recommended that `gets` be avoided in favor of `fgets`.

SEE ALSO

`lseek`(2), `read`(2), `ferror`(3S), `fopen`(3S), `fread`(3S), `getc`(3S), `scanf`(3S), `stdio`(3S), `ungetc`(3S).

DIAGNOSTICS

If end-of-file is encountered and no characters have been read, no characters are transferred to *s* and a null pointer is returned. If a read error occurs, such as trying to use these functions on a file that has not been opened for reading, a null pointer is returned and the error indicator for the stream is set. If end-of-file is encountered, the `EOF` indicator for the stream is set. Otherwise *s* is returned.

NAME

getsubopt – parse suboptions from a string

SYNOPSIS

```
#include <stdlib.h>

int getsubopt (char **optionp, char * const *tokens, char **valuep);
```

DESCRIPTION

getsubopt parses suboptions in a flag argument that was initially parsed by getopt. These suboptions are separated by commas and may consist of either a single token or a token-value pair separated by an equal sign. Since commas delimit suboptions in the option string, they are not allowed to be part of the suboption or the value of a suboption. A command that uses this syntax is mount(1M), which allows the user to specify mount parameters with the -o option as follows:

```
mount -o rw,hard,bg,wsize=1024 speed:/usr /usr
```

In this example there are four suboptions: rw, hard, bg, and wsize, the last of which has an associated value of 1024.

getsubopt takes the address of a pointer to the option string, a vector of possible tokens, and the address of a value string pointer. It returns the index of the token that matched the suboption in the input string or −1 if there was no match. If the option string at *optionp* contains only one subobtion, getsubopt updates *optionp* to point to the null character at the end of the string; otherwise it isolates the suboption by replacing the comma separator with a null character, and updates *optionp* to point to the start of the next suboption. If the suboption has an associated value, getsubopt updates *valuep* to point to the value's first character. Otherwise it sets *valuep* to NULL.

The token vector is organized as a series of pointers to null strings. The end of the token vector is identified by a null pointer.

When getsubopt returns, if *valuep* is not NULL, then the suboption processed included a value. The calling program may use this information to determine if the presence or lack of a value for this subobtion is an error.

Additionally, when getsubopt fails to match the suboption with the tokens in the *tokens* array, the calling program should decide if this is an error, or if the unrecognized option should be passed to another program.

EXAMPLE

The following code fragment shows how to process options to the mount command using getsubopt.

```
#include <stdlib.h>

char *myopts[] = {
#define READONLY        0
                "ro",
#define READWRITE       1
                "rw",
```

```
#define WRITESIZE     2
                  "wsize",
#define READSIZE      3
                  "rsize",
                  NULL};

main(argc, argv)
     int  argc;
     char **argv;
{
     int sc, c, errflag;
     char *options, *value;
     extern char *optarg;
     extern int optind;
     .
     .
     .
     while((c = getopt(argc, argv, "abf:o:")) != -1) {
          switch (c) {
          case 'a': /* process a option */
               break;
          case 'b': /* process b option */
               break;
          case 'f':
               ofile = optarg;
               break;
          case '?':
               errflag++;
               break;
          case 'o':
               options = optarg;
               while (*options != '\0') {
                    switch(getsubopt(&options,myopts,&value) {
                    case READONLY : /* process ro option */
                         break;
                    case READWRITE : /* process rw option */
                         break;
                    case WRITESIZE : /* process wsize option */
                         if (value == NULL) {
                              error_no_arg();
                              errflag++;
                         } else
                              write_size = atoi(value);
                         break;
                    case READSIZE : /* process rsize option */
                         if (value == NULL) {
                              error_no_arg();
                              errflag++;
                         } else
```

```
                                read_size = atoi(value);
                            break;
                        default :
                            /* process unknown token */
                            error_bad_token(value);
                            errflag++;
                            break;
                        }
                    }
                    break;
                }
            }
            if (errflag) {
                /* print usage instructions etc. */
            }
            for (; optind<argc; optind++) {
                /* process remaining arguments */
            }
            .
            .
            .
        }
```

SEE ALSO

getopt(3C).

DIAGNOSTICS

getsubopt returns −1 when the token it is scanning is not in the token vector. The variable addressed by *valuep* contains a pointer to the first character of the token that was not recognized rather than a pointer to a value for that token.

The variable addressed by *optionp* points to the next option to be parsed, or a null character if there are no more options.

NOTES

During parsing, commas in the option input string are changed to null characters. White space in tokens or token-value pairs must be protected from the shell by quotes.

NAME

getut: getutent, getutid, getutline, pututline, setutent, endutent, utmpname – access utmp file entry

SYNOPSIS

```
#include <utmp.h>

struct utmp *getutent (void);

struct utmp *getutid (const struct utmp *id);

struct utmp *getutline (const struct utmp *line);

struct utmp *pututline (const struct utmp *utmp);

void setutent (void);

void endutent (void);

int utmpname (const char *file);
```

DESCRIPTION

getutent, getutid, getutline, and pututline each return a pointer to a structure with the following members:

```
char     ut_user[8];  /* User login name */
char     ut_id[4];    /* /etc/inittab id (usually line #) */
char     ut_line[12]; /* device name (console, lnxx) */
short    ut_pid;      /* process id   */
short    ut_type;     /* type of entry */
struct   exit_status {
} ut_exit;            /* The exit status of a process
                       /* marked as DEAD_PROCESS. */
time_t   ut_time;     /* time entry was made */
```

The structure exit_status includes the following members:

```
short    e_termination;   /* Process termination status */
short    e_exit;          /* Process exit status */
```

getutent reads in the next entry from a utmp-like file. If the file is not already open, it opens it. If it reaches the end of the file, it fails.

getutid searches forward from the current point in the utmp file until it finds an entry with a *ut_type* matching id->*ut_type* if the type specified is RUN_LVL, BOOT_TIME, OLD_TIME or NEW_TIME. If the type specified in id is INIT_PROCESS, LOGIN_PROCESS, USER_PROCESS or DEAD_PROCESS, then getutid will return a pointer to the first entry whose type is one of these four and whose ut_id field matches id->*ut_id*. If the end of file is reached without a match, it fails.

getutline searches forward from the current point in the utmp file until it finds an entry of the type LOGIN_PROCESS or USER_PROCESS that also has a *ut_line* string matching the line->*ut_line* string. If the end of file is reached without a match, it fails.

pututline writes out the supplied utmp structure into the utmp file. It uses getutid to search forward for the proper place if it finds that it is not already at the proper place. It is expected that normally the user of pututline will have searched for the proper entry using one of the getut routines. If so, pututline will not search. If pututline does not find a matching slot for the new entry, it will add a new entry to the end of the file. It returns a pointer to the utmp structure.

setutent resets the input stream to the beginning of the file. This reset should be done before each search for a new entry if it is desired that the entire file be examined.

endutent closes the currently open file.

utmpname allows the user to change the name of the file examined, from /etc/utmp to any other file. It is most often expected that this other file will be /etc/wtmp. If the file does not exist, this will not be apparent until the first attempt to reference the file is made. utmpname does not open the file. It just closes the old file if it is currently open and saves the new file name. If the file name given is longer than 79 characters, utmpname returns 0. Otherwise, it will return 1.

FILES

/etc/utmp
/etc/wtmp

SEE ALSO

ttyslot(3C), utmp(4).

DIAGNOSTICS

A NULL pointer is returned upon failure to read, whether for permissions or having reached the end of file, or upon failure to write.

NOTES

The most current entry is saved in a static structure. Multiple accesses require that it be copied before further accesses are made. On each call to either getutid or getutline, the routine examines the static structure before performing more I/O. If the contents of the static structure match what it is searching for, it looks no further. For this reason, to use getutline to search for multiple occurrences, it would be necessary to zero out the static area after each success, or getutline would just return the same structure over and over again. There is one exception to the rule about emptying the structure before further reads are done. The implicit read done by pututline (if it finds that it is not already at the correct place in the file) will not hurt the contents of the static structure returned by the getutent, getutid or getutline routines, if the user has just modified those contents and passed the pointer back to pututline.

These routines use buffered standard I/O for input, but pututline uses an unbuffered non-standard write to avoid race conditions between processes trying to modify the utmp and wtmp files.

NAME

hsearch, hcreate, hdestroy – manage hash search tables

SYNOPSIS

```
#include <search.h>

ENTRY *hsearch (ENTRY item, ACTION action);

int hcreate (size_t nel);

void hdestroy (void);
```

DESCRIPTION

hsearch is a hash-table search routine generalized from Knuth (6.4) Algorithm D. It returns a pointer into a hash table indicating the location at which an entry can be found. The comparison function used by hsearch is strcmp [see string(3C)]. *item* is a structure of type ENTRY (defined in the search.h header file) containing two pointers: *item.key* points to the comparison key, and *item.data* points to any other data to be associated with that key. (Pointers to types other than void should be cast to pointer-to-void.) *action* is a member of an enumeration type ACTION (defined in search.h) indicating the disposition of the entry if it cannot be found in the table. ENTER indicates that the item should be inserted in the table at an appropriate point. Given a duplicate of an existing item, the new item is not entered and hsearch returns a pointer to the existing item. FIND indicates that no entry should be made. Unsuccessful resolution is indicated by the return of a null pointer.

hcreate allocates sufficient space for the table, and must be called before hsearch is used. *nel* is an estimate of the maximum number of entries that the table will contain. This number may be adjusted upward by the algorithm in order to obtain certain mathematically favorable circumstances.

hdestroy destroys the search table, and may be followed by another call to hcreate.

EXAMPLE

The following example will read in strings followed by two numbers and store them in a hash table, discarding duplicates. It will then read in strings and find the matching entry in the hash table and print it out.

```
#include <stdio.h>
#include <search.h>
#include <string.h>
#include <stdlib.h>

struct info {           /* this is the info stored in table */
     int age, room;     /* other than the key */
};

#define NUM_EMPL    5000    /* # of elements in search table */

main( )
{
     /* space to store strings */
```

```
        char string_space[NUM_EMPL*20];
        /* space to store employee info */
        struct info info_space[NUM_EMPL];
        /* next avail space in string_space */
        char *str_ptr = string_space;
        /* next avail space in info_space */
        struct info *info_ptr = info_space;
        ENTRY item, *found_item;
        /* name to look for in table */
        char name_to_find[30];
        int i = 0;

        /* create table */
        (void) hcreate(NUM_EMPL);
        while (scanf("%s%d%d", str_ptr, &info_ptr->age,
               &info_ptr->room) != EOF && i++ < NUM_EMPL) {
             /* put info in structure, and structure in item */
             item.key = str_ptr;
             item.data = (void *)info_ptr;
             str_ptr += strlen(str_ptr) + 1;
             info_ptr++;
             /* put item into table */
             (void) hsearch(item, ENTER);
        }

        /* access table */
        item.key = name_to_find;
        while (scanf("%s", item.key) != EOF) {
            if ((found_item = hsearch(item, FIND)) != NULL) {
             /* if item is in the table */
             (void)printf("found %s, age = %d, room = %d\n",
                  found_item->key,
                  ((struct info *)found_item->data)->age,
                  ((struct info *)found_item->data)->room);
            } else {
             (void)printf("no such employee %s\n",
                  name_to_find)
            }
        }
        return 0;
}
```

SEE ALSO

`bsearch`(3C), `lsearch`(3C), `malloc`(3C), `malloc`(3X), `string`(3C), `tsearch`(3C).

DIAGNOSTICS

`hsearch` returns a null pointer if either the action is `FIND` and the item could not be found or the action is `ENTER` and the table is full.

`hcreate` returns zero if it cannot allocate sufficient space for the table.

NOTES

`hsearch` and `hcreate` use `malloc`(3C) to allocate space.

Only one hash search table may be active at any given time.

NAME

insque, remque – insert/remove element from a queue

SYNOPSIS

```
include <search.h>

void insque(struct qelem *elem, struct qelem *pred);

void remque(struct qelem *elem);
```

DESCRIPTION

insque and remque manipulate queues built from doubly linked lists. Each element in the queue must be in the following form:

```
struct qelem {
      struct     qelem *q_forw;
      struct     qelem *q_back;
      char  q_data[];
};
```

insque inserts *elem* in a queue immediately after *pred*. remque removes an entry *elem* from a queue.

NAME

isnan, isnand, isnanf, finite, fpclass, unordered – determine type of floating-point number

SYNOPSIS

```
#include <ieeefp.h>

int isnand (double dsrc);

int isnanf (float fsrc);

int finite (double dsrc);

fpclass_t fpclass (double dsrc);

int unordered (double dsrc1, double dsrc2);

#include <math.h>

int isnan (double dsrc);
```

DESCRIPTION

isnan, isnand, and **isnanf** return true (1) if the argument *dsrc* or *fsrc* is a NaN; otherwise they return false (0). The functionalty of **isnan** is identical to that of **isnand**.

isnanf is implemented as a macro included in the **ieeefp.h** header file.

fpclass returns the class the *dsrc* belongs to. The 10 possible classes are as follows:

FP_SNAN	signaling NaN
FP_QNAN	quiet NaN
FP_NINF	negative infinity
FP_PINF	positive infinity
FP_NDENORM	negative denormalized non-zero
FP_PDENORM	positive denormalized non-zero
FP_NZERO	negative zero
FP_PZERO	positive zero
FP_NNORM	negative normalized non-zero
FP_PNORM	positive normalized non-zero

finite returns true (1) if the argument *dsrc* is neither infinity nor NaN; otherwise it returns false (0).

unordered returns true (1) if one of its two arguments is unordered with respect to the other argument. This is equivalent to reporting whether either argument is NaN. If neither of the arguments is NaN, false (0) is returned.

None of these routines generate any exception, even for signaling NaNs.

SEE ALSO

fpgetround(3C), **intro**(3M).

NAME

l3tol, ltol3 – convert between 3-byte integers and long integers

SYNOPSIS

```
#include <stdlib.h>

void l3tol (long *lp, const char *cp, int n);

void ltol3 (char *cp, const long *lp, int n);
```

DESCRIPTION

l3tol converts a list of *n* three-byte integers packed into a character string pointed to by *cp* into a list of long integers pointed to by *lp*.

ltol3 performs the reverse conversion from long integers (*lp*) to three-byte integers (*cp*).

These functions are useful for file-system maintenance where the block numbers are three bytes long.

SEE ALSO

fs(4).

NOTES

Because of possible differences in byte ordering, the numerical values of the long integers are machine-dependent.

NAME

localeconv – get numeric formatting information

SYNOPSIS

```
#include <locale.h>

struct lconv *localeconv (void);
```

DESCRIPTION

localeconv sets the components of an object with type struct lconv (defined in locale.h) with the values appropriate for the formatting of numeric quantities (monetary and otherwise) according to the rules of the current locale [see setlocale(3C)]. The definition of struct lconv is given below (the values for the fields in the C locale are given in comments):

```
char *decimal_point;       /* "." */
char *thousands_sep;       /* "" (zero length string) */
char *grouping;            /* "" */
char *int_curr_symbol;     /* "" */
char *currency_symbol;     /* "" */
char *mon_decimal_point;   /* "" */
char *mon_thousands_sep;   /* "" */
char *mon_grouping;        /* "" */
char *positive_sign;       /* "" */
char *negative_sign;       /* "" */
char int_frac_digits;      /* CHAR_MAX */
char frac_digits;          /* CHAR_MAX */
char p_cs_precedes;        /* CHAR_MAX */
char p_sep_by_space;       /* CHAR_MAX */
char n_cs_precedes;        /* CHAR_MAX */
char n_sep_by_space;       /* CHAR_MAX */
char p_sign_posn;          /* CHAR_MAX */
char n_sign_posn;          /* CHAR_MAX */
```

The members of the structure with type char * are strings, any of which (except decimal_point) can point to "", to indicate that the value is not available in the current locale or is of zero length. The members with type char are nonnegative numbers, any of which can be CHAR_MAX (defined in the limits.h header file) to indicate that the value is not available in the current locale. The members are the following:

char *decimal_point
: The decimal-point character used to format non-monetary quantities.

char *thousands_sep
: The character used to separate groups of digits to the left of the decimal-point character in formatted non-monetary quantities.

char *grouping
: A string in which each element is taken as an integer that indicates the number of digits that comprise the current group in a formatted non-monetary quantity. The elements of grouping are interpreted according to the following:

CHAR-MAX	No further grouping is to be performed.
0	The previous element is to be repeatedly used for the remainder of the digits.
other	The value is the number of digits that comprise the current group. The next element is examined to determine the size of the next group of digits to the left of the current group.

`char *int_curr_symbol`
The international currency symbol applicable to the current locale, left-justified within a four-character space-padded field. The character sequences should match with those specified in: *ISO 4217 Codes for the Representation of Currency and Funds.*

`char *currency_symbol`
The local currency symbol applicable to the current locale.

`char *mon_decimal_point`
The decimal point used to format monetary quantities.

`char *mon_thousands_sep`
The separator for groups of digits to the left of the decimal point in formatted monetary quantities.

`char *mon_grouping`
A string in which each element is taken as an integer that indicates the number of digits that comprise the current group in a formatted monetary quantity. The elements of `mon_grouping` are interpreted according to the rules described under `grouping`.

`char *positive_sign`
The string used to indicate a nonnegative-valued formatted monetary quantity.

`char *negative_sign`
The string used to indicate a negative-valued formatted monetary quantity.

`char int_frac_digits`
The number of fractional digits (those to the right of the decimal point) to be displayed in an internationally formatted monetary quantity.

`char frac_digits`
The number of fractional digits (those to the right of the decimal point) to be displayed in a formatted monetary quantity.

`char p_cs_precedes`
Set to 1 or 0 if the `currency_symbol` respectively precedes or succeeds the value for a nonnegative formatted monetary quantity.

`char p_sep_by_space`
Set to 1 or 0 if the `currency_symbol` respectively is or is not separated by a space from the value for a nonnegative formatted monetary quantity.

char n_cs_precedes
Set to 1 or 0 if the currency_symbol respectively precedes or succeeds the value for a negative formatted monetary quantity.

char n_sep_by_space
Set to 1 or 0 if the currency_symbol respectively is or is not separated by a space from the value for a negative formatted monetary quantity.

char p_sign_posn
Set to a value indicating the positioning of the positive_sign for a non-negative formatted monetary quantity. The value of p_sign_posn is interpreted according to the following:

0 Parentheses surround the quantity and currency_symbol.

1 The sign string precedes the quantity and currency_symbol.

2 The sign string succeeds the quantity and currency_symbol.

3 The sign string immediately precedes the currency_symbol.

4 The sign string immediately succeeds the currency_symbol.

char n_sign_posn
Set to a value indicating the positioning of the negative_sign for a negative formatted monetary quantity. The value of n_sign_posn is interpreted according to the rules described under p_sign_posn.

EXAMPLES

The following table illustrates the rules used by four countries to format monetary quantities.

Country	Positive format	Negative format	International format
Italy	L.1.234	-L.1.234	ITL.1.234
Netherlands	F 1.234,56	F -1.234,56	NLG 1.234,56
Norway	kr1.234,56	kr1.234,56-	NOK 1.234,56
Switzerland	SFrs.1,234.56	SFrs.1,234.56C	CHF 1,234.56

For these four countries, the respective values for the monetary members of the structure returned by localeconv are as follows:

	Italy	Netherlands	Norway	Switzerland
int_curr_symbol	"ITL."	"NLG "	"NOK "	"CHF "
currency_symbol	"L."	"F"	"kr"	"SFrs."
mon_decimal_point	""	","	","	"."
mon_thousands_sep	"."	"."	"."	","
mon_grouping	"\3"	"\3"	"\3"	"\3"
positive_sign	""	""	""	""
negative_sign	"-"	"-"	"-"	"C"
int_frac_digits	0	2	2	2
frac_digits	0	2	2	2
p_cs_precedes	1	1	1	1
p_sep_by_space	0	1	0	0
n_cs_precedes	1	1	1	1

n_sep_by_space	0	1	0	0
p_sign_posn	1	1	1	1
n_sign_posn	1	4	2	2

FILES

/usr/lib/locale/*locale*/LC_MONETARY LC_MONETARY database for *locale*
/usr/lib/locale/*locale*/LC_NUMERIC LC_NUMERIC database for *locale*

SEE ALSO

chrtbl(1M), montbl(1M), setlocale(3C).

DIAGNOSTICS

localeconv returns a pointer to the filled-in object. The structure pointed to by the return value may be overwritten by a subsequent call to localeconv.

NAME

`lockf` – record locking on files

SYNOPSIS

```
#include <unistd.h>

int lockf (int fildes, int function, long size);
```

DESCRIPTION

`lockf` allows sections of a file to be locked; advisory or mandatory write locks depending on the mode bits of the file [see chmod(2)]. Locking calls from other processes that attempt to lock the locked file section will either return an error value or be put to sleep until the resource becomes unlocked. All the locks for a process are removed when the process terminates. [See `fcntl`(2) for more information about record locking.]

fildes is an open file descriptor. The file descriptor must have `O_WRONLY` or `O_RDWR` permission in order to establish locks with this function call.

function is a control value that specifies the action to be taken. The permissible values for *function* are defined in `unistd.h` as follows:

```
#define   F_ULOCK    0   /* unlock previously locked section */
#define   F_LOCK     1   /* lock section for exclusive use */
#define   F_TLOCK    2   /* test & lock section for exclusive use */
#define   F_TEST     3   /* test section for other locks */
```

All other values of *function* are reserved for future extensions and will result in an error return if not implemented.

`F_TEST` is used to detect if a lock by another process is present on the specified section. `F_LOCK` and `F_TLOCK` both lock a section of a file if the section is available. `F_ULOCK` removes locks from a section of the file.

size is the number of contiguous bytes to be locked or unlocked. The resource to be locked or unlocked starts at the current offset in the file and extends forward for a positive size and backward for a negative size (the preceding bytes up to but not including the current offset). If *size* is zero, the section from the current offset through the largest file offset is locked (i.e., from the current offset through the present or any future end-of-file). An area need not be allocated to the file in order to be locked as such locks may exist past the end-of-file.

The sections locked with `F_LOCK` or `F_TLOCK` may, in whole or in part, contain or be contained by a previously locked section for the same process. Locked sections will be unlocked starting at the the point of the offset through *size* bytes or to the end of file if *size* is (`off_t`) 0. When this situation occurs, or if this situation occurs in adjacent sections, the sections are combined into a single section. If the request requires that a new element be added to the table of active locks and this table is already full, an error is returned, and the new section is not locked.

`F_LOCK` and `F_TLOCK` requests differ only by the action taken if the resource is not available. `F_LOCK` will cause the calling process to sleep until the resource is available. `F_TLOCK` will cause the function to return a −1 and set `errno` to `EACCES` if the section is already locked by another process.

F_ULOCK requests may, in whole or in part, release one or more locked sections controlled by the process. When sections are not fully released, the remaining sections are still locked by the process. Releasing the center section of a locked section requires an additional element in the table of active locks. If this table is full, an errno is set to ENOLK and the requested section is not released.

A potential for deadlock occurs if a process controlling a locked resource is put to sleep by requesting another process's locked resource. Thus calls to lockf or fcntl scan for a deadlock prior to sleeping on a locked resource. An error return is made if sleeping on the locked resource would cause a deadlock.

Sleeping on a resource is interrupted with any signal. The alarm system call may be used to provide a timeout facility in applications that require this facility.

lockf will fail if one or more of the following are true:

EBADF *fildes* is not a valid open descriptor.

EAGAIN *cmd* is F_TLOCK or F_TEST and the section is already locked by another process.

EDEADLK *cmd* is F_LOCK and a deadlock would occur.

ENOLK *cmd* is F_LOCK, F_TLOCK, or F_ULOCK and the number of entries in the lock table would exceed the number allocated on the system.

ECOMM *fildes* is on a remote machine and the link to that machine is no longer active.

SEE ALSO

intro(2), alarm(2), chmod(2), close(2), creat(2), fcntl(2), open(2), read(2), write(2).

DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and errno is set to indicate the error.

NOTES

Unexpected results may occur in processes that do buffering in the user address space. The process may later read/write data that is/was locked. The standard I/O package is the most common source of unexpected buffering.

Because in the future the variable errno will be set to EAGAIN rather than EACCES when a section of a file is already locked by another process, portable application programs should expect and test for either value.

NAME

lsearch, lfind – linear search and update

SYNOPSIS

```
#include <search.h>

void *lsearch (const void *key, void * base, size_t *nelp,
    size_t width, int (*compar) (const void *, const void *));

void *lfind (const void *key, const void *base, size_t *nelp,
    size_t width, int (*compar)(const void *, const void *));
```

DESCRIPTION

`lsearch` is a linear search routine generalized from Knuth (6.1) Algorithm S. It returns a pointer into a table indicating where a datum may be found. If the datum does not occur, it is added at the end of the table. *key* points to the datum to be sought in the table. *base* points to the first element in the table. *nelp* points to an integer containing the current number of elements in the table. The integer is incremented if the datum is added to the table. *width* is the size of an element in bytes. *compar* is a pointer to the comparison function that the user must supply (`strcmp`, for example). It is called with two arguments that point to the elements being compared. The function must return zero if the elements are equal and non-zero otherwise.

`lfind` is the same as `lsearch` except that if the datum is not found, it is not added to the table. Instead, a null pointer is returned.

NOTES

The pointers to the key and the element at the base of the table may be pointers to any type.

The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

The value returned should be cast into type pointer-to-element.

EXAMPLE

This program will read in less than `TABSIZE` strings of length less than `ELSIZE` and store them in a table, eliminating duplicates, and then will print each entry.

```
#include <search.h>
#include <string.h>
#include <stdlib.h>
#include <stdio.h>

#define TABSIZE 50
#define ELSIZE 120

main()
{
        char line[ELSIZE];      /* buffer to hold input string */
        char tab[TABSIZE][ELSIZE]; /* table of strings */
        size_t nel = 0;         /* number of entries in tab */
        int i;
```

```
                while (fgets(line, ELSIZE, stdin) != NULL &&
                     nel < TABSIZE)
                     (void) lsearch(line, tab, &nel, ELSIZE, mycmp);
                for( i = 0; i < nel; i++ )
                     (void)fputs(tab[i], stdout);
                return 0;
        }
```

SEE ALSO

bsearch(3C), hsearch(3C), string(3C), tsearch(3C).

NOTES

If the searched-for datum is found, both `lsearch` and `lfind` return a pointer to it. Otherwise, `lfind` returns `NULL` and `lsearch` returns a pointer to the newly added element.

Undefined results can occur if there is not enough room in the table to add a new item.

NAME

malloc, free, realloc, calloc – memory allocator

SYNOPSIS

```
#include <stdlib.h>

void *malloc (size_t size);

void free (void *ptr);

void *realloc (void *ptr, size_t size);

void *calloc (size_t nelem, size_t elsize);
```

DESCRIPTION

malloc and free provide a simple general-purpose memory allocation package. malloc returns a pointer to a block of at least *size* bytes suitably aligned for any use.

The argument to free is a pointer to a block previously allocated by malloc, calloc or realloc. After free is performed this space is made available for further allocation. If *ptr* is a NULL pointer, no action occurs.

Undefined results will occur if the space assigned by malloc is overrun or if some random number is handed to free.

realloc changes the size of the block pointed to by *ptr* to *size* bytes and returns a pointer to the (possibly moved) block. The contents will be unchanged up to the lesser of the new and old sizes. If *ptr* is NULL, realloc behaves like malloc for the specified size. If *size* is zero and *ptr* is not a null pointer, the object pointed to is freed.

calloc allocates space for an array of *nelem* elements of size *elsize*. The space is initialized to zeros.

Each of the allocation routines returns a pointer to space suitably aligned (after possible pointer coercion) for storage of any type of object.

malloc, realloc, and calloc will fail if there is not enough available memory.

SEE ALSO

malloc(3X).

DIAGNOSTICS

If there is no available memory, malloc, realloc, and calloc return a null pointer. When realloc returns NULL, the block pointed to by *ptr* is left intact. If *size, nelem* or *elsize* is 0, a unique pointer to the arena is returned.

NAME

mbchar: mbtowc, mblen, wctomb – multibyte character handling

SYNOPSIS

```
#include <stdlib.h>

int mbtowc (wchar_t *pwc, const char *s, size_t n);

int mblen (const char *s, size_t n);

int wctomb (char *s, wchar_t wchar);
```

DESCRIPTION

Multibyte characters are used to represent characters in an extended character set. This is needed for locales where 8 bits are not enough to represent all the characters in the character set.

The multibyte character handling functions provide the means of translating multibyte characters into wide characters and back again. Wide characters have type wchar_t (defined in stdlib.h), which is an integral type whose range of values can represent distinct codes for all members of the largest extended character set specified among the supported locales.

A maximum of 3 extended character sets are supported for each locale. The number of bytes in an extended character set is defined by the LC_CTYPE category of the locale [see setlocale(3C)]. However, the maximum number of bytes in any multibyte character will never be greater than MB_LEN_MAX (see stdlib.h). The maximum number of bytes in a character in an extended character set in the current locale is given by the macro MB_CUR_MAX (see stdlib.h).

mbtowc determines the number of bytes that comprise the multibyte character pointed to by *s*. Also, if *pwc* is not a null pointer, mbtowc converts the multibyte character to a wide character and places the result in the object pointed to by *pwc*. (The value of the wide character corresponding to the null character is zero.) At most *n* characters will be examined, starting at the character pointed to by *s*.

If *s* is a null pointer, mbtowc simply returns 0. If *s* is not a null pointer, then, if *s* points to the null character, mbtowc returns 0; if the next *n* or fewer bytes form a valid multibyte character, mbtowc returns the number of bytes that comprise the converted multibyte character; otherwise, *s* does not point to a valid multibyte character and mbtowc returns −1.

mblen determines the number of bytes comprising the multibyte character pointed to by *s*. It is equivalent to

```
mbtowc ((wchar_t *)0, s, n);
```

wctomb determines the number of bytes needed to represent the multibyte character corresponding to the code whose value is *wchar*, and, if *s* is not a null pointer, stores the multibyte character representation in the array pointed to by *s*. At most MB_CUR_MAX characters are stored.

If *s* is a null pointer, `wctomb` simply returns 0. If *s* is not a null pointer, `wctomb` returns -1 if the value of *wchar* does not correspond to a valid multibyte character; otherwise it returns the number of bytes that comprise the multibyte character corresponding to the value of *wchar*.

SEE ALSO

`chrtbl`(1M), `mbstring`(3C), `setlocale`(3C), `environ`(5).

NAME

mbstring: mbstowcs, wcstombs – multibyte string functions

SYNOPSIS

```
#include <stdlib.h>

size_t mbstowcs (wchar_t *pwcs, const char *s, size_t n);

size_t wcstombs (char *s, const wchar_t *pwcs, size_t n);
```

DESCRIPTION

mbstowcs converts a sequence of multibyte characters from the array pointed to by *s* into a sequence of corresponding wide character codes and stores these codes into the array pointed to by *pwcs*, stopping after *n* codes are stored or a code with value zero (a converted null character) is stored. If an invalid multibyte character is encountered, **mbstowcs** returns (size_t)−1. Otherwise, **mbstowcs** returns the number of array elements modified, not including the terminating zero code, if any.

wcstombs converts a sequence of wide character codes from the array pointed to by *pwcs* into a sequence of multibyte characters and stores these multibyte characters into the array pointed to by *s*, stopping if a multibyte character would exceed the limit of *n* total bytes or if a null character is stored. If a wide character code is encountered that does not correspond to a valid multibyte character, **wcstombs** returns (size_t)−1. Otherwise, **wcstombs** returns the number of bytes modified, not including a terminating null character, if any.

SEE ALSO

chrtbl(1M), mbchar(3C), setlocale(3C), environ(5).

NAME

memory: memccpy, memchr, memcmp, memcpy, memmove, memset – memory operations

SYNOPSIS

```
#include <string.h>

void *memccpy (void *s1, const void *s2, int c, size_t n);

void *memchr (const void *s, int c, size_t n);

int memcmp (const void *s1, const void *s2, size_t n);

void *memcpy (void *s1, const void *s2, size_t n);

void *memmove (void *s1, const void *s2, size_t n);

void *memset (void *s, int c, size_t n);
```

DESCRIPTION

These functions operate as efficiently as possible on memory areas (arrays of bytes bounded by a count, not terminated by a null character). They do not check for the overflow of any receiving memory area.

memccpy copies bytes from memory area *s2* into *s1*, stopping after the first occurrence of *c* (converted to an `unsigned char`) has been copied, or after *n* bytes have been copied, whichever comes first. It returns a pointer to the byte after the copy of *c* in *s1*, or a null pointer if *c* was not found in the first *n* bytes of *s2*.

memchr returns a pointer to the first occurrence of *c* (converted to an `unsigned char`) in the first *n* bytes (each interpreted as an `unsigned char`) of memory area *s*, or a null pointer if *c* does not occur.

memcmp compares its arguments, looking at the first *n* bytes (each interpreted as an `unsigned char`), and returns an integer less than, equal to, or greater than 0, according as *s1* is lexicographically less than, equal to, or greater than *s2* when taken to be unsigned characters.

memcpy copies *n* bytes from memory area *s2* to *s1*. It returns *s1*.

memmove copies *n* bytes from memory areas *s2* to *s1*. Copying between objects that overlap will take place correctly. It returns *s1*.

memset sets the first *n* bytes in memory area *s* to the value of *c* (converted to an `unsigned char`). It returns *s*.

SEE ALSO

`string`(3C).

NAME

mkfifo − create a new FIFO

SYNOPSIS

```
#include <sys/types.h>
#include <sys/stat.h>

int mkfifo (const char *path, mode_t mode);
```

DESCRIPTION

The mkfifo routine creates a new FIFO special file named by the pathname pointed to by *path*. The mode of the new FIFO is initialized from *mode*. The file permission bits of the *mode* argument are modified by the process's file creation mask [see umask(2)].

The FIFO's owner id is set to the process's effective user id. The FIFO's group id is set to the process's effective group id, or if the S_ISGID bit is set in the parent directory then the group id of the FIFO is inherited from the parent.

mkfifo calls the system call mknod to make the file.

SEE ALSO

chmod(2), exec(2), mknod(2), umask(2), fs(4), stat(5).
mkdir(1) in the *User's Reference Manual*.

DIAGNOSTICS

Upon successful completion a value of 0 is returned. Otherwise, a value of −1 is returned and errno is set to indicate the error.

NOTES

Bits other than the file permission bits in *mode* are ignored.

NAME

mktemp − make a unique file name

SYNOPSIS

```
#include <stdlib.h>

char *mktemp(char *template);
```

DESCRIPTION

mktemp replaces the contents of the string pointed to by *template* with a unique file name, and returns *template*. The string in *template* should look like a file name with six trailing Xs; mktemp will replace the Xs with a character string that can be used to create a unique file name.

SEE ALSO

tmpfile(3S), tmpnam(3S).

DIAGNOSTIC

mktemp will assign to *template* the empty string if it cannot create a unique name.

NOTES

mktemp can create only 26 unique file names per process for each unique *template*.

NAME

mktime – converts a tm structure to a calendar time

SYNOPSIS

```
#include <time.h>

time_t mktime (struct tm *timeptr);
```

DESCRIPTION

mktime converts the time represented by the tm structure pointed to by *timeptr* into a calendar time (the number of seconds since 00:00:00 UTC, January 1, 1970).

