AT&T

# UNIX® System V

## PROGRAMMER'S REFERENCE MANUAL

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# Table of Contents

# Introduction

This manual describes the programming features of the UNIX system. 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 which may not exist on your system.

This manual is divided into five sections, some containing interfiled subclasses:

1. Commands
2. System Calls.
3. Subroutines:
   - 3C. C Programming Language Libraries
   - 3S. Standard I/O Library Routines
   - 3M. Mathematical Library Routines
   - 3N. Networking Support Utilities
   - 3X. Specialized Libraries
   - 3F. FORTRAN Programming Libraries
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 subroutines. Their binary versions reside in various system libraries in the directories **/lib** and **/usr/lib**. 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). 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* (P-H). Those followed by **(1M)**, **(7)**, or **(8)** are contained in the *System Administrator's Reference Manual* (AT&T).

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 (also Section 3 is in alphabetical order by suffixes). 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.

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 being described. A few conventions are used, particularly in Section 2 (*System Calls*):
  - **Boldface** 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 −, plus +, or equal 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.
- The **WARNINGS** part points out potential pitfalls.
- The **BUGS** part gives known bugs and sometimes deficiencies.
- The **CAVEATS** part gives details of the implementation that might affect usage.

A "Table of Contents" and a "Permuted Index" derived from that table precedes section 1.

Some of the manual pages refer to the MAU, which is the WE®32106 Math Acceleration Unit. This unit is a high performance floating point support processor chip that supports a large subset of IEEE (Institute of Electrical and Electronics Engineers) P754 Draft 10 requirements for Binary Floating Point Arithmetic.

# **UNIX® System V**

# Programmer's Reference Manual

## NAME

intro – introduction to programming commands

## DESCRIPTION

This section describes, in alphabetical order, commands available for the AT&T 3B2 Computer. The top of each page indicates the utilities package to which the command belongs. The packages are:

Advanced C Utilities
AT&T Windowing Utilities
C Programming Language Utilities
Directory and File Management Utilities
Extended Software Generation System Utilities
Software Generation System Utilitites
Source Code Control System Utilities
Terminal Information Utilities

### COMMAND SYNTAX

Unless otherwise noted, the commands described 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<br>– *argletter*<>*optarg*<br><br>where:<br><br>*noargletter* is a single letter representing an option without an option-argument<br><br>*argletter* is a single letter representing an option requiring an option-argument<br><br><> is optional white space<br><br>*optarg* is an option-argument (character string) satisfying the preceding *argletter*. |
| *cmdarg* | is a path name (or other command argument) *not* beginning with "–", or "–" by itself indicating the standard input. |

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

## 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.

## WARNINGS

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, which 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 as is.

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 as follows. Each is explained as though only one named file is to be processed since the effects of the arguments apply 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 descriptive text (if any) 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) 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*(1) 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, which may be retrieved by a *get*(1) 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, which may be retrieved by a *get*(1) command for editing. The default value for an unspecified **f** flag is 1.

**d***SID* The default delta number (SIDs+1) to be used by a *get*(1) command.

**i***[str]* Causes the "No id keywords (ge6)" message issued by *get*(1) or *delta*(1) 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, however the string must contain a keyword, and no embedded newlines.

**j** Allows concurrent *get*(1) commands for editing on the same SIDs+1 of an SCCS file. This 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>˜::= | **a**

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

**n** Causes *delta*(1) 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*(1).

**m***mod* *Mod*ule name of the SCCS file substituted for all occurrences of the %M% keyword in SCCS file text retrieved by *get*(1). 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*(1).

**v***pgm* Causes *delta*(1) 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)]. (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 on a single *admin* command. See the −**f** keyletter for allowable *flag* names.

**l***list* 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 which 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 *login*s, 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*(1). 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*(1). Omission of the **−y** keyletter results in a default comment line being inserted in the form:

date and time created *YY/MM/DD HH:MM:SS* by *login*

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*(5)], 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. keyletter inhibits writing on the file, so that it nullifies the effect of any other keyletters supplied, and is, therefore, 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-name*. 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-name*, [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 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.