The tm structure has the following format.

```
struct     tm {
      int  tm_sec;     /* seconds after the minute [0, 61]  */
      int  tm_min;     /* minutes after the hour [0, 59] */
      int  tm_hour;    /* hour since midnight [0, 23] */
      int  tm_mday;    /* day of the month [1, 31] */
      int  tm_mon;     /* months since January [0, 11] */
      int  tm_year;    /* years since 1900 */
      int  tm_wday;    /* days since Sunday [0, 6] */
      int  tm_yday;    /* days since January 1 [0, 365] */
      int  tm_isdst;   /* flag for daylight savings time */
};
```

In addition to computing the calendar time, mktime normalizes the supplied tm structure. The original values of the tm_wday and tm_yday components of the structure are ignored, and the original values of the other components are not restricted to the ranges indicated in the definition of the structure. On successful completion, the values of the tm_wday and tm_yday components are set appropriately, and the other components are set to represent the specified calendar time, but with their values forced to be within the appropriate ranges. The final value of tm_mday is not set until tm_mon and tm_year are determined.

The original values of the components may be either greater than or less than the specified range. For example, a tm_hour of –1 means 1 hour before midnight, tm_mday of 0 means the day preceding the current month, and tm_mon of –2 means 2 months before January of tm_year.

If tm_isdst is positive, the original values are assumed to be in the alternate timezone. If it turns out that the alternate timezone is not valid for the computed calendar time, then the components are adjusted to the main timezone. Likewise, if tm_isdst is zero, the original values are assumed to be in the main timezone and are converted to the alternate timezone if the main timezone is not valid. If tm_isdst is negative, the correct timezone is determined and the components are not adjusted.

Local timezone information is used as if mktime had called tzset.

mktime returns the specified calendar time. If the calendar time cannot be represented, the function returns the value (time_t)–1.

EXAMPLE

What day of the week is July 4, 2001?

```
#include <stdio.h>
#include <time.h>

static char *const wday[] = {
      "Sunday", "Monday", "Tuesday", "Wednesday",
      "Thursday", "Friday", "Saturday", "-unknown-"
};
struct tm time_str;
/*...*/
time_str.tm_year= 2001 - 1900;
time_str.tm_mon = 7 - 1;
time_str.tm_mday= 4;
time_str.tm_hour= 0;
time_str.tm_min = 0;
time_str.tm_sec      = 1;
time_str.tm_isdst    = -1;
if (mktime(&time_str)== -1)
    time_str.tm_wday=7;
printf("%s\n", wday[time_str.tm_wday]);
```

SEE ALSO

ctime(3C), getenv(3C), timezone(4).

NOTES

tm_year of the tm structure must be for year 1970 or later. Calendar times before 00:00:00 UTC, January 1, 1970 or after 03:14:07 UTC, January 19, 2038 cannot be represented.

NAME

monitor – prepare execution profile

SYNOPSIS

```
#include <mon.h>

void monitor (int (*lowpc)(), int (*highpc)(), WORD *buffer,
    size_t bufsize, size_t nfunc);
```

DESCRIPTION

monitor is an interface to profil, and is called automatically with default parameters by any program created by cc -p. Except to establish further control over profiling activity, it is not necessary to explicitly call monitor.

When used, monitor is called at least at the beginning and the end of a program. The first call to monitor initiates the recording of two different kinds of execution-profile information: execution-time distribution and function call count. Execution-time distribution data is generated by profil and the function call counts are generated by code supplied to the object file (or files) by cc -p. Both types of information are collected as a program executes. The last call to monitor writes this collected data to the output file mon.out.

lowpc and *highpc* are the beginning and ending addresses of the region to be profiled.

buffer is the address of a user-supplied array of WORD (WORD is defined in the header file mon.h). *buffer* is used by monitor to store the histogram generated by profil and the call counts.

bufsize identifies the number of array elements in *buffer*.

nfunc is the number of call count cells that have been reserved in *buffer*. Additional call count cells will be allocated automatically as they are needed.

bufsize should be computed using the following formula:

```
size_of_buffer =
        sizeof(struct hdr) +
        nfunc * sizeof(struct cnt) +
        ((highpc-lowpc)/BARSIZE) * sizeof(WORD) +
        sizeof(WORD) - 1 ;

bufsize = (size_of_buffer / sizeof(WORD)) ;
```

where:

lowpc, highpc, nfunc are the same as the arguments to monitor;

BARSIZE is the number of program bytes that correspond to each histogram bar, or cell, of the profil buffer;

the hdr and cnt structures and the type WORD are defined in the header file mon.h.

The default call to `monitor` is shown below:

```
monitor (&eprol, &etext, wbuf, wbufsz, 600);
```

where:

`eprol` is the beginning of the user's program when linked with `cc -p` [see end(3C)];

`etext` is the end of the user's program [see end(3C)];

wbuf is an array of `WORD` with *wbufsz* elements;

wbufsz is computed using the *bufsize* formula shown above with *BARSIZE* of 8;

600 is the number of call count cells that have been reserved in *buffer*.

These parameter settings establish the computation of an execution-time distribution histogram that uses `profil` for the entire program, initially reserves room for 600 call count cells in *buffer*, and provides for enough histogram cells to generate significant distribution-measurement results. [For more information on the effects of *bufsize* on execution-distribution measurements, see `profil`(2).]

To stop execution monitoring and write the results to a file, use the following:

```
monitor((int (*)())0, (int (*)())0, (WORD *)0, 0, 0);
```

Use `prof` to examine the results.

FILES

`mon.out`

SEE ALSO

cc(1), `prof`(1), `profil`(2), end(3C).

NOTE

Additional calls to `monitor` after `main` has been called and before `exit` has been called will add to the function-call count capacity, but such calls will also replace and restart the `profil` histogram computation.

The name of the file written by `monitor` is controlled by the environment variable `PROFDIR`. If `PROFDIR` does not exist, the file `mon.out` is created in the current directory. If `PROFDIR` exists but has no value, `monitor` does no profiling and creates no output file. If `PROFDIR` is *dirname*, and `monitor` is called automatically by compilation with `cc -p`, the file created is *dirname/pid.progname* where *progname* is the name of the program.

NAME

`offsetof` – offset of structure member

SYNOPSIS

```
#include <stddef.h>

size_t offsetof (type, member-designator);
```

DESCRIPTION

`offsetof` is a macro defined in `stddef.h` which expands to an integral constant expression that has type `size_t`, the value of which is the offset in bytes, to the structure member (designated by *member-designator*), from the beginning of its structure (designated by *type*).

NAME

perror – print system error messages

SYNOPSIS

```
#include <stdio.h>

void perror (const char *s);
```

DESCRIPTION

perror produces a message on the standard error output (file descriptor 2), describing the last error encountered during a call to a system or library function. The argument string *s* is printed first, then a colon and a blank, then the message and a newline. (However, if *s* is a null pointer or points to a null string, the colon is not printed.) To be of most use, the argument string should include the name of the program that incurred the error. The error number is taken from the external variable errno, which is set when errors occur but not cleared when non-erroneous calls are made.

SEE ALSO

intro(2), fmtmsg(3C), strerror(3C).

NAME

popen, pclose – initiate pipe to/from a process

SYNOPSIS

```
#include <stdio.h>

FILE *popen (const char *command, const char *type);

int pclose (FILE *stream);
```

DESCRIPTION

popen creates a pipe between the calling program and the command to be executed. The arguments to popen are pointers to null-terminated strings. *command* consists of a shell command line. *type* is an I/O mode, either r for reading or w for writing. The value returned is a stream pointer such that one can write to the standard input of the command, if the I/O mode is w, by writing to the file *stream* [see intro(3)]; and one can read from the standard output of the command, if the I/O mode is r, by reading from the file *stream*.

A stream opened by popen should be closed by pclose, which waits for the associated process to terminate and returns the exit status of the command.

Because open files are shared, a type r command may be used as an input filter and a type w as an output filter.

EXAMPLE

Here is an example of a typical call:

```
#include <stdio.h>
#include <stdlib.h>

main()
{
        char *cmd = "/usr/bin/ls *.c";
        char buf[BUFSIZ];
        FILE *ptr;

        if ((ptr = popen(cmd, "r")) != NULL)
                while (fgets(buf, BUFSIZ, ptr) != NULL)
                        (void) printf("%s", buf);
        return 0;
}
```

This program will print on the standard output [see stdio(3S)] all the file names in the current directory that have a .c suffix.

SEE ALSO

pipe(2), wait(2), fclose(3S), fopen(3S), stdio(3S), system(3S).

DIAGNOSTICS

popen returns a null pointer if files or processes cannot be created.

pclose returns −1 if *stream* is not associated with a popened command.

NOTES

If the original and popened processes concurrently read or write a common file, neither should use buffered I/O. Problems with an output filter may be forestalled by careful buffer flushing, e.g., with **fflush** [see **fclose**(3S)].

A security hole exists through the **IFS** and **PATH** environment variables. Full pathnames should be used (or **PATH** reset) and **IFS** should be set to space and tab (" \t").

NAME

printf, fprintf, sprintf – print formatted output

SYNOPSIS

```
#include <stdio.h>

int printf(const char *format, .../* args */);

int fprintf(FILE *strm, const char *format, .../* args */);

int sprintf(char *s, const char *format, .../* args */);
```

DESCRIPTION

`printf` places output on the standard output stream `stdout`.

`fprintf` places output on *strm*.

`sprintf` places output, followed by the null character (\0), in consecutive bytes starting at *s*. It is the user's responsibility to ensure that enough storage is available. Each function returns the number of characters transmitted (not including the \0 in the case of `sprintf`) or a negative value if an output error was encountered.

Each of these functions converts, formats, and prints its *args* under control of the *format*. The *format* is a character string that contains three types of objects defined below:

1. plain characters that are simply copied to the output stream;
2. escape sequences that represent non-graphic characters;
3. conversion specifications.

The following escape sequences produce the associated action on display devices capable of the action:

`\a` Alert. Ring the bell.

`\b` Backspace. Move the printing position to one character before the current position, unless the current position is the start of a line.

`\f` Form feed. Move the printing position to the initial printing position of the next logical page.

`\n` Newline. Move the printing position to the start of the next line.

`\r` Carriage return. Move the printing position to the start of the current line.

`\t` Horizontal tab. Move the printing position to the next implementation-defined horizontal tab position on the current line.

`\v` Vertical tab. Move the printing position to the start of the next implementation-defined vertical tab position.

All forms of the `printf` functions allow for the insertion of a language-dependent decimal-point character. The decimal-point character is defined by the program's locale (category `LC_NUMERIC`). In the `C` locale, or in a locale where the decimal-point character is not defined, the decimal-point character defaults to a period (`.`).

Each conversion specification is introduced by the character `%`. After the character `%`, the following appear in sequence:

An optional field, consisting of a decimal digit string followed by a `$`, specifying the next *args* to be converted. If this field is not provided, the *args* following the last *args* converted will be used.

Zero or more *flags*, which modify the meaning of the conversion specification.

An optional string of decimal digits to specify a minimum *field width*. If the converted value has fewer characters than the field width, it will be padded on the left (or right, if the left-adjustment flag (–), described below, has been given) to the field width.

An optional precision that gives the minimum number of digits to appear for the `d`, `i`, `o`, `u`, `x`, or `X` conversions (the field is padded with leading zeros), the number of digits to appear after the decimal-point character for the `e`, `E`, and `f` conversions, the maximum number of significant digits for the `g` and `G` conversions, or the maximum number of characters to be printed from a string in `s` conversion. The precision takes the form of a period (`.`) followed by a decimal digit string; a null digit string is treated as zero. Padding specified by the precision overrides the padding specified by the field width.

An optional `h` specifies that a following `d`, `i`, `o`, `u`, `x`, or `X` conversion specifier applies to a `short int` or `unsigned short int` argument (the argument will be promoted according to the integral promotions and its value converted to `short int` or `unsigned short int` before printing); an optional `h` specifies that a following `n` conversion specifier applies to a pointer to a `short int` argument. An optional `l` (ell) specifies that a following `d`, `i`, `o`, `u`, `x`, or `X` conversion specifier applies to a `long int` or `unsigned long int` argument; an optional `l` (ell) specifies that a following `n` conversion specifier applies to a pointer to `long int` argument. An optional `L` specifies that a following `e`, `E`, `f`, `g`, or `G` conversion specifier applies to a `long double` argument. If an `h`, `l`, or `L` appears before any other conversion specifier, the behavior is undefined.

A conversion character (see below) that indicates the type of conversion to be applied.

A field width or precision may be indicated by an asterisk (`*`) instead of a digit string. In this case, an integer *args* supplies the field width or precision. The *args* that is actually converted is not fetched until the conversion letter is seen, so the *args* specifying field width or precision must appear before the *args* (if any) to be converted. If the *precision* argument is negative, it will be changed to zero. A negative field width argument is taken as a – flag, followed by a positive field width.

In format strings containing the **digits$* form of a conversion specification, a field width or precision may also be indicated by the sequence **digits$*, giving the position in the argument list of an integer *args* containing the field width or precision.

When numbered argument specifications are used, specifying the *N*th argument requires that all the leading arguments, from the first to the (*N*−1)th, be specified in the format string.

The *flag* characters and their meanings are:

– The result of the conversion will be left-justified within the field. (It will be right-justified if this flag is not specified.)

+ The result of a signed conversion will always begin with a sign (+ or −). (It will begin with a sign only when a negative value is converted if this flag is not specified.)

space If the first character of a signed conversion is not a sign, a space will be placed before the result. This means that if the space and + flags both appear, the space flag will be ignored.

The value is to be converted to an alternate form. For `c`, `d`, `i`, `s`, and `u` conversions, the flag has no effect. For an `o` conversion, it increases the precision to force the first digit of the result to be a zero. For `x` (or `X`) conversion, a non-zero result will have `0x` (or `0X`) prepended to it. For `e`, `E`, `f`, `g`, and `G` conversions, the result will always contain a decimal-point character, even if no digits follow the point (normally, a decimal point appears in the result of these conversions only if a digit follows it). For `g` and `G` conversions, trailing zeros will not be removed from the result as they normally are.

0 For `d`, `i`, `o`, `u`, `x`, `X`, `e`, `E`, `f`, `g`, and `G` conversions, leading zeros (following any indication of sign or base) are used to pad to the field width; no space padding is performed. If the 0 and – flags both appear, the 0 flag will be ignored. For `d`, `i`, `o`, `u`, `x`, and `X` conversions, if a precision is specified, the 0 flag will be ignored. For other conversions, the behavior is undefined.

Each conversion character results in fetching zero or more *args*. The results are undefined if there are insufficient *args* for the format. If the format is exhausted while *args* remain, the excess *args* are ignored.

The conversion characters and their meanings are:

d,i,o,u,x,X The integer *arg* is converted to signed decimal (`d` or `i`), (unsigned octal (`o`), unsigned decimal (`u`), or unsigned hexadecimal notation (`x` and `X`). The `x` conversion uses the letters `abcdef` and the `X` conversion uses the letters `ABCDEF`. The precision specifies the minimum number of digits to appear. If the value being converted can be represented in fewer digits than the specified minimum, it will be expanded with leading zeros. The default precision is 1. The result of converting a zero value with a precision of zero is no characters.

`f` The double *args* is converted to decimal notation in the style `[-]`*ddd*`.`*ddd*, where the number of digits after the decimal-point character [see `setlocale`(3C)] is equal to the precision specification. If the precision is omitted from *arg*, six digits are output; if the precision is explicitly zero and the # flag is not specified, no decimal-point character appears. If a decimal-point character appears, at least 1 digit appears before it. The value is rounded to the appropriate number of digits.

e,E The double *args* is converted to the style `[-]`*d*`.`*ddd*e±*dd*, where there is one digit before the decimal-point character (which is non-zero if the argument is non-zero) and the number of digits after it is equal to the precision. When the precision is missing, six digits are produced; if the precision is zero and the # flag is not specified, no decimal-point character appears. The `E` conversion character will produce a number with `E` instead of `e` introducing the exponent. The exponent always contains at least two digits. The value is rounded to the appropriate number of digits.

g,G The double *args* is printed in style `f` or `e` (or in style `E` in the case of a `G` conversion character), with the precision specifying the number of significant digits. If the precision is zero, it is taken as one. The style used depends on the value converted: style `e` (or `E`) will be used only if the exponent resulting from the conversion is less than -4 or greater than or equal to the precision. Trailing zeros are removed from the fractional part of the result. A decimal-point character appears only if it is followed by a digit.

c The `int` *args* is converted to an `unsigned char`, and the resulting character is printed.

s The *args* is taken to be a string (character pointer) and characters from the string are written up to (but not including) a terminating null character; if the precision is specified, no more than that many characters are written. If the precision is not specified, it is taken to be infinite, so all characters up to the first null character are printed. A `NULL` value for *args* will yield undefined results.

p The *args* should be a pointer to `void`. The value of the pointer is converted to an implementation-defined set of sequences of printable characters, which should be the same as the set of sequences that are matched by the `%p` conversion of the `scanf` function.

n The argument should be a pointer to an integer into which is written the number of characters written to the output standard I/O stream so far by this call to `printf`, `fprintf`, or `sprintf`. No argument is converted.

% Print a `%`; no argument is converted.

If the character after the `%` or `%`*digits*`$` sequence is not a valid conversion character, the results of the conversion are undefined.

If a floating-point value is the internal representation for infinity, the output is [±]*inf*, where *inf* is either `inf` or `INF`, depending on the conversion character. Printing of the sign follows the rules described above.

If a floating-point value is the internal representation for "not-a-number," the output is [±]*nan*0*xm*. Depending on the conversion character, *nan* is either nan or NAN. Additionally, 0*xm* represents the most significant part of the mantissa. Again depending on the conversion character, *x* will be x or X, and *m* will use the letters abcdef or ABCDEF. Printing of the sign follows the rules described above.

In no case does a non-existent or small field width cause truncation of a field; if the result of a conversion is wider than the field width, the field is simply expanded to contain the conversion result. Characters generated by printf and fprintf are printed as if the putc routine had been called.

EXAMPLE

To print a date and time in the form Sunday, July 3, 10:02, where weekday and month are pointers to null-terminated strings:

```
printf("%s, %s %i, %d:%.2d",
        weekday, month, day, hour, min);
```

To print π to 5 decimal places:

```
printf("pi = %.5f", 4 * atan(1.0));
```

SEE ALSO

exit(2), lseek(2), write(2), abort(3C), ecvt(3C), putc(3S), scanf(3S), setlocale(3C), stdio(3S).

DIAGNOSTICS

printf, fprintf, and sprintf return the number of characters transmitted, or return a negative value if an error was encountered.

NAME

putc, putchar, fputc, putw – put character or word on a stream

SYNOPSIS

```
#include <stdio.h>

int putc (int c, FILE *stream);

int putchar (int c);

int fputc (int c, FILE *stream);

int putw (int w, FILE *stream);
```

DESCRIPTION

putc writes *c* (converted to an unsigned char) onto the output *stream* [see intro(3)] at the position where the file pointer (if defined) is pointing, and advances the file pointer appropriately. If the file cannot support positioning requests, or *stream* was opened with append mode, the character is appended to the output *stream*. putchar(c) is defined as putc(c, stdout). putc and putchar are macros.

fputc behaves like putc, but is a function rather than a macro. fputc runs more slowly than putc, but it takes less space per invocation and its name can be passed as an argument to a function.

putw writes the word (i.e., integer) *w* to the output *stream* (where the file pointer, if defined, is pointing). The size of a word is the size of an integer and varies from machine to machine. putw neither assumes nor causes special alignment in the file.

SEE ALSO

exit(2), lseek(2), write(2), abort(3C), fclose(3S), ferror(3S), fopen(3S), fread(3S), printf(3S), puts(3S), setbuf(3S), stdio(3S).

DIAGNOSTICS

On success, these functions (with the exception of putw) each return the value they have written. putw returns ferror (*stream*). On failure, they return the constant EOF. This result will occur, for example, if the file *stream* is not open for writing or if the output file cannot grow.

NOTES

Because it is implemented as a macro, putc evaluates a *stream* argument more than once. In particular, putc(c, *f++); doesn't work sensibly. fputc should be used instead.

Because of possible differences in word length and byte ordering, files written using putw are machine-dependent, and may not be read using getw on a different processor.

Functions exist for all the above defined macros. To get the function form, the macro name must be undefined (e.g., #undef putc).

NAME

putenv – change or add value to environment

SYNOPSIS

```
#include <stdlib.h>

int putenv (char *string);
```

DESCRIPTION

string points to a string of the form *"name=value."* **putenv** makes the value of the environment variable *name* equal to *value* by altering an existing variable or creating a new one. In either case, the string pointed to by *string* becomes part of the environment, so altering the string will change the environment. The space used by *string* is no longer used once a new string-defining *name* is passed to **putenv**. Because of this limitation, *string* should be declared static if it is declared within a function.

SEE ALSO

exec(2), **getenv**(3C), **malloc**(3C), **environ**(5).

DIAGNOSTICS

putenv returns non-zero if it was unable to obtain enough space via **malloc** for an expanded environment, otherwise zero.

NOTES

putenv manipulates the environment pointed to by *environ*, and can be used in conjunction with **getenv**. However, *envp* (the third argument to *main*) is not changed.

This routine uses **malloc**(3C) to enlarge the environment.

After **putenv** is called, environmental variables are not in alphabetical order. A potential error is to call the function **putenv** with a pointer to an automatic variable as the argument and to then exit the calling function while *string* is still part of the environment.

NAME

putpwent – write password file entry

SYNOPSIS

```
#include <pwd.h>

int putpwent (const struct passwd *p, FILE *f);
```

DESCRIPTION

putpwent is the inverse of getpwent(3C). Given a pointer to a passwd structure created by getpwent (or getpwuid or getpwnam), putpwent writes a line on the stream *f*, which matches the format of /etc/passwd.

SEE ALSO

getpwent(3C).

DIAGNOSTICS

putpwent returns non-zero if an error was detected during its operation, otherwise zero.

NAME

puts, fputs – put a string on a stream

SYNOPSIS

```
#include <stdio.h>

int puts (const char *s);

int fputs (const char *s, FILE *stream);
```

DESCRIPTION

puts writes the string pointed to by *s*, followed by a new-line character, to the standard output stream stdout [see intro(3)].

fputs writes the null-terminated string pointed to by *s* to the named output *stream*.

Neither function writes the terminating null character.

SEE ALSO

exit(2), lseek(2), write(2), abort(3C), fclose(3S), ferror(3S), fopen(3S), fread(3S), printf(3S), putc(3S), stdio(3S).

DIAGNOSTICS

On success both routines return the number of characters written; otherwise they return EOF.

NOTES

puts appends a new-line character while fputs does not.

NAME

qsort – quicker sort

SYNOPSIS

```
#include <stdlib.h>

void qsort (void* base, size_t nel, size_t width), int (*compar)
    (const void *, const void *));
```

DESCRIPTION

qsort is an implementation of the quicker-sort algorithm. It sorts a table of data in place. The contents of the table are sorted in ascending order according to the user-supplied comparison function.

base points to the element at the base of the table. *nel* is the number of elements in the table. *width* specifies the size of each element in bytes. *compar* is the name of the comparison function, which is called with two arguments that point to the elements being compared. The function must return an integer less than, equal to, or greater than zero to indicate if the first argument is to be considered less than, equal to, or greater than the second.

The contents of the table are sorted in ascending order according to the user supplied comparison function.

SEE ALSO

bsearch(3C), lsearch(3C), string(3C).
sort(1) in the *User's Reference Manual*.

NOTES

The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

The relative order in the output of two items that compare as equal is unpredictable.

NAME

`raise` – send signal to program

SYNOPSIS

```
#include <signal.h>

int raise (int sig);
```

DESCRIPTION

`raise` sends the signal *sig* to the executing program.

`raise` returns zero if the operation succeeds. Otherwise, `raise` returns −1 and *errno* is set to indicate the error. `raise` uses `kill` to send the signal to the executing program:

```
kill(getpid(), sig);
```

See `kill`(2) for a detailed list of failure conditions. See `signal`(2) for a list of signals.

SEE ALSO

`getpid`(2), `kill`(2), `signal`(2).

NAME

rand, srand – simple random-number generator

SYNOPSIS

```
#include <stdlib.h>

int rand (void);

void srand (unsigned int seed);
```

DESCRIPTION

rand uses a multiplicative congruential random-number generator with period 2^{32} that returns successive pseudo-random numbers in the range from 0 to RAND_MAX (defined in stdlib.h).

The function srand uses the argument *seed* as a seed for a new sequence of pseudo-random numbers to be returned by subsequent calls to the function rand. If the function srand is then called with the same *seed* value, the sequence of pseudo-random numbers will be repeated. If the function rand is called before any calls to srand have been made, the same sequence will be generated as when srand is first called with a *seed* value of 1.

NOTES

The spectral properties of rand are limited. drand48(3C) provides a much better, though more elaborate, random-number generator.

SEE ALSO

drand48(3C).

NAME

remove – remove file

SYNOPSIS

```
#include <stdio.h>

int remove(const char *path);
```

DESCRIPTION

remove causes the file or empty directory whose name is the string pointed to by *path* to be no longer accessible by that name. A subsequent attempt to open that file using that name will fail, unless the file is created anew.

For files, **remove** is identical to **unlink**. For directories, **remove** is identical to **rmdir**.

See **rmdir**(2) and **unlink**(2) for a detailed list of failure conditions.

SEE ALSO

rmdir(2), **unlink**(2).

RETURN VALUE

Upon successful completion, **remove** returns a value of 0; otherwise, it returns a value of –1 and sets **errno** to indicate an error.

NAME

`rename` – rename file

SYNOPSIS

```
#include <stdio.h>

int rename (const char *old, const char *new);
```

DESCRIPTION

rename causes the file whose name is the string pointed to by *old* to be known by the name given by the string pointed to by *new*. The file named *old* is no longer accessible by that name. If a file named by the string pointed to by *new* exists prior to the call to **rename**, **rename** fails.

rename returns zero if the operation succeeds. Otherwise, **rename** returns −1 and, if the file existed previously, it is still known by its original name.

rename simply performs the following operations:

```
link(old, new);
unlink(old);
```

[See `link`(2) and `unlink`(2) for a detailed list of failure conditions.]

SEE ALSO

`link`(2), `unlink`(2).

NAME

scanf, fscanf, sscanf – convert formatted input

SYNOPSIS

```
#include <stdio.h>

int scanf(const char *format, ...);

int fscanf(FILE *strm, const char *format, ...);

int sscanf(const char *s, const char *format, ...);
```

DESCRIPTION

`scanf` reads from the standard input stream, `stdin`.

`fscanf` reads from the stream *strm*.

`sscanf` reads from the character string *s*.

Each function reads characters, interprets them according to a format, and stores the results in its arguments. Each expects, as arguments, a control string, *format*, described below and a set of pointer arguments indicating where the converted input should be stored. If there are insufficient arguments for the format, the behavior is undefined. If the format is exhausted while arguments remain, the excess arguments are simply ignored.

The control string usually contains conversion specifications, which are used to direct interpretation of input sequences. The control string may contain:

1. White-space characters (blanks, tabs, new-lines, or form-feeds) that, except in two cases described below, cause input to be read up to the next non-white-space character.
2. An ordinary character (not `%`) that must match the next character of the input stream.
3. Conversion specifications consisting of the character `%` or the character sequence `%`*digits*`$`, an optional assignment suppression character `*`, a decimal digit string that specifies an optional numerical maximum field width, an optional letter `l` (ell), `L`, or `h` indicating the size of the receiving object, and a conversion code. The conversion specifiers `d`, `i`, and `n` should be preceded by `h` if the corresponding argument is a pointer to `short int` rather than a pointer to `int`, or by `l` if it is a pointer to `long int`. Similarly, the conversion specifiers `o`, `u`, and `x` should be preceded by `h` if the corresponding argument is a pointer to `unsigned short int` rather than a pointer to `unsigned int`, or by `l` if it is a pointer to `unsigned long int`. Finally, the conversion specifiers `e`, `f`, and `g` should be preceded by `l` if the corresponding argument is a pointer to `double` rather than a pointer to `float`, or by `L` if it is a pointer to `long double`. The `h`, `l`, or `L` modifier is ignored with any other conversion specifier.

A conversion specification directs the conversion of the next input field; the result is placed in the variable pointed to by the corresponding argument unless assignment suppression was indicated by the character `*`. The suppression of assignment provides a way of describing an input field that is to be skipped. An input field is defined as a string of non-space characters; it extends to the next inappropriate character or until the maximum field width, if one is specified, is exhausted. For all descriptors except the character `[` and the character `c`, white space leading an input field is ignored.

Conversions can be applied to the *nth* argument in the argument list, rather than to the next unused argument. In this case, the conversion character `%` (see above) is replaced by the sequence `%`*digits*`$` where *digits* is a decimal integer *n*, giving the position of the argument in the argument list. The first such argument, `%1$`, immediately follows *format*. The control string can contain either form of a conversion specification, i.e., `%` or `%`*digits*`$`, although the two forms cannot be mixed within a single control string.

The conversion code indicates the interpretation of the input field; the corresponding pointer argument must usually be of a restricted type. For a suppressed field, no pointer argument is given. The following conversion codes are valid:

`%` A single `%` is expected in the input at this point; no assignment is done.

`d` Matches an optionally signed decimal integer, whose format is the same as expected for the subject sequence of the `strtol` function with the value 10 for the *base* argument. The corresponding argument should be a pointer to integer.

`u` Matches an optionally signed decimal integer, whose format is the same as expected for the subject sequence of the `strtoul` function with the value 10 for the *base* argument. The corresponding argument should be a pointer to unsigned integer.

`o` Matches an optionally signed octal integer, whose format is the same as expected for the subject sequence of the `strtoul` function with the value 8 for the *base* argument. The corresponding argument should be a pointer to unsigned integer.

`x` Matches an optionally signed hexadecimal integer, whose format is the same as expected for the subject sequence of the `strtoul` function with the value 16 for the *base* argument. The corresponding argument should be a pointer to unsigned integer.

`i` Matches an optionally signed integer, whose format is the same as expected for the subject sequence of the `strtol` function with the value 0 for the *base* argument. The corresponding argument should be a pointer to integer.

`n` No input is consumed. The corresponding argument should be a pointer to integer into which is to be written the number of characters read from the input stream so far by the call to the function. Execution of a `%n` directive does not increment the assignment count returned at the completion of execution of the function.

`e,f,g` Matches an optionally signed floating point number, whose format is the same as expected for the subject string of the `strtod` function. The corresponding argument should be a pointer to floating.

s A character string is expected; the corresponding argument should be a character pointer pointing to an array of characters large enough to accept the string and a terminating `\0`, which will be added automatically. The input field is terminated by a white-space character.

c Matches a sequence of characters of the number specified by the field width (1 if no field width is present in the directive). The corresponding argument should be a pointer to the initial character of an array large enough to accept the sequence. No null character is added. The normal skip over white space is suppressed.

[Matches a nonempty sequence of characters from a set of expected characters (the *scanset*). The corresponding argument should be a pointer to the initial character of an array large enough to accept the sequence and a terminating null character, which will be added automatically. The conversion specifier includes all subsequent characters in the *format* string, up to and including the matching right bracket (`]`). The characters between the brackets (the *scanlist*) comprise the scanset, unless the character after the left bracket is a circumflex (`^`), in which case the scanset contains all characters that do not appear in the scanlist between the circumflex and the right bracket. If the conversion specifier begins with `[]` or `[^]`, the right bracket character is in the scanlist and the next right bracket character is the matching right bracket that ends the specification; otherwise the first right bracket character is the one that ends the specification.

A range of characters in the scanset may be represented by the construct *first* – *last*; thus `[0123456789]` may be expressed `[0-9]`. Using this convention, *first* must be lexically less than or equal to *last*, or else the dash will stand for itself. The character – will also stand for itself whenever it is the first or the last character in the scanlist. To include the right bracket as an element of the scanset, it must appear as the first character (possibly preceded by a circumflex) of the scanlist and in this case it will not be syntactically interpreted as the closing bracket. At least one character must match for this conversion to be considered successful.

p Matches an implementation-defined set of sequences, which should be the same as the set of sequences that may be produced by the `%p` conversion of the `printf` function. The corresponding argument should be a pointer to `void`. The interpretation of the input item is implementation-defined. If the input item is a value converted earlier during the same program execution, the pointer that results shall compare equal to that value; otherwise, the behavior of the `%p` conversion is undefined.

If an invalid conversion character follows the `%`, the results of the operation may not be predictable.

The conversion specifiers `E`, `G`, and `X` are also valid and, under the `-Xa` and `-Xc` compilation modes [see cc(1)], behave the same as `e`, `g`, and `x`, respectively. Under the `-Xt` compilation mode, `E`, `G`, and `X` behave the same as `le`, `lg`, and `lx`, respectively.

Each function allows for detection of a language-dependent decimal point character in the input string. The decimal point character is defined by the program's locale (category LC_NUMERIC). In the "C" locale, or in a locale where the decimal point character is not defined, the decimal point character defaults to a period (.).

The scanf conversion terminates at end of file, at the end of the control string, or when an input character conflicts with the control string.

If end-of-file is encountered during input, conversion is terminated. If end-of-file occurs before any characters matching the current directive have been read (other than leading white space, where permitted), execution of the current directive terminates with an input failure; otherwise, unless execution of the current directive is terminated with a matching failure, execution of the following directive (if any) is terminated with an input failure.

If conversion terminates on a conflicting input character, the offending input character is left unread in the input stream. Trailing white space (including new-line characters) is left unread unless matched by a directive. The success of literal matches and suppressed assignments is not directly determinable other than via the %n directive.

EXAMPLES

The call to the function scanf:

```
int i, n; float x; char name[50];
n = scanf ("%d%f%s", &i, &x, name);
```

with the input line:

```
25 54.32E-1 thompson
```

will assign to n the value 3, to i the value 25, to x the value 5.432, and name will contain thompson\0.

The call to the function scanf:

```
int i; float x; char name[50];
(void) scanf ("%2d%f%*d %[0-9]", &i, &x, name);
```

with the input line:

```
56789 0123 56a72
```

will assign 56 to i, 789.0 to x, skip 0123, and place the characters 56\0 in name. The next character read from stdin will be a.

SEE ALSO

cc(1), printf(3S), strtod(3C), strtol(3C), strtoul(3C).

DIAGNOSTICS

These routines return the number of successfully matched and assigned input items; this number can be zero in the event of an early matching failure between an input character and the control string. If the input ends before the first matching failure or conversion, EOF is returned.

NAME

`setbuf`, `setvbuf` – assign buffering to a stream

SYNOPSIS

```
#include <stdio.h>

void setbuf (FILE *stream, char *buf);

int setvbuf (FILE *stream, char *buf, int type, size_t size);
```

DESCRIPTION

`setbuf` may be used after a *stream* [see `intro`(3)] has been opened but before it is read or written. It causes the array pointed to by *buf* to be used instead of an automatically allocated buffer. If *buf* is the `NULL` pointer input/output will be completely unbuffered.

While there is no limititation on the size of the buffer, the constant `BUFSIZ`, defined in the `<stdio.h>` header file, is typically a good buffer size:

```
char buf[BUFSIZ];
```

`setvbuf` may be used after a stream has been opened but before it is read or written. *type* determines how *stream* will be buffered. Legal values for *type* (defined in `stdio.h`) are:

`_IOFBF` causes input/output to be fully buffered.

`_IOLBF` causes output to be line buffered; the buffer will be flushed when a newline is written, the buffer is full, or input is requested.

`_IONBF` causes input/output to be completely unbuffered.

If *buf* is not the `NULL` pointer, the array it points to will be used for buffering, instead of an automatically allocated buffer. *size* specifies the size of the buffer to be used. If input/output is unbuffered, *buf* and *size* are ignored.

For a further discussion of buffering, see `stdio`(3S).

SEE ALSO

`fopen`(3S), `getc`(3S), `malloc`(3C), `putc`(3S), `stdio`(3S).

DIAGNOSTICS

If an illegal value for *type* is provided, `setvbuf` returns a non-zero value. Otherwise, it returns zero.

NOTES

A common source of error is allocating buffer space as an "automatic" variable in a code block, and then failing to close the stream in the same block.