If it should be necessary to patch an SCCS file for any reason, the mode may be changed to 644 by the owner allowing use of *ed*(1). *Care must be taken!* The edited file should *always* be processed by an **admin −h** 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.

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

## 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.* |
| /usr/bin/bdiff | Program to compute differences between the "gotten" file and the *g-file.* |

## SEE ALSO

delta(1), get(1), prs(1), what(1), sccsfile(4).
ed(1), help(1) in the *User's Reference Manual.*

## DIAGNOSTICS

Use *help*(1) for explanations.

## NAME

ar − archive and library maintainer for portable archives

## SYNOPSIS

**ar** key [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 as used by the link editor. It can be used, though, 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 is described in detail in *ar*(4). The archive symbol table [described in *ar*(4)] is used by the link editor [*ld*(1)] 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 which is always the first file in the archive. This file is never mentioned or accessible to the user. Whenever the *ar*(1) 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.

Unlike command options, the command key is a required part of *ar*'s command line. The key (which may begin with a −) is formed with one of the following letters: **drqtpmx**. Arguments to the *key*, alternatively, are made with one or 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. Unchecked, the file may grow exponentially up to the second degree.

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

**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 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**, precede each file with a name.

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

**l** Place temporary files in the local (current working) directory rather than in the default temporary directory, *TMPDIR*.

**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.

## FILES

| | |
|---|---|
| *$TMPDIR/** | temporary files |

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

## SEE ALSO

ld(1), lorder(1), strip(1), tmpnam(3S), 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.

## NAME

as − common assembler

## SYNOPSIS

**as** [options] filename

## DESCRIPTION

The *as* command assembles the named file. 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** | Do not produce line number information in the object file. |
| **−V** | Write the version number of the assembler being run on the standard error output. |
| −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

| | |
|---|---|
| *TMPDIR/** | temporary files |

*TMPDIR* is usually /usr/tmp but can be redefined 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)

## WARNING

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 are assembler symbols and which are real *m4* macros.

## BUGS

The **.align** assembler directive may not work in the **.text** section when optimization is performed.

## CAVEATS

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

## NOTES

Wherever possible, the assembler should be accessed through a compilation system interface program [such as *cc*(1)].

## NAME

cb – C program beautifier

## SYNOPSIS

**cb** [ **–s** ] [ **–j** ] [ **–l** leng ] [ file ... ]

## DESCRIPTION

The *cb* comand reads 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 code. Under default options, *cb* preserves all user new-lines.

*cb* accepts the following options.

| | |
|---|---|
| **–s** | Canonicalizes the code to the style of Kernighan and Ritchie in *The C Programming Language*. |
| **–j** | Causes split lines to be put back together. |
| **–l** *leng* | Causes *cb* to split lines that are longer than *leng*. |

## SEE ALSO

cc(1).
*The C Programming Language.* Prentice-Hall, 1978.

## BUGS

Punctuation that is hidden in preprocessor statements will cause indentation errors.

## NAME

cc − C compiler

## SYNOPSIS

**cc** [ options ] files

## DESCRIPTION

The *cc* command is the interface to the C Compilation System. The compilation tools consist of a preprocessor, compiler, optimizer, assembler and link editor. The *cc* command processes the supplied options and then executes the various tools with the proper arguments. The *cc* command accepts several types of files as arguments:

Files whose names end with **.c** are taken to be C source programs and may be preprocessed, compiled, optimized, 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 program is produced and is left in the file whose name is that of the source with **.o** substituted for **.c.** However, the **.o** file is normally deleted if a single C program is compiled and then immediately link edited. In the same way, files whose names end in **.s** are taken to be assembly source programs, and may be assembled and link edited; and files whose names end in .i are taken to be preprocessed C source programs and may be compiled, optimized, assembled and link edited. Files whose names do not end in **.c, .s** or **.i** are handed to the link editor.

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

The following options are interpreted by *cc*: .

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

**−ds** Don't generate symbol attribute information for the symbolic debugger.

**−dl** Don't generate symbolic debugging line number information. This and the above flag may be used in conjunction as **−dsl** (**−dsl** is the default unless the **−g** flag is given).