Parts of `buf` will be used for internal bookkeeping of the stream and, therefore, `buf` will contain less than *size* bytes when full. It is recommended that the automatically allocated buffer is used when using `setvbuf`.

NAME

setjmp, longjmp – non-local goto

SYNOPSIS

```
#include <setjmp.h>

int setjmp (jmp_buf env);

void longjmp (jmp_buf env, int val);
```

DESCRIPTION

These functions are useful for dealing with errors and interrupts encountered in a low-level subroutine of a program.

`setjmp` saves its stack environment in `env` (whose type, *jmp_buf*, is defined in the `<setjmp.h>` header file) for later use by `longjmp`. It returns the value 0.

`longjmp` restores the environment saved by the last call of `setjmp` with the corresponding `env` argument. After `longjmp` is completed, program execution continues as if the corresponding call of `setjmp` had just returned the value `val`. (The caller of `setjmp` must not have returned in the interim.) `longjmp` cannot cause `setjmp` to return the value 0. If `longjmp` is invoked with a second argument of 0, `setjmp` will return 1. At the time of the second return from `setjmp`, all external and static variables have values as of the time `longjmp` is called (see example). The values of register and automatic variables are undefined.

Register or automatic variables whose value must be relied upon must be declared as `volatile`.

EXAMPLE

```
#include <stdio.h>
#include <stdlib.h>
#include <setjmp.h>

jmp_buf env;
int i = 0;
main ()
{
   void exit();

   if(setjmp(env) != 0) {
      (void) printf("value of i on 2nd return from setjmp: %d\n", i);
      exit(0);
   }
   (void) printf("value of i on 1st return from setjmp: %d\n", i);
   i = 1;
   g();
   /*NOTREACHED*/
}

g()
{
   longjmp(env, 1);
   /*NOTREACHED*/
}
```

If the a.out resulting from this C language code is run, the output will be:

```
value of i on 1st return from setjmp:0

value of i on 2nd return from setjmp:1
```

SEE ALSO

signal(2).

NOTES

If longjmp is called even though env was never primed by a call to setjmp, or when the last such call was in a function that has since returned, absolute chaos is guaranteed.

NAME

setlocale – modify and query a program's locale

SYNOPSIS

```
#include <locale.h>

char *setlocale (int category, const char *locale);
```

DESCRIPTION

setlocale selects the appropriate piece of the program's locale as specified by the *category* and *locale* arguments. The *category* argument may have the following values: LC_CTYPE, LC_NUMERIC, LC_TIME, LC_COLLATE, LC_MONETARY, and LC_ALL. These names are defined in the locale.h header file. LC_CTYPE affects the behavior of the character handling functions (isdigit, tolower, etc.) and the multibyte character functions (such as mbtowc and wctomb). LC_NUMERIC affects the decimal-point character for the formatted input/output functions and the string conversion functions as well as the non-mandatory formatting information returned by localeconv. [See localeconv(3C).] LC_TIME affects the behavior of ascftime, cftime, getdate and strftime. LC_COLLATE affects the behavior of strcoll and strxfrm. LC_MONETARY affects the monetary formatted information returned by localeconv. LC_ALL names the program's entire locale.

Each category corresponds to a set of databases which contain the relevant information for each defined locale. The location of a database is given by the following path, /usr/lib/locale/*locale*/*category*, where *locale* and *category* are the names of locale and category, respectively. For example, the database for the LC_CTYPE category for the "german" locale would be found in /usr/lib/locale/german/LC_CTYPE.

A value of "C" for *locale* specifies the default environment.

A value of "" for *locale* specifies that the locale should be taken from environment variables. The order in which the environment variables are checked for the various categories is given below:

Category	1st Env. Var.	2nd Env. Var
LC_CTYPE:	LC_CTYPE	LANG
LC_COLLATE:	LC_COLLATE	LANG
LC_TIME:	LC_TIME	LANG
LC_NUMERIC:	LC_NUMERIC	LANG
LC_MONETARY:	LC_MONETARY	LANG

At program startup, the equivalent of

```
setlocale(LC_ALL, "C")
```

is executed. This has the effect of initializing each category to the locale described by the environment "C".

If a pointer to a string is given for *locale*, setlocale attempts to set the locale for the given category to *locale*. If setlocale succeeds, *locale* is returned. If setlocale fails, a null pointer is returned and the program's locale is not changed.

For category `LC_ALL`, the behavior is slightly different. If a pointer to a string is given for *locale* and `LC_ALL` is given for *category*, **`setlocale`** attempts to set the locale for all the categories to *locale*. The *locale* may be a simple locale, consisting of a single locale, or a composite locale. A composite locale is a string beginning with a "/" followed by the locale of each category separated by a "/". If **`setlocale`** fails to set the locale for any category, a null pointer is returned and the program's locale for all categories is not changed. Otherwise, locale is returned.

A null pointer for *locale* causes **`setlocale`** to return the current locale associated with the *category*. The program's locale is not changed.

FILES

`/usr/lib/locale/C/LC_CTYPE` – `LC_CTYPE` database for the C locale.
`/usr/lib/locale/C/LC_NUMERIC` – `LC_NUMERIC` database for the C locale.
`/usr/lib/locale/C/LC_TIME` – `LC_TIME` database for the C locale.
`/usr/lib/locale/C/LC_COLLATE` – `LC_COLLATE` database for the C locale.
`/usr/lib/locale/`*locale*/*category* – files containing the locale specific information for each locale and category.

SEE ALSO

`ctime`(3C), `ctype`(3C), `getdate`(3C), `localeconv`(3C), `mbtowc`(3C), `printf`(3S), `strcoll`(3C), `strftime`(3C), `strtod`(3C), `strxfrm`(3C), `wctomb`(3C), `environ`(5).

NAME

`sleep` – suspend execution for interval

SYNOPSIS

```
#include <unistd.h>

unsigned sleep (unsigned seconds);
```

DESCRIPTION

The current process is suspended from execution for the number of *seconds* specified by the argument. The actual suspension time may be less than that requested because any caught signal will terminate the **sleep** following execution of that signal's catching routine. Also, the suspension time may be longer than requested by an arbitrary amount because of the scheduling of other activity in the system. The value returned by **sleep** will be the "unslept" amount (the requested time minus the time actually slept) in case the caller had an alarm set to go off earlier than the end of the requested **sleep** time, or premature arousal because of another caught signal.

The routine is implemented by setting an alarm signal and pausing until it (or some other signal) occurs. The previous state of the alarm signal is saved and restored. The calling program may have set up an alarm signal before calling **sleep**. If the **sleep** time exceeds the time until such alarm signal, the process sleeps only until the alarm signal would have occurred. The caller's alarm catch routine is executed just before the **sleep** routine returns. But if the **sleep** time is less than the time till such alarm, the prior alarm time is reset to go off at the same time it would have without the intervening **sleep**.

SEE ALSO

`alarm`(2), `pause`(2), `signal`(2), `wait`(2).

NAME

ssignal, gsignal – software signals

SYNOPSIS

```
#include <signal.h>

int (*ssignal (int sig, int (*action) (int))) (int);

int gsignal (int sig);
```

DESCRIPTION

ssignal and gsignal implement a software facility similar to signal(2). This facility is made available to users for their own purposes.

Software signals made available to users are associated with integers in the inclusive range 1 through 17. A call to ssignal associates a procedure, *action*, with the software signal *sig*; the software signal, *sig*, is raised by a call to gsignal. Raising a software signal causes the action established for that signal to be *taken*.

The first argument to ssignal is a number identifying the type of signal for which an action is to be established. The second argument defines the action; it is either the name of a (user-defined) *action function* or one of the manifest constants SIG_DFL (default) or SIG_IGN (ignore). ssignal returns the action previously established for that signal type; if no action has been established or the signal number is illegal, ssignal returns SIG_DFL.

gsignal raises the signal identified by its argument, *sig*:

> If an action function has been established for *sig*, then that action is reset to SIG_DFL and the action function is entered with argument *sig*. gsignal returns the value returned to it by the action function.
>
> If the action for *sig* is SIG_IGN, gsignal returns the value 1 and takes no other action.
>
> If the action for *sig* is SIG_DFL, gsignal returns the value 0 and takes no other action.
>
> If *sig* has an illegal value or no action was ever specified for *sig*, gsignal returns the value 0 and takes no other action.

SEE ALSO

signal(2), sigset(2), raise(3C).

NAME

stdio – standard buffered input/output package

SYNOPSIS

```
#include <stdio.h>

FILE *stdin, *stdout, *stderr;
```

DESCRIPTION

The functions described in the entries of sub-class 3S of this manual constitute an efficient, user-level I/O buffering scheme. The in-line macros getc and putc handle characters quickly. The macros getchar and putchar, and the higher-level routines fgetc, fgets, fprintf, fputc, fputs, fread, fscanf, fwrite, gets, getw, printf, puts, putw, and scanf all use or act as if they use getc and putc; they can be freely intermixed.

A file with associated buffering is called a *stream* [see intro(3)] and is declared to be a pointer to a defined type FILE. fopen creates certain descriptive data for a stream and returns a pointer to designate the stream in all further transactions. Normally, there are three open streams with constant pointers declared in the <stdio.h> header file and associated with the standard open files:

stdin	standard input file
stdout	standard output file
stderr	standard error file

The following symbolic values in <unistd.h> define the file descriptors that will be associated with the C-language *stdin*, *stdout* and *stderr* when the application is started:

STDIN_FILENO	Standard input value, stdin. It has the value of 0.
STDOUT_FILENO	Standard output value, stdout. It has the value of 1.
STDERR_FILENO	Standard error value, stderr. It has the value of 2.

A constant null designates a null pointer.

An integer-constant EOF (−1) is returned upon end-of-file or error by most integer functions that deal with streams (see the individual descriptions for details).

An integer constant BUFSIZ specifies the size of the buffers used by the particular implementation.

An integer constant FILENAME_MAX specifies the size needed for an array of char large enough to hold the longest file name string that the implementation guarantees can be opened.

An integer constant FOPEN_MAX specifies the minimum number of files that the implementation guarantees can be open simultaneously. Note that no more than 255 files may be opened via fopen, and only file descriptors 0 through 255 are valid.

Any program that uses this package must include the header file of pertinent macro definitions, as follows:

```
#include <stdio.h>
```

The functions and constants mentioned in the entries of sub-class 3S of this manual are declared in that header file and need no further declaration. The constants and the following "functions" are implemented as macros (redeclaration of these names is perilous): `getc`, `getchar`, `putc`, `putchar`, `ferror`, `feof`, `clearerr`, and `fileno`. There are also function versions of `getc`, `getchar`, `putc`, `putchar`, `ferror`, `feof`, `clearerr`, and `fileno`.

Output streams, with the exception of the standard error stream `stderr`, are by default buffered if the output refers to a file and line-buffered if the output refers to a terminal. The standard error output stream `stderr` is by default unbuffered, but use of `freopen` [see `fopen`(3S)] will cause it to become buffered or line-buffered. When an output stream is unbuffered, information is queued for writing on the destination file or terminal as soon as written; when it is buffered, many characters are saved up and written as a block. When it is line-buffered, each line of output is queued for writing on the destination terminal as soon as the line is completed (that is, as soon as a new-line character is written or terminal input is requested). `setbuf` or `setvbuf` [both described in `setbuf`(3S)] may be used to change the stream's buffering strategy.

SEE ALSO

`open`(2), `close`(2), `lseek`(2), `pipe`(2), `read`(2), `write`(2), `ctermid`(3S), `cuserid`(3S), `fclose`(3S), `ferror`(3S), `fopen`(3S), `fread`(3S), `fseek`(3S), `getc`(3S), `gets`(3S), `popen`(3S), `printf`(3S), `putc`(3S), `puts`(3S), `scanf`(3S), `setbuf`(3S), `system`(3S), `tmpfile`(3S), `tmpnam`(3S), `ungetc`(3S).

DIAGNOSTICS

Invalid *stream* pointers usually cause grave disorder, possibly including program termination. Individual function descriptions describe the possible error conditions.

NAME

`stdipc`: `ftok` – standard interprocess communication package

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>

key_t ftok(const char *path, int id);
```

DESCRIPTION

All interprocess communication facilities require the user to supply a key to be used by the `msgget`(2), `semget`(2), and `shmget`(2) system calls to obtain interprocess communication identifiers. One suggested method for forming a key is to use the `ftok` subroutine described below. Another way to compose keys is to include the project ID in the most significant byte and to use the remaining portion as a sequence number. There are many other ways to form keys, but it is necessary for each system to define standards for forming them. If some standard is not adhered to, it will be possible for unrelated processes to unintentionally interfere with each other's operation. It is still possible to interface intentionally. Therefore, it is strongly suggested that the most significant byte of a key in some sense refer to a project so that keys do not conflict across a given system.

`ftok` returns a key based on *path* and *id* that is usable in subsequent `msgget`, `semget`, and `shmget` system calls. *path* must be the path name of an existing file that is accessible to the process. *id* is a character that uniquely identifies a project. Note that `ftok` will return the same key for linked files when called with the same *id* and that it will return different keys when called with the same file name but different *ids*.

SEE ALSO

`intro`(2), `msgget`(2), `semget`(2), `shmget`(2).

DIAGNOSTICS

`ftok` returns `(key_t) -1` if *path* does not exist or if it is not accessible to the process.

NOTES

If the file whose *path* is passed to `ftok` is removed when keys still refer to the file, future calls to `ftok` with the same *path* and *id* will return an error. If the same file is recreated, then `ftok` is likely to return a different key than it did the original time it was called.

NAME

strcoll – string collation

SYNOPSIS

```
#include <string.h>

int strcoll (const char *s1, const char *s2);
```

DESCRIPTION

strcoll returns an integer greater than, equal to, or less than zero in direct correlation to whether string *s1* is greater than, equal to, or less than the string *s2*. The comparison is based on strings interpreted as appropriate to the program's locale for category LC_COLLATE [see setlocale(3C)].

Both strcoll and strxfrm provide for locale-specific string sorting. strcoll is intended for applications in which the number of comparisons per string is small. When strings are to be compared a number of times, strxfrm is a more appropriate utility because the transformation process occurs only once.

FILES

/usr/lib/locale/*locale*/LC_COLLATE LC_COLLATE database for *locale*.

SEE ALSO

colltbl(1M), setlocale(3C), string(3C), strxfrm(3C), environ(5).

NAME

strerror – get error message string

SYNOPSIS

```
#include <string.h>

char *strerror (int errnum);
```

DESCRIPTION

strerror maps the error number in *errnum* to an error message string, and returns a pointer to that string. strerror uses the same set of error messages as perror. The returned string should not be overwritten.

SEE ALSO

perror(3C).

NAME

strftime, cftime, ascftime, - convert date and time to string

SYNOPSIS

```
#include <time.h>

size_t *strftime (char *s, size_t maxsize,
                  const char *format, const struct tm *timeptr);

int cftime (char *s, char *format, const time_t *clock);

int ascftime (char *s, const char *format,
                  const struct tm *timeptr);
```

DESCRIPTION

`strftime`, `ascftime` and `cftime` place characters into the array pointed to by `s` as controlled by the string pointed to by *format*. The *format* string consists of zero or more directives and ordinary characters. All ordinary characters (including the terminating null character) are copied unchanged into the array. For `strftime`, no more than *maxsize* characters are placed into the array.

If *format* is (char *)0, then the locale's default format is used. For `strftime` the default format is the same as `"%c"`, for `cftime` and `ascftime` the default format is the same as `"%C"`. `cftime` and `ascftime` first try to use the value of the environment variable `CFTIME`, and if that is undefined or empty, the default format is used.

Each directive is replaced by appropriate characters as described in the following list. The appropriate characters are determined by the `LC_TIME` category of the program's locale and by the values contained in the structure pointed to by *timeptr* for `strftime` and `ascftime`, and by the time represented by *clock* for `cftime`.

`%%`	same as %
`%a`	locale's abbreviated weekday name
`%A`	locale's full weekday name
`%b`	locale's abbreviated month name
`%B`	locale's full month name
`%c`	locale's appropriate date and time representation
`%C`	locale's date and time representation as produced by `date`(1)
`%d`	day of month (01 - 31)
`%D`	date as %m/%d/%y
`%e`	day of month (1-31; single digits are preceded by a blank)
`%h`	locale's abbreviated month name.
`%H`	hour (00 - 23)
`%I`	hour (01 - 12)
`%j`	day number of year (001 - 366)
`%m`	month number (01 - 12)
`%M`	minute (00 - 59)
`%n`	same as \n
`%p`	locale's equivalent of either AM or PM

`%r`	time as %I:%M:%S [AM|PM]
`%R`	time as %H:%M
`%S`	seconds (00 - 61), allows for leap seconds
`%t`	insert a tab
`%T`	time as %H:%M:%S
`%U`	week number of year (00 - 53), Sunday is the first day of week 1
`%w`	weekday number (0 - 6), Sunday = 0
`%W`	week number of year (00 - 53), Monday is the first day of week 1
`%x`	locale's appropriate date representation
`%X`	locale's appropriate time representation
`%y`	year within century (00 - 99)
`%Y`	year as ccyy (e.g. 1986)
`%Z`	time zone name or no characters if no time zone exists

The difference between `%U` and `%W` lies in which day is counted as the first of the week. Week number 01 is the first week in January starting with a Sunday for `%U` or a Monday for `%W`. Week number 00 contains those days before the first Sunday or Monday in January for `%U` and `%W`, respectively.

If the total number of resulting characters including the terminating null character is not more than *maxsize*, `strftime`, `cftime` and `ascftime` return the number of characters placed into the array pointed to by *s* not including the terminating null character. Otherwise, zero is returned and the contents of the array are indeterminate. `cftime` and `ascftime` return the number of characters placed into the array pointed to by *s* not including the terminating null character.

Selecting the Output's Language

By default, the output of `strftime`, `cftime`, and `ascftime` appear in US English. The user can request that the output of `strftime`, `cftime` or `ascftime` be in a specific language by setting the *locale* for *category* `LC_TIME` in `setlocale`.

Timezone

The timezone is taken from the environment variable `TZ` [see ctime(3C) for a description of `TZ`].

EXAMPLES

The example illustrates the use of `strftime`. It shows what the string in `str` would look like if the structure pointed to by *tmptr* contains the values corresponding to Thursday, August 28, 1986 at 12:44:36 in New Jersey.

```
strftime (str, strsize, "%A %b %d %j", tmptr)
```

This results in `str` containing "Thursday Aug 28 240".

FILES

`/usr/lib/locale/`*locale*`/LC_TIME` – file containing locale specific date and time information

SEE ALSO

`ctime`(3C), `getenv`(3C), `setlocale`(3C), `strftime`(4), `timezone`(4), `environ`(5).

NOTE

`cftime` and `ascftime` are obsolete. `strftime` should be used instead.

NAME

string: strcat, strdup, strncat, strcmp, strncmp, strcpy, strncpy, strlen, strchr, strrchr, strpbrk, strspn, strcspn, strtok, strstr – string operations

SYNOPSIS

```
#include <string.h>

char *strcat (char *s1, const char *s2);

char *strdup (const char *s1);

char *strncat (char *s1, const char *s2, size_t n);

int strcmp (const char *s1, const char *s2);

int strncmp (const char *s1, const char *s2, size_t n);

char *strcpy (char *s1, const char *s2);

char *strncpy (char *s1, const char *s2, size_t n);

size_t strlen (const char *s);

char *strchr (const char *s, int c);

char *strrchr (const char *s, int c);

char *strpbrk (const char *s1, const char *s2);

size_t strspn (const char *s1, const char *s2);

size_t strcspn (const char *s1, const char *s2);

char *strtok (char *s1, const char *s2);

char *strstr (const char *s1, const char *s2);
```

DESCRIPTION

The arguments *s*, *s1*, and *s2* point to strings (arrays of characters terminated by a null character). The functions strcat, strncat, strcpy, strncpy, and strtok. all alter *s1*. These functions do not check for overflow of the array pointed to by *s1*.

strcat appends a copy of string *s2*, including the terminating null character, to the end of string *s1*. strncat appends at most *n* characters. Each returns a pointer to the null-terminated result. The initial character of *s2* overrides the null character at the end of *s1*.

strcmp compares its arguments and returns an integer less than, equal to, or greater than 0, based upon whether *s1* is lexicographically less than, equal to, or greater than *s2*. strncmp makes the same comparison but looks at at most *n* characters. Characters following a null character are not compared.

strcpy copies string *s2* to *s1* including the terminating null character, stopping after the null character has been copied. strncpy copies exactly *n* characters, truncating *s2* or adding null characters to *s1* if necessary. The result will not be null-terminated if the length of *s2* is *n* or more. Each function returns *s1*.

`strdup` returns a pointer to a new string which is a duplicate of the string pointed to by *s1*. The space for the new string is obtained using `malloc`(3C). If the new string can not be created, a NULL pointer is returned.

`strlen` returns the number of characters in *s*, not including the terminating null character.

`strchr` (or `strrchr`) returns a pointer to the first (last) occurrence of *c* (converted to a `char`) in string *s*, or a NULL pointer if *c* does not occur in the string. The null character terminating a string is considered to be part of the string.

`strpbrk` returns a pointer to the first occurrence in string *s1* of any character from string *s2*, or a NULL pointer if no character from *s2* exists in *s1*.

`strspn` (or `strcspn`) returns the length of the initial segment of string *s1* which consists entirely of characters from (not from) string *s2*.

`strtok` considers the string *s1* to consist of a sequence of zero or more text tokens separated by spans of one or more characters from the separator string *s2*. The first call (with pointer *s1* specified) returns a pointer to the first character of the first token, and will have written a null character into *s1* immediately following the returned token. The function keeps track of its position in the string between separate calls, so that subsequent calls (which must be made with the first argument a NULL pointer) will work through the string *s1* immediately following that token. In this way subsequent calls will work through the string *s1* until no tokens remain. The separator string *s2* may be different from call to call. When no token remains in *s1*, a NULL pointer is returned.

`strstr` locates the first occurrence in string *s1* of the sequence of characters (excluding the terminating null character) in string *s2*. `strstr` returns a pointer to the located string, or a null pointer if the string is not found. If *s2* points to a string with zero length (i.e., the string ""), the function returns *s1*.

SEE ALSO

`malloc`(3C), `setlocale`(3C), `strxfrm`(3C).

NOTES

All of these functions assume the default locale "C." For some locales, `strxfrm` should be applied to the strings before they are passed to the functions.

NAME

strtod, atof, – convert string to double-precision number

SYNOPSIS

```
#include <stdlib.h>

double strtod (const char *nptr, char **endptr);

double atof (const char *nptr);
```

DESCRIPTION

strtod returns as a double-precision floating-point number the value represented by the character string pointed to by *nptr*. The string is scanned up to the first unrecognized character.

strtod recognizes an optional string of "white-space" characters [as defined by isspace in ctype(3C)], then an optional sign, then a string of digits optionally containing a decimal point character, then an optional exponent part including an e or E followed by an optional sign, followed by an integer.

If the value of *endptr* is not (char **)NULL, a pointer to the character terminating the scan is returned in the location pointed to by *endptr*. If no number can be formed, **endptr* is set to *nptr*, and zero is returned.

atof(nptr) is equivalent to:

```
strtod(nptr, (char **)NULL).
```

SEE ALSO

ctype(3C), scanf(3S), strtol(3C).

DIAGNOSTICS

If the correct value would cause overflow, ±HUGE is returned (according to the sign of the value), and *errno* is set to ERANGE.
If the correct value would cause underflow, zero is returned and *errno* is set to ERANGE.
When the -Xc or -Xa compilation options are used, HUGE_VAL is returned instead of HUGE.

NAME

strtol, strtoul, atol, atoi – convert string to integer

SYNOPSIS

```
#include <stdlib.h>

long strtol (const char *str, char **ptr, int base);

unsigned long strtoul (const char *str, char **ptr, int base);

long atol (const char *str);

int atoi (const char *str);
```

DESCRIPTION

strtol returns as a long integer the value represented by the character string pointed to by str. The string is scanned up to the first character inconsistent with the base. Leading "white-space" characters [as defined by isspace in ctype(3C)] are ignored.

If the value of *ptr* is not (char **)NULL, a pointer to the character terminating the scan is returned in the location pointed to by *ptr*. If no integer can be formed, that location is set to str, and zero is returned.

If *base* is positive (and not greater than 36), it is used as the base for conversion. After an optional leading sign, leading zeros are ignored, and "0x" or "0X" is ignored if *base* is 16.

If *base* is zero, the string itself determines the base as follows: After an optional leading sign a leading zero indicates octal conversion, and a leading "0x" or "0X" hexadecimal conversion. Otherwise, decimal conversion is used.

Truncation from long to int can, of course, take place upon assignment or by an explicit cast.

If the value represented by *str* would cause overflow, LONG_MAX or LONG_MIN is returned (according to the sign of the value), and errno is set to the value, ERANGE.

strtoul is similar to strtol except that strtoul returns as an unsigned long integer the value represented by *str*. If the value represented by *str* would cause overflow, ULONG_MAX is returned, and errno is set to the value, ERANGE.

Except for behavior on error, atol(str) is equivalent to: strtol(str, (char **)NULL, 10).

Except for behavior on error, atoi(str) is equivalent to: (int) strtol(str, (char **)NULL, 10).

DIAGNOSTICS

If strtol is given a *base* greater than 36, it returns 0 and sets errno to EINVAL.

SEE ALSO

ctype(3C), scanf(3S), strtod(3C).

NOTES

strtol no longer accepts values greater than LONG_MAX as valid input. Use strtoul instead.

NAME

strxfrm – string transformation

SYNOPSIS

```
#include <string.h>

size_t strxfrm (char *s1, const char *s2, size_t n);
```

DESCRIPTION

strxfrm transforms the string *s2* and places the resulting string into the array *s1*. The transformation is such that if strcmp is applied to two transformed strings, it will return the same result as strcoll applied to the same two original strings. The transformation is based on the program's locale for category LC_COLLATE [see setlocale(3C)].

No more than *n* characters will be placed into the resulting array pointed to by *s1*, including the terminating null character. If *n* is 0, then *s1* is permitted to be a null pointer. If copying takes place between objects that overlap, the behavior is undefined.

strxfrm returns the length of the transformed string (not including the terminating null character). If the value returned is *n* or more, the contents of the array *s1* are indeterminate.

EXAMPLE

The value of the following expression is the size of the array needed to hold the transformation of the string pointed to by *s*.

```
1 + strxfrm(NULL, s, 0);
```

FILES

/usr/lib/locale/*locale*/LC_COLLATE LC_COLLATE database for *locale*.

SEE ALSO

colltbl(1M), setlocale(3C), strcoll(3C), string(3C), environ(5).

DIAGNOSTICS

On failure, strxfrm returns (size_t) -1.

NAME

swab – swap bytes

SYNOPSIS

```
#include <stdlib.h>

void swab (const char *from, char *to, int nbytes);
```

DESCRIPTION

swab copies *nbytes* bytes pointed to by *from* to the array pointed to by *to*, exchanging adjacent even and odd bytes. *nbytes* should be even and non-negative. If *nbytes* is odd and positive, **swab** uses *nbytes*−1 instead. If *nbytes* is negative, **swab** does nothing.

NAME

system – issue a shell command

SYNOPSIS

```
#include <stdlib.h>

int system (const char *string);
```

DESCRIPTION

system causes the *string* to be given to the shell [see sh(1)] as input, as if the string had been typed as a command at a terminal. The current process waits until the shell has completed, then returns the exit status of the shell in the format specified by wait.

If *string* is a NULL pointer, system checks if /bin/sh exists and is executable. If /bin/sh is available, system returns non-zero; otherwise it returns zero.

system fails if one or more of the following are true:

EAGAIN The system-imposed limit on the total number of processes under execution by a single user would be exceeded.

EINTR system was interupted by a signal.

ENOMEM The new process requires more memory than is allowed by the system-imposed maximum {MAXMEM}.

SEE ALSO

exec(2), wait(3C).
sh(1) in the *User's Reference Manual.*

DIAGNOSTICS

system forks to create a child process that in turn execs /bin/sh in order to execute *string*. If the fork or exec fails, system returns a value of -1 and sets errno.

NAME

`tmpfile` – create a temporary file

SYNOPSIS

```
#include <stdio.h>

FILE *tmpfile (void);
```

DESCRIPTION

`tmpfile` creates a temporary file using a name generated by the `tmpnam` routine and returns a corresponding `FILE` pointer. If the file cannot be opened, a `NULL` pointer is returned. The file is automatically deleted when the process using it terminates or when the file is closed. The file is opened for update ("w+").

SEE ALSO

`creat`(2), `open`(2), `unlink`(2), `fopen`(3S), `mktemp`(3C), `perror`(3C), `stdio`(3S), `tmpnam`(3S).

NAME

tmpnam, tempnam – create a name for a temporary file

SYNOPSIS

```
#include <stdio.h>

char *tmpnam (char *s);

char *tempnam (const char *dir, const char *pfx);
```

DESCRIPTION

These functions generate file names that can safely be used for a temporary file.

`tmpnam` always generates a file name using the path-prefix defined as `P_tmpdir` in the `<stdio.h>` header file. If *s* is `NULL`, `tmpnam` leaves its result in an internal static area and returns a pointer to that area. The next call to `tmpnam` will destroy the contents of the area. If *s* is not `NULL`, it is assumed to be the address of an array of at least `L_tmpnam` bytes, where `L_tmpnam` is a constant defined in `<stdio.h>`; `tmpnam` places its result in that array and returns *s*.

`tempnam` allows the user to control the choice of a directory. The argument *dir* points to the name of the directory in which the file is to be created. If *dir* is `NULL` or points to a string that is not a name for an appropriate directory, the path-prefix defined as `P_tmpdir` in the `<stdio.h>` header file is used. If that directory is not accessible, `/tmp` will be used as a last resort. This entire sequence can be up-staged by providing an environment variable `TMPDIR` in the user's environment, whose value is the name of the desired temporary-file directory.

Many applications prefer their temporary files to have certain favorite initial letter sequences in their names. Use the *pfx* argument for this. This argument may be `NULL` or point to a string of up to five characters to be used as the first few characters of the temporary-file name.

`tempnam` uses `malloc` to get space for the constructed file name, and returns a pointer to this area. Thus, any pointer value returned from `tempnam` may serve as an argument to `free` [see `malloc`(3C)]. If `tempnam` cannot return the expected result for any reason—e.g., `malloc` failed—or none of the above mentioned attempts to find an appropriate directory was successful, a `NULL` pointer will be returned.

`tempnam` fails if there is not enough space.

FILES

`P_tmpdir` `/usr/tmp`

SEE ALSO

`creat`(2), `unlink`(2), `fopen`(3S), `malloc`(3C), `mktemp`(3C), `tmpfile`(3S).

NOTES

These functions generate a different file name each time they are called.

Files created using these functions and either `fopen` or `creat` are temporary only in the sense that they reside in a directory intended for temporary use, and their names are unique. It is the user's responsibility to remove the file when its use is ended.

If called more than `TMP_MAX` (defined in `stdio.h`) times in a single process, these functions start recycling previously used names.

Between the time a file name is created and the file is opened, it is possible for some other process to create a file with the same name. This can never happen if that other process is using these functions or `mktemp` and the file names are chosen to render duplication by other means unlikely.

NAME

`tsearch`, `tfind`, `tdelete`, `twalk` – manage binary search trees

SYNOPSIS

```
#include <search.h>

void *tsearch (const void *key, void **rootp, int (*compar)
    (const void *, const void *));

void *tfind (const void *key, void * const *rootp, int (*compar)
    (const void *, const void *));

void *tdelete (const void *key, void **rootp, int (*compar)
    (const void *, const void *));

void twalk (void *root, void(*action) (void *, VISIT, int));
```

DESCRIPTION

`tsearch`, `tfind`, `tdelete`, and `twalk` are routines for manipulating binary search trees. They are generalized from Knuth (6.2.2) Algorithms T and D. All comparisons are done with a user-supplied routine. This routine is called with two arguments, the pointers to the elements being compared. It returns an integer less than, equal to, or greater than 0, according to whether the first argument is to be considered less than, equal to or greater than the second argument. The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

`tsearch` is used to build and access the tree. *key* is a pointer to a datum to be accessed or stored. If there is a datum in the tree equal to *key (the value pointed to by *key*), a pointer to this found datum is returned. Otherwise, *key is inserted, and a pointer to it returned. Only pointers are copied, so the calling routine must store the data. *rootp* points to a variable that points to the root of the tree. A `NULL` value for the variable pointed to by *rootp* denotes an empty tree; in this case, the variable will be set to point to the datum which will be at the root of the new tree.

Like `tsearch`, `tfind` will search for a datum in the tree, returning a pointer to it if found. However, if it is not found, `tfind` will return a `NULL` pointer. The arguments for `tfind` are the same as for `tsearch`.

`tdelete` deletes a node from a binary search tree. The arguments are the same as for `tsearch`. The variable pointed to by *rootp* will be changed if the deleted node was the root of the tree. `tdelete` returns a pointer to the parent of the deleted node, or a `NULL` pointer if the node is not found.

`twalk` traverses a binary search tree. *root* is the root of the tree to be traversed. (Any node in a tree may be used as the root for a walk below that node.) *action* is the name of a routine to be invoked at each node. This routine is, in turn, called with three arguments. The first argument is the address of the node being visited. The second argument is a value from an enumeration data type *typedef enum* { *preorder, postorder, endorder, leaf* } *VISIT;* (defined in the `search.h` header file), depending on whether this is the first, second or third time that the node has been visited (during a depth-first, left-to-right traversal of the tree), or whether the node is a leaf. The third argument is the level of the node in the tree, with the root being level zero.

The pointers to the key and the root of the tree should be of type pointer-to-element, and cast to type pointer-to-character. Similarly, although declared as type pointer-to-character, the value returned should be cast into type pointer-to-element.

EXAMPLE

The following code reads in strings and stores structures containing a pointer to each string and a count of its length. It then walks the tree, printing out the stored strings and their lengths in alphabetical order.