**−f** Cause the link editor to load floating point emulation code. This option is needed only when loading old objects which use floating point. Current objects do not require floating point emulation code.

**−g** Cause the compiler to generate additional information needed for the use of *sdb* (1).

**−o** *outfile*
Produce an output object file by the name *outfile*. The name of the default file is **a.out**. This is a link editor option.

**−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 −lm option) are linked and *monitor*(3C) is automatically called. 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*(1).

**−qp** Arrange for profiled code to be produced where the **p** argument produces identical results to the **−p** option [allows profiling with *prof*(1)].

**−B***string*
**−t***[***p02al***]*
These options will be removed in the next release. Use the **−Y** option.

**−E** Run only *cpp*(1) on the named C programs, and send the result to the standard output.

**−F** Cause the compiler to generate code for single precision arithmetic whenever an expression contains float variables and no doubles.

**−H** Print out on *stderr* the pathname of each file included during the current compilation.

**−O** Do compilation phase optimization. This option will not have any affect on **.s** files.

**−P** Run only *cpp*(1) on the named C programs and leave the result in corresponding files suffixed **.i**. This option is passed to *cpp*(1).

**−S** Compile and do not assemble the named C programs, and leave the assembler-language output in corresponding files suffixed **.s**.

**−V** Print the version of the compiler, optimizer, assembler and/or link editor that is invoked.

**−Wc,arg1[,arg2...]**
Hand off the argument[s] *argi* to pass *c* where *c* is one of [**p02al**] indicating the preprocessor, compiler, optimizer, assembler, or link editor, respectively. For example: **−Wa,−m** passes **−m** to the assembler.

**−Y [p02alSILU],***dirname*
Specify a new pathname, *dirname,* for the locations of the tools and directories designated in the first argument. **[p02alSILU]** represents:

**p** preprocessor
**0** compiler
**2** optimizer
**a** assembler
**l** link editor
**S** directory containing the start-up routines
**I** default include directory searched by *cpp*(1)
**L** first default library directory searched by *ld*(1)
**U** second default library directory searched by *ld*(1)

If the location of a tool is being specified, then the new pathname for the tool will be *dirname/tool.* If more than one **−Y** option is applied to any one tool or directory, then the last occurrence holds.

The *cc* command also recognizes −C, −D, −H, −I and −U and passes these options and their arguments directly to the preprocessor without using the −W option. Similarly, the *cc* command recognizes −a, −l, −m, −o, −r, −s, −t, −u, −x, −z, −L, −M and −V and passes these options and their arguments directly to the loader. See the manual pages for *cpp*(1) and *ld*(1) for descriptions.

Other arguments are taken to be C compatible object programs, typically produced by an earlier *cc* run, or perhaps libraries of C compatible routines and are passed directly to the link editor. These programs, together with the results of any compilations specified, are link edited (in the order given) to produce an executable program with name **a.out** unless the **−o** option of the link editor is used.

If the cc command is put in a file *prefix*cc the prefix will be parsed off the command and used to call the tools, i.e., *prefix*tool. For example, OLDcc will call OLDcpp, OLDcomp, OLDoptim, OLDas, and OLDld and will link OLDcrt1.o. Therefore, one MUST be careful when moving the cc command around. The prefix will apply to the preprocessor, compiler, optimizer, assembler, link editor, and the start-up routines.

The C language standard was extended to allow arbitrary length variable names. The option pair "**−Wp,−T −W0,−XT**" will cause cc to truncate arbitrary length variable names.

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*/*crt1.o | start-up routine |
| *LIBDIR*/crtn.o | start-up routine |
| *TMPDIR*/* | temporary files |
| *LIBDIR*/cpp | preprocessor, *cpp*(1) |
| *LIBDIR*/comp | compiler |
| *LIBDIR*/optim | optimizer |
| *BINDIR*/as | assembler, *as*(1) |
| *BINDIR*/ld | link editor, *ld*(1) |
| *LIBDIR*/libc.a | standard C library |
| *LIBDIR*/libc_s.a | standard C shared library |

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

SEE ALSO

as(1), ld(1), cpp(1), gencc(1), lint(1), prof(1), sdb(1), tmpnam(3S).
Kernighan, B. W., and Ritchie, D. M., *The C Programming Language*, Prentice-Hall, 1978.

DIAGNOSTICS

The diagnostics produced by the C compiler are sometimes cryptic. Occasional messages may be produced by the assembler or link editor. If an outdated version of the assembler has been installed over the assembler that is part of Issue 4 of the C Programming Language Utilities and that outdated assembler is used with the Issue 4 compiler, one of the following error messages will appear.

```
aline 2 : invalid instruction name
      ... ".version"

aline 2 : Invalid instruction name
aline 2 : syntax error
```

To ensure that the compilation system works correctly, re-install the C Programming Language Utilities Issue 4 assembler.

NOTES

By default, the return value from a compiled C program is completely random. The only two guaranteed ways to return a specific value is to explicitly call *exit*(2) or to leave the function **main**() with a *"return expression;"* construct.

## NAME

cdc − change the delta commentary of an SCCS delta

## SYNOPSIS

**cdc** −rSID [−**m**[mrlist]] [−**y**[comment]] files

## DESCRIPTION

*cdc* changes the *delta commentary,* for the SID (**S**CCS **ID**entification string) specified by the −**r** keyletter, of each named SCCS file.

*Delta commentary* is defined to be the Modification Request (MR) and comment information normally specified via the *delta*(1) command (−**m** and −**y** keyletters).

If a directory is named, *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 *WARNINGS*) 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 commentary 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 commentary of the SID specified by the −**r** keyletter *may* be supplied. A null MR list has no effect.

**MR** entries are added to the list of MRs in the same manner as that of *delta*(1). In order to delete an MR, precede the MR number with the character **!** (see *EXAMPLES*). 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 commentary 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).

**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) which 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 commentary 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 newline character terminates the *comment* text.

Simply stated, the keyletter arguments are either (1) if you made the delta, you can change its delta commentary; or (2) if you own the file and directory you can modify the delta commentary.

## EXAMPLES

```
cdc −r1.6 −m"bl78-12345 !bl77-54321 bl79-00001" −ytrouble s.file
```

adds bl78-12345 and bl79-00001 to the MR list, removes bl77-54321 from the MR list, and adds the comment **trouble** to delta 1.6 of s.file.

```
cdc −r1.6 s.file
MRs? !bl77-54321 bl78-12345 bl79-00001
comments? trouble
```

does the same thing.

## WARNINGS

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.

## FILES

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

## SEE ALSO

admin(1), delta(1), get(1), prs(1), sccsfile(4).
help(1) in the *User's Reference Manual.*

## DIAGNOSTICS

Use *help*(1) for explanations.

## 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 attempts to build a graph charting the external references. Files suffixed with **.y**, **.l**, and **.c** are yacced, lexed, and C-preprocessed as appropriate. The results of the preprocessed files, and files suffixed with **.i**, are then run through the first pass of *lint*(1). 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 which is displayed upon 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, given the following 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 *pr*(1), 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*(1) and *cpp*(1)], 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 is a very large number. Attempts to set the cutoff depth to a nonpositive integer will be ignored.

## DIAGNOSTICS

Complains about bad options. Complains about multiple definitions and only believes the first. Other messages may come from the various programs used (e.g., the C-preprocessor).

## SEE ALSO

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

## BUGS

Files produced by *lex*(1) and *yacc*(1) cause the reordering of line number declarations which can confuse *cflow*. To get proper results, feed *cflow* the *yacc* or *lex* input.

## NAME

comb – combine SCCS deltas

## SYNOPSIS

**comb** files

## DESCRIPTION

*comb* generates a shell procedure [see *sh*(1)] which, when run, will reconstruct the given SCCS files. The reconstructed files will, hopefully, be 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 is explained as though only one named file is to be processed, but the effects of any keyletter argument apply independently to each named file. each **get –e** generated, 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. argument causes *comb* to generate a shell procedure which, when run, will produce a report giving, 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. *S*CCS *ID*entification string (SID) of the oldest delta to be preserved. All older deltas are discarded in the reconstructed file. *list* (see *get*(1) for the syntax of a *list*) of deltas to be preserved. All other deltas are discarded.