```
#include <string.h>
#include <stdio.h>
#include <search.h>

struct node {
      char *string;
      int length;
};
char string_space[10000];
struct node nodes[500];
void *root = NULL;

int node_compare(const void *node1, const void *node2) {
      return strcmp(((const struct node *) node1)->string,
                 ((const struct node *) node2)->string);
}

void print_node(void **node, VISIT order, int level) {
      if (order == preorder || order == leaf) {
           printf("length=%d, string=%20s\n",
           (*(struct node **)node)->length,
           (*(struct node **)node)->string);
      }
}

main() {
      char *strptr = string_space;
      struct node *nodeptr = nodes;
      int i = 0;

      while (gets(strptr) != NULL && i++ < 500) {
           nodeptr->string = strptr;
           nodeptr->length = strlen(strptr);
           (void) tsearch((void *)nodeptr,
                    &root, node_compare);
           strptr += nodeptr->length + 1;
           nodeptr++;
      }
      twalk(root, print_node);
}
```

SEE ALSO

bsearch(3C), hsearch(3C), lsearch(3C).

DIAGNOSTICS

A NULL pointer is returned by tsearch if there is not enough space available to create a new node.

A NULL pointer is returned by tfind and tdelete if *rootp* is NULL on entry.

If the datum is found, both tsearch and tfind return a pointer to it. If not, tfind returns NULL, and tsearch returns a pointer to the inserted item.

NOTES

The root argument to twalk is one level of indirection less than the *rootp* arguments to tsearch and tdelete.

There are two nomenclatures used to refer to the order in which tree nodes are visited. tsearch uses preorder, postorder and endorder to refer respectively to visiting a node before any of its children, after its left child and before its right, and after both its children. The alternate nomenclature uses preorder, inorder and postorder to refer to the same visits, which could result in some confusion over the meaning of postorder.

If the calling function alters the pointer to the root, results are unpredictable.

NAME

`ttyname`, `isatty` – find name of a terminal

SYNOPSIS

```
#include <stdlib.h>

char *ttyname (int fildes);

int isatty (int fildes);
```

DESCRIPTION

`ttyname` returns a pointer to a string containing the null-terminated path name of the terminal device associated with file descriptor *fildes*.

`isatty` returns 1 if *fildes* is associated with a terminal device, 0 otherwise.

FILES

`/dev/*`

DIAGNOSTICS

`ttyname` returns a `NULL` pointer if *fildes* does not describe a terminal device in directory `/dev`.

NOTES

The return value points to static data whose content is overwritten by each call.

NAME

ttyslot – find the slot in the utmp file of the current user

SYNOPSIS

```
#include <stdlib.h>

int ttyslot (void);
```

DESCRIPTION

ttyslot returns the index of the current user's entry in the /etc/utmp file. The returned index is accomplished by scanning files in /dev for the name of the terminal associated with the standard input, the standard output, or the standard error output (0, 1, or 2).

FILES

/etc/utmp

SEE ALSO

getut(3C), ttyname(3C).

DIAGNOSTICS

A value of −1 is returned if an error was encountered while searching for the terminal name or if none of the above file descriptors are associated with a terminal device.

NAME

ungetc – push character back onto input stream

SYNOPSIS

```
#include <stdio.h>

int ungetc (int c, FILE *stream);
```

DESCRIPTION

ungetc inserts the character specified by *c* (converted to an unsigned char) into the buffer associated with an input *stream* [see intro(3)]. That character, *c*, will be returned by the next getc(3S) call on that *stream*. ungetc returns *c*, and leaves the file corresponding to *stream* unchanged. A successful call to ungetc clears the EOF indicator for stream.

Four bytes of pushback are guaranteed.

The value of the file position indicator for *stream* after reading or discarding all pushed-back characters will be the same as it was before the characters were pushed back.

If *c* equals EOF, ungetc does nothing to the buffer and returns EOF.

fseek, rewind [both described on fseek(3S)], and fsetpos erase the memory of inserted characters for the stream on which they are applied.

SEE ALSO

fseek(3S), fsetpos(3C), getc(3S), setbuf(3S), stdio(3S).

DIAGNOSTICS

ungetc returns EOF if it cannot insert the character.

NAME

vprintf, vfprintf, vsprintf – print formatted output of a variable argument list

SYNOPSIS

```
#include <stdio.h>
#include <stdarg.h>

int vprintf(const char *format, va_list ap);

int vfprintf(FILE *stream, const char *format, va_list ap);

int vsprintf(char *s, const char *format, va_list ap);
```

DESCRIPTION

vprintf, **vfprintf** and **vsprintf** are the same as **printf**, **fprintf**, and **sprintf** respectively, except that instead of being called with a variable number of arguments, they are called with an argument list as defined by the **<stdarg.h>** header file.

The **<stdarg.h>** header file defines the type **va_list** and a set of macros for advancing through a list of arguments whose number and types may vary. The argument *ap* to the vprint family of routines is of type **va_list**. This argument is used with the **<stdarg.h>** header file macros **va_start**, **va_arg** and **va_end** [see **va_start**, **va_arg**, and **va_end** in **stdarg**(5)]. The EXAMPLE section below shows their use with **vprintf**.

EXAMPLE

The following demonstrates how **vfprintf** could be used to write an **error** routine:

```
#include <stdio.h>
#include <stdarg.h>
/*
 *   error should be called like
 *         error(function_name, format, arg1, ...);
 */
void error(char *function_name, char *format, ...)

{
    va_list ap;

    va_start(ap, format);
    /* print out name of function causing error */
    (void) fprintf(stderr, "ERR in %s: ", function_name);
    va_arg(ap, char*);
    /* print out remainder of message */
    (void) vfprintf(stderr, format, ap);
    va_end(ap);
    (void) abort;
}
```

SEE ALSO

`printf`(3S), `stdarg`(5).

DIAGNOSTICS

`vprintf` and `vfprintf` return the number of characters transmitted, or return `-1` if an error was encountered.

NAME

`elf` – object file access library

SYNOPSIS

`cc` [*flag* ...] *file* ... `-lelf` [*library* ...]

`#include <libelf.h>`

DESCRIPTION

Functions in the ELF access library let a program manipulate ELF (Executable and Linking Format) object files, archive files, and archive members. The header file provides type and function declarations for all library services.

Programs communicate with many of the higher-level routines using an *ELF descriptor*. That is, when the program starts working with a file, `elf_begin` creates an ELF descriptor through which the program manipulates the structures and information in the file. These ELF descriptors can be used both to read and to write files. After the program establishes an ELF descriptor for a file, it may then obtain *section descriptors* to manipulate the sections of the file [see `elf_getscn`(3E)]. Sections hold the bulk of an object file's real information, such as text, data, the symbol table, and so on. A section descriptor "belongs" to a particular ELF descriptor, just as a section belongs to a file. Finally, *data descriptors* are available through section descriptors, allowing the program to manipulate the information associated with a section. A data descriptor "belongs" to a section descriptor.

Descriptors provide private handles to a file and its pieces. In other words, a data descriptor is associated with one section descriptor, which is associated with one ELF descriptor, which is associated with one file. Although descriptors are private, they give access to data that may be shared. Consider programs that combine input files, using incoming data to create or update another file. Such a program might get data descriptors for an input and an output section. It then could update the output descriptor to reuse the input descriptor's data. That is, the descriptors are distinct, but they could share the associated data bytes. This sharing avoids the space overhead for duplicate buffers and the performance overhead for copying data unnecessarily.

FILE CLASSES

ELF provides a framework in which to define a family of object files, supporting multiple processors and architectures. An important distinction among object files is the *class*, or capacity, of the file. The 32-bit class supports architectures in which a 32-bit object can represent addresses, file sizes, etc., as in the following table.

Name	Purpose
Elf32_Addr	Unsigned address
Elf32_Half	Unsigned medium integer
Elf32_Off	Unsigned file offset
Elf32_Sword	Signed large integer
Elf32_Word	Unsigned large integer
unsigned char	Unsigned small integer

Other classes will be defined as necessary, to support larger (or smaller) machines. Some library services deal only with data objects for a specific class, while others are class-independent. To make this distinction clear, library function names reflect their status, as described below.

DATA REPRESENTATIONS

Conceptually, two parallel sets of objects support cross compilation environments. One set corresponds to file contents, while the other set corresponds to the native memory image of the program manipulating the file. Type definitions supplied by the header files work on the native machine, which may have different data encodings (size, byte order, etc.) than the target machine. Although native memory objects should be at least as big as the file objects (to avoid information loss), they may be bigger if that is more natural for the host machine.

Translation facilities exist to convert between file and memory representations. Some library routines convert data automatically, while others leave conversion as the program's responsibility. Either way, programs that create object files must write file-typed objects to those files; programs that read object files must take a similar view. See **elf_xlate**(3E) and **elf_fsize**(3E) for more information.

Programs may translate data explicitly, taking full control over the object file layout and semantics. If the program prefers not to have and exercise complete control, the library provides a higher-level interface that hides many object file details. **elf_begin** and related functions let a program deal with the native memory types, converting between memory objects and their file equivalents automatically when reading or writing an object file.

ELF VERSIONS

Object file versions allow ELF to adapt to new requirements. Three—independent—versions can be important to a program. First, an application program knows about a particular version by virtue of being compiled with certain header files. Second, the access library similarly is compiled with header files that control what versions it understands. Third, an ELF object file holds a value identifying its version, determined by the ELF version known by the file's creator. Ideally, all three versions would be the same, but they may differ.

> If a program's version is newer than the access library, the program might use information unknown to the library. Translation routines might not work properly, leading to undefined behavior. This condition merits installing a new library.

The library's version might be newer than the program's and the file's. The library understands old versions, thus avoiding compatibility problems in this case.

Finally, a file's version might be newer than either the program or the library understands. The program might or might not be able to process the file properly, depending on whether the file has extra information and whether that information can be safely ignored. Again, the safe alternative is to install a new library that understands the file's version.

To accommodate these differences, a program must use `elf_version` to pass its version to the library, thus establishing the *working version* for the process. Using this, the library accepts data from and presents data to the program in the proper representations. When the library reads object files, it uses each file's version to interpret the data. When writing files or converting memory types to the file equivalents, the library uses the program's working version for the file data.

SYSTEM SERVICES

As mentioned above, `elf_begin` and related routines provide a higher-level interface to ELF files, performing input and output on behalf of the application program. These routines assume a program can hold entire files in memory, without explicitly using temporary files. When reading a file, the library routines bring the data into memory and perform subsequent operations on the memory copy. Programs that wish to read or write large object files with this model must execute on a machine with a large process virtual address space. If the underlying operating system limits the number of open files, a program can use `elf_cntl` to retrieve all necessary data from the file, allowing the program to close the file descriptor and reuse it.

Although the `elf_begin` interfaces are convenient and efficient for many programs, they might be inappropriate for some. In those cases, an application may invoke the `elf_xlate` data translation routines directly. These routines perform no input or output, leaving that as the application's responsibility. By assuming a larger share of the job, an application controls its input and output model.

LIBRARY NAMES

Names associated with the library take several forms.

`elf_`*name*	These class-independent names perform some service, *name*, for the program.
`elf32_`*name*	Service names with an embedded class, 32 here, indicate they work only for the designated class of files.
`Elf_`*Type*	Data types can be class-independent as well, distinguished by *Type*.
`Elf32_`*Type*	Class-dependent data types have an embedded class name, 32 here.
`ELF_C_`*CMD*	Several functions take commands that control their actions. These values are members of the `Elf_Cmd` enumeration; they range from zero through `ELF_C_NUM-1`.

ELF_F_*FLAG* Several functions take flags that control library status and/or actions. Flags are bits that may be combined.

ELF32_FSZ_*TYPE*
These constants give the file sizes in bytes of the basic ELF types for the 32-bit class of files. See **elf_fsize** for more information.

ELF_K_*KIND* The function **elf_kind** identifies the *KIND* of file associated with an ELF descriptor. These values are members of the **Elf_Kind** enumeration; they range from zero through **ELF_K_NUM-1**.

ELF_T_*TYPE* When a service function, such as **elf_xlate**, deals with multiple types, names of this form specify the desired *TYPE*. Thus, for example, **ELF_T_EHDR** is directly related to **Elf32_Ehdr**. These values are members of the **Elf_Type** enumeration; they range from zero through **ELF_T_NUM-1**.

SEE ALSO

cof2elf(1), **elf_begin**(3E), **elf_cntl**(3E), **elf_end**(3E), **elf_error**(3E), **elf_fill**(3E), **elf_flag**(3E), **elf_fsize**(3E), **elf_getarhdr**(3E), **elf_getarsym**(3E), **elf_getbase**(3E), **elf_getdata**(3E), **elf_getehdr**(3E), **elf_getident**(3E), **elf_getphdr**(3E), **elf_getscn**(3E), **elf_getshdr**(3E), **elf_hash**(3E), **elf_kind**(3E), **elf_next**(3E), **elf_rand**(3E), **elf_rawfile**(3E), **elf_strptr**(3E), **elf_update**(3E), **elf_version**(3E), **elf_xlate**(3E), **a.out**(4) **ar**(4)
The "Object Files" in the chapter *Programmer's Guide: ANSI C and Programming Support Tools*.

NOTES

Information in the ELF header files is separated into common parts and processor-specific parts. A program can make a processor's information available by including the appropriate header file: **<sys/elf_*NAME*.h>** where *NAME* matches the processor name as used in the ELF file header.

Symbol	Processor
M32	AT&T WE 32100
SPARC	SPARC
386	Intel 80386
486	Intel 80486
860	Intel 80860
68K	Motorola 68000
88K	Motorola 88000

Other processors will be added to the table as necessary. To illustrate, a program could use the following code to "see" the processor-specific information for the WE 32100.

```
#include <libelf.h>
#include <sys/elf_M32.h>
```

Without the `<sys/elf_M32.h>` definition, only the common ELF information would be visible.

NAME

`elf_begin` – make a file descriptor

SYNOPSIS

`cc` [*flag* ...] *file* ... `-lelf` [*library* ...]

```
#include <libelf.h>

Elf *elf_begin(int fildes, Elf_Cmd cmd, Elf *ref);
```

DESCRIPTION

`elf_begin`, `elf_next`, `elf_rand`, and `elf_end` work together to process ELF object files, either individually or as members of archives. After obtaining an ELF descriptor from `elf_begin`, the program may read an existing file, update an existing file, or create a new file. *fildes* is an open file descriptor that `elf_begin` uses for reading or writing. The initial file offset [see `lseek`(2)] is unconstrained, and the resulting file offset is undefined.

cmd may have the following values.

`ELF_C_NULL` When a program sets *cmd* to this value, `elf_begin` returns a null pointer, without opening a new descriptor. *ref* is ignored for this command. See `elf_next`(3E) and the examples below for more information.

`ELF_C_READ` When a program wishes to examine the contents of an existing file, it should set *cmd* to this value. Depending on the value of *ref*, this command examines archive members or entire files. Three cases can occur.

First, if *ref* is a null pointer, `elf_begin` allocates a new ELF descriptor and prepares to process the entire file. If the file being read is an archive, `elf_begin` also prepares the resulting descriptor to examine the initial archive member on the next call to `elf_begin`, as if the program had used `elf_next` or `elf_rand` to "move" to the initial member.

Second, if *ref* is a non-null descriptor associated with an archive file, `elf_begin` lets a program obtain a separate ELF descriptor associated with an individual member. The program should have used `elf_next` or `elf_rand` to position *ref* appropriately (except for the initial member, which `elf_begin` prepares; see the example below). In this case, *fildes* should be the same file descriptor used for the parent archive.

Finally, if *ref* is a non-null ELF descriptor that is not an archive, `elf_begin` increments the number of activations for the descriptor and returns *ref*, without allocating a new descriptor and without changing the descriptor's read/write permissions. To terminate the descriptor for *ref*, the program must call `elf_end` once for each activation. See `elf_next`(3E) and the examples below for more information.

ELF_C_RDWR — This command duplicates the actions of `ELF_C_READ` and additionally allows the program to update the file image [see `elf_update`(3E)]. That is, using `ELF_C_READ` gives a read-only view of the file, while `ELF_C_RDWR` lets the program read *and* write the file. `ELF_C_RDWR` is not valid for archive members. If *ref* is non-null, it must have been created with the `ELF_C_RDWR` command.

ELF_C_WRITE — If the program wishes to ignore previous file contents, presumably to create a new file, it should set *cmd* to this value. *ref* is ignored for this command.

`elf_begin` "works" on all files (including files with zero bytes), providing it can allocate memory for its internal structures and read any necessary information from the file. Programs reading object files thus may call `elf_kind` or `elf_getehdr` to determine the file type (only object files have an ELF header). If the file is an archive with no more members to process, or an error occurs, `elf_begin` returns a null pointer. Otherwise, the return value is a non-null ELF descriptor.

Before the first call to `elf_begin`, a program must call `elf_version` to coordinate versions.

SYSTEM SERVICES

When processing a file, the library decides when to read or write the file, depending on the program's requests. Normally, the library assumes the file descriptor remains usable for the life of the ELF descriptor. If, however, a program must process many files simultaneously and the underlying operating system limits the number of open files, the program can use `elf_cntl` to let it reuse file descriptors. After calling `elf_cntl` with appropriate arguments, the program may close the file descriptor without interfering with the library.

All data associated with an ELF descriptor remain allocated until `elf_end` terminates the descriptor's last activation. After the descriptors have been terminated, the storage is released; attempting to reference such data gives undefined behavior. Consequently, a program that deals with multiple input (or output) files must keep the ELF descriptors active until it finishes with them.

EXAMPLES

A prototype for reading a file appears below. If the file is a simple object file, the program executes the loop one time, receiving a null descriptor in the second iteration. In this case, both `elf` and `arf` will have the same value, the activation count will be two, and the program calls `elf_end` twice to terminate the descriptor. If the file is an archive, the loop processes each archive member in turn, ignoring those that are not object files.

```
if (elf_version(EV_CURRENT) == EV_NONE)
{
        /* library out of date */
        /* recover from error */
}
cmd = ELF_C_READ;
arf = elf_begin(fildes, cmd, (Elf *)0);
while ((elf = elf_begin(fildes, cmd, arf)) != 0)
{
        if ((ehdr = elf32_getehdr(elf)) != 0)
        {
                /* process the file ... */
        }
        cmd = elf_next(elf);
        elf_end(elf);
}
elf_end(arf);
```

Alternatively, the next example illustrates random archive processing. After identifying the file as an archive, the program repeatedly processes archive members of interest. For clarity, this example omits error checking and ignores simple object files. Additionally, this fragment preserves the ELF descriptors for all archive members, because it does not call elf_end to terminate them.

```
elf_version(EV_CURRENT);
arf = elf_begin(fildes, ELF_C_READ, (Elf *)0);
if (elf_kind(arf) != ELF_K_AR)
{
        /* not an archive */
}
/* initial processing */
/* set offset = ... for desired member header */
while (elf_rand(arf, offset) == offset)
{
        if ((elf = elf_begin(fildes, ELF_C_READ, arf)) == 0)
                break;
        if ((ehdr = elf32_getehdr(elf)) != 0)
        {
                /* process archive member ... */
        }
        /* set offset = ... for desired member header */
}
```

The following outline shows how one might create a new ELF file. This example is simplified to show the overall flow.

```
elf_version(EV_CURRENT);
fildes = open("path/name", O_RDWR|O_TRUNC|O_CREAT, 0666);
if ((elf = elf_begin(fildes, ELF_C_WRITE, (Elf *)0)) == 0)
        return;
ehdr = elf32_newehdr(elf);
phdr = elf32_newphdr(elf, count);
scn = elf_newscn(elf);
shdr = elf32_getshdr(scn);
data = elf_newdata(scn);
elf_update(elf, ELF_C_WRITE);
elf_end(elf);
```

Finally, the following outline shows how one might update an existing ELF file. Again, this example is simplified to show the overall flow.

```
elf_version(EV_CURRENT);
fildes = open("path/name", O_RDWR);
elf = elf_begin(fildes, ELF_C_RDWR, (Elf *)0);

/* add new or delete old information ... */

close(creat("path/name", 0666));
elf_update(elf, ELF_C_WRITE);
elf_end(elf);
```

In the example above, the call to `creat` truncates the file, thus ensuring the resulting file will have the "right" size. Without truncation, the updated file might be as big as the original, even if information were deleted.

SEE ALSO

`cof2elf`(1), `creat`(2), `lseek`(2), `open`(2), `elf`(3E), `elf_cntl`(3E), `elf_end`(3E), `elf_getarhdr`(3E), `elf_getbase`(3E), `elf_getdata`(3E), `elf_getehdr`(3E), `elf_getphdr`(3E), `elf_getscn`(3E), `elf_kind`(3E), `elf_next`(3E), `elf_rand`(3E), `elf_rawfile`(3E), `elf_update`(3E), `elf_version`(3E), `ar`(4)

NOTES

COFF is an object file format that preceded ELF. When a program calls `elf_begin` on a COFF file, the library translates COFF structures to their ELF equivalents, allowing programs to read (but not to write) a COFF file as if it were ELF. This conversion happens only to the memory image and not to the file itself. After the initial `elf_begin`, file offsets and addresses in the ELF header, the program headers, and the section headers retain the original COFF values [see `elf_getehdr`, `elf_getphdr`, and `elf_getshdr`]. A program may call `elf_update` to adjust these values (without writing the file), and the library will then present a consistent, ELF view of the file. Data obtained through `elf_getdata` are translated (the COFF symbol table is presented as ELF, etc.). Data viewed through `elf_rawdata` undergo no conversion, allowing the program to view the bytes from the file itself.

Some COFF debugging information is not translated, though this does not affect the semantics of a running program.

Although the ELF library supports COFF, programmers are strongly encouraged to recompile their programs, obtaining ELF object files.

NAME

elf_cntl – control a file descriptor

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

`#include <libelf.h>`

`int elf_cntl(Elf *elf, Elf_Cmd cmd);`

DESCRIPTION

`elf_cntl` instructs the library to modify its behavior with respect to an ELF descriptor, *elf*. As `elf_begin`(3E) describes, an ELF descriptor can have multiple activations, and multiple ELF descriptors may share a single file descriptor. Generally, `elf_cntl` commands apply to all activations of *elf*. Moreover, if the ELF descriptor is associated with an archive file, descriptors for members within the archive will also be affected as described below. Unless stated otherwise, operations on archive members do not affect the descriptor for the containing archive.

The *cmd* argument tells what actions to take and may have the following values.

`ELF_C_FDDONE`
: This value tells the library not to use the file descriptor associated with *elf*. A program should use this command when it has requested all the information it cares to use and wishes to avoid the overhead of reading the rest of the file. The memory for all completed operations remains valid, but later file operations, such as the initial `elf_getdata` for a section, will fail if the data are not in memory already.

`ELF_C_FDREAD`
: This command is similar to `ELF_C_FDDONE`, except it forces the library to read the rest of the file. A program should use this command when it must close the file descriptor but has not yet read everything it needs from the file. After `elf_cntl` completes the `ELF_C_FDREAD` command, future operations, such as `elf_getdata`, will use the memory version of the file without needing to use the file descriptor.

If `elf_cntl` succeeds, it returns zero. Otherwise *elf* was null or an error occurred, and the function returns -1.

SEE ALSO

`elf`(3E), `elf_begin`(3E), `elf_getdata`(3E), `elf_rawfile`(3E).

NOTE

If the program wishes to use the "raw" operations [see `elf_rawdata`, which `elf_getdata`(3E) describes, and `elf_rawfile`(3E)] after disabling the file descriptor with `ELF_C_FDDONE` or `ELF_C_FDREAD`, it must execute the raw operations explicitly beforehand. Otherwise, the raw file operations will fail. Calling `elf_rawfile` makes the entire image available, thus supporting subsequent `elf_rawdata` calls.

NAME

elf_end – finish using an object file

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

int elf_end(Elf *elf);
```

DESCRIPTION

A program uses elf_end to terminate an ELF descriptor, *elf*, and to deallocate data associated with the descriptor. Until the program terminates a descriptor, the data remain allocated. *elf* should be a value previously returned by elf_begin; a null pointer is allowed as an argument, to simplify error handling. If the program wishes to write data associated with the ELF descriptor to the file, it must use elf_update before calling elf_end.

As elf_begin(3E) explains, a descriptor can have more than one activation. Calling elf_end removes one activation and returns the remaining activation count. The library does not terminate the descriptor until the activation count reaches zero. Consequently, a zero return value indicates the ELF descriptor is no longer valid.

SEE ALSO

elf(3E), elf_begin(3E), elf_update(3E).

NAME

elf_errmsg, elf_errno – error handling

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

const char *elf_errmsg(int err);
int elf_errno(void);
```

DESCRIPTION

If an ELF library function fails, a program may call elf_errno to retrieve the library's internal error number. As a side effect, this function resets the internal error number to zero, which indicates no error.

elf_errmsg takes an error number, *err*, and returns a null-terminated error message (with no trailing new-line) that describes the problem. A zero *err* retrieves a message for the most recent error. If no error has occurred, the return value is a null pointer (not a pointer to the null string). Using *err* of −1 also retrieves the most recent error, except it guarantees a non-null return value, even when no error has occurred. If no message is available for the given number, elf_errmsg returns a pointer to an appropriate message. This function does not have the side effect of clearing the internal error number.

EXAMPLE

The following fragment clears the internal error number and checks it later for errors. Unless an error occurs after the first call to elf_errno, the next call will return zero.

```
(void)elf_errno();
while (more_to_do)
{
        /* processing ... */
        if ((err = elf_errno()) != 0)
        {
                msg = elf_errmsg(err);
                /* print msg */
        }
}
```

SEE ALSO

elf(3E), elf_version(3E).

NAME

elf_fill − set fill byte

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

void elf_fill(int fill);
```

DESCRIPTION

Alignment constraints for ELF files sometimes require the presence of "holes." For example, if the data for one section are required to begin on an eight-byte boundary, but the preceding section is too "short," the library must fill the intervening bytes. These bytes are set to the *fill* character. The library uses zero bytes unless the application supplies a value. See **elf_getdata**(3E) for more information about these holes.

SEE ALSO

elf(3E), **elf_getdata**(3E), **elf_flag**(3E), **elf_update**(3E).

NOTE

An application can assume control of the object file organization by setting the ELF_F_LAYOUT bit [see **elf_flag**(3E)]. When this is done, the library does *not* fill holes.

NAME

`elf_flagdata`, `elf_flagehdr`, `elf_flagelf`, `elf_flagphdr`, `elf_flagscn`, `elf_flagshdr` – manipulate flags

SYNOPSIS

cc [*flag* ...] *file* ... `-lelf` [*library* ...]

```
#include <libelf.h>

unsigned elf_flagdata(Elf_Data *data, Elf_Cmd cmd, unsigned flags);

unsigned elf_flagehdr(Elf *elf, Elf_Cmd cmd, unsigned flags);

unsigned elf_flagelf(Elf *elf, Elf_Cmd cmd, unsigned flags);

unsigned elf_flagphdr(Elf *elf, Elf_Cmd cmd, unsigned flags);

unsigned elf_flagscn(Elf_Scn *scn, Elf_Cmd cmd, unsigned flags);

unsigned elf_flagshdr(Elf_Scn *scn, Elf_Cmd cmd, unsigned flags);
```

DESCRIPTION

These functions manipulate the flags associated with various structures of an ELF file. Given an ELF descriptor (*elf*), a data descriptor (*data*), or a section descriptor (*scn*), the functions may set or clear the associated status bits, returning the updated bits. A null descriptor is allowed, to simplify error handling; all functions return zero for this degenerate case.

cmd may have the following values.

`ELF_C_CLR` The functions clear the bits that are asserted in *flags*. Only the non-zero bits in *flags* are cleared; zero bits do not change the status of the descriptor.

`ELF_C_SET` The functions set the bits that are asserted in *flags*. Only the non-zero bits in *flags* are set; zero bits do not change the status of the descriptor.

Descriptions of the defined *flags* bits appear below.

`ELF_F_DIRTY` When the program intends to write an ELF file, this flag asserts the associated information needs to be written to the file. Thus, for example, a program that wished to update the ELF header of an existing file would call `elf_flagehdr` with this bit set in *flags* and *cmd* equal to `ELF_C_SET`. A later call to `elf_update` would write the marked header to the file.

`ELF_F_LAYOUT` Normally, the library decides how to arrange an output file. That is, it automatically decides where to place sections, how to align them in the file, etc. If this bit is set for an ELF descriptor, the program assumes responsibility for determining all file positions. This bit is meaningful only for `elf_flagelf` and applies to the entire file associated with the descriptor.

When a flag bit is set for an item, it affects all the subitems as well. Thus, for example, if the program sets the ELF_F_DIRTY bit with elf_flagelf, the entire logical file is "dirty."

EXAMPLE

The following fragment shows how one might mark the ELF header to be written to the output file.

```
ehdr = elf32_getehdr(elf);
/* dirty ehdr ... */
elf_flagehdr(elf, ELF_C_SET, ELF_F_DIRTY);
```

SEE ALSO

elf(3E), elf_end(3E), elf_getdata(3E), elf_getehdr(3E), elf_update(3E).

NAME

elf_fsize: elf32_fsize – return the size of an object file type

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

size_t elf32_fsize(Elf_Type type, size_t count, unsigned ver);
```

DESCRIPTION

elf32_fsize gives the size in bytes of the 32-bit file representation of *count* data objects with the given *type*. The library uses version *ver* to calculate the size [see elf(3E) and elf_version(3E)].

Constant values are available for the sizes of fundamental types.

Elf_Type	File Size	Memory Size
ELF_T_ADDR	ELF32_FSZ_ADDR	sizeof(Elf32_Addr)
ELF_T_BYTE	1	sizeof(unsigned char)
ELF_T_HALF	ELF32_FSZ_HALF	sizeof(Elf32_Half)
ELT_T_OFF	ELF32_FSZ_OFF	sizeof(Elf32_Off)
ELF_T_SWORD	ELF32_FSZ_SWORD	sizeof(Elf32_Sword)
ELF_T_WORD	ELF32_FSZ_WORD	sizeof(Elf32_Word)

elf32_fsize returns zero if the value of *type* or *ver* is unknown. See elf_xlate(3E) for a list of the *type* values.

SEE ALSO

elf(3E), elf_version(3E), elf_xlate(3E).

NAME

elf_getarhdr – retrieve archive member header

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

Elf_Arhdr *elf_getarhdr(Elf *elf);
```

DESCRIPTION

elf_getarhdr returns a pointer to an archive member header, if one is available for the ELF descriptor *elf*. Otherwise, no archive member header exists, an error occurred, or *elf* was null; elf_getarhdr then returns a null value. The header includes the following members.

```
char            *ar_name;
time_t          ar_date;
long            ar_uid;
long            ar_gid;
unsigned long   ar_mode;
off_t           ar_size;
char            *ar_rawname;
```

An archive member name, available through ar_name, is a null-terminated string, with the ar format control characters removed. The ar_rawname member holds a null-terminated string that represents the original name bytes in the file, including the terminating slash and trailing blanks as specified in the archive format.

In addition to "regular" archive members, the archive format defines some special members. All special member names begin with a slash (/), distinguishing them from regular members (whose names may not contain a slash). These special members have the names (ar_name) defined below.

/ This is the archive symbol table. If present, it will be the first archive member. A program may access the archive symbol table through elf_getarsym. The information in the symbol table is useful for random archive processing [see elf_rand(3E)].

// This member, if present, holds a string table for long archive member names. An archive member's header contains a 16-byte area for the name, which may be exceeded in some file systems. The library automatically retrieves long member names from the string table, setting ar_name to the appropriate value.

Under some error conditions, a member's name might not be available. Although this causes the library to set ar_name to a null pointer, the ar_rawname member will be set as usual.

SEE ALSO

elf(3E), elf_begin(3E), elf_getarsym(3E), elf_rand(3E), ar(4).

NAME

elf_getarsym – retrieve archive symbol table

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

Elf_Arsym *elf_getarsym(Elf *elf, size_t *ptr);
```

DESCRIPTION

elf_getarsym returns a pointer to the archive symbol table, if one is available for the ELF descriptor *elf*. Otherwise, the archive doesn't have a symbol table, an error occurred, or *elf* was null; elf_getarsym then returns a null value. The symbol table is an array of structures that include the following members.

```
char            *as_name;
size_t          as_off;
unsigned long   as_hash;
```

These members have the following semantics.

as_name A pointer to a null-terminated symbol name resides here.

as_off This value is a byte offset from the beginning of the archive to the member's header. The archive member residing at the given offset defines the associated symbol. Values in as_off may be passed as arguments to elf_rand to access the desired archive member.

as_hash This is a hash value for the name, as computed by elf_hash.

If *ptr* is non-null, the library stores the number of table entries in the location to which *ptr* points. This value is set to zero when the return value is null. The table's last entry, which is included in the count, has a null as_name, a zero value for as_off, and ~0UL for as_hash.

SEE ALSO

elf(3E), elf_getarhdr(3E), elf_hash(3E), elf_rand(3E), ar(4).

NAME

`elf_getbase` – get the base offset for an object file

SYNOPSIS

cc [*flag* ...] *file* ... `-lelf` [*library* ...]

```
#include <libelf.h>

off_t elf_getbase(Elf *elf);
```

DESCRIPTION

`elf_getbase` returns the file offset of the first byte of the file or archive member associated with *elf*, if it is known or obtainable, and −1 otherwise. A null *elf* is allowed, to simplify error handling; the return value in this case is −1. The base offset of an archive member is the beginning of the member's information, *not* the beginning of the archive member header.

SEE ALSO

`elf`(3E), `elf_begin`(3E), `ar`(4).

NAME

elf_getdata, elf_newdata, elf_rawdata – get section data

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

Elf_Data *elf_getdata(Elf_Scn *scn, Elf_Data *data);

Elf_Data *elf_newdata(Elf_Scn *scn);

Elf_Data *elf_rawdata(Elf_Scn *scn, Elf_Data *data);
```

DESCRIPTION

These functions access and manipulate the data associated with a section descriptor, *scn*. When reading an existing file, a section will have a single data buffer associated with it. A program may build a new section in pieces, however, composing the new data from multiple data buffers. For this reason, "the" data for a section should be viewed as a list of buffers, each of which is available through a data descriptor.

elf_getdata lets a program step through a section's data list. If the incoming data descriptor, *data*, is null, the function returns the first buffer associated with the section. Otherwise, *data* should be a data descriptor associated with *scn*, and the function gives the program access to the next data element for the section. If *scn* is null or an error occurs, elf_getdata returns a null pointer.

elf_getdata translates the data from file representations into memory representations [see elf_xlate(3E)] and presents objects with memory data types to the program, based on the file's *class* [see elf(3E)]. The working library version [see elf_version(3E)] specifies what version of the memory structures the program wishes elf_getdata to present.

elf_newdata creates a new data descriptor for a section, appending it to any data elements already associated with the section. As described below, the new data descriptor appears empty, indicating the element holds no data. For convenience, the descriptor's type (d_type below) is set to ELF_T_BYTE, and the version (d_version below) is set to the working version. The program is responsible for setting (or changing) the descriptor members as needed. This function implicitly sets the ELF_F_DIRTY bit for the section's data [see elf_flag(3E)]. If *scn* is null or an error occurs, elf_newdata returns a null pointer.

elf_rawdata differs from elf_getdata by returning only uninterpreted bytes, regardless of the section type. This function typically should be used only to retrieve a section image from a file being read, and then only when a program must avoid the automatic data translation described below. Moreover, a program may not close or disable [see elf_cntl(3E)] the file descriptor associated with *elf* before the initial raw operation, because elf_rawdata might read the data from the file to ensure it doesn't interfere with elf_getdata. See elf_rawfile(3E) for a related facility that applies to the entire file. When elf_getdata provides the right translation, its use is recommended over elf_rawdata. If *scn* is null or an error occurs, elf_rawdata returns a null pointer.

The `Elf_Data` structure includes the following members.

```
void            *d_buf;
Elf_Type        d_type;
size_t          d_size;
off_t           d_off;
size_t          d_align;
unsigned        d_version;
```

These members are available for direct manipulation by the program. Descriptions appear below.

`d_buf` A pointer to the data buffer resides here. A data element with no data has a null pointer.

`d_type` This member's value specifies the type of the data to which `d_buf` points. A section's type determines how to interpret the section contents, as summarized below.

`d_size` This member holds the total size, in bytes, of the memory occupied by the data. This may differ from the size as represented in the file. The size will be zero if no data exist. [See the discussion of `SHT_NOBITS` below for more information.]

`d_off` This member gives the offset, within the section, at which the buffer resides. This offset is relative to the file's section, not the memory object's.

`d_align` This member holds the buffer's required alignment, from the beginning of the section. That is, `d_off` will be a multiple of this member's value. For example, if this member's value is four, the beginning of the buffer will be four-byte aligned within the section. Moreover, the entire section will be aligned to the maximum of its constituents, thus ensuring appropriate alignment for a buffer within the section and within the file.

`d_version` This member holds the version number of the objects in the buffer. When the library originally read the data from the object file, it used the working version to control the translation to memory objects.

DATA ALIGNMENT

As mentioned above, data buffers within a section have explicit alignment constraints. Consequently, adjacent buffers sometimes will not abut, causing "holes" within a section. Programs that create output files have two ways of dealing with these holes.

First, the program can use `elf_fill` to tell the library how to set the intervening bytes. When the library must generate gaps in the file, it uses the fill byte to initialize the data there. The library's initial fill value is zero, and `elf_fill` lets the application change that.