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

## FILES

| | |
|---|---|
| s.COMB | The name of the reconstructed SCCS file. |
| comb????? | Temporary. |

## SEE ALSO

admin(1), delta(1), get(1), prs(1), sccsfile(4).
help(1), sh(1) in the *User's Reference Manual.*

## DIAGNOSTICS

Use *help*(1) for explanations.

## BUGS

*comb* may rearrange the shape of the tree of deltas. It may not save any space; in fact, it is possible for the reconstructed file to actually be larger than the original.

## NAME

conv – common object file converter

## SYNOPSIS

**conv** [**−a**] [**−o**] [**−p**] **−t** target [− | files]

## DESCRIPTION

The *conv* command converts object files in the common object file format from their current byte ordering to the byte ordering of the *target* machine. The converted file is written to *file.v*. The *conv* command can be used on either the source (sending) or target (receiving) machine.

Command line options are:

| | |
|---|---|
| − | indicates that the names of *files* should be read from the standard input. |
| **−a** | If the input file is an archive, produce the output file in the UNIX System V Release 2.0 portable archive format. |
| **−o** | If the input file is an archive, produce the output file in the old (pre- UNIX System V) archive format. |
| **−p** | If the input file is an archive, produce the output file in the UNIX System V Release 1.0 random access archive format. |
| **−t** target | Convert the object file to the byte ordering of the machine (*target*) to which the object file is being shipped. This may be another host or a target machine. Legal values for *target* are: pdp, vax, ibm, x86, b16, n3b, mc68 and m32. |

The *conv* command is meant to ease the problems created by a multi-host cross-compilation development environment. The *conv* command is best used within a procedure for shipping object files from one machine to another.

The *conv* command will recognize and produce archive files in three formats: the pre- UNIX System V format, the UNIX System V Release 1.0 random access format, and the UNIX System V Release 2.0 portable ASCII format. By default, *conv* will create the output archive file in the same format as the input file. To produce an output file in a different format than the input file, use the **−a**, **−o**, or **−p** option. If the output archive format is the same as the input format, the archive symbol table will be converted, otherwise the symbol table will be stripped from the archive. The *ar*(1) command with its **−t** and **−s** options must be used on the target machine to recreate the archive symbol table.

## EXAMPLE

To ship object files from a VAX to a 3B2 Computer, execute the following commands:

```
conv −t m32 *.out

uucp *.out.v my3b2!~/rje/
```

## DIAGNOSTICS

The diagnostics are self-explanatory. Fatal diagnostics on the command lines cause termination. Fatal diagnostics on an input file cause the program to continue to the next input file.

## CAVEATS

The *conv* command will not convert archives from one format to another if both the source and target machines have the same byte ordering. The UNIX system tool *convert*(1) should be used for this purpose.

## SEE ALSO

ar(1), convert(1), ar(4), a.out(4).

## NAME

convert − convert archive files to common formats

## SYNOPSIS

**convert** infile outfile

## DESCRIPTION

The *convert* command transforms input *infile* 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).

*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

cpp − the C language preprocessor

## SYNOPSIS

**LIBDIR/cpp** [ option ... ] [ ifile [ ofile ] ]

## DESCRIPTION

The C language preprocessor, *cpp*, is invoked as the first pass of any C compilation by the *cc*(1) command. Thus *cpp*'s output is designed to be in a form acceptable as input to the next pass of the C compiler. As the C language evolves, *cpp* and the rest of the C compilation package will be modified to follow these changes. Therefore, the use of *cpp* other than through the *cc*(1) command is not suggested, since the functionality of *cpp* may someday be moved elsewhere. See *m4*(1) for a general macro processor.

*cpp* optionally accepts two file names as arguments. *Ifile* and *ofile* are respectively the input and output for the preprocessor. They default to standard input and standard output if not supplied.

The following *options* to *cpp* are recognized:

**−P** Preprocess the input without producing the line control information used by the next pass of the C compiler.

**−C** By default, *cpp* strips C-style comments. If the **−C** option is specified, all comments (except those found on *cpp* directive lines) are passed along.

**−U***name*
Remove any initial definition of *name*, where *name* is a reserved symbol that is predefined by the particular preprocessor. Following is the current list of these possibly reserved symbols. On AT&T 3B2 and 3B5 Computers, *unix* and one of *u3b2* or *u3b5* are defined.

| | |
|---|---|
| operating system: | unix, dmert, gcos, ibm, os, tss |
| hardware: | interdata, pdp11, u370, u3b, u3b5, u3b2, u3b20d, vax |
| UNIX system variant: | RES, RT |
| *lint*(1): | lint |

**−D***name*
**−D***name=def*
Define *name* with value *def* as if by a **#define**. If no *=def* is given, *name* is defined with value 1. The **−D** option has lower precedence than the **−U** option. That is, if the same name is used in both a **−U** option and a **−D** option, the name will be undefined regardless of the order of the options.

**−T** The **−T** option forces *cpp* to use only the first eight characters to distinguish preprocessor symbols and is included for backward compatibility.

**−I***dir* Change the algorithm for searching for **#include** files whose names do not begin with / to look in *dir* before looking in the directories on the standard list. Thus, **#include** files whose names are enclosed in "" will be searched for first in the directory of the file with the **#include** line, then in directories named in **−I** options, and last in directories on a standard list. For **#include** files whose names are enclosed in <>, the directory of the file with the **#include** line is not searched.

**−Y***dir* Use directory *dir* in place of the standard list of directories when searching for **#include** files.

**−H** Print, one per line on standard error, the path names of included files.

Two special names are understood by *cpp*. The name **__LINE__** is defined as the current line number (as a decimal integer) as known by *cpp*, and **__FILE__** is defined as the current file name (as a C string) as known by *cpp*. They can be used anywhere (including in macros) just as any other defined name.

All *cpp* directive lines start with # in column 1. Any number of blanks and tabs is allowed between the # and the directive. The directives are:

**#define** *name token-string*
Replace subsequent instances of *name* with *token-string*.

**#define** *name***(** *arg*, ..., *arg* **)** *token-string*
Notice that there can be no space between *name* and the **(**. Replace subsequent instances of *name* followed by a **(**, a list of comma-separated sets of tokens, and a **)** followed by *token-string*, where each occurrence of an *arg* in the *token-string* is replaced by the corresponding set of tokens in the comma-separated list. When a macro with arguments is expanded, the arguments are placed into the expanded *token-string* unchanged. After the entire *token-string* has been expanded, *cpp* re-starts its scan for names to expand at the beginning of the newly created *token-string*.

**#undef** *name*
Cause the definition of *name* (if any) to be forgotten from now on. No additional tokens are permitted on the directive line after *name*.

**#ident** "*string*"
Put *string* into the .comment section of an object file.

**#include** "*filename*"
**#include** <*filename*>
Include at this point the contents of *filename* (which will then be run through *cpp*). When the <*filename*> notation is used, *filename* is only searched for in the standard places. See the **−I** and **−Y** options above for more detail. No additional tokens are permitted on the directive line after the final " or >.

**#line** *integer-constant* "*filename*"
Causes *cpp* to generate line control information for the next pass of the C compiler. *Integer-constant* is the line number of the next line and *filename* is the file from which it comes. If "*filename*" is not given, the current file name is unchanged. No additional tokens are permitted on the directive line after the optional *filename*.

**#endif**
Ends a section of lines begun by a test directive (**#if**, **#ifdef**, or **#ifndef**). Each test directive must have a matching **#endif**. No additional tokens are permitted on the directive line.

**#ifdef** *name*
The lines following will appear in the output if and only if *name* has been the subject of a previous **#define** without being the subject of an intervening **#undef**. No additional tokens are permitted on the directive line after *name*.

**#ifndef** *name*
The lines following will appear in the output if and only if *name* has not been the subject of a previous **#define**. No additional tokens are permitted on the directive line after *name*.