Second, the application can generate its own data buffers to occupy the gaps, filling the gaps with values appropriate for the section being created. A program might even use different fill values for different sections. For example, it could set text sections' bytes to no-operation instructions, while filling data section holes with zero. Using this technique, the library finds no holes to fill, because the application eliminated them.

SECTION AND MEMORY TYPES

`elf_getdata` interprets sections' data according to the section type, as noted in the section header available through `elf_getshdr`. The following table shows the section types and how the library represents them with memory data types for the 32-bit file class. Other classes would have similar tables. By implication, the memory data types control translation by `elf_xlate`.

Section Type	`Elf_Type`	32-Bit Type
SHT_DYNAMIC	ELF_T_DYN	Elf32_Dyn
SHT_DYNSYM	ELF_T_SYM	Elf32_Sym
SHT_HASH	ELF_T_WORD	Elf32_Word
SHT_NOBITS	ELF_T_BYTE	unsigned char
SHT_NOTE	ELF_T_BYTE	unsigned char
SHT_NULL	*none*	*none*
SHT_PROGBITS	ELF_T_BYTE	unsigned char
SHT_REL	ELF_T_REL	Elf32_Rel
SHT_RELA	ELF_T_RELA	Elf32_Rela
SHT_STRTAB	ELF_T_BYTE	unsigned char
SHT_SYMTAB	ELF_T_SYM	Elf32_Sym
other	ELF_T_BYTE	unsigned char

`elf_rawdata` creates a buffer with type ELF_T_BYTE.

As mentioned above, the program's working version controls what structures the library creates for the application. The library similarly interprets section types according to the versions. If a section type "belongs" to a version newer than the application's working version, the library does not translate the section data. Because the application cannot know the data format in this case, the library presents an untranslated buffer of type ELF_T_BYTE, just as it would for an unrecognized section type.

A section with a special type, `SHT_NOBITS`, occupies no space in an object file, even when the section header indicates a non-zero size. `elf_getdata` and `elf_rawdata` "work" on such a section, setting the *data* structure to have a null buffer pointer and the type indicated above. Although no data are present, the `d_size` value is set to the size from the section header. When a program is creating a new section of type `SHT_NOBITS`, it should use `elf_newdata` to add data buffers to the section. These "empty" data buffers should have the `d_size` members set to the desired size and the `d_buf` members set to null.

EXAMPLE

The following fragment obtains the string table that holds section names (ignoring error checking). See `elf_strptr`(3E) for a variation of string table handling.

```
ehdr = elf32_getehdr(elf);
scn = elf_getscn(elf, (size_t)ehdr->e_shstrndx);
shdr = elf32_getshdr(scn);
if (shdr->sh_type != SHT_STRTAB)
{
        /* not a string table */
}
data = 0;
if ((data = elf_getdata(scn, data)) == 0 || data->d_size == 0)
{
        /* error or no data */
}
```

The `e_shstrndx` member in an ELF header holds the section table index of the string table. The program gets a section descriptor for that section, verifies it is a string table, and then retrieves the data. When this fragment finishes, `data->d_buf` points at the first byte of the string table, and `data->d_size` holds the string table's size in bytes.

SEE ALSO

`elf`(3E), `elf_cntl`(3E), `elf_fill`(3E), `elf_flag`(3E), `elf_getehdr`(3E), `elf_getscn`(3E), `elf_getshdr`(3E), `elf_rawfile`(3E), `elf_version`(3E), `elf_xlate`(3E).

NAME

elf_getehdr: elf32_getehdr, elf32_newehdr − retrieve class-dependent object file header

SYNOPSIS

cc [*flag* ...] *file* ... −lelf [*library* ...]

```
#include <libelf.h>

Elf32_Ehdr *elf32_getehdr(Elf *elf);

Elf32_Ehdr *elf32_newehdr(Elf *elf);
```

DESCRIPTION

For a 32-bit class file, elf32_getehdr returns a pointer to an ELF header, if one is available for the ELF descriptor *elf*. If no header exists for the descriptor, elf32_newehdr allocates a "clean" one, but it otherwise behaves the same as elf32_getehdr. It does not allocate a new header if one exists already. If no header exists (for elf_getehdr), one cannot be created (for elf_newehdr), a system error occurs, the file is not a 32-bit class file, or *elf* is null, both functions return a null pointer.

The header includes the following members.

```
unsigned char   e_ident[EI_NIDENT];
Elf32_Half      e_type;
Elf32_Half      e_machine;
Elf32_Word      e_version;
Elf32_Addr      e_entry;
Elf32_Off       e_phoff;
Elf32_Off       e_shoff;
Elf32_Word      e_flags;
Elf32_Half      e_ehsize;
Elf32_Half      e_phentsize;
Elf32_Half      e_phnum;
Elf32_Half      e_shentsize;
Elf32_Half      e_shnum;
Elf32_Half      e_shstrndx;
```

elf32_newehdr automatically sets the ELF_F_DIRTY bit [see elf_flag(3E)]. A program may use elf_getident to inspect the identification bytes from a file.

SEE ALSO

elf(3E), elf_begin(3E), elf_flag(3E), elf_getident(3E).

NAME

elf_getident – retrieve file identification data

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

char *elf_getident(Elf *elf, size_t *ptr);
```

DESCRIPTION

As elf(3E) explains, ELF provides a framework for various classes of files, where basic objects may have 32 bits, 64 bits, etc. To accommodate these differences, without forcing the larger sizes on smaller machines, the initial bytes in an ELF file hold identification information common to all file classes. Every ELF header's e_ident has EI_NIDENT bytes with the following interpretation.

e_ident Index	Value	Purpose
EI_MAG0 EI_MAG1 EI_MAG2 EI_MAG3	ELFMAG0 ELFMAG1 ELFMAG2 ELFMAG3	File identification
EI_CLASS	ELFCLASSNONE ELFCLASS32 ELFCLASS64	File class
EI_DATA	ELFDATANONE ELFDATA2LSB ELFDATA2MSB	Data encoding
EI_VERSION	EV_CURRENT	File version
7–15	0	Unused, set to zero

Other kinds of files [see elf_kind(3E)] also may have identification data, though they would not conform to e_ident.

elf_getident returns a pointer to the file's "initial bytes." If the library recognizes the file, a conversion from the file image to the memory image may occur. In any case, the identification bytes are guaranteed not to have been modified, though the size of the unmodified area depends on the file type. If *ptr* is non-null, the library stores the number of identification bytes in the location to which *ptr* points. If no data are present, *elf* is null, or an error occurs, the return value is a null pointer, with zero optionally stored through *ptr*.

SEE ALSO

elf(3E), elf_begin(3E), elf_getehdr(3E), elf_kind(3E), elf_rawfile(3E).

NAME

elf_getphdr: elf32_getphdr, elf32_newphdr − retrieve class-dependent program header table

SYNOPSIS

cc [*flag* ...] *file* ... −lelf [*library* ...]

```
#include &lt;libelf.h&gt;

Elf32_Phdr *elf32_getphdr(Elf *elf);

Elf32_Phdr *elf32_newphdr(Elf *elf, size_t count);
```

DESCRIPTION

For a 32-bit class file, elf32_getphdr returns a pointer to the program execution header table, if one is available for the ELF descriptor *elf*.

elf32_newphdr allocates a new table with *count* entries, regardless of whether one existed previously, and sets the **ELF_F_DIRTY** bit for the table [see elf_flag(3E)]. Specifying a zero *count* deletes an existing table. Note this behavior differs from that of elf32_newehdr [see elf32_getehdr(3E)], allowing a program to replace or delete the program header table, changing its size if necessary.

If no program header table exists, the file is not a 32-bit class file, an error occurs, or *elf* is null, both functions return a null pointer. Additionally, elf32_newphdr returns a null pointer if *count* is zero.

The table is an array of Elf32_Phdr structures, each of which includes the following members.

```
Elf32_Word      p_type;
Elf32_Off       p_offset;
Elf32_Addr      p_vaddr;
Elf32_Addr      p_paddr;
Elf32_Word      p_filesz;
Elf32_Word      p_memsz;
Elf32_Word      p_flags;
Elf32_Word      p_align;
```

The ELF header's e_phnum member tells how many entries the program header table has [see elf_getehdr(3E)]. A program may inspect this value to determine the size of an existing table; elf32_newphdr automatically sets the member's value to *count*. If the program is building a new file, it is responsible for creating the file's ELF header before creating the program header table.

SEE ALSO

elf(3E), elf_begin(3E), elf_flag(3E), elf_getehdr(3E).

NAME

elf_getscn, elf_ndxscn, elf_newscn, elf_nextscn – get section information

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

Elf_Scn *elf_getscn(Elf *elf, size_t index);

size_t elf_ndxscn(Elf_Scn *scn);

Elf_Scn *elf_newscn(Elf *elf);

Elf_Scn *elf_nextscn(Elf *elf, Elf_Scn *scn);
```

DESCRIPTION

These functions provide indexed and sequential access to the sections associated with the ELF descriptor *elf*. If the program is building a new file, it is responsible for creating the file's ELF header before creating sections; see elf_getehdr(3E).

elf_getscn returns a section descriptor, given an *index* into the file's section header table. Note the first "real" section has index 1. Although a program can get a section descriptor for the section whose *index* is 0 (SHN_UNDEF, the undefined section), the section has no data and the section header is "empty" (though present). If the specified section does not exist, an error occurs, or *elf* is null, elf_getscn returns a null pointer.

elf_newscn creates a new section and appends it to the list for *elf*. Because the SHN_UNDEF section is required and not "interesting" to applications, the library creates it automatically. Thus the first call to elf_newscn for an ELF descriptor with no existing sections returns a descriptor for section 1. If an error occurs or *elf* is null, elf_newscn returns a null pointer.

After creating a new section descriptor, the program can use elf_getshdr to retrieve the newly created, "clean" section header. The new section descriptor will have no associated data [see elf_getdata(3E)]. When creating a new section in this way, the library updates the e_shnum member of the ELF header and sets the ELF_F_DIRTY bit for the section [see elf_flag(3E)]. If the program is building a new file, it is responsible for creating the file's ELF header [see elf_getehdr(3E)] before creating new sections.

elf_nextscn takes an existing section descriptor, *scn*, and returns a section descriptor for the next higher section. One may use a null *scn* to obtain a section descriptor for the section whose index is 1 (skipping the section whose index is SHN_UNDEF). If no further sections are present or an error occurs, elf_nextscn returns a null pointer.

elf_ndxscn takes an existing section descriptor, *scn*, and returns its section table index. If *scn* is null or an error occurs, elf_ndxscn returns SHN_UNDEF.

EXAMPLE

An example of sequential access appears below. Each pass through the loop processes the next section in the file; the loop terminates when all sections have been processed.

```
scn = 0;
while ((scn = elf_nextscn(elf, scn)) != 0)
{
        /* process section */
}
```

SEE ALSO

elf(3E), elf_begin(3E), elf_flag(3E), elf_getdata(3E), elf_getehdr(3E), elf_getshdr(3E).

NAME

elf_getshdr: elf32_getshdr – retrieve class-dependent section header

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

#include <libelf.h>

Elf32_Shdr *elf32_getshdr(Elf_Scn *scn);

DESCRIPTION

For a 32-bit class file, elf32_getshdr returns a pointer to a section header for the section descriptor *scn*. Otherwise, the file is not a 32-bit class file, *scn* was null, or an error occurred; elf32_getshdr then returns null.

The header includes the following members.

```
Elf32_Word      sh_name;
Elf32_Word      sh_type;
Elf32_Word      sh_flags;
Elf32_Addr      sh_addr;
Elf32_Off       sh_offset;
Elf32_Word      sh_size;
Elf32_Word      sh_link;
Elf32_Word      sh_info;
Elf32_Word      sh_addralign;
Elf32_Word      sh_entsize;
```

If the program is building a new file, it is responsible for creating the file's ELF header before creating sections.

SEE ALSO

elf(3E), elf_flag(3E), elf_getscn(3E), elf_strptr(3E).

NAME

`elf_hash` – compute hash value

SYNOPSIS

cc [*flag* ...] *file* ... `-lelf` [*library* ...]

```
#include <libelf.h>

unsigned long elf_hash(const char *name);
```

DESCRIPTION

`elf_hash` computes a hash value, given a null terminated string, *name*. The returned hash value, *h*, can be used as a bucket index, typically after computing *h* mod *x* to ensure appropriate bounds.

Hash tables may be built on one machine and used on another because `elf_hash` uses unsigned arithmetic to avoid possible differences in various machines' signed arithmetic. Although *name* is shown as `char*` above, `elf_hash` treats it as `unsigned char*` to avoid sign extension differences. Using `char*` eliminates type conflicts with expressions such as `elf_hash("name")`.

ELF files' symbol hash tables are computed using this function [see `elf_getdata`(3E) and `elf_xlate`(3E)]. The hash value returned is guaranteed not to be the bit pattern of all ones (~0UL).

SEE ALSO

`elf`(3E), `elf_getdata`(3E), `elf_xlate`(3E).

NAME

elf_kind – determine file type

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

Elf_Kind elf_kind(Elf *elf);
```

DESCRIPTION

This function returns a value identifying the kind of file associated with an ELF descriptor (*elf*). Currently defined values appear below.

ELF_K_AR — The file is an archive [see ar(4)]. An ELF descriptor may also be associated with an archive *member*, not the archive itself, and then elf_kind identifies the member's type.

ELF_K_COFF — The file is a COFF object file. elf_begin(3E) describes the library's handling for COFF files.

ELF_K_ELF — The file is an ELF file. The program may use elf_getident to determine the class. Other functions, such as elf_getehdr, are available to retrieve other file information.

ELF_K_NONE — This indicates a kind of file unknown to the library.

Other values are reserved, to be assigned as needed to new kinds of files. *elf* should be a value previously returned by elf_begin. A null pointer is allowed, to simplify error handling, and causes elf_kind to return ELF_K_NONE.

SEE ALSO

elf(3E), elf_begin(3E), elf_getehdr(3E), elf_getident(3E), ar(4).

NAME

elf_next − sequential archive member access

SYNOPSIS

cc [*flag* ...] *file* ... −lelf [*library* ...]

```
#include <libelf.h>

Elf_Cmd elf_next(Elf *elf);
```

DESCRIPTION

elf_next, elf_rand, and elf_begin manipulate simple object files and archives. *elf* is an ELF descriptor previously returned from elf_begin.

elf_next provides sequential access to the next archive member. That is, having an ELF descriptor, *elf*, associated with an archive member, elf_next prepares the containing archive to access the following member when the program calls elf_begin. After successfully positioning an archive for the next member, elf_next returns the value ELF_C_READ. Otherwise, the open file was not an archive, *elf* was null, or an error occurred, and the return value is ELF_C_NULL. In either case, the return value may be passed as an argument to elf_begin, specifying the appropriate action.

SEE ALSO

elf(3E), elf_begin(3E), elf_getarsym(3E), elf_rand(3E), ar(4).

NAME

elf_rand – random archive member access

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

`#include <libelf.h>`

`size_t elf_rand(Elf *elf, size_t offset);`

DESCRIPTION

elf_rand, elf_next, and elf_begin manipulate simple object files and archives. *elf* is an ELF descriptor previously returned from elf_begin.

elf_rand provides random archive processing, preparing *elf* to access an arbitrary archive member. *elf* must be a descriptor for the archive itself, not a member within the archive. *offset* gives the byte offset from the beginning of the archive to the archive header of the desired member. See elf_getarsym(3E) for more information about archive member offsets. When elf_rand works, it returns *offset*. Otherwise it returns 0, because an error occurred, *elf* was null, or the file was not an archive (no archive member can have a zero offset). A program may mix random and sequential archive processing.

EXAMPLE

An archive starts with a "magic string" that has SARMAG bytes; the initial archive member follows immediately. An application could thus provide the following function to rewind an archive (the function returns −1 for errors and 0 otherwise).

```
#include <ar.h>
#include <libelf.h>

int
rewindelf(Elf *elf)
{
        if (elf_rand(elf, (size_t)SARMAG) == SARMAG)
                return 0;
        return -1;
}
```

SEE ALSO

elf(3E), elf_begin(3E), elf_getarsym(3E), elf_next(3E), ar(4).

NAME

elf_rawfile – retrieve uninterpreted file contents

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

`#include <libelf.h>`

`char *elf_rawfile(Elf *elf, size_t *ptr);`

DESCRIPTION

elf_rawfile returns a pointer to an uninterpreted byte image of the file. This function should be used only to retrieve a file being read. For example, a program might use elf_rawfile to retrieve the bytes for an archive member.

A program may not close or disable [see elf_cntl(3E)] the file descriptor associated with *elf* before the initial call to elf_rawfile, because elf_rawfile might have to read the data from the file if it does not already have the original bytes in memory. Generally, this function is more efficient for unknown file types than for object files. The library implicitly translates object files in memory, while it leaves unknown files unmodified. Thus asking for the uninterpreted image of an object file may create a duplicate copy in memory.

elf_rawdata [see elf_getdata(3E)] is a related function, providing access to sections within a file.

If *ptr* is non-null, the library also stores the file's size, in bytes, in the location to which *ptr* points. If no data are present, *elf* is null, or an error occurs, the return value is a null pointer, with zero optionally stored through *ptr*.

SEE ALSO

elf(3E), elf_begin(3E), elf_cntl(3E), elf_getdata(3E), elf_getehdr(3E), elf_getident(3E), elf_kind(3E).

NOTE

A program that uses elf_rawfile and that also interprets the same file as an object file potentially has two copies of the bytes in memory. If such a program requests the raw image first, before it asks for translated information (through such functions as elf_getehdr, elf_getdata, and so on), the library "freezes" its original memory copy for the raw image. It then uses this frozen copy as the source for creating translated objects, without reading the file again. Consequently, the application should view the raw file image returned by elf_rawfile as a read-only buffer, unless it wants to alter its own view of data subsequently translated. In any case, the application may alter the translated objects without changing bytes visible in the raw image.

Multiple calls to elf_rawfile with the same ELF descriptor return the same value; the library does not create duplicate copies of the file.

NAME

elf_strptr – make a string pointer

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

char *elf_strptr(Elf *elf, size_t section, size_t offset);
```

DESCRIPTION

This function converts a string section *offset* to a string pointer. *elf* identifies the file in which the string section resides, and *section* gives the section table index for the strings. elf_strptr normally returns a pointer to a string, but it returns a null pointer when *elf* is null, *section* is invalid or is not a section of type SHT_STRTAB, the section data cannot be obtained, *offset* is invalid, or an error occurs.

EXAMPLE

A prototype for retrieving section names appears below. The file header specifies the section name string table in the e_shstrndx member. The following code loops through the sections, printing their names.

```
if ((ehdr = elf32_getehdr(elf)) == 0)
{
        /* handle the error */
        return;
}
ndx = ehdr->e_shstrndx;
scn = 0;
while ((scn = elf_nextscn(elf, scn)) != 0)
{
        char    *name = 0;
        if ((shdr = elf32_getshdr(scn)) != 0)
          name = elf_strptr(elf, ndx, (size_t)shdr->sh_name);
        printf("'%s'\n", name? name: "(null)");
}
```

SEE ALSO

elf(3E), elf_getdata(3E), elf_getshdr(3E), elf_xlate(3E).

NOTE

A program may call elf_getdata to retrieve an entire string table section. For some applications, that would be both more efficient and more convenient than using elf_strptr.

NAME

elf_update – update an ELF descriptor

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

off_t elf_update(Elf *elf, Elf_Cmd cmd);
```

DESCRIPTION

elf_update causes the library to examine the information associated with an ELF descriptor, *elf*, and to recalculate the structural data needed to generate the file's image.

cmd may have the following values.

ELF_C_NULL — This value tells elf_update to recalculate various values, updating only the ELF descriptor's memory structures. Any modified structures are flagged with the ELF_F_DIRTY bit. A program thus can update the structural information and then reexamine them without changing the file associated with the ELF descriptor. Because this does not change the file, the ELF descriptor may allow reading, writing, or both reading and writing [see elf_begin(3E)].

ELF_C_WRITE — If *cmd* has this value, elf_update duplicates its ELF_C_NULL actions and also writes any "dirty" information associated with the ELF descriptor to the file. That is, when a program has used elf_getdata or the elf_flag facilities to supply new (or update existing) information for an ELF descriptor, those data will be examined, coordinated, translated if necessary [see elf_xlate(3E)], and written to the file. When portions of the file are written, any ELF_F_DIRTY bits are reset, indicating those items no longer need to be written to the file [see elf_flag(3E)]. The sections' data are written in the order of their section header entries, and the section header table is written to the end of the file.

When the ELF descriptor was created with elf_begin, it must have allowed writing the file. That is, the elf_begin command must have been either ELF_C_RDWR or ELF_C_WRITE.

If elf_update succeeds, it returns the total size of the file image (not the memory image), in bytes. Otherwise an error occurred, and the function returns −1.

When updating the internal structures, elf_update sets some members itself. Members listed below are the application's responsibility and retain the values given by the program.

	Member	Notes
ELF Header	e_ident [EI_DATA]	Library controls other e_ident values
	e_type	
	e_machine	
	e_version	
	e_entry	
	e_phoff	Only when ELF_F_LAYOUT asserted
	e_shoff	Only when ELF_F_LAYOUT asserted
	e_flags	
	e_shstrndx	

	Member	Notes
Program Header	p_type	The application controls all program header entries
	p_offset	
	p_vaddr	
	p_paddr	
	p_filesz	
	p_memsz	
	p_flags	
	p_align	

	Member	Notes
Section Header	sh_name	
	sh_type	
	sh_flags	
	sh_addr	
	sh_offset	Only when ELF_F_LAYOUT asserted
	sh_size	Only when ELF_F_LAYOUT asserted
	sh_link	
	sh_info	
	sh_addralign	Only when ELF_F_LAYOUT asserted
	sh_entsize	

	Member	Notes
Data Descriptor	d_buf d_type d_size d_off d_align d_version	Only when ELF_F_LAYOUT asserted

Note the program is responsible for two particularly important members (among others) in the ELF header. The e_version member controls the version of data structures written to the file. If the version is EV_NONE, the library uses its own internal version. The e_ident[EI_DATA] entry controls the data encoding used in the file. As a special case, the value may be ELFDATANONE to request the native data encoding for the host machine. An error occurs in this case if the native encoding doesn't match a file encoding known by the library.

Further note that the program is responsible for the sh_entsize section header member. Although the library sets it for sections with known types, it cannot reliably know the correct value for all sections. Consequently, the library relies on the program to provide the values for unknown section type. If the entry size is unknown or not applicable, the value should be set to zero.

When deciding how to build the output file, elf_update obeys the alignments of individual data buffers to create output sections. A section's most strictly aligned data buffer controls the section's alignment. The library also inserts padding between buffers, as necessary, to ensure the proper alignment of each buffer.

SEE ALSO

elf(3E), elf_begin(3E), elf_flag(3E), elf_fsize(3E), elf_getdata(3E), elf_getehdr(3E), elf_getshdr(3E), elf_xlate(3E).

NOTE

As mentioned above, the ELF_C_WRITE command translates data as necessary, before writing them to the file. This translation is *not* always transparent to the application program. If a program has obtained pointers to data associated with a file [for example, see elf_getehdr(3E) and elf_getdata(3E)], the program should reestablish the pointers after calling elf_update.

As elf_begin(3E) describes, a program may "update" a COFF file to make the image consistent for ELF . The ELF_C_NULL command updates only the memory image; one can use the ELF_C_WRITE command to modify the file as well. Absolute executable files (a.out files) require special alignment, which cannot normally be preserved between COFF and ELF . Consequently, one may not update an executable COFF file with the ELF_C_WRITE command (though ELF_C_NULL is allowed).

NAME

elf_version – coordinate ELF library and application versions

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <libelf.h>

unsigned elf_version(unsigned ver);
```

DESCRIPTION

As elf(3E) explains, the program, the library, and an object file have independent notions of the "latest" ELF version. elf_version lets a program determine the ELF library's *internal version*. It further lets the program specify what memory types it uses by giving its own *working version, ver*, to the library. Every program that uses the ELF library must coordinate versions as described below.

The header file <libelf.h> supplies the version to the program with the macro EV_CURRENT. If the library's internal version (the highest version known to the library) is lower than that known by the program itself, the library may lack semantic knowledge assumed by the program. Accordingly, elf_version will not accept a working version unknown to the library.

Passing *ver* equal to EV_NONE causes elf_version to return the library's internal version, without altering the working version. If *ver* is a version known to the library, elf_version returns the previous (or initial) working version number. Otherwise, the working version remains unchanged and elf_version returns EV_NONE.

EXAMPLE

The following excerpt from an application program protects itself from using an older library.

```
if (elf_version(EV_CURRENT) == EV_NONE)
{
        /* library out of date */
        /* recover from error */
}
```

NOTES

The working version should be the same for all operations on a particular elf descriptor. Changing the version between operations on a descriptor will probably not give the expected results.

SEE ALSO

elf(3E), elf_begin(3E), elf_xlate(3E).

NAME

elf_xlate: **elf32_xlatetof**, **elf32_xlatetom** – class-dependent data translation

SYNOPSIS

cc [*flag* ...] *file* ... **-lelf** [*library* ...]

```
#include <libelf.h>

Elf_Data *elf32_xlatetof(Elf_Data *dst, const Elf_Data *src,
     unsigned encode);

Elf_Data *elf32_xlatetom(Elf_Data *dst, const Elf_Data *src,
     unsigned encode);
```

DESCRIPTION

elf32_xlatetom translates various data structures from their 32-bit class file representations to their memory representations; **elf32_xlatetof** provides the inverse. This conversion is particularly important for cross development environments. *src* is a pointer to the source buffer that holds the original data; *dst* is a pointer to a destination buffer that will hold the translated copy. *encode* gives the byte encoding in which the file objects are (to be) represented and must have one of the encoding values defined for the ELF header's **e_ident[EI_DATA]** entry [see **elf_getident**(3E)]. If the data can be translated, the functions return *dst*. Otherwise, they return null because an error occurred, such as incompatible types, destination buffer overflow, etc.

elf_getdata(3E) describes the **Elf_Data** descriptor, which the translation routines use as follows.

d_buf Both the source and destination must have valid buffer pointers.

d_type This member's value specifies the type of the data to which **d_buf** points and the type of data to be created in the destination. The program supplies a **d_type** value in the source; the library sets the destination's **d_type** to the same value. These values are summarized below.

d_size This member holds the total size, in bytes, of the memory occupied by the source data and the size allocated for the destination data. If the destination buffer is not large enough, the routines do not change its original contents. The translation routines reset the destination's **d_size** member to the actual size required, after the translation occurs. The source and destination sizes may differ.

d_version This member holds version number of the objects (desired) in the buffer. The source and destination versions are independent.

Translation routines allow the source and destination buffers to coincide. That is, **dst->d_buf** may equal **src->d_buf**. Other cases where the source and destination buffers overlap give undefined behavior.

Elf_Type	32-Bit Memory Type
ELF_T_ADDR	Elf32_Addr
ELF_T_BYTE	unsigned char
ELF_T_DYN	Elf32_Dyn
ELF_T_EHDR	Elf32_Ehdr
ELF_T_HALF	Elf32_Half
ELT_T_OFF	Elf32_Off
ELF_T_PHDR	Elf32_Phdr
ELF_T_REL	Elf32_Rel
ELF_T_RELA	Elf32_Rela
ELF_T_SHDR	Elf32_Shdr
ELF_T_SWORD	Elf32_Sword
ELF_T_SYM	Elf32_Sym
ELF_T_WORD	Elf32_Word

"Translating" buffers of type ELF_T_BYTE does not change the byte order.

SEE ALSO

elf(3E), elf_fsize(3E), elf_getdata(3E), elf_getident(3E).

NAME

nlist − get entries from name list

SYNOPSIS

cc [*flag* ...] *file* ... -lelf [*library* ...]

```
#include <nlist.h>

int nlist (const char *filename, struct nlist *nl);
```

DESCRIPTION

nlist examines the name list in the executable file whose name is pointed to by *filename*, and selectively extracts a list of values and puts them in the array of nlist structures pointed to by *nl*. The name list *nl* consists of an array of structures containing names of variables, types, and values. The list is terminated with a null name, that is, a null string is in the name position of the structure. Each variable name is looked up in the name list of the file. If the name is found, the type, value, storage class, and section number of the name are inserted in the other fields. The type field may be set to 0 if the file was not compiled with the -g option to cc(1). nlist will always return the information for an external symbol of a given name if the name exists in the file. If an external symbol does not exist, and there is more than one symbol with the specified name in the file (such as static symbols defined in separate files), the values returned will be for the last occurrence of that name in the file. If the name is not found, all fields in the structure except n_name are set to 0.

This function is useful for examining the system name list kept in the file /unix. In this way programs can obtain system addresses that are up to date.

SEE ALSO

a.out(4)

DIAGNOSTICS

All value entries are set to 0 if the file cannot be read or if it does not contain a valid name list.

nlist returns 0 on success, −1 on error.

3G

NAME

basename – return the last element of a path name

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

```
#include <libgen.h>

char *basename (char *path);
```

DESCRIPTION

Given a pointer to a null-terminated character string that contains a path name, basename returns a pointer to the last element of *path*. Trailing "/" characters are deleted.

If *path* or **path* is zero, pointer to a static constant "." is returned.

EXAMPLES

Input string	Output pointer
/usr/lib	lib
/usr/	usr
/	/

SEE ALSO

dirname(3G).
basename(1) in the *User's Reference Manual.*

NAME

bgets – read stream up to next delimiter

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

```
#include <libgen.h>

char *bgets (char *buffer, size_t *count, FILE  *stream,
     const char *breakstring);
```

DESCRIPTION

bgets reads characters from *stream* into *buffer* until either *count* is exhausted or one of the characters in *breakstring* is encountered in the stream. The read data is terminated with a null byte ('\0') and a pointer to the trailing null is returned. If a *breakstring* character is encountered, the last non-null is the delimiter character that terminated the scan.

Note that, except for the fact that the returned value points to the end of the read string rather than to the beginning, the call

```
bgets (buffer, sizeof buffer, stream, "\n");
```

is identical to

```
fgets (buffer, sizeof buffer, stream);
```

There is always enough room reserved in the buffer for the trailing null.

If *breakstring* is a null pointer, the value of *breakstring* from the previous call is used. If *breakstring* is null at the first call, no characters will be used to delimit the string.

EXAMPLES

```
#include   <libgen.h>

char buffer[8];
/* read in first user name from /etc/passwd */
fp = fopen("/etc/passwd","r");
bgets(buffer, 8, fp, ":");
```

DIAGNOSTICS

NULL is returned on error or end-of-file. Reporting the condition is delayed to the next call if any characters were read but not yet returned.

SEE ALSO

gets(3S).

NAME

`bufsplit` – split buffer into fields

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

```
#include <libgen.h>

size_t bufsplit (char *buf, size_t n, char **a);
```

DESCRIPTION

`bufsplit` examines the buffer, *buf,* and assigns values to the pointer array, *a,* so that the pointers point to the first *n* fields in *buf* that are delimited by tabs or new-lines.

To change the characters used to separate fields, call `bufsplit` with *buf* pointing to the string of characters, and *n* and *a* set to zero. For example, to use ':', '.', and ',' as separators along with tab and new-line:

```
bufsplit (":.,\t\n", 0, (char**)0 );
```

RETURN VALUE

The number of fields assigned in the array *a*. If *buf* is zero, the return value is zero and the array is unchanged. Otherwise the value is at least one. The remainder of the elements in the array are assigned the address of the null byte at the end of the buffer.

EXAMPLES

```
/*
 * set a[0] = "This", a[1] = "is", a[2] = "a",
 * a[3] = "test"
 */
bufsplit("This\tis\ta\ttest\n", 4, a);
```

NOTES

`bufsplit` changes the delimiters to null bytes in *buf*.

NAME

copylist – copy a file into memory

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

`#include <libgen.h>`

`char *copylist (const char *filenm, off_t *szptr);`

DESCRIPTION

copylist copies a list of items from a file into freshly allocated memory, replacing new-lines with null characters. It expects two arguments: a pointer *filenm* to the name of the file to be copied, and a pointer *szptr* to a variable where the size of the file will be stored.

Upon success, copylist returns a pointer to the memory allocated. Otherwise it returns NULL if it has trouble finding the file, calling malloc, or opening the file.

EXAMPLES

```
/* read "file" into buf */
off_t size;
char *buf;
buf = copylist("file", &size);
for (i = 0; i < size; i++)
      if(buf[i])
            putchar(buf[i]);
      else
            putchar('\n');
```

SEE ALSO

malloc(3C).

NAME

dirname – report the parent directory name of a file path name

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

`#include <libgen.h>`

`char *dirname (char *path);`

DESCRIPTION

Given a pointer to a null-terminated character string that contains a file system path name, dirname returns a pointer to a static constant string that is the parent directory of that file. In doing this, it sometimes places a null byte in the path name after the next to last element, so the content of *path* must be disposable. Trailing "/" characters in the path are not counted as part of the path.

If *path* or **path* is zero, a pointer to a static constant "." is returned.

dirname and basename together yield a complete path name. dirname (*path*) is the directory where basename (*path*) is found.

EXAMPLES

A simple file name and the strings "." and ".." all have "." as their return value.

Input string	Output pointer
/usr/lib	/usr
/usr/	/
usr	.
/	/
.	.
..	.

The following code reads a path name, changes directory to the appropriate directory [see chdir(2)], and opens the file.

```
char path[100], *pathcopy;
int fd;
gets (path);
pathcopy = strdup (path);
chdir (dirname (pathcopy) );
fd = open (basename (path), O_RDONLY);
```

SEE ALSO

chdir(2), basename(3G).
basename(1) in the *User's Reference Manual.*

NAME

gmatch – shell global pattern matching

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

```
#include <libgen.h>

int gmatch (const char *str, const char *pattern);
```

DESCRIPTION

gmatch checks whether the null-terminated string *str* matches the null-terminated pattern string *pattern*. See the sh(1) section "File Name Generation" for a discussion of pattern matching. gmatch returns non-zero if the pattern matches the string, zero if the pattern doesn't. A backslash ('\') is used as an escape character in pattern strings.

EXAMPLE

```
char *s;

gmatch (s, "*[a\-]" )
```

gmatch returns non-zero (true) for all strings with 'a' or '–' as their last character.

SEE ALSO

sh(1) in the *User's Reference Manual*

NAME

isencrypt – determine whether a character buffer is encrypted

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

```
#include <libgen.h>

int isencrypt (const char *fbuf, size_t ninbuf);
```

DESCRIPTION

isencrypt uses heuristics to determine whether a buffer of characters is encrypted. It requires two arguments: a pointer to an array of characters and the number of characters in the buffer.

isencrypt assumes that the file is not encrypted if all the characters in the first block are ASCII characters. If there are non-ASCII characters in the first *ninbuf* characters, isencrypt assumes that the buffer is encrypted if the setlocale LC_CTYPE category is set to C or ascii.

If the LC_CTYPE category is set to a value other than C or ascii, then isencrypt uses a combination of heuristics to determine if the buffer is encrypted. If *ninbuf* has at least 64 characters, a chi-square test is used to determine if the bytes in the buffer have a uniform distribution; and isencrypt assumes the buffer is encrypted if it does. If the buffer has less than 64 characters, a check is made for null characters and a terminating new-line to determine whether the buffer is encrypted.

DIAGNOSTICS

If the buffer is encrypted, 1 is returned; otherwise zero is returned.

SEE ALSO

setlocale(3C).