**#if** *constant-expression*
Lines following will appear in the output if and only if the *constant-expression* evaluates to non-zero. All binary non-assignment C operators, the **?:** operator, the unary −, !, and ˜ operators are all legal in *constant-expression*. The precedence of the operators is the same as defined by the C language. There is also a unary operator **defined**, which can be used in *constant-expression* in these two forms: **defined (** *name* **)** or **defined** *name*. This allows the utility of **#ifdef** and **#ifndef** in a **#if** directive. Only these operators, integer constants, and names which are known by *cpp* should be used in *constant-expression*. In particular, the **sizeof** operator is not available.

To test whether either of two symbols, *foo* and *fum*, are defined, use

```
#if defined(foo) | defined(fum)
```

**#elif** *constant-expression*
An arbitrary number of **#elif** directives is allowed between a **#if**, **#ifdef**, or **#ifndef** directive and a **#else** or **#endif** directive. The lines following the **#elif** directive will appear in the output if and only if the preceding test directive evaluates to zero, all intervening **#elif** directives evaluate to zero, and the *constant-expression* evaluates to non-zero. If *constant-expression* evaluates to non-zero, all succeeding **#elif** and **#else** directives will be ignored. Any *constant-expression* allowed in a **#if** directive is allowed in a **#elif** directive.

**#else** The lines following will appear in the output if and only if the preceding test directive evaluates to zero, and all intervening **#elif** directives evaluate to zero. No additional tokens are permitted on the directive line.

The test directives and the possible **#else** directives can be nested.

FILES

| | |
|---|---|
| *INCDIR* | standard directory list for **#include** files, usually /usr/include |
| *LIBDIR* | usually /lib |

SEE ALSO
cc(1), lint(1), m4(1).

## DIAGNOSTICS

The error messages produced by *cpp* are intended to be self-explanatory. The line number and file name where the error occurred are printed along with the diagnostic.

## NOTES

The unsupported **−W** option enables the **#class** directive. If it encounters a **#class** directive, *cpp* will exit with code 27 after finishing all other processing. This option provides support for "C with classes".

Because the standard directory for included files may be different in different environments, this form of **#include** directive:

```
#include <file.h>
```

should be used, rather than one with an absolute path, like:

```
#include "/usr/include/file.h"
```

*cpp* warns about the use of the absolute pathname.

## NAME

cprs — compress a common object file

## SYNOPSIS

**cprs** [**−p**] file1 file2

## DESCRIPTION

The *cprs* command reduces the size of a common object file, *file1*, by removing duplicate structure and union descriptors. The reduced file, *file2*, is produced as output.

The sole option to *cprs* is:

**−p** Print statistical messages including: total number of tags, total duplicate tags, and total reduction of *file1*.

## SEE ALSO

strip(1), a.out(4), syms(4).

## NAME

ctrace – C program debugger

## SYNOPSIS

**ctrace** [options] [file]

## DESCRIPTION

The *ctrace* command allows you to follow the execution of a C program, statement-by-statement. 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 you do 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. You must put the output of *ctrace* into a temporary file because the *cc*(1) command does not allow the use of a pipe. You then compile and execute this file.

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, 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 every 1000 times through the loop to help you detect infinite loops. The trace output goes to the standard output so you 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.* |

You 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. You 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** | Run the C preprocessor on the input before tracing it. You can also use the **−D**, **−I**, and **−U** *cpp*(1) options. |

These options are used to tailor the run-time trace package when the traced program will run in a non-UNIX System environment:

**−b** Use only basic functions in the trace code, that is, those in *ctype*(3C), *printf*(3S), and *string*(3C). These are usually available even in cross-compilers for microprocessors. In particular, this option is needed when the traced program runs under an operating system that does not have *signal*(2), *fflush*(3S), *longjmp*(3C), or *setjmp*(3C).

**−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 lets you change the entire print function, instead of just the name and leading arguments (see the **−p** option).