NAME

mkdirp, rmdirp – create, remove directories in a path

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

`#include <libgen.h>`

`int mkdirp (const char *path, mode_t mode);`

`int rmdirp (char *d, char *d1);`

DESCRIPTION

mkdirp creates all the missing directories in the given *path* with the given *mode*. [See chmod(2) for the values of *mode*.]

rmdirp removes directories in path *d*. This removal starts at the end of the path and moves back toward the root as far as possible. If an error occurs, the remaining path is stored in *d1*. rmdirp returns a 0 only if it is able to remove every directory in the path.

EXAMPLES

```
/* create scratch directories */
if(mkdirp("/tmp/sub1/sub2/sub3", 0755) == -1) {
      fprintf(stderr, "cannot create directory");
      exit(1);
}
chdir("/tmp/sub1/sub2/sub3");
.
.
.
/* cleanup */
chdir("/tmp");
rmdirp("sub1/sub2/sub3");
```

SEE ALSO

mkdir(2), rmdir(2).

DIAGNOSTICS

If a needed directory cannot be created, mkdirp returns −1 and sets errno to one of the mkdir error numbers. If all the directories are created, or existed to begin with, it returns zero.

NOTES

mkdirp uses malloc to allocate temporary space for the string.

rmdirp returns −2 if a "." or ".." is in the path and −3 if an attempt is made to remove the current directory. If an error occurs other than one of the above, −1 is returned.

NAME

p2open, p2close – open, close pipes to and from a command

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

`#include <libgen.h>`

`int p2open (const char *cmd, FILE *fp[2]);`

`int p2close (FILE *fp[2]);`

DESCRIPTION

p2open forks and execs a shell running the command line pointed to by *cmd*. On return, `fp[0]` points to a `FILE` pointer to write the command's standard input and `fp[1]` points to a `FILE` pointer to read from the command's standard output. In this way the program has control over the input and output of the command.

The function returns 0 if successful; otherwise it returns −1.

p2close is used to close the file pointers that p2open opened. It waits for the process to terminate and returns the process status. It returns 0 if successful; otherwise it returns −1.

EXAMPLES

```
#include <stdio.h>
#include <libgen.h>

main(argc,argv)
int argc;
char **argv;
{
      FILE *fp[2];
      pid_t pid;
      char buf[16];

      pid=p2open("/usr/bin/cat", fp);
      if ( pid == 0 ) {
            fprintf(stderr, "p2open failed\n");
            exit(1);
      }
      write(fileno(fp[0]),"This is a test\n", 16);
      if(read(fileno(fp[1]), buf, 16) <=0)
            fprintf(stderr, "p2open failed\n");
      else
            write(1, buf, 16);
      (void)p2close(fp);
}
```

SEE ALSO

fclose(3S), popen(3S), setbuf(3S).

DIAGNOSTICS

A common problem is having too few file descriptors. p2close returns −1 if the two file pointers are not from the same p2open.

NOTES

Buffered writes on `fp[0]` can make it appear that the command is not listening. Judiciously placed **`fflush`** calls or unbuffering `fp[0]` can be a big help; see **`fclose`**(3S).

Many commands use buffered output when connected to a pipe. That, too, can make it appear as if things are not working.

Usage is not the same as for popen, although it is closely related.

NAME

pathfind – search for named file in named directories

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

```
#include <libgen.h>

char *pathfind (const char *path, const char *name, const char
    *mode);
```

DESCRIPTION

pathfind searches the directories named in *path* for the file *name*. The directories named in *path* are separated by semicolons. *mode* is a string of option letters chosen from the set rwxfbcdpugks:

Letter	Meaning
r	readable
w	writable
x	executable
f	normal file
b	block special
c	character special
d	directory
p	FIFO (pipe)
u	set user ID bit
g	set group ID bit
k	sticky bit
s	size nonzero

Options read, write, and execute are checked relative to the real (not the effective) user ID and group ID of the current process.

If the file *name*, with all the characteristics specified by *mode*, is found in any of the directories specified by *path*, then pathfind returns a pointer to a string containing the member of *path*, followed by a slash character (/), followed by *name*.

If *name* begins with a slash, it is treated as an absolute path name, and *path* is ignored.

An empty *path* member is treated as the current directory. ./ is not prepended at the occurrence of the first match; rather, the unadorned *name* is returned.

EXAMPLES

To find the ls command using the PATH environment variable:

```
pathfind (getenv ("PATH"), "ls", "rx")
```

SEE ALSO

access(2), mknod(2), stat(2), getenv(3C).
sh(1), test(1) in the *User's Reference Manual*.

DIAGNOSTICS

If no match is found, pathname returns a null pointer, ((char *) 0).

NOTES

The string pointed to by the returned pointer is stored in a static area that is reused on subsequent calls to `pathfind`.

NAME

regcmp, regex – compile and execute regular expression

SYNOPSIS

```
#include <libgen.h>
```

cc [*flag* ...] *file* ... –lgen [*library* ...]

```
char *regcmp (const char *string1 [, char *string2, . . .],
    (char *)0);

char *regex (const char *re, const char *subject
    [, char *ret0, . . .]);

extern char *__loc1;
```

DESCRIPTION

regcmp compiles a regular expression (consisting of the concatenated arguments) and returns a pointer to the compiled form. malloc(3C) is used to create space for the compiled form. It is the user's responsibility to free unneeded space so allocated. A NULL return from regcmp indicates an incorrect argument. regcmp(1) has been written to generally preclude the need for this routine at execution time.

regex executes a compiled pattern against the subject string. Additional arguments are passed to receive values back. regex returns NULL on failure or a pointer to the next unmatched character on success. A global character pointer __loc1 points to where the match began. regcmp and regex were mostly borrowed from the editor, ed(1); however, the syntax and semantics have been changed slightly. The following are the valid symbols and associated meanings.

[ ] * . ^ These symbols retain their meaning in ed(1).

$ Matches the end of the string; \n matches a newline.

– Within brackets the minus means *through*. For example, [a–z] is equivalent to [abcd . . . xyz]. The – can appear as itself only if used as the first or last character. For example, the character class expression []–] matches the characters] and –.

\+ A regular expression followed by + means *one or more times*. For example, [0–9]+ is equivalent to [0–9][0–9]*.

{*m*} {*m*,} {*m*,*u*}
Integer values enclosed in { } indicate the number of times the preceding regular expression is to be applied. The value *m* is the minimum number and *u* is a number, less than 256, which is the maximum. If only *m* is present (i.e., {*m*}), it indicates the exact number of times the regular expression is to be applied. The value {*m*,} is analogous to {*m*,*infinity*}. The plus (+) and star (*) operations are equivalent to {1,} and {0,} respectively.

(. . .)$*n*
The value of the enclosed regular expression is to be returned. The value will be stored in the (*n*+1)th argument following the subject argument. At most, ten enclosed regular expressions are allowed. regex makes its assignments unconditionally.

(. . .) Parentheses are used for grouping. An operator, e.g., *, +, { }, can work on a single character or a regular expression enclosed in parentheses. For example, (a*(cb+)*)$0.

By necessity, all the above defined symbols are special. They must, therefore, be escaped with a \ (backslash) to be used as themselves.

EXAMPLES

The following example matches a leading newline in the subject string pointed at by cursor.

```
char *cursor, *newcursor, *ptr;
    . . .
newcursor = regex((ptr = regcmp("^\n", (char *)0)), cursor);
free(ptr);
```

The following example matches through the string Testing3 and returns the address of the character after the last matched character (the "4"). The string Testing3 is copied to the character array ret0.

```
char ret0[9];
char *newcursor, *name;
    . . .
name = regcmp("([A-Za-z][A-za-z0-9]{0,7})$0", (char *)0);
newcursor = regex(name, "012Testing345", ret0);
```

The following example applies a precompiled regular expression in file.i [see regcmp(1)] against *string*.

```
#include "file.i"
char *string, *newcursor;
    . . .
newcursor = regex(name, string);
```

SEE ALSO

regcmp(1), malloc(3C).
ed(1) in the *User's Reference Manual*.

NOTES

The user program may run out of memory if regcmp is called iteratively without freeing the vectors no longer required.

NAME

regexpr: compile, step, advance – regular expression compile and match routines

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

```
#include <regexpr.h>

char *compile (const char *instring, char *expbuf, char *endbuf);

int step (const char *string, char *expbuf);

int advance (const char *string, char *expbuf);

extern char *loc1, *loc2, *locs;

extern int nbra, regerrno, reglength;

extern char *braslist[], *braelist[];
```

DESCRIPTION

These routines are used to compile regular expressions and match the compiled expressions against lines. The regular expressions compiled are in the form used by ed.

The syntax of the `compile` routine is as follows:

```
compile (instring, expbuf, endbuf)
```

The parameter *instring* is a null-terminated string representing the regular expression.

The parameter *expbuf* points to the place where the compiled regular expression is to be placed. If *expbuf* is `NULL`, `compile` uses `malloc` to allocate the space for the compiled regular expression. If an error occurs, this space is freed. It is the user's responsibility to free unneeded space after the compiled regular expression is no longer needed.

The parameter *endbuf* is one more than the highest address where the compiled regular expression may be placed. This argument is ignored if *expbuf* is `NULL`. If the compiled expression cannot fit in (*endbuf*–*expbuf*) bytes, `compile` returns `NULL` and `regerrno` (see below) is set to 50.

If `compile` succeeds, it returns a non-`NULL` pointer whose value depends on *expbuf*. If *expbuf* is non-`NULL`, `compile` returns a pointer to the byte after the last byte in the compiled regular expression. The length of the compiled regular expression is stored in `reglength`. Otherwise, `compile` returns a pointer to the space allocated by `malloc`.

If an error is detected when compiling the regular expression, a `NULL` pointer is returned from `compile` and `regerrno` is set to one of the non-zero error numbers indicated below:

ERROR	MEANING
11	Range endpoint too large.
16	Bad number.
25	"\digit" out of range.
36	Illegal or missing delimiter.
41	No remembered search string.
42	`\( ~\)` imbalance.
43	Too many `\(`.
44	More than 2 numbers given in `\{ ~\}`.
45	`}` expected after `\`.
46	First number exceeds second in `\{ ~\}`.
49	`[ ]` imbalance.
50	Regular expression overflow.

The call to **step** is as follows:

```
step (string, expbuf)
```

The first parameter to **step** is a pointer to a string of characters to be checked for a match. This string should be null-terminated.

The parameter *expbuf* is the compiled regular expression obtained by a call of the function **compile**.

The function **step** returns non-zero if the given string matches the regular expression, and zero if the expressions do not match. If there is a match, two external character pointers are set as a side effect to the call to **step**. The variable set in **step** is `loc1`. `loc1` is a pointer to the first character that matched the regular expression. The variable `loc2` points to the character after the last character that matches the regular expression. Thus if the regular expression matches the entire line, `loc1` points to the first character of *string* and `loc2` points to the null at the end of *string*.

The purpose of **step** is to step through the *string* argument until a match is found or until the end of *string* is reached. If the regular expression begins with ^, **step** tries to match the regular expression at the beginning of the string only.

The function **advance** has the same arguments and side effects as **step**, but it always restricts matches to the beginning of the string.

If one is looking for successive matches in the same string of characters, `locs` should be set equal to `loc2`, and **step** should be called with *string* equal to `loc2`. `locs` is used by commands like **ed** and **sed** so that global substitutions like `s/y*//g` do not loop forever, and is `NULL` by default.

The external variable **nbra** is used to determine the number of subexpressions in the compiled regular expression. **braslist** and **braelist** are arrays of character pointers that point to the start and end of the **nbra** subexpressions in the matched string. For example, after calling **step** or **advance** with string `sabcdefg` and regular expression `\(abcdef\)`, `braslist[0]` will point at **a** and `braelist[0]` will point at `g`. These arrays are used by commands like **ed** and **sed** for substitute replacement patterns that contain the *n* notation for subexpressions.

Note that it isn't necessary to use the external variables regerrno, nbra, loc1, loc2 locs, braelist, and braslist if one is only checking whether or not a string matches a regular expression.

EXAMPLES

The following is similar to the regular expression code from grep:

```
#include <regexpr.h>

. . .
if(compile(*argv, (char *)0, (char *)0) == (char *)0)
    regerr(regerrno);
. . .
if (step(linebuf, expbuf))
    succeed();
```

SEE ALSO

regexp(5).
ed(1), grep(1), sed(1) in the *User's Reference Manual.*

NAME

str: strfind, strrspn, strtrns – string manipulations

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

```
#include <libgen.h>

int strfind (const char *as1, const char *as2);

char *strrspn (const char *string, const char *tc);

char * strtrns (const char *str, const char *old, const char *new,
    char *result);
```

DESCRIPTION

strfind returns the offset of the second string, *as2*, if it is a substring of string *as1*.

strrspn returns a pointer to the first character in the string to be trimmed (all characters from the first character to the end of *string* are in *tc*).

strtrns transforms str and copies it into *result*. Any character that appears in *old* is replaced with the character in the same position in *new*. The *new* result is returned.

EXAMPLES

```
/* find pointer to substring "hello" in as1 */
i = strfind(as1, "hello");

/* trim junk from end of string */
s2 = strrspn(s1, "*?#$%");
*s2 = '\0';

/* transform lower case to upper case */
a1[] = "abcdefghijklmnopqrstuvwxyz";
a2[] = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
s2 = strtrns(s1, a1, a2, s2);
```

SEE ALSO

string(3C).

DIAGNOSTICS

If the second string is not a substring of the first string strfind returns −1.

NAME

strccpy: streadd, strcadd, strecpy – copy strings, compressing or expanding escape codes

SYNOPSIS

cc [*flag* ...] *file* ... -lgen [*library* ...]

```
#include <libgen.h>

char *strccpy (char *output, const char *input);

char *strcadd (char *output, const char *input);

char *strecpy (char *output, const char *input, const char
    *exceptions);

char *streadd (char *output, const char *input, const char
    *exceptions);
```

DESCRIPTION

strccpy copies the *input* string, up to a null byte, to the *output* string, compressing the C-language escape sequences (for example, \n, \001) to the equivalent character. A null byte is appended to the output. The *output* argument must point to a space big enough to accommodate the result. If it is as big as the space pointed to by *input* it is guaranteed to be big enough. strccpy returns the *output* argument.

strcadd is identical to strccpy, except that it returns the pointer to the null byte that terminates the output.

strecpy copies the *input* string, up to a null byte, to the *output* string, expanding non-graphic characters to their equivalent C-language escape sequences (for example, \n, \001). The *output* argument must point to a space big enough to accommodate the result; four times the space pointed to by *input* is guaranteed to be big enough (each character could become \ and 3 digits). Characters in the *exceptions* string are not expanded. The *exceptions* argument may be zero, meaning all non-graphic characters are expanded. strecpy returns the *output* argument

streadd is identical to strecpy, except that it returns the pointer to the null byte that terminates the output.

EXAMPLES

```
/* expand all but newline and tab */
strecpy( output, input, "\n\t" );

/* concatenate and compress several strings */
cp = strcadd( output, input1 );
cp = strcadd( cp, input2 );
cp = strcadd( cp, input3 );
```

SEE ALSO

string(3C), str(3G).

3M

NAME

intro – introduction to the math library

SYNOPSIS

cc [*flag* ...] *file* ... -lm [*library* ...]

#include <math.h>

DESCRIPTION

This section describes the functions in the math library, libm. Declarations for these functions may be obtained from the #include file math.h. Several generally useful mathematical constants are also defined there [see intro(3) and math(5)].

The math library is not automatically loaded by the C compilation system; use the -l option to cc to access the library as shown in above.

libm contains the full set of double-precision routines plus some single-precision routines (designated by the suffix f) that give better performance with less precision. Selected routines are hand-optimized for performance. The optimized routines include sin, cos, tan, atan, atan2, exp, log, log10, pow, and sqrt and their single-precision equivalents.

DEFINITIONS

See intro(3) for C language definitions.

FILES

LIBDIR	usually /usr/ccs/lib
LIBDIR/libm.a	

SEE ALSO

cc(1), intro(2), intro(3), math(5).
The "Floating Point Operations" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools.*

DIAGNOSTICS

Error handling varies according to compilation mode. Under the -Xt (default) option to cc, these functions return the conventional values 0, ±HUGE, or NaN when the function is undefined for the given arguments or when the value is not representable. In the -Xa and -Xc compilation modes, ±HUGE_VAL is returned instead of ±HUGE. (HUGE_VAL and HUGE are defined in math.h to be infinity and the largest-magnitude single-precision number, respectively.) In every case, the external variable errno [see intro(2)] is set to the value EDOM or ERANGE, although the value may vary for a given error depending on compilation mode. See the table under matherr(3M) below.

NAME

bessel: j0, j1, jn, y0, y1, yn – Bessel functions

SYNOPSIS

cc [*flag* ...] *file* ... -lm [*library* ...]

```
#include <math.h>

double j0 (double x);

double j1 (double x);

double jn (int n, double x);

double y0 (double x);

double y1 (double x);

double yn (int n, double x);
```

DESCRIPTION

j0 and j1 return Bessel functions of *x* of the first kind of orders 0 and 1, respectively. jn returns the Bessel function of *x* of the first kind of order *n*.

y0 and y1 return Bessel functions of *x* of the second kind of orders 0 and 1, respectively. yn returns the Bessel function of *x* of the second kind of order *n*. The value of *x* must be positive.

SEE ALSO

matherr(3M).

DIAGNOSTICS

Non-positive arguments cause y0, y1, and yn to return the value -HUGE and to set errno to EDOM. In addition, a message indicating DOMAIN error is printed on the standard error output.

Arguments too large in magnitude cause j0, j1, y0, and y1 to return 0 and to set errno to ERANGE. In addition, a message indicating TLOSS error is printed on the standard error output.

Except when the -Xc compilation option is used, these error-handling procedures may be changed with the function matherr. When the -Xa or -Xc compilation options are used, HUGE_VAL is returned instead of HUGE and no error messages are printed.

NAME

`erf`, `erfc` – error function and complementary error function

SYNOPSIS

cc [*flag* ...] *file* ... `-lm` [*library* ...]

```
#include <math.h>

double erf (double x);

double erfc (double x);
```

DESCRIPTION

`erf` returns the error function of x, defined as

$$\frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$$

`erfc`, which returns 1.0 – `erf(`*x*`)`, is provided because of the extreme loss of relative accuracy if `erf(`*x*`)` is called for large x and the result subtracted from 1.0 (e.g., for $x = 5$, 12 places are lost).

SEE ALSO

exp(3M).

NAME

exp, expf, cbrt, log, logf, log10, log10f, pow, powf, sqrt, sqrtf – exponential, logarithm, power, square root functions

SYNOPSIS

cc [*flag* ...] *file* ... -lm [*library* ...]

cc -O -Ksd [*flag* ...] *file* ... -J sfm [*library* ...]

```
#include <math.h>

double exp (double x);

float expf (float x);

double cbrt (double x);

double log (double x);

float logf (float x);

double log10 (double x);

float log10f (float x);

double pow (double x, double y);

float powf (float x, float y);

double sqrt (double x);

float sqrtf (float x);
```

DESCRIPTION

exp and expf return e^x.

cbrt returns the cube root of x.

log and logf return the natural logarithm of x. The value of x must be positive.

log10 and log10f return the base ten logarithm of x. The value of x must be positive.

pow and powf return x^y. If x is 0, y must be positive. If x is negative, y must be an integer.

sqrt and sqrtf return the non-negative square root of x. The value of x may not be negative.

SEE ALSO

hypot(3M), matherr(3M), sinh(3M).

DIAGNOSTICS

exp and expf return HUGE when the correct value would overflow, or 0 when the correct value would underflow, and set errno to ERANGE.

log, logf, log10, and log10f return -HUGE and set errno to EDOM when x is non-positive. A message indicating DOMAIN error is printed on standard error.

pow and powf return 0 and set errno to EDOM when x is 0 and y is non-positive, or when x is negative and y is not an integer. In these cases, a message indicating DOMAIN error is printed on standard error. When the correct value for pow or powf would overflow or underflow, these functions return ±HUGE or 0, respectively, and set errno to ERANGE.

sqrt and sqrtf return 0 and set errno to EDOM when *x* is negative. A message indicating DOMAIN error is printed on standard error.

Except when the -Xc compilation option is used, these error-handling procedures may be changed with the function matherr. When the -Xa or -Xc compilation options are used, HUGE_VAL is returned instead of HUGE and no error messages are printed. In these compilation modes, pow and powf return 1, with no error, when both *x* and *y* are 0; when *x* is 0 and *y* is negative, they return -HUGE_VAL and set errno to EDOM. Under -Xc, log and logf return -HUGE_VAL and set errno to ERANGE when *x* is 0. Under -Xc, sqrt and sqrtf return NaN when *x* is negative.

NAME

`floor`, `floorf`, `ceil`, `ceilf`, `copysign`, `fmod`, `fmodf`, `fabs`, `fabsf`, `rint`, `remainder` – floor, ceiling, remainder, absolute value functions

SYNOPSIS

cc [*flag* ...] *file* ... -lm [*library* ...]

```
#include <math.h>

double floor (double x);

float floorf (float x);

double ceil (double x);

float ceilf (float x);

double copysign (double x, double y);

double fmod (double x, double y);

float fmodf (float x, float y);

double fabs (double x);

float fabsf (float x);

double rint (double x);

double remainder (double x, double y);
```

DESCRIPTION

`floor` and `floorf` return the largest integer not greater than x. `ceil` and `ceilf` return the smallest integer not less than x.

`copysign` returns x but with the sign of y.

`fmod` and `fmodf` return the floating point remainder of the division of x by y. More precisely, they return the number f with the same sign as x, such that $x = iy + f$ for some integer i, and $|f| < |y|$.

`fabs` and `fabsf` return the absolute value of x, $|x|$.

`rint` returns the nearest integer value to its floating point argument x as a double-precision floating point number. The returned value is rounded according to the currently set machine rounding mode. If round-to-nearest (the default mode) is set and the difference between the function argument and the rounded result is exactly 0.5, then the result will be rounded to the nearest even integer.

`remainder` returns the floating point remainder of the division of x by y. More precisely, it returns the value $r = x - yn$, where n is the integer nearest the exact value x/y. Whenever $|n - x/y| = ½$, then n is even.

SEE ALSO

`abs`(3C), `matherr`(3M).

DIAGNOSTICS

`fmod` and `fmodf` return x when y is 0 and set `errno` to `EDOM`. `remainder` returns `NaN` when y is 0 and sets `errno` to `EDOM`. In both cases, except in compilation modes `-Xa` or `-Xc`, a message indicating `DOMAIN` error is printed on standard error. Except under `-Xc`, these error-handling procedures may be changed with the function `matherr`.

NAME

gamma, lgamma – log gamma function

SYNOPSIS

cc [*flag* ...] *file* ... -lm [*library* ...]

```
#include <math.h>

double gamma (double x);

double lgamma (double x);

extern int signgam;
```

DESCRIPTION

gamma and lgamma return

$$\ln(\,|\,\Gamma(x)\,|\,)$$

where $\Gamma(x)$ is defined as

$$\int_0^\infty e^{-t} t^{x-1} dt$$

The sign of $\Gamma(x)$ is returned in the external integer signgam. The argument x may not be a non-positive integer.

The following C program fragment might be used to calculate Γ:

```
if ((y = gamma(x)) > LN_MAXDOUBLE)
        error();
y = signgam * exp(y);
```

where LN_MAXDOUBLE is the least value that causes exp to return a range error, and is defined in the values.h header file.

SEE ALSO

exp(3M), matherr(3M), values(5).

DIAGNOSTICS

For non-positive integer arguments HUGE is returned and errno is set to EDOM. A message indicating SING error is printed on the standard error output.

If the correct value would overflow, gamma and lgamma return HUGE and set errno to ERANGE.

Except when the -Xc compilation option is used, these error-handling procedures may be changed with the function matherr. When the -Xa or -Xc compilation options are used, HUGE_VAL is returned instead of HUGE and no error messages are printed.

NAME

hypot – Euclidean distance function

SYNOPSIS

cc [*flag* ...] *file* ... -lm [*library* ...]

```
#include <math.h>

double hypot (double x, double y);
```

DESCRIPTION

hypot returns

```
sqrt(x * x + y * y)
```

taking precautions against unwarranted overflows.

SEE ALSO

matherr(3M).

DIAGNOSTICS

When the correct value would overflow, hypot returns HUGE and sets errno to ERANGE.

Except when the -Xc compilation option is used, these error-handling procedures may be changed with the function matherr. When the -Xa or -Xc compilation options are used, HUGE_VAL is returned instead of HUGE.

NAME

matherr – error-handling function

SYNOPSIS

cc [*flag* ...] *file* ... -lm [*library* ...]

```
#include <math.h>

int matherr (struct exception *x);
```

DESCRIPTION

matherr is invoked by functions in the math libraries when errors are detected. Note that matherr is not invoked when the -Xc compilation option is used. Users may define their own procedures for handling errors, by including a function named matherr in their programs. matherr must be of the form described above. When an error occurs, a pointer to the exception structure *x* will be passed to the user-supplied matherr function. This structure, which is defined in the math.h header file, is as follows:

```
struct exception {
      int type;
      char *name;
      double arg1, arg2, retval;
};
```

The element type is an integer describing the type of error that has occurred, from the following list of constants (defined in the header file):

DOMAIN	argument domain error
SING	argument singularity
OVERFLOW	overflow range error
UNDERFLOW	underflow range error
TLOSS	total loss of significance
PLOSS	partial loss of significance

The element name points to a string containing the name of the function that incurred the error. The variables arg1 and arg2 are the arguments with which the function was invoked. retval is set to the default value that will be returned by the function unless the user's matherr sets it to a different value.

If the user's matherr function returns non-zero, no error message will be printed, and errno will not be set.

If matherr is not supplied by the user, the default error-handling procedures, described with the math functions involved, will be invoked upon error. These procedures are also summarized in the table below. In every case, errno is set to EDOM or ERANGE and the program continues.

Default Error Handling Procedures						
	Types of Errors					
type	DOMAIN	SING	OVERFLOW	UNDERFLOW	TLOSS	PLOSS
errno	EDOM	EDOM	ERANGE	ERANGE	ERANGE	ERANGE
BESSEL:	–	–	–	–	M, 0	–
y0, y1, yn (arg ≤ 0)	M, –H	–	–	–	–	–
EXP, EXPF:	–	–	H	0	–	–
LOG, LOG10:						
LOGF, LOG10F:						
(arg < 0)	M, –H	–	–	–	–	–
(arg = 0)	M, –H	–	–	–	–	–
POW, POWF:	–	–	±H	0	–	–
neg ** non-int	M, 0	–	–	–	–	–
0 ** non-pos	M, 0	–	–	–	–	–
SQRT, SQRTF:	M, 0	–	–	–	–	–
FMOD, FMODF:						
(arg2 = 0)	M, X	–	–	–	–	–
REMAINDER:						
(arg2 = 0)	M, N	–	–	–	–	–
GAMMA, LGAMMA:	–	M, H	H	–	–	–
HYPOT:	–	–	H	–	–	–
SINH, SINHF:	–	–	±H	–	–	–
COSH, COSHF:	–	–	H	–	–	–
ASIN, ACOS, ATAN2:						
ASINF, ACOSF, ATAN2F:	M, 0	–	–	–	–	–
ACOSH:	M, N	–	–	–	–	–
ATANH:						
(| arg| > 1)	M, N	–	–	–	–	–
(| arg| = 1)	–	M, N	–	–	–	–

Abbreviations	
M	Message is printed (not with the -Xa or -Xc options).
H	HUGE is returned (HUGE_VAL with the -Xa or -Xc options).
-H	-HUGE is returned (-HUGE_VAL with the -Xa or -Xc options).
±H	HUGE or -HUGE is returned. (HUGE_VAL or -HUGE_VAL with the -Xa or -Xc options).
0	0 is returned.
X	*arg1* is returned.
N	NaN is returned.

EXAMPLE

```
#include <math.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

int
matherr(register struct exception *x);
{
        switch (x->type) {
        case DOMAIN:
                /* change sqrt to return sqrt(-arg1), not 0 */
                if (!strcmp(x->name, "sqrt")) {
                        x->retval = sqrt(-x->arg1);
                        return (0); /* print message and set errno */
                }
        case SING:
                /* all other domain or sing errors, print message */
                /* and abort */
                fprintf(stderr, "domain error in %s\n", x->name);
                abort( );
        case PLOSS:
                /* print detailed error message */
                fprintf(stderr, "loss of significance in %s(%g)=%g\n",
                        x->name, x->arg1, x->retval);
                return (1); /* take no other action */
        }
        return (0); /* all other errors, execute default procedure */
}
```

NOTES

Error handling in -Xa and -Xt modes [see cc(1)] is described more completely on individual math library pages.

NAME

sinh, sinhf, cosh, coshf, tanh, tanhf, asinh, acosh, atanh – hyperbolic functions

SYNOPSIS

cc [*flag* ...] *file* ... -lm [*library* ...]

```
#include <math.h>

double sinh (double x);

float sinhf (float x);

double cosh (double x);

float coshf (float x);

double tanh (double x);

float tanhf (float x);

double asinh (double x);

double acosh (double x);

double atanh (double x);
```

DESCRIPTION

sinh, cosh, and tanh and the single-precision versions sinhf, coshf, and tanhf return, respectively, the hyberbolic sine, cosine, and tangent of their argument.

asinh, acosh, and atanh return, respectively, the inverse hyperolic sine, cosine, and tangent of their argument.

SEE ALSO

matherr(3M).

DIAGNOSTICS

sinh, sinhf, cosh, and coshf return HUGE (and sinh and sinhf may return -HUGE for negative x) when the correct value would overflow and set errno to ERANGE.

acosh returns NaN and sets errno to EDOM when the argument x is less than 1. A message indicating DOMAIN error is printed on the standard error output.

atanh returns NaN and sets errno to EDOM if $|x| \geq 1$. If $|x| = 1$, a message indicating SING error is printed on the standard error output; if $|x| > 1$ the message will indicate DOMAIN error.

Except when the -Xc compilation option is used, these error-handling procedures may be changed with the function matherr. When the -Xa or -Xc compilation options are used, HUGE_VAL is returned instead of HUGE and no error messages are printed.

NAME

trig: sin, sinf, cos, cosf, tan, tanf, asin, asinf, acos, acosf, atan, atanf, atan2, atan2f − trigonometric functions

SYNOPSIS

cc [*flag* ...] *file* ... -lm [*library* ...]

cc -O -Ksd [*flag* ...] *file* ... -J sfm [*library* ...]

```
#include <math.h>

double sin (double x);

float sinf (float x);

double cos (double x);

float cosf (float x);

double tan (double x);

float tanf (float x);

double asin (double x);

float asinf (float x);

double acos (double x);

float acosf (float x);

double atan (double x);

float atanf (float x);

double atan2 (double y, double x);

float atan2f (float y, float x);
```

DESCRIPTION

sin, cos, and tan and the single-precision versions sinf, cosf, and tanf return, respectively, the sine, cosine, and tangent of their argument, x, measured in radians.

asin and asinf return the arcsine of x, in the range $[-\pi/2,+\pi/2]$.

acos and acosf return the arccosine of x, in the range $[0,+\pi]$.

atan and atanf return the arctangent of x, in the range $(-\pi/2,+\pi/2)$.

atan2 and atan2f return the arctangent of y/x, in the range $(-\pi,+\pi]$, using the signs of both arguments to determine the quadrant of the return value.

SEE ALSO

matherr(3M).

DIAGNOSTICS

If the magnitude of the argument of asin, asinf, acos, or acosf is greater than 1, or if both arguments of atan2 or atan2f are 0, 0 is returned and errno is set to EDOM. In addition, a message indicating DOMAIN error is printed on the standard error output.

Except when the -Xc compilation option is used, these error-handling procedures may be changed with the function matherr. When the -Xa or -Xc compilation options are used, no error messages are printed.

3X

NAME

`assert` – verify program assertion

SYNOPSIS

`#include <assert.h>`

`void assert (int expression);`

DESCRIPTION

This macro is useful for putting diagnostics into programs. When it is executed, if *expression* is false (zero), `assert` prints

`Assertion failed:` *expression*`, file` *xyz*`, line` *nnn*

on the standard error output and aborts. In the error message, *xyz* is the name of the source file and *nnn* the source line number of the `assert` statement. The latter are respectively the values of the preprocessor macros `__FILE__` and `__LINE__`.

Compiling with the preprocessor option `-DNDEBUG` [see cc(1)], or with the preprocessor control statement `#define NDEBUG` ahead of the `#include <assert.h>` statement, will stop assertions from being compiled into the program.

SEE ALSO

cc(1), `abort`(3C).

NOTES

Since `assert` is implemented as a macro, the *expression* may not contain any string literals.

NAME

crypt – password and file encryption functions

SYNOPSIS

cc [*flag* ...] *file* ... -lcrypt [*library* ...]

```
#include <crypt.h>

char *crypt (const char *key, const char *salt);

void setkey (const char *key);

void encrypt (char *block, int flag);

char *des_crypt (const char *key, const char *salt);

void des_setkey (const char *key);

void des_encrypt (char *block, int flag);

int run_setkey (int *p, const char *key);

int run_crypt (long offset, char *buffer, unsigned int count,
    int *p);

int crypt_close(int *p);
```

DESCRIPTION

des_crypt is the password encryption function. It is based on a one-way hashing encryption algorithm with variations intended (among other things) to frustrate use of hardware implementations of a key search.

key is a user's typed password. *salt* is a two-character string chosen from the set [a-zA-Z0-9./]; this string is used to perturb the hashing algorithm in one of 4096 different ways, after which the password is used as the key to encrypt repeatedly a constant string. The returned value points to the encrypted password. The first two characters are the salt itself.

The des_setkey and des_encrypt entries provide (rather primitive) access to the actual hashing algorithm. The argument of des_setkey is a character array of length 64 containing only the characters with numerical value 0 and 1. If this string is divided into groups of 8, the low-order bit in each group is ignored, thereby creating a 56-bit key that is set into the machine. This key is the key that will be used with the hashing algorithm to encrypt the string *block* with the function des_encrypt.

The argument to the des_encrypt entry is a character array of length 64 containing only the characters with numerical value 0 and 1. The argument array is modified in place to a similar array representing the bits of the argument after having been subjected to the hashing algorithm using the key set by des_setkey. If *flag* is zero, the argument is encrypted; if non-zero, it is decrypted.

Note that decryption is not provided in the international version of crypt. The international version is part of the C Development Set, and the domestic version is part of the Security Administration Utilities. If decryption is attempted with the international version of des_encrypt, an error message is printed.

crypt, setkey, and encrypt are front-end routines that invoke *des_crypt*, *des_setkey*, and *des_encrypt* respectively.

The routines run_setkey and run_crypt are designed for use by applications that need cryptographic capabilities [such as ed(1) and vi(1)] that must be compatible with the crypt(1) user-level utility. run_setkey establishes a two-way pipe connection with the crypt utility, using *key* as the password argument. run_crypt takes a block of characters and transforms the cleartext or ciphertext into their ciphertext or cleartext using the crypt utility. *offset* is the relative byte position from the beginning of the file that the block of text provided in *block* is coming from. *count* is the number of characters in *block*, and *connection* is an array containing indices to a table of input and output file streams. When encryption is finished, crypt_close is used to terminate the connection with the crypt utility.

run_setkey returns −1 if a connection with the crypt utility cannot be established. This result will occur in international versions of the UNIX system in which the crypt utility is not available. If a null key is passed to run_setkey, 0 is returned. Otherwise, 1 is returned. run_crypt returns −1 if it cannot write output or read input from the pipe attached to crypt. Otherwise it returns 0.

The program must be linked with the object file access routine library libcrypt.a.

SEE ALSO

getpass(3C), passwd(4).
crypt(1), login(1), passwd(1) in the *User's Reference Manual.*

DIAGNOSTICS

In the international version of crypt(3X), a flag argument of 1 to encrypt or des_encrypt is not accepted, and errno is set to ENOSYS to indicate that the functionality is not available.

NOTES

The return value in crypt points to static data that are overwritten by each call.

NAME

`libwindows` – windowing terminal function library

SYNOPSIS

`cc` [*flag* ...] *file* ... `-lwindows` [*library* ...]

```
int openagent (void);

int New (int cntlfd, int origin_x, int origin_y,
  int corner_x, int corner_y);

int Newlayer (int cntlfd, int origin_x, int origin_y,
  int corner_x, int corner_y);

int openchan (int chan);

int Runlayer (int chan, char *command);

int Current (int cntlfd, int chan);

int Delete (int cntlfd, int chan);

int Top (int cntlfd, int chan);

int Bottom (int cntlfd, int chan);

int Move (int cntlfd, int chan, int origin_x, int origin_y);

int Reshape (int cntlfd, int chan, int origin_x, int origin_y,
  int corner_x, int corner_y);

int Exit (int cntlfd);
```

DESCRIPTION

This library of routines enables a program running on a host UNIX system to perform windowing terminal functions [see `layers`(1)].

The `openagent` routine opens the control channel of the `xt`(7) channel group to which the calling process belongs. Upon successful completion, `openagent` returns a file descriptor that can be passed to any of the other `libwindows` routines except `openchan` and `Runlayer`. (The file descriptor can also be passed to the `close` system call.) Otherwise, the value `-1` is returned.

The `New` routine creates a new layer with a separate shell. The *origin_x, origin_y, corner_x,* and *corner_y* arguments are the coordinates of the layer rectangle. If all the coordinate arguments are 0, the user must define the layer's rectangle interactively. The layer appears on top of any overlapping layers. The layer is not made current (i.e., the keyboard is not attached to the new layer). Upon successful completion, `New` returns the `xt`(7) channel number associated with the layer. Otherwise, the value `-1` is returned.

The `Newlayer` routine creates a new layer without executing a separate shell. Otherwise it is identical to `New`, described above.

The `openchan` routine opens the channel argument *chan* which is obtained from the `New` or `Newlayer` routine. Upon successful completion, `openchan` returns a file descriptor that can be used as input to `write`(2) or `close`(2). Otherwise, the value `-1` is returned.

The `Runlayer` routine runs the specified *command* in the layer associated with the channel argument *chan*. This layer is usually a layer previously created with `Newlayer`. Any processes currently attached to this layer will be killed, and the new process will have the environment of the `layers` process.

The `Current` routine makes the layer associated with the channel argument *chan* current (i.e., attached to the keyboard).

The `Delete` routine deletes the layer associated with the channel argument *chan* and kills all host processes associated with the layer.

The `Top` routine makes the layer associated with the channel argument *chan* appear on top of all overlapping layers.

The `Bottom` routine puts the layer associated with the channel argument *chan* under all overlapping layers.

The `Move` routine moves the layer associated with the channel argument *chan* from its current screen location to a new screen location at the origin point (*origin_x, origin_y*). The size and contents of the layer are maintained.

The `Reshape` routine reshapes the layer associated with the channel argument *chan*. The arguments *origin_x, origin_y, corner_x,* and *corner_y* are the new coordinates of the layer rectangle. If all the coordinate arguments are 0, the user is allowed to define the layer's rectangle interactively.

The `Exit` routine causes the `layers` program to exit, killing all processes associated with it.

FILES

ULIBDIR/`libwindows.a` windowing terminal function library
ULIBDIR usually `/usr/lib`

SEE ALSO

`close`(2), `write`(2), `jagent`(5).
`layers`(1) in the *User's Reference Manual.*

DIAGNOSTICS

Upon successful completion, `Runlayer`, `Current`, `Delete`, `Top`, `Bottom`, `Move`, `Reshape`, and `Exit` return 0, while `openagent`, `New`, `Newlayer`, and `openchan` return values as described above under each routine. If an error occurs, `-1` is returned.

NOTES

The values of layer rectangle coordinates are dependent on the type of terminal. This dependency affects the routines that pass layer rectangle coordinates: `Move`, `New`, `Newlayer`, and `Reshape`. Some terminals will expect these numbers to be passed as character positions (bytes); others will expect the information to be in pixels (bits).

For example, for the AT&T 5620 DMD terminal, `New`, `Newlayer`, and `Reshape` take minimum values of 8 (pixels) for *origin_x* and *origin_y* and maximum values of 792 (pixels) for *corner_x* and 1016 (pixels) for *corner_y*. The minimum layer size is 28 by 28 pixels and the maximum layer size is 784 by 1008 pixels.

It is recommended that applications use `/dev/xt/??[0-7]` instead of `/dev/xt??[0-7]` when accessing the `xt` driver.

NAME

`maillock` – manage lockfile for user's mailbox

SYNOPSIS

cc [*flag* ...] *file* ... `-lmail` [*library* ...]

```
#include &lt;maillock.h&gt;

int maillock (const char *user, int retrycnt);

int mailunlock (void);
```

DESCRIPTION

The `maillock` function attempts to create a lockfile for the user's mailfile. If a lockfile already exists, `maillock` assumes the contents of the file is the process ID (as a null-terminated ASCII string) of the process that created the lockfile (presumably with a call to `maillock`). If the process that created the lockfile is still alive, `maillock` will sleep and try again *retrycnt* times before returning with an error indication. The sleep algorithm is to sleep for 5 seconds times the attempt number. That is, the first sleep will be for 5 seconds, the next sleep will be for 10 seconds, etc. until the number of attempts reaches *retrycnt*. When the lockfile is no longer needed, it should be removed by calling `mailunlock`.

user is the login name of the user for whose mailbox the lockfile will be created. `maillock` assumes that users' mailfiles are in the "standard" place as defined in `maillock.h`.

RETURN VALUE

The following return code definitions are contained in `maillock.h`.

```
#define   L_SUCCESS    0   /* Lockfile created or removed */
#define   L_NAMELEN    1   /* Recipient name > 13 chars */
#define   L_TMPLOCK    2   /* Can't create tmp file */
#define   L_TMPWRITE   3   /* Can't write pid into lockfile */
#define   L_MAXTRYS    4   /* Failed after retrycnt attempts */
#define   L_ERROR      5   /* Check errno for reason */
```

FILES

LIBDIR/`llib-mail.ln`
LIBDIR/`mail.a`
`/var/mail/*`
`/var/mail/*.lock`

NOTES

`mailunlock` will only remove the lockfile created from the most previous call to `maillock`. Calling `maillock` for different users without intervening calls to `mailunlock` will cause the initially created lockfile(s) to remain, potentially blocking subsequent message delivery until the current process finally terminates.

NAME

`malloc`, `free`, `realloc`, `calloc`, `mallopt`, `mallinfo` – memory allocator

SYNOPSIS

`cc` [*flag* ...] *file* ... `-lmalloc` [*library* ...]

```
#include <stdlib.h>

void *malloc (size_t size)

void free (void *ptr)

void *realloc (void *ptr, size_t size)

void *calloc (size_t nelem, size_t elsize)

#include <malloc.h>

int mallopt (int cmd, int value)

struct mallinfo mallinfo (void)
```

DESCRIPTION

`malloc` and `free` provide a simple general-purpose memory allocation package.

`malloc` returns a pointer to a block of at least *size* bytes suitably aligned for any use.

The argument to `free` is a pointer to a block previously allocated by `malloc`; after `free` is performed this space is made available for further allocation, and its contents have been destroyed (but see `mallopt` below for a way to change this behavior). If *ptr* is a null pointer, no action occurs.

Undefined results occur if the space assigned by `malloc` is overrun or if some random number is handed to `free`.

`realloc` changes the size of the block pointed to by *ptr* to *size* bytes and returns a pointer to the (possibly moved) block. The contents are unchanged up to the lesser of the new and old sizes. If *ptr* is a null pointer, `realloc` behaves like `malloc` for the specified size. If *size* is zero and *ptr* is not a null pointer, the object it points to is freed.

`calloc` allocates space for an array of *nelem* elements of size *elsize*. The space is initialized to zeros.

`mallopt` provides for control over the allocation algorithm. The available values for *cmd* are:

`M_MXFAST` Set *maxfast* to *value*. The algorithm allocates all blocks below the size of *maxfast* in large groups and then doles them out very quickly. The default value for *maxfast* is 24.

`M_NLBLKS` Set *numlblks* to *value*. The above mentioned "large groups" each contain *numlblks* blocks. *numlblks* must be greater than 0. The default value for *numlblks* is 100.

`M_GRAIN` Set *grain* to *value*. The sizes of all blocks smaller than *maxfast* are considered to be rounded up to the nearest multiple of *grain*. *grain* must be greater than 0. The default value of *grain* is the smallest number of bytes that will allow alignment of any data type. Value will be rounded up to a multiple of the default when *grain* is set.

M_KEEP Preserve data in a freed block until the next malloc, realloc, or calloc. This option is provided only for compatibility with the old version of malloc and is not recommended.

These values are defined in the malloc.h header file.

mallopt may be called repeatedly, but may not be called after the first small block is allocated.

mallinfo provides instrumentation describing space usage. It returns the structure:

```
struct mallinfo  {
     int arena;        /* total space in arena */
     int ordblks;      /* number of ordinary blocks */
     int smblks;       /* number of small blocks */
     int hblkhd;       /* space in holding block headers */
     int hblks;        /* number of holding blocks */
     int usmblks;      /* space in small blocks in use */
     int fsmblks;      /* space in free small blocks */
     int uordblks;     /* space in ordinary blocks in use */
     int fordblks;     /* space in free ordinary blocks */
     int keepcost;     /* space penalty if keep option */
                       /* is used */
}
```

This structure is defined in the malloc.h header file.

Each of the allocation routines returns a pointer to space suitably aligned (after possible pointer coercion) for storage of any type of object.

SEE ALSO

brk(2), malloc(3C).

DIAGNOSTICS

malloc, realloc, and calloc return a NULL pointer if there is not enough available memory. When realloc returns NULL, the block pointed to by *ptr* is left intact. If mallopt is called after any allocation or if *cmd* or *value* are invalid, non-zero is returned. Otherwise, it returns zero.

NOTES

Note that unlike malloc(3C), this package does not preserve the contents of a block when it is freed, unless the M_KEEP option of mallopt is used.

Undocumented features of malloc(3C) have not been duplicated.

Function prototypes for malloc, realloc, calloc and free are also defined in the <malloc.h> header file for compatibility with old applications. New applications should include <stdlib.h> to access the prototypes for these functions.

NAME

sputl, sgetl – access long integer data in a machine-independent fashion

SYNOPSIS

cc [*flag* ...] *file* ... -lld [*library* ...]

```
#include <ldfcn.h>

void sputl (long value, char *buffer);

long sgetl (const char *buffer);
```

DESCRIPTION

sputl takes the four bytes of the long integer *value* and places them in memory starting at the address pointed to by *buffer*. The ordering of the bytes is the same across all machines.

sgetl retrieves the four bytes in memory starting at the address pointed to by *buffer* and returns the long integer value in the byte ordering of the host machine.

The combination of sputl and sgetl provides a machine-independent way of storing long numeric data in a file in binary form without conversion to characters.

FILE FORMATS (4)

NAME

intro – introduction to file formats

DESCRIPTION

This section outlines the formats of various files. The C structure declarations for the file formats are given where applicable. Usually, the header files containing these structure declarations can be found in the directories /usr/include or /usr/include/sys. For inclusion in C language programs, however, the syntax #include <*filename.h*> or #include <sys/*filename.h*> should be used.

NAME

`a.out` – ELF (Executable and Linking Format) files

SYNOPSIS

```
#include <elf.h>
```

DESCRIPTION

The file name `a.out` is the default output file name from the link editor, `ld`(1). The link editor will make an `a.out` executable if there were no errors in linking. The output file of the assembler, `as`(1), also follows the format of the `a.out` file although its default file name is different.

Programs that manipulate ELF files may use the library that `elf`(3E) describes. An overview of the file format follows. For more complete information, see the references given below.

Linking View
ELF header
Program header table *optional*
Section 1
. . .
Section *n*
. . .
. . .
Section header table

Execution View
ELF header
Program header table
Segment 1
Segment 2
. . .
Section header table *optional*

An ELF header resides at the beginning and holds a "road map" describing the file's organization. Sections hold the bulk of object file information for the linking view: instructions, data, symbol table, relocation information, and so on. Segments hold the object file information for the program execution view. As shown, a segment may contain one or more sections.

A program header table, if present, tells the system how to create a process image. Files used to build a process image (execute a program) must have a program header table; relocatable files do not need one. A section header table contains information describing the file's sections. Every section has an entry in the table; each entry gives information such as the section name, the section size, etc. Files used during linking must have a section header table; other object files may or may not have one.

Although the figure shows the program header table immediately after the ELF header, and the section header table following the sections, actual files may differ. Moreover, sections and segments have no specified order. Only the ELF header has a fixed position in the file.

When an `a.out` file is loaded into memory for execution, three logical segments are set up: the text segment, the data segment (initialized data followed by uninitialized, the latter actually being initialized to all 0's), and a stack. The text segment is not writable by the program; if other processes are executing the same `a.out` file, the processes will share a single text segment.

The data segment starts at the next maximal page boundary past the last text address. (If the system supports more than one page size, the "maximal page" is the largest supported size.) When the process image is created, the part of the file holding the end of text and the beginning of data may appear twice. The duplicated chunk of text that appears at the beginning of data is never executed; it is duplicated so that the operating system may bring in pieces of the file in multiples of the actual page size without having to realign the beginning of the data section to a page boundary. Therefore, the first data address is the sum of the next maximal page boundary past the end of text plus the remainder of the last text address divided by the maximal page size. If the last text address is a multiple of the maximal page size, no duplication is necessary. The stack is automatically extended as required. The data segment is extended as requested by the `brk`(2) system call.

SEE ALSO

`as`(1), `cc`(1), `ld`(1), `brk`(2), `elf`(3E).

The "Object Files" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools.*

NAME

ar – archive file format

SYNOPSIS

`#include <ar.h>`

DESCRIPTION

The archive command ar(1) is used to combine several files into one. Archives are used mainly as libraries to be searched by the link editor ld(1).

Each archive begins with the archive magic string.

```
#define  ARMAG   "!<arch>\n"    /* magic string */
#define  SARMAG  8              /* length of magic string */
```

Following the archive magic string are the archive file members. Each file member is preceded by a file member header which is of the following format:

```
#define  ARFMAG     "`\n"  /* header trailer string */

struct  ar_hdr             /* file member header */
{
    char     ar_name[16]; /* '/' terminated file member name */
    char     ar_date[12]; /* file member date */
    char     ar_uid[6];   /* file member user identification */
    char     ar_gid[6];   /* file member group identification */
    char     ar_mode[8];  /* file member mode (octal) */
    char     ar_size[10]; /* file member size */
    char     ar_fmag[2];  /* header trailer string */
};
```

All information in the file member headers is in printable ASCII. The numeric information contained in the headers is stored as decimal numbers (except for *ar_mode* which is in octal). Thus, if the archive contains printable files, the archive itself is printable.

If the file member name fits, the *ar_name* field contains the name directly, and is terminated by a slash (/) and padded with blanks on the right. If the member's name does not fit, *ar_name* contains a slash (/) followed by a decimal representation of the name's offset in the archive string table described below.

The *ar_date* field is the modification date of the file at the time of its insertion into the archive. Common format archives can be moved from system to system as long as the portable archive command ar(1) is used.

Each archive file member begins on an even byte boundary; a newline is inserted between files if necessary. Nevertheless, the size given reflects the actual size of the file exclusive of padding.

Notice there is no provision for empty areas in an archive file.

Each archive that contains object files [see `a.out`(4)] includes an archive symbol table. This symbol table is used by the link editor `ld`(1) to determine which archive members must be loaded during the link edit process. The archive symbol table (if it exists) is always the first file in the archive (but is never listed) and is automatically created and/or updated by `ar`.

The archive symbol table has a zero length name (i.e., `ar_name[0]` is `'/'`, `ar_name[1]=='  '`, etc.). All "words" in this symbol table have four bytes, using the machine-independent encoding shown below. (All machines use the encoding described here for the symbol table, even if the machine's "natural" byte order is different.)

	0	1	2	3
`0x01020304`	01	02	03	04

The contents of this file are as follows:

1. The number of symbols. Length: 4 bytes.
2. The array of offsets into the archive file. Length: 4 bytes * "the number of symbols".
3. The name string table. Length: *ar_size* − 4 bytes * ("the number of symbols" + 1).

As an example, the following symbol table defines 4 symbols. The archive member at file offset 114 defines `name` and `object`. The archive member at file offset 426 defines `function` and a second version of `name`.

Offset	+0	+1	+2	+3	
0	4				4 offset entries
4	114				`name`
8	114				`object`
12	426				`function`
16	426				`name`
20	n	a	m	e	
24	\0	o	b	j	
28	e	c	t	\0	
32	f	u	n	c	
36	t	i	o	n	
40	\0	n	a	m	
44	e	\0			

The number of symbols and the array of offsets are managed with `sgetl` and `sputl`. The string table contains exactly as many null terminated strings as there are elements in the offsets array. Each offset from the array is associated with the corresponding name from the string table (in order). The names in the string table are all the defined global symbols found in the common object files in the archive. Each offset is the location of the archive header for the associated symbol.

SEE ALSO

`ar`(1), `ld`(1), `strip`(1), `sputl`(3X), `a.out`(4).

NOTES

`strip`(1) will remove all archive symbol entries from the header. The archive symbol entries must be restored via the `-ts` options of the `ar`(1) command before the archive can be used with the link editor `ld`(1).

NAME

core − format of core image file

DESCRIPTION

The UNIX system writes out a core image of a terminated process when any of various errors occur. See signal(2) for the list of reasons; the most common are memory violations, illegal instructions, bus errors, and user-generated quit signals. The core image is called core and is written in the process's working directory (provided it can be; normal access controls apply). A process with an effective user ID different from the real user ID will not produce a core image.

The first section of the core image is a copy of the system's per-user data for the process, including the registers as they were at the time of the fault. The size of this section depends on the parameter *usize*, which is defined in <sys/param.h>. The remainder represents the actual contents of the user's core area when the core image was written. If the text segment is read-only and shared, or separated from data space, it is not dumped.

The format of the information in the first section is described by the user structure of the system, defined in <sys/user.h>. Not included in this file are the locations of the registers. These are outlined in <sys/reg.h>.

SEE ALSO

sdb(1), setuid(2), signal(2).
crash(1M) in the *System Administrator's Reference Manual.*

NAME

`limits` – header file for implementation-specific constants

SYNOPSIS

`#include <limits.h>`

DESCRIPTION

The header file `limits.h` is a list of minimal magnitude limitations imposed by a specific implementation of the operating system.

```
ARG_MAX        5120                    /* max length of arguments to exec */
CHAR_BIT       8                       /* max # of bits in a "char" */
CHAR_MAX       127                     /* max value of a "char" */
CHAR_MIN       -128                    /* min value of a "char" */
CHILD_MAX      25                      /* max # of processes per user id */
CLK_TCK        100                     /* clock ticks per second */
DBL_DIG        15                      /* digits of precision of a "double" */
DBL_MAX        1.7976931348623157E+308 /* max decimal value of a "double"*/
DBL_MIN        2.2250738585072014E-308 /* min decimal value of a "double"*/
FCHR_MAX       1048576                 /* max size of a file in bytes */
FLT_DIG        6                       /* digits of precision of a "float" */
FLT_MAX        3.40282347e+38F         /* max decimal value of a "float" */
FLT_MIN        1.17549435E-38F         /* min decimal value of a "float" */
INT_MAX        2147483647              /* max value of an "int" */
INT_MIN        (-2147483647-1)         /* min value of an "int" */
LINK_MAX       1000                    /* max # of links to a single file */
LOGNAME_MAX    8                       /* max # of characters in a login name */
LONG_BIT       32                      /* # of bits in a "long" */
LONG_MAX       2147483647              /* max value of a "long int" */
LONG_MIN       (-2147483647-1)         /* min value of a "long int" */
MAX_CANON      256                     /* max bytes in a line for canonical
                                       processing */
MAX_INPUT      512                     /* max size of a char input buffer */
MB_LEN_MAX     5                       /* max # of bytes in a multibyte
                                       character */
NAME_MAX       14                      /* max # of characters in a file name */
NGROUPS_MAX    16                      /* max # of groups for a user */
NL_ARGMAX      9                       /* max value of "digit" in calls to the
                                       NLS printf() and scanf() */
NL_LANGMAX     14                      /* max # of bytes in a LANG name */
NL_MSGMAX      32767                   /* max message number */
NL_NMAX        1                       /* max # of bytes in N-to-1 mapping
                                       characters */
NL_SETMAX      255                     /* max set number */
NL_TEXTMAX     255                     /* max # of bytes in a message string */
NZERO          20                      /* default process priority */
OPEN_MAX       60                      /* max # of files a process can have
                                       open */
PASS_MAX       8                       /* max # of characters in a password */
```

```
PATH_MAX        256              /* max # of characters in a path name */
PID_MAX         30000            /* max value for a process ID */
PIPE_BUF        5120             /* max # bytes atomic in write to a pipe */
PIPE_MAX        5120             /* max # bytes written to a pipe
                                 in a write */
SCHAR_MAX       127              /* max value of a "signed char" */
SCHAR_MIN       (-128)           /* min value of a "signed char" */
SHRT_MAX        32767            /* max value of a "short int" */
SHRT_MIN        (-32768)         /* min value of a "short int" */
STD_BLK         1024             /* # bytes in a physical I/O block */
SYS_NMLN        9                /* 4.0 size of utsname elements */
                                 /* also defined in sys/utsname.h */
SYSPID_MAX      1                /* max pid of system processes */
TMP_MAX         17576            /* max # of unique names generated
                                 by tmpnam */
UCHAR_MAX       255              /* max value of an "unsigned char" */
UID_MAX         60000            /* max value for a user or group ID */
UINT_MAX        4294967295       /* max value of an "unsigned int" */
ULONG_MAX       4294967295       /* max value of an "unsigned long int" */
USHRT_MAX       65535            /* max value of an "unsigned short int" */
USI_MAX         4294967295       /* max decimal value of an "unsigned" */
WORD_BIT        32               /* # of bits in a "word" or "int" */
```

The following POSIX definitions are the most restrictive values to be used by a POSIX conformant application. Conforming implementations shall provide values at least this large.

```
_POSIX_ARG_MAX          4096     /* max length of arguments to exec */
_POSIX_CHILD_MAX        6        /* max # of processes per user ID */
_POSIX_LINK_MAX         8        /* max # of links to a single file */
_POSIX_MAX_CANON        255      /* max # of bytes in a line of input */
_POSIX_MAX_INPUT        255      /* max # of bytes in terminal
                                 input queue */
_POSIX_NAME_MAX         14       /* # of bytes in a filename */
_POSIX_NGROUPS_MAX       0       /* max # of groups in a process */
_POSIX_OPEN_MAX         16       /* max # of files a process can have open */
_POSIX_PATH_MAX         255      /* max # of characters in a pathname */
_POSIX_PIPE_BUF         512      /* max # of bytes atomic in write
                                 to a pipe */
```

NAME

`sccsfile` – format of SCCS file

DESCRIPTION

An SCCS (Source Code Control System) file is an ASCII file. It consists of six logical parts: the checksum, the delta table (contains information about each delta), user names (contains login names and/or numerical group IDs of users who may add deltas), flags (contains definitions of internal keywords), comments (contains arbitrary descriptive information about the file), and the body (contains the actual text lines intermixed with control lines).

Throughout an SCCS file there are lines which begin with the ASCII SOH (start of heading) character (octal 001). This character is hereafter referred to as the control character and will be represented graphically as `@`. Any line described below that is not depicted as beginning with the control character is prevented from beginning with the control character.

Entries of the form *DDDDD* represent a five-digit string (a number between 00000 and 99999).

Each logical part of an SCCS file is described in detail below.

Checksum

The checksum is the first line of an SCCS file. The form of the line is:

`@h`*DDDDD*

The value of the checksum is the sum of all characters, except those of the first line. The `@h` provides a magic number of (octal) 064001, depending on byte order.

Delta table

The delta table consists of a variable number of entries of one of the following forms:

`@s` *DDDDD/DDDDD/DDDDD*
`@d` *<type> <SCCS ID> yr/mo/da hr:mi:se <pgmr> DDDDD DDDDD*
`@i` *DDDDD* . . .
`@x` *DDDDD* . . .
`@g` *DDDDD* . . .
`@m` <MR *number*>
. . .
`@c` *<comments>* . . .
. . .
`@e`

The first line (`@s`) contains the number of lines inserted/deleted/unchanged, respectively. The second line (`@d`) contains the type of the delta (normal: `D` or removed: `R`), the SCCS ID of the delta, the date and time of creation of the delta, the login name corresponding to the real user ID at the time the delta was created, and the serial numbers of the delta and its predecessor, respectively.

The `@i`, `@x`, and `@g` lines contain the serial numbers of deltas included, excluded, and ignored, respectively. These lines are optional.

The @m lines (optional) each contain one MR number associated with the delta; the @c lines contain comments associated with the delta. The @e line ends the delta table entry.

User names

The list of login names and/or numerical group IDs of users who may add deltas to the file, separated by new-lines. The lines containing these login names and/or numerical group IDs are surrounded by the bracketing lines @u and @U. An empty list allows anyone to make a delta. Any line starting with a ! prohibits the succeeding group or user from making deltas.

Flags

Keywords used internally. See admin(1) for more information on their use. Each flag line takes the form:

@f *<flag>* *<optional text>*

The following flags are defined:

@f t *<type of program>*
@f v *<program name>*
@f i *<keyword string>*
@f b
@f m *<module name>*
@f f *<floor>*
@f c *<ceiling>*
@f d *<default-sid>*
@f n
@f j
@f l *<lock-releases>*
@f q *<user defined>*
@f z *<reserved for use in interfaces>*

The t flag defines the replacement for the %Y% identification keyword. The v flag controls prompting for MR numbers in addition to comments; if the optional text is present it defines an MR number validity checking program. The i flag controls the warning/error aspect of the "No id keywords" message. When the i flag is not present, this message is only a warning; when the i flag is present, this message causes a fatal error (the file will not be "gotten", or the delta will not be made). When the b flag is present the -b keyletter may be used on the get command to cause a branch in the delta tree. The m flag defines the first choice for the replacement text of the %M% identification keyword. The f flag defines the floor release; the release below which no deltas may be added. The c flag defines the ceiling release; the release above which no deltas may be added. The d flag defines the default SID to be used when none is specified on a get command. The n flag causes delta to insert a null delta (a delta that applies no changes) in those releases that are skipped when a delta is made in a new release (e.g., when delta 5.1 is made after delta 2.7, releases 3 and 4 are skipped). The absence of the n flag causes skipped releases to be completely empty. The j flag causes get to allow concurrent edits of the same base SID. The l flag defines a *list* of releases that are locked against editing. The q flag defines the replacement for the %Q% identification keyword. The z flag is used in specialized interface programs.

NAME

`timezone` – set default system time zone

SYNOPSIS

`/etc/TIMEZONE`

DESCRIPTION

This file sets and exports the time zone environmental variable `TZ`.

This file is "dotted" into other files that must know the time zone.

EXAMPLES

`/etc/TIMEZONE` for the east coast:

```
#     Time Zone
TZ=EST5EDT
export TZ
```

SEE ALSO

`ctime`(3C), `environ`(5).
`rc2`(1M), `profile`(4) in the *System Administrator's Reference Manual.*

NAME

`strftime` – language specific strings

DESCRIPTION

There can exist one printable file per locale to specify its date and time formatting information. These files must be kept in the directory `/usr/lib/locale/`*<locale>*`/LC_TIME`. The contents of these files are:

1. abbreviated month names (in order)
2. month names (in order)
3. abbreviated weekday names (in order)
4. weekday names (in order)
5. default strings that specify formats for locale time (`%X`) and locale date (`%x`).
6. default format for cftime, if the argument for cftime is zero or null.
7. AM (ante meridian) string
8. PM (post meridian) string

Each string is on a line by itself. All white space is significant. The order of the strings in the above list is the same order in which they must appear in the file.

EXAMPLE

`/usr/lib/locale/C/LC_TIME`

```
Jan
Feb
 ...
January
February
 ...
Sun
Mon
 ...
Sunday
Monday
 ...
%H:%M:%S
%m/%d/%y
%a %b %d %T %Z %Y
AM
PM
```

FILES

`/usr/lib/locale/`*<locale>*`/LC_TIME`

SEE ALSO

`ctime`(3C), `setlocale`(3C), `strftime`(3C).

Comments

Arbitrary text is surrounded by the bracketing lines `@t` and `@T`. The comments section typically will contain a description of the file's purpose.

Body

The body consists of text lines and control lines. Text lines do not begin with the control character, control lines do. There are three kinds of control lines: insert, delete, and end, represented by:

`@I` *DDDDD*
`@D` *DDDDD*
`@E` *DDDDD*

respectively. The digit string is the serial number corresponding to the delta for the control line.

SEE ALSO

`admin`(1), `delta`(1), `get`(1), `prs`(1).

MISCELLANEOUS (5)

NAME

`intro` – introduction to miscellany

DESCRIPTION

This section describes miscellaneous facilities such as macro packages, character set tables, etc.

NAME

utmp, wtmp – utmp and wtmp entry formats

SYNOPSIS

```
#include <utmp.h>
```

DESCRIPTION

These files, which hold user and accounting information for such commands as who, write, and login, have the following structure, defined in <utmp.h>:

```
#define   UTMP_FILE     "/etc/utmp"
#define   WTMP_FILE     "/etc/wtmp"
#define   ut_name       ut_user

struct     utmp {
   char    ut_user[8];         /* user login name */
   char    ut_id[4];           /* /sbin/inittab id (created by process
                                  that puts entry in utmp) */
   char    ut_line[12];        /* device name (console, lnxx) */
   short   ut_pid;             /* process id */
   short   ut_type;            /* type of entry */
   struct  exit_status {
      short  e_termination;    /* process termination status */
      short  e_exit;           /* process exit status */
   } ut_exit;                  /* exit status of a process
                                 * marked as DEAD_PROCESS */
   time_t  ut_time;            /* time entry was made */
};

/*  Definitions for ut_type  */

#define EMPTY          0
#define RUN_LVL        1
#define BOOT_TIME      2
#define OLD_TIME       3
#define NEW_TIME       4
#define INIT_PROCESS   5    /* process spawned by "init" */
#define LOGIN_PROCESS  6    /* a "getty" process waiting for login */
#define USER_PROCESS   7    /* a user process */
#define DEAD_PROCESS   8
#define ACCOUNTING     9
#define UTMAXTYPE      ACCOUNTING /* max legal value of ut_type */
```

```
/*  special strings or formats used in the "ut_line" field when  */
/*  accounting for something other than a process  */
/*  no string for the ut_line field can be more than 11 chars +  */
/*  a null character in length  */

#define RUNLVL_MSG    "run-level %c"
#define BOOT_MSG      "system boot"
#define OTIME_MSG     "old time"
#define NTIME_MSG     "new time"
```

FILES

/etc/utmp
/etc/wtmp

SEE ALSO

login(1), who(1), write(1) in the *User's Reference Manual*
getut(3C).

NAME

`ascii` – map of ASCII character set

DESCRIPTION

`ascii` is a map of the ASCII character set, giving both octal and hexadecimal equivalents of each character, to be printed as needed. It contains:

000 nul	001 soh	002 stx	003 etx	004 eot	005 enq	006 ack	007 bel
010 bs	011 ht	012 nl	013 vt	014 np	015 cr	016 so	017 si
020 dle	021 dc1	022 dc2	023 dc3	024 dc4	025 nak	026 syn	027 etb
030 can	031 em	032 sub	033 esc	034 fs	035 gs	036 rs	037 us
040 sp	041 !	042 "	043 #	044 $	045 %	046 &	047 ´
050 (	051)	052 *	053 +	054 ,	055 -	056 .	057 /
060 0	061 1	062 2	063 3	064 4	065 5	066 6	067 7
070 8	071 9	072 :	073 ;	074 <	075 =	076 >	077 ?
100 @	101 A	102 B	103 C	104 D	105 E	106 F	107 G
110 H	111 I	112 J	113 K	114 L	115 M	116 N	117 O
120 P	121 Q	122 R	123 S	124 T	125 U	126 V	127 W
130 X	131 Y	132 Z	133 [	134 \	135]	136 ^	137 _
140 `	141 a	142 b	143 c	144 d	145 e	146 f	147 g
150 h	151 i	152 j	153 k	154 l	155 m	156 n	157 o
160 p	161 q	162 r	163 s	164 t	165 u	166 v	167 w
170 x	171 y	172 z	173 {	174 |	175 }	176 ~	177 del

00 nul	01 soh	02 stx	03 etx	04 eot	05 enq	06 ack	07 bel
08 bs	09 ht	0a nl	0b vt	0c np	0d cr	0e so	0f si
10 dle	11 dc1	12 dc2	13 dc3	14 dc4	15 nak	16 syn	17 etb
18 can	19 em	1a sub	1b esc	1c fs	1d gs	1e rs	1f us
20 sp	21 !	22 "	23 #	24 $	25 %	26 &	27 ´
28 (	29)	2a *	2b +	2c ,	2d -	2e .	2f /
30 0	31 1	32 2	33 3	34 4	35 5	36 6	37 7
38 8	39 9	3a :	3b ;	3c <	3d =	3e >	3f ?
40 @	41 A	42 B	43 C	44 D	45 E	46 F	47 G
48 H	49 I	4a J	4b K	4c L	4d M	4e N	4f O
50 P	51 Q	52 R	53 S	54 T	55 U	56 V	57 W
58 X	59 Y	5a Z	5b [	5c \	5d]	5e ^	5f _
60 `	61 a	62 b	63 c	64 d	65 e	66 f	67 g
68 h	69 i	6a j	6b k	6c l	6d m	6e n	6f o
70 p	71 q	72 r	73 s	74 t	75 u	76 v	77 w
78 x	79 y	7a z	7b {	7c |	7d }	7e ~	7f del

FILES

`/usr/pub/ascii`

NAME

environ – user environment

DESCRIPTION

When a process begins execution, exec routines make available an array of strings called the environment [see exec(2)]. By convention, these strings have the form *variable=value*, for example, PATH=/bin:/usr/bin. These environmental variables provide a way to make information about a program's environment available to programs. The following environmental variables can be used by applications and are expected to be set in the target run-time environment.

HOME The name of the user's login directory, set by login(1) from the password file (see passwd(4)).

LANG The string used to specify localization information that allows users to work with different national conventions. The setlocale(3C) function looks for the LANG environment variable when it is called with "" as the *locale* argument. LANG is used as the default locale if the corresponding environment variable for a particular category is unset.

For example, when setlocale() is invoked as

```
setlocale(LC_CTYPE, ""),
```

setlocale() will query the LC_CTYPE environment variable first to see if it is set and non-null. If LC_CTYPE is not set or null, then setlocale() will check the LANG environment variable to see if it is set and non-null. If both LANG and LC_CTYPE are unset or null, the default C locale will be used to set the LC_CTYPE category.

Most commands will invoke

```
setlocale(LC_ALL, "")
```

prior to any other processing. This allows the command to be used with different national conventions by setting the appropriate environment variables.

The following environment variables are supported to correspond with each category of setlocale(3C):

LC_COLLATE This category specifies the collation sequence being used. The information corresponding to this category is stored in a database created by the colltbl(1M) command. This environment variable affects strcoll(3C) and strxfrm(3C).

LC_CTYPE This category specifies character classification, character conversion, and widths of multibyte characters. The information corresponding to this category is stored in a database created by the chrtbl(1M) command. The default C locale corresponds to the 7-bit ASCII character set. This environment variable is used by ctype(3C), mbchar(3C), and many commands; for example, cat(1), ed(1), ls(1), and vi(1).