EXAMPLE

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

```
 1 #include <stdio.h>
 2 main()        /* count lines in input */
 3 {
 4       int c, nl;
 5
 6       nl = 0;
 7       while ((c = getchar()) != EOF)
 8               if (c = '\n')
 9                       ++nl;
10       printf("%d\n", nl);
11 }
```

and you enter these commands and test data:

```
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 not correct because there is only one line in the test data. The error in this program is common, but subtle. If you invoke *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 you enter 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 you now enter an end of file character (cntl-d) the final output will be:

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

Note that the program output printed at the end of the trace line for the **nl** variable. 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 your attention is drawn to this **if** statement, you will probably realize that you used the assignment operator (=) in place of the equality operator (==). You can easily miss this error during code reading.

## EXECUTION-TIME TRACE CONTROL

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

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

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

You can also call these functions from *sdb*(1) if you compile 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
```

You can also turn the trace off and on by setting static variable tr_ct_ to 0 and 1, respectively. This is useful if you are using a debugger that cannot call these functions directly.

## DIAGNOSTICS

This section contains diagnostic messages from both *ctrace* and *cc*(1), since the traced code often gets some *cc* warning messages. You 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 you are using tabs to indent your 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. If you still get the error message, check the Warnings section below.

### Cc Diagnostics

*warning: illegal combination of pointer and integer*
*warning: statement not reached*
*warning: sizeof returns 0*
: Ignore these messages.

*compiler takes size of function*
: See the *ctrace* "possible syntax error" message above.

*yacc stack overflow*
: See the *ctrace* "'if ... else if' sequence too long" message above.

*out of tree space; simplify expression*
: Use the **−t** option to reduce the number of traced variables per statement from the default of 10. Ignore the "ctrace: too many variables to trace" warnings you will now get.

*redeclaration of signal*
: Either correct this declaration of *signal*(2), or remove it and #include <signal.h>.

## SEE ALSO

signal(2), ctype(3C), fclose(3S), printf(3S), setjmp(3C), string(3C).
bfs(1), tail(1) in the *User's Reference Manual.*

## WARNINGS

You will get a *ctrace* syntax error if you omit the semicolon at the end of the last element declaration in a structure or union, just before the right brace (}). This is optional in some C compilers.

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.

## BUGS

*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.

Pointer values are always treated as pointers to character strings.

The loop trace output elimination is done separately for each file of a multi-file program. This 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.

## FILES

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

NAME

cxref − generate C program cross-reference

SYNOPSIS

**cxref** [ options ] files

DESCRIPTION

The *cxref* command analyzes a collection of C files and attempts to build a cross-reference table. *cxref* uses a special version of *cpp* to include **#define**'d information in its symbol table. It produces a listing on standard output of all symbols (auto, static, and global) in each file separately, or, with the **−c** option, in combination. Each symbol contains an asterisk (*) before the declaring reference.

In addition to the **−D**, **−I** and **−U** options [which are interpreted just as they are by *cc*(1) and *cpp*(1)], the following *options* are interpreted by *cxref*:

**−c** Print a combined cross-reference of all input files.

**−w**<*num*>
Width option which formats output no wider than <num> (decimal) columns. This option will default to 80 if <num> is not specified or is less than 51.

**−o** file Direct output to *file*.

**−s** Operate silently; do not print input file names.

**−t** Format listing for 80-column width.

FILES

| | |
|---|---|
| *LLIBDIR* | usually /usr/lib |
| *LLIBDIR*/xcpp | special version of the C preprocessor. |

SEE ALSO

cc(1), cpp(1).

DIAGNOSTICS

Error messages are unusually cryptic, but usually mean that you cannot compile these files.

BUGS

*cxref* considers a formal argument in a *#define* macro definition to be a declaration of that symbol. For example, a program that *#includes* **ctype.h**, will contain many declarations of the variable **c**.

## 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*(1) (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 *WARNINGS*); 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 upon 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 *get*s 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* a *list* (see *get*(1) for the definition of *list*) of deltas which 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) which 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.* |
| /usr/bin/bdiff | Program to compute differences between the "gotten" file and the *g-file.* |

WARNINGS

Lines beginning with an **SOH** ASCII character (binary 001) cannot be placed in the SCCS file unless the **SOH** is escaped. This character has special meaning to SCCS [see *sccsfile*(4) (5)] and will cause an error.

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 to occur.

Comments are limited to text strings of at most 512 characters.

SEE