LC_MONETARY This category specifies the monetary symbols and delimiters used for a particular locale. The information corresponding to this category is stored in a database created by the montbl(1M) command. This environment variable is used by localeconv(3C).

LC_NUMERIC This category specifies the decimal and thousands delimiters. The information corresponding to this category is stored in a database created by the chrtbl(1M) command. The default C locale corresponds to "." as the decimal delimiter and no thousands delimiter. This environment variable is used by localeconv(3C), printf(3C), and strtod(3C).

LC_TIME This category specifies date and time formats. The information corresponding to this category is stored in a database specified in strftime(4). The default C locale corresponds to U.S. date and time formats. This environment variable is used by many commands and functions; for example: at(1), calendar(1), date(1), strftime(3C), and getdate(3C).

MSGVERB Controls which standard format message components fmtmsg selects when messages are displayed to stderr [see fmtmsg(3C)].

SEV_LEVEL Define severity levels and associate and print strings with them in standard format error messages [see addseverity(3C) and fmtmsg(3C)].

PATH The sequence of directory prefixes that sh(1), time(1), nice(1), nohup(1), etc., apply in searching for a file known by an incomplete path name. The prefixes are separated by colons (:). login(1) sets PATH=/bin:/usr/bin. (For more detail, see sh(1).)

TERM The kind of terminal for which output is to be prepared. This information is used by commands, such as mm(1) or vi(1), which may exploit special capabilities of that terminal.

TZ Time zone information.
The contents of the environment variable named TZ are used by the functions ctime(3C), localtime() (see ctime(3C)), strftime(3C) and mktime(3C) to override the default timezone. If the first character of TZ is a colon (:), the behavior is implementation defined, otherwise TZ has the form:

std offset [*dst* [*offset*] , [*start* [/*time*] , *end* [/*time*]]]

Where:

std and *dst*
: Three or more bytes that are the designation for the standard (*std*) and daylight savings time (*dst*) timezones. Only *std* is required, if *dst* is missing, then daylight savings time does not apply in this locale. Upper- and lower-case letters are allowed. Any characters except a leading colon (:), digits, a comma (,), a minus (–) or a plus (+) are allowed.

offset Indicates the value one must add to the local time to arrive at Coordinated Universal Time. The offset has the form:

hh [: *mm* [: *ss*]]

The minutes (*mm*) and seconds (*ss*) are optional. The hour (*hh*) is required and may be a single digit. The *offset* following *std* is required. If no *offset* follows *dst* , daylight savings time is assumed to be one hour ahead of standard time. One or more digits may be used; the value is always interpreted as a decimal number. The hour must be between 0 and 24, and the minutes (and seconds) if present between 0 and 59. Out of range values may cause unpredictable behavior. If preceded by a "–", the timezone is east of the Prime Meridian; otherwise it is west (which may be indicated by an optional preceding "+" sign).

start/time,end/time
: Indicates when to change to and back from daylight savings time, where *start/time* describes when the change from standard time to daylight savings time occurs, and *end/time* describes when the change back happens. Each *time* field describes when, in current local time, the change is made.

The formats of *start* and *end* are one of the following:

Jn The Julian day n ($1 \le n \le 365$). Leap days are not counted. That is, in all years, February 28 is day 59 and March 1 is day 60. It is impossible to refer to the occasional February 29.

n The zero-based Julian day ($0 \le n \le 365$). Leap days are counted, and it is possible to refer to February 29.

Mm.n.d
: The d^{th} day, ($0 \le d \le 6$) of week n of month m of the year ($1 \le n \le 5$, $1 \le m \le 12$), where week 5 means "the last d-day in month m" which may occur in either the fourth or the fifth week). Week 1 is the first week in which the d^{th} day occurs. Day zero is Sunday.

Implementation specific defaults are used for *start* and *end* if these optional fields are not given.

The *time* has the same format as *offset* except that no leading sign ("−" or "+") is allowed. The default, if *time* is not given is 02:00:00.

Further names may be placed in the environment by the export command and *name=value* arguments in sh(1), or by exec(2). It is unwise to conflict with certain shell variables that are frequently exported by .profile files: MAIL, PS1, PS2, IFS [see profile(4)].

SEE ALSO

strftime(4), passwd(4), profile(4) in the *System Administrator's Reference Manual*.

chrtbl(1M), colltbl(1M), montbl(1M), exec(2), addseverity(3C), ctime(3C), ctype(3C), fmtmsg(3C), getdate(3C), localeconv(3C), mbchar(3C), mktime(3C), printf(3C), strcoll(3C), strftime(3C), strtod(3C), strxfrm(3C), strftime(4), timezone(4).

cat(1), date(1), ed(1), ls(1), login(1), nice(1), nohup(1), sh(1), sort(1), time(1), vi(1) in the *User's Reference Manual*.

mm(1) in the *DOCUMENTER'S WORKBENCH Software Technical Discussion and Reference Manual*.

NAME

`fcntl` – file control options

SYNOPSIS

`#include <fcntl.h>`

DESCRIPTION

The `<fcntl.h>` header defines the following requests and arguments for use by the functions `fcntl` [see `fcntl`(2)] and `open` [see `open`(2)].

Values for *cmd* used by `fcntl` (the following values are unique):

F_DUPFD	Duplicate file descriptor
F_GETFD	Get file descriptor flags
F_SETFD	Set file descriptor flags
F_GETFL	Get file status flags
F_SETFL	Set file status flags
F_GETLK	Get record locking information
F_SETLK	Set record locking information
F_SETLKW	Set record locking information; wait if blocked

File descriptor flags used for `fcntl`:

FD_CLOEXEC	Close the file descriptor upon execution of an exec function [see exec(2)]

Values for `l_type` used for record locking with `fcntl` (the following values are unique):

F_RDLCK	Shared or read lock
F_UNLCK	Unlock
F_WRLCK	Exclusive or write lock

The following three sets of values are bitwise distinct:
Values for `oflag` used by `open`:

O_CREAT	Create file if it does not exist
O_EXCL	Exclusive use flag
O_NOCTTY	Do not assign controlling tty
O_TRUNC	Truncate flag

File status flags used for `open` and `fcntl`:

O_APPEND	Set append mode
O_NDELAY	Non-blocking mode
O_NONBLOCK	Non-blocking mode (POSIX)
O_SYNC	Synchronous writes

Mask for use with file access modes:

O_ACCMODE	Mask for file access modes

File access modes used for open and `fcntl`:

O_RDONLY	Open for reading only
O_RDWR	Open for reading and writing
O_WRONLY	Open for writing only

The structure `flock` describes a file lock. It includes the following members:

```
short   l_type;     /* Type of lock */
short   l_whence;   /* Flag for starting offset */
off_t   l_start;    /* Relative offset in bytes */
off_t   l_len;      /* Size; if 0 then until EOF */
long    l_sysid;    /* Returned with F_GETLK */
pid_t   l_pid;      /* Returned with F_GETLK */
```

SEE ALSO

creat(2), exec(2), fcntl(2), open(2).

NAME

jagent – host control of windowing terminal

SYNOPSIS

`#include <sys/jioctl.h>`

`int ioctl (int cntlfd, JAGENT, &arg);`

DESCRIPTION

The `ioctl` system call, when performed on an `xt`(7) device with the `JAGENT` request, allows a host program to send information to a windowing terminal.

`ioctl` has three arguments:

cntlfd the `xt`(7) control channel file descriptor

`JAGENT` the `xt ioctl` request to invoke a windowing terminal agent routine.

&arg the address of a `bagent` structure, defined in `<sys/jioctl.h>` as follows:

```
struct  bagent {
  int   size;  /* size of src in & dest out */
  char  *src;  /* the source byte string */
  char  *dest; /* the destination byte string */
};
```

The `src` pointer must be initialized to point to a byte string that is sent to the windowing terminal. See `layers`(5) for a list of `JAGENT` strings recognized by windowing terminals. Likewise, the `dest` pointer must be initialized to the address of a buffer to receive a byte string returned by the terminal. When `ioctl` is called, the `size` argument must be set to the length of the `src` string. Upon return, `size` is set by `ioctl` to the length of the destination byte string, `dest`.

SEE ALSO

`ioctl`(2), `libwindows`(3X), `layers`(5).
`xt`(7) in the *Programmer's Guide: STREAMS*.

DIAGNOSTICS

Upon successful completion, a non-negative value, the size of the destination byte string, is returned. If an error occurs, -1 is returned.

NAME

`layers` – protocol used between host and windowing terminal under `layers`(1)

DESCRIPTION

Layers are asynchronous windows supported by the operating system in a windowing terminal. Communication between the UNIX System processes and terminal processes under the `layers` command [see `layers`(1)] occurs via multiplexed channels managed by the respective operating systems using a protocol as specified in `xtproto`(5).

The contents of packets transferring data between a UNIX System process and a layer are asymmetric. Data sent from the UNIX System to a particular terminal process are undifferentiated and it is up to the terminal process to interpret the contents of packets.

Control information for terminal processes is sent via channel 0. Process 0 in the windowing terminal performs the designated functions on behalf of the process connected to the designated channel. These packets take the form:

command, channel

except for `JTIMOM` and `JAGENT` information, which takes the form

command, data ...

The commands are the bottom eight bits extracted from the following `ioctl`(2) codes:

`JBOOT` Prepare to load a new terminal program into the designated layer.

`JTERM` Kill the downloaded layer program, and restore the default window program.

`JTIMOM` Set the timeout parameters for the protocol. The data consist of four bytes in two groups: the value of the receive timeout in milliseconds (the low eight bits followed by the high eight bits) and the value of the transmit timeout (in the same format).

`JZOMBOOT` Like `JBOOT`, but do not execute the program after loading.

`JAGENT` Send a source byte string to the terminal agent routine and wait for a reply byte string to be returned.

The data are from a `bagent` structure [see `jagent`(5)] and consist of a one-byte size field followed by a two-byte agent command code and parameters. Two-byte integers transmitted as part of an agent command are sent with the high-order byte first. The response from the terminal is generally identical to the command packet, with the two command bytes replaced by the return code: 0 for success, `-1` for failure. Note that the routines in the `libwindows`(3X) library all send parameters in an `agentrect` structure. The agent command codes and their parameters are as follows:

`A_NEWLAYER` followed by a two-byte channel number and a rectangle structure (four two-byte coordinates).

A_CURRENT	followed by a two-byte channel number.
A_DELETE	followed by a two-byte channel number.
A_TOP	followed by a two-byte channel number.
A_BOTTOM	followed by a two-byte channel number.
A_MOVE	followed by a two-byte channel number and a point to move to (two two-byte coordinates).
A_RESHAPE	followed by a two-byte channel number and the new rectangle (four two-byte coordinates).
A_NEW	followed by a two-byte channel number and a rectangle structure (four two-byte coordinates).
A_EXIT	no parameters needed.
A_ROMVERSION	no parameters needed. The response packet contains the size byte, two-byte return code, two unused bytes, and the parameter part of the terminal ID string (e.g., 8;7;3) .

JXTPROTO Set xt protocol type [see xtproto(5)]. The data consist of one byte specifying maximum size for the data part of regular xt packets sent from the host to the terminal. This number may be lower than the number returned by A_XTPROTO at lower baud rates or if the -m option was specified upon invocation of layers(1). A size of 1 specifies network xt protocol.

Packets from the windowing terminal to the UNIX System all take the following form:

command, data ...

The single-byte commands are as follows:

C_SENDCHAR	Send the next byte to the UNIX System process.
C_NEW	Create a new UNIX System process group for this layer. Remember the window size parameters for this layer. The data for this command is in the form described by the jwinsize structure. The size of the window is specified by two 2-byte integers, sent low byte first.
C_UNBLK	Unblock transmission to this layer. There are no data for this command.
C_DELETE	Delete the UNIX System process group attached to this layer. There are no data for this command.
C_EXIT	Exit. Kill all UNIX System process groups associated with this terminal and terminate the session. There are no data for this command.
C_DEFUNCT	Layer program has died, send a terminate signal to the UNIX System process groups associated with this terminal. There are no data for this command.

C_SENDNCHARS	The rest of the data are characters to be passed to the UNIX System process.
C_RESHAPE	The layer has been reshaped. Change the window size parameters for this layer. The data take the same form as for the C_NEW command. A SIGWINCH signal is also sent to the process in the window, so that the process knows that the window has been reshaped and it can get the new window parameters.
C_NOFLOW	Disable network xt flow control [see xtproto(5)].
C_YESFLOW	Enable network xt flow control [see xtproto(5)].

FILES

/usr/include/windows.h
/usr/include/sys/jioctl.h

SEE ALSO

layers(1), libwindows(3X), jagent(5), xtproto(5).
xt(7) in the *Programmer's Guide: STREAMS*.

NAME

math − math functions and constants

SYNOPSIS

```
#include <math.h>
```

DESCRIPTION

This file contains declarations of all the functions in the Math Library (described in Section 3M), as well as various functions in the C Library (Section 3C) that return floating-point values.

It defines the structure and constants used by the matherr(3M) error-handling mechanisms, including the following constant used as a error-return value:

HUGE	The maximum value of a single-precision floating-point number.

The following mathematical constants are defined for user convenience:

M_E	The base of natural logarithms (*e*).
M_LOG2E	The base-2 logarithm of *e*.
M_LOG10E	The base-10 logarithm of *e*.
M_LN2	The natural logarithm of 2.
M_LN10	The natural logarithm of 10.
M_PI	π, the ratio of the circumference of a circle to its diameter.
M_PI_2	$\pi/2$.
M_PI_4	$\pi/4$.
M_1_PI	$1/\pi$.
M_2_PI	$2/\pi$.
M_2_SQRTPI	$2/\sqrt{\pi}$.
M_SQRT2	The positive square root of 2.
M_SQRT1_2	The positive square root of 1/2.

The following mathematical constants are also defined in this header file:

MAXFLOAT	The maximum value of a non-infinite single-precision floating point number.
HUGE_VAL	positive infinity.

For the definitions of various machine-dependent constants, see values(5).

SEE ALSO

intro(3), matherr(3M), values(5).

NAME

prof – profile within a function

SYNOPSIS

```
#define MARK
#include <prof.h>

void MARK (name);
```

DESCRIPTION

MARK introduces a mark called *name* that is treated the same as a function entry point. Execution of the mark adds to a counter for that mark, and program-counter time spent is accounted to the immediately preceding mark or to the function if there are no preceding marks within the active function.

name may be any combination of letters, numbers, or underscores. Each *name* in a single compilation must be unique, but may be the same as any ordinary program symbol.

For marks to be effective, the symbol MARK must be defined before the header file prof.h is included, either by a preprocessor directive as in the synopsis, or by a command line argument:

```
cc -p -DMARK foo.c
```

If MARK is not defined, the MARK(*name*) statements may be left in the source files containing them and are ignored. prof –g must be used to get information on all labels.

EXAMPLE

In this example, marks can be used to determine how much time is spent in each loop. Unless this example is compiled with MARK defined on the command line, the marks are ignored.

```
#include <prof.h>
foo( )
{
      int i, j;
      . . .
      MARK(loop1);
      for (i = 0; i < 2000; i++) {
            . . .
      }
      MARK(loop2);
      for (j = 0; j < 2000; j++) {
            . . .
      }
}
```

SEE ALSO

prof(1), profil(2), monitor(3C).

NAME

regexp: compile, step, advance – regular expression compile and match routines

SYNOPSIS

```
#define INIT declarations
#define GETC(void) getc code
#define PEEKC(void) peekc code
#define UNGETC(void) ungetc code
#define RETURN(ptr) return code
#define ERROR(val) error code

#include <regexp.h>

char *compile(char *instring, char *expbuf, char *endbuf, int eof);

int step(char *string, char *expbuf);

int advance(char *string, char *expbuf);

extern char *loc1, *loc2, *locs;
```

DESCRIPTION

These functions are general purpose regular expression matching routines to be used in programs that perform regular expression matching. These functions are defined by the <regexp.h> header file.

The functions step and advance do pattern matching given a character string and a compiled regular expression as input.

The function compile takes as input a regular expression as defined below and produces a compiled expression that can be used with step or advance.

A regular expression specifies a set of character strings. A member of this set of strings is said to be matched by the regular expression. Some characters have special meaning when used in a regular expression; other characters stand for themselves.

The regular expressions available for use with the regexp functions are constructed as follows:

Expression	*Meaning*
c	the character *c* where *c* is not a special character.
c	the character *c* where *c* is any character, except a digit in the range 1–9.
^	the beginning of the line being compared.
$	the end of the line being compared.
.	any character in the input.
[*s*]	any character in the set *s*, where *s* is a sequence of characters and/or a range of characters, *e.g.*, [*c*–*c*].

[^s] any character not in the set *s*, where *s* is defined as above.

*r** zero or more successive occurrences of the regular expression *r*. The longest leftmost match is chosen.

rx the occurrence of regular expression *r* followed by the occurrence of regular expression *x*. (Concatenation)

r\{*m*,*n*\} any number of *m* through *n* successive occurrences of the regular expression *r*. The regular expression *r*\{*m*\} matches exactly *m* occurrences; *r*\{*m*,\} matches at least *m* occurrences.

\(*r*\) the regular expression *r*. When *n* (where *n* is a number greater than zero) appears in a constructed regular expression, it stands for the regular expression *x* where *x* is the n^{th} regular expression enclosed in \(and \) that appeared earlier in the constructed regular expression. For example, \(*r*\)*x*\(*y*\)z\2 is the concatenation of regular expressions *rxyzy*.

Characters that have special meaning except when they appear within square brackets ([]) or are preceded by \ are: ., *, [, \. Other special characters, such as $ have special meaning in more restricted contexts.

The character ^ at the beginning of an expression permits a successful match only immediately after a newline, and the character $ at the end of an expression requires a trailing newline.

Two characters have special meaning only when used within square brackets. The character – denotes a range, [*c*–*c*], unless it is just after the open bracket or before the closing bracket, [–*c*] or [*c*–] in which case it has no special meaning. When used within brackets, the character ^ has the meaning *complement of* if it immediately follows the open bracket (example: [^*c*]); elsewhere between brackets (example: [*c*^]) it stands for the ordinary character ^.

The special meaning of the \ operator can be escaped only by preceding it with another \, *e.g.* \\.

Programs must have the following five macros declared before the `#include <regexp.h>` statement. These macros are used by the `compile` routine. The macros GETC, PEEKC, and UNGETC operate on the regular expression given as input to `compile`.

GETC This macro returns the value of the next character (byte) in the regular expression pattern. Successive calls to GETC should return successive characters of the regular expression.

PEEKC This macro returns the next character (byte) in the regular expression. Immediately successive calls to PEEKC should return the same character, which should also be the next character returned by GETC.

UNGETC This macro causes the argument c to be returned by the next call to GETC and PEEKC. No more than one character of pushback is ever needed and this character is guaranteed to be the last character read by GETC. The return value of the macro UNGETC(c) is always ignored.

RETURN(*ptr*) This macro is used on normal exit of the `compile` routine. The value of the argument *ptr* is a pointer to the character after the last character of the compiled regular expression. This is useful to programs which have memory allocation to manage.

ERROR(*val*) This macro is the abnormal return from the `compile` routine. The argument *val* is an error number [see ERRORS below for meanings]. This call should never return.

The syntax of the `compile` routine is as follows:

`compile`(*instring*, *expbuf*, *endbuf*, *eof*)

The first parameter, *instring*, is never used explicitly by the `compile` routine but is useful for programs that pass down different pointers to input characters. It is sometimes used in the `INIT` declaration (see below). Programs which call functions to input characters or have characters in an external array can pass down a value of `(char *)0` for this parameter.

The next parameter, *expbuf*, is a character pointer. It points to the place where the compiled regular expression will be placed.

The parameter *endbuf* is one more than the highest address where the compiled regular expression may be placed. If the compiled expression cannot fit in `(endbuf-expbuf)` bytes, a call to `ERROR(50)` is made.

The parameter *eof* is the character which marks the end of the regular expression. This character is usually a `/`.

Each program that includes the `<regexp.h>` header file must have a `#define` statement for `INIT`. It is used for dependent declarations and initializations. Most often it is used to set a register variable to point to the beginning of the regular expression so that this register variable can be used in the declarations for `GETC`, `PEEKC`, and `UNGETC`. Otherwise it can be used to declare external variables that might be used by `GETC`, `PEEKC` and `UNGETC`. [See EXAMPLE below.]

The first parameter to the `step` and `advance` functions is a pointer to a string of characters to be checked for a match. This string should be null terminated.

The second parameter, *expbuf*, is the compiled regular expression which was obtained by a call to the function `compile`.

The function `step` returns non-zero if some substring of *string* matches the regular expression in *expbuf* and zero if there is no match. If there is a match, two external character pointers are set as a side effect to the call to `step`. The variable `loc1` points to the first character that matched the regular expression; the variable `loc2` points to the character after the last character that matches the regular expression. Thus if the regular expression matches the entire input string, `loc1` will point to the first character of *string* and `loc2` will point to the null at the end of *string*.

The function `advance` returns non-zero if the initial substring of *string* matches the regular expression in *expbuf*. If there is a match, an external character pointer, `loc2`, is set as a side effect. The variable `loc2` points to the next character in *string* after the last character that matched.

When **advance** encounters a * or \{ \} sequence in the regular expression, it will advance its pointer to the string to be matched as far as possible and will recursively call itself trying to match the rest of the string to the rest of the regular expression. As long as there is no match, **advance** will back up along the string until it finds a match or reaches the point in the string that initially matched the * or \{ \}. It is sometimes desirable to stop this backing up before the initial point in the string is reached. If the external character pointer `locs` is equal to the point in the string at sometime during the backing up process, **advance** will break out of the loop that backs up and will return zero.

The external variables `circf`, `sed`, and `nbra` are reserved.

DIAGNOSTICS

The function `compile` uses the macro RETURN on success and the macro ERROR on failure (see above). The functions **step** and **advance** return non-zero on a successful match and zero if there is no match. Errors are:

11 range endpoint too large.

16 bad number.

25 \ *digit* out of range.

36 illegal or missing delimiter.

41 no remembered search string.

42 \(\) imbalance.

43 too many \(.

44 more than 2 numbers given in \{ \}.

45 } expected after \.

46 first number exceeds second in \{ \}.

49 [ ] imbalance.

50 regular expression overflow.

EXAMPLE

The following is an example of how the regular expression macros and calls might be defined by an application program:

```
#define INIT          register char *sp = instring;
#define GETC         (*sp++)
#define PEEKC        (*sp)
#define UNGETC(c)     (--sp)
#define RETURN(*c)     return;
#define ERROR(c)      regerr

#include <regexp.h>

  . . .
      (void) compile(*argv, expbuf, &expbuf[ESIZE],'\0');
  . . .
      if (step(linebuf, expbuf))
                        succeed;
```

NAME

stat – data returned by stat system call

SYNOPSIS

```
#include <sys/types.h>
#include <sys/stat.h>
```

DESCRIPTION

The system calls stat and fstat return data in a stat structure, which is defined in stat.h.

The constants used in the st_mode field are also defined in this file:

```
#define   S_IFMT     /* type of file */
#define   S_IAMB     /* access mode bits */
#define   S_IFIFO    /* fifo */
#define   S_IFCHR    /* character special */
#define   S_IFDIR    /* directory */
#define   S_IFNAM    /* XENIX special named file */
#define   S_INSEM    /* XENIX semaphore subtype of IFNAM */
#define   S_INSHD    /* XENIX shared data subtype of IFNAM */
#define   S_IFBLK    /* block special */
#define   S_IFREG    /* regular */
#define   S_IFLNK    /* symbolic link */
#define   S_ISUID    /* set user id on execution */
#define   S_ISGID    /* set group id on execution */
#define   S_ISVTX    /* save swapped text even after use */
#define   S_IREAD    /* read permission, owner */
#define   S_IWRITE   /* write permission, owner */
#define   S_IEXEC    /* execute/search permission, owner */
#define   S_ENFMT    /* record locking enforcement flag */
#define   S_IRWXU    /* read, write, execute: owner */
#define   S_IRUSR    /* read permission: owner */
#define   S_IWUSR    /* write permission: owner */
#define   S_IXUSR    /* execute permission: owner */
#define   S_IRWXG    /* read, write, execute: group */
#define   S_IRGRP    /* read permission: group */
#define   S_IWGRP    /* write permission: group */
#define   S_IXGRP    /* execute permission: group */
#define   S_IRWXO    /* read, write, execute: other */
#define   S_IROTH    /* read permission: other */
#define   S_IWOTH    /* write permission: other */
#define   S_IXOTH    /* execute permission: other */
```

The following macros are for POSIX conformance:

#define	S_ISBLK(mode)	block special file
#define	S_ISCHR(mode)	character special file
#define	S_ISDIR(mode)	directory file
#define	S_ISFIFO(mode)	pipe or fifo file
#define	S_ISREG(mode)	regular file

SEE ALSO

stat(2), types(5).

NAME

stdarg – handle variable argument list

SYNOPSIS

```
#include <stdarg.h>

va_list pvar;

void va_start(va_list pvar, parmN);

type va_arg(va_list pvar, type);

void va_end(va_list pvar);
```

DESCRIPTION

This set of macros allows portable procedures that accept variable numbers of arguments of variable types to be written. Routines that have variable argument lists [such as `printf`] but do not use *stdarg* are inherently non-portable, as different machines use different argument-passing conventions.

`va_list` is a type defined for the variable used to traverse the list.

The `va_start()` macro is invoked before any access to the unnamed arguments and initializes `pvar` for subsequent use by `va_arg()` and `va_end()`. The parameter *parmN* is the identifier of the rightmost parameter in the variable parameter list in the function definition (the one just before the `, ...`). If this parameter is declared with the `register` storage class or with a function or array type, or with a type that is not compatible with the type that results after application of the default argument promotions, the behavior is undefined.

The parameter *parmN* is required under strict ANSI C compilation. In other compilation modes, *parmN* need not be supplied and the second parameter to the `va_start()` macro can be left empty [e.g., `va_start(pvar, );`]. This allows for routines that contain no parameters before the `...` in the variable parameter list.

The `va_arg()` macro expands to an expression that has the type and value of the next argument in the call. The parameter `pvar` should have been previously initialized by `va_start()`. Each invocation of `va_arg()` modifies `pvar` so that the values of successive arguments are returned in turn. The parameter *type* is the type name of the next argument to be returned. The type name must be specified in such a way so that the type of a pointer to an object that has the specified type can be obtained simply by postfixing a `*` to *type*. If there is no actual next argument, or if *type* is not compatible with the type of the actual next argument (as promoted according to the default argument promotions), the behavior is undefined.

The `va_end()` macro is used to clean up.

Multiple traversals, each bracketed by `va_start` and `va_end`, are possible.

EXAMPLE

This example gathers into an array a list of arguments that are pointers to strings (but not more than `MAXARGS` arguments) with function `f1`, then passes the array as a single argument to function `f2`. The number of pointers is specified by the first argument to `f1`.

```
#include <stdarg.h>
#define MAXARGS 31

void f1(int n_ptrs, ...)
{
     va_list ap;
     char *array[MAXARGS];
     int ptr_no = 0;

     if (n_ptrs > MAXARGS)
          n_ptrs = MAXARGS;
     va_start(ap, n_ptrs);
     while (ptr_no < n_ptrs)
          array[ptr_no++] = va_arg(ap, char*);
     va_end(ap);
     f2(n_ptrs, array);
}
```

Each call to `f1` shall have visible the definition of the function or a declaration such as

```
void f1(int, ...)
```

SEE ALSO

`vprintf`(3S).

NOTES

It is up to the calling routine to specify in some manner how many arguments there are, since it is not always possible to determine the number of arguments from the stack frame. For example, `execl` is passed a zero pointer to signal the end of the list. `printf` can tell how many arguments there are by the format. It is non-portable to specify a second argument of `char`, `short`, or `float` to `va_arg`, because arguments seen by the called function are not `char`, `short`, or `float`. C converts `char` and `short` arguments to `int` and converts `float` arguments to `double` before passing them to a function.

NAME

types – primitive system data types

SYNOPSIS

```
#include <sys/types.h>
```

DESCRIPTION

The data types defined in types.h are used in UNIX System code. Some data of these types are accessible to user code:

```
typedef  struct { int r[1]; } *physadr;
typedef  long             clock_t;
typedef  long             daddr_t;
typedef  char *           caddr_t;
typedef  unsigned char    unchar;
typedef  unsigned short   ushort;
typedef  unsigned int     uint;
typedef  unsigned long    ulong;
typedef  ushort           ino_t;
typedef  ushort           uid_t;
typedef  ushort           gid_t;
typedef  ushort           nlink_t;
typedef  ulong            mode_t;
typedef  short            cnt_t;
typedef  long             time_t;
typedef  int              label_t[6];
typedef  short            dev_t;
typedef  long             off_t;
typedef  long             pid_t;
typedef  unsigned long    paddr_t;
typedef  int              key_t;
typedef  unsigned char    use_t;
typedef  short            sysid_t;
typedef  short            index_t;
typedef  short            lock_t;
typedef  unsigned int     size_t;
typedef  long             clock_t;
```

The form daddr_t is used for disk addresses except in an i-node on disk, see fs(4). Times are encoded in seconds since 00:00:00 UTC, January 1, 1970. The major and minor parts of a device code specify kind and unit number of a device and are installation-dependent. Offsets are measured in bytes from the beginning of a file. The label_t variables are used to save the processor state while another process is running.

NAME

values – machine-dependent values

SYNOPSIS

#include <values.h>

DESCRIPTION

This file contains a set of manifest constants, conditionally defined for particular processor architectures.

The model assumed for integers is binary representation (one's or two's complement), where the sign is represented by the value of the high-order bit.

BITS(*type*) The number of bits in a specified type (e.g., int).

HIBITS The value of a short integer with only the high-order bit set.

HIBITL The value of a long integer with only the high-order bit set.

HIBITI The value of a regular integer with only the high-order bit set.

MAXSHORT The maximum value of a signed short integer.

MAXLONG The maximum value of a signed long integer.

MAXINT The maximum value of a signed regular integer.

MAXFLOAT, LN_MAXFLOAT
The maximum value of a single-precision floating-point number, and its natural logarithm.

MAXDOUBLE, LN_MAXDOUBLE
The maximum value of a double-precision floating-point number, and its natural logarithm.

MINFLOAT, LN_MINFLOAT
The minimum positive value of a single-precision floating-point number, and its natural logarithm.

MINDOUBLE, LN_MINDOUBLE
The minimum positive value of a double-precision floating-point number, and its natural logarithm.

FSIGNIF The number of significant bits in the mantissa of a single-precision floating-point number.

DSIGNIF The number of significant bits in the mantissa of a double-precision floating-point number.

SEE ALSO

intro(3), math(5).

NAME

varargs – handle variable argument list

SYNOPSIS

```
#include <varargs.h>

va_alist

va_dcl

va_list pvar;

void va_start(va_list pvar);

type va_arg(va_list pvar, type);

void va_end(va_list pvar);
```

DESCRIPTION

This set of macros allows portable procedures that accept variable argument lists to be written. Routines that have variable argument lists [such as printf(3S)] but do not use varargs are inherently non-portable, as different machines use different argument-passing conventions.

va_alist is used as the parameter list in a function header.

va_dcl is a declaration for va_alist. No semicolon should follow va_dcl.

va_list is a type defined for the variable used to traverse the list.

va_start is called to initialize pvar to the beginning of the list.

va_arg will return the next argument in the list pointed to by pvar. *type* is the type the argument is expected to be. Different types can be mixed, but it is up to the routine to know what type of argument is expected, as it cannot be determined at runtime.

va_end is used to clean up.

Multiple traversals, each bracketed by va_start and va_end, are possible.

EXAMPLE

This example is a possible implementation of execl [see exec(2)].

```
#include <unistd.h>
#include <varargs.h>
#define MAXARGS 100

/*    execl is called by
            execl(file, arg1, arg2, ..., (char *)0);
*/
execl(va_alist)
va_dcl
{
      va_list ap;
      char *file;
      char *args[MAXARGS];          /* assumed big enough*/
      int argno = 0;
```

```
        va_start(ap);
        file = va_arg(ap, char *);
        while ((args[argno++] = va_arg(ap, char *)) != 0)
             ;
        va_end(ap);
        return execv(file, args);
}
```

SEE ALSO

exec(2), printf(3S), vprintf(3S), stdarg(5).

NOTES

It is up to the calling routine to specify in some manner how many arguments there are, since it is not always possible to determine the number of arguments from the stack frame. For example, execl is passed a zero pointer to signal the end of the list. printf can tell how many arguments are there by the format.

It is non-portable to specify a second argument of char, short, or float to va_arg, since arguments seen by the called function are not char, short, or float. C converts char and short arguments to int and converts float arguments to double before passing them to a function.

stdarg is the preferred interface.

NAME

xtproto – multiplexed channels protocol used by xt driver

DESCRIPTION

This xt protocol is used for communication between multiple UNIX System host processes and an AT&T windowing terminal operating under the layers command; see xt(7). It is a multiplexed protocol that directs traffic between host processes and terminal windows, thereby allowing multiple virtual terminal sessions over a single connection. The protocol is implemented by the xt host driver and corresponding firmware in a windowing terminal.

The xt driver implements two distinct low level protocols. Which protocol is used depends on the media used for communication with the terminal. The regular xt protocol is used when communicating over unreliable media such as RS-232. The regular xt protocol provides flow control and error correction, thereby guaranteeing error-free delivery of data. The network xt protocol is used when communicating over reliable media such as a local area network. In order to achieve maximum possible throughput, the network xt protocol relies on the underlying network to provide flow control and error correction.

The layers command queries the windowing terminal whether to use regular or network xt protocol through an A_XTPROTO JAGENT ioctl system call [see layers(5)]. The layers command then decides what protocol to use based on the return value of A_XTPROTO, baud rate, and the -m option of layers.

The regular xt protocol uses packets with a 2-byte header containing a 3-bit sequence number, 3-bit channel number, control flag, and one byte for data size. The data part of packets sent from the host to the terminal may not be larger than 252 bytes. The maximum data part size can be less than 252 at lower baud rates, or if the -m option of layers was specified. Also, when communicating with some earlier windowing terminals, maximum data part size is fixed at 32 bytes. The maximum data part size of packets sent from the terminal to the host is always fixed at 32 bytes. The trailer contains a CRC-16 code in 2 bytes. Each channel is double-buffered.

Correctly received regular xt packets in sequence are acknowledged with a control packet containing an ACK; however, out of sequence packets generate a control packet containing a NAK, which causes the retransmission in sequence of all unacknowledged packets.

Unacknowledged regular xt packets are retransmitted after a timeout interval that is dependent on baud rate. Another timeout parameter specifies the interval after which incomplete receive packets are discarded.

Network xt protocol uses a 3-byte header containing a 3-bit channel number, various control flags, and 2-bytes for data size. The data part of packets sent from the host to the terminal has no size limit. The data part of packets sent from the terminal to the host is restricted to 1025 bytes.

Since network xt protocol relies on the underlying media to guarantee error-free delivery of data, no CRC codes or timeouts are needed.

Network xt protocol provides a simple flow control mechanism to limit the amount of data sent to a window in the terminal before a NETWORK XT ACK acknowledgement is received by the host. The intent of this flow control is to limit the amount of data sent to a window in the terminal not reading its input because, for example, the user has pressed the scroll lock key. This is necessary to prevent data from backing up and blocking other data directed to other windows. To improve overall throughput, network xt flow control can be disabled by processes in the terminal that always read their input quickly.

FILES

`/usr/include/sys/xtproto.h` channel multiplexing protocol definitions

SEE ALSO

jagent(5), layers(5).
layers(1) in the *User's Reference Manual.*
xt(7) in the *Programmer's Guide: STREAMS.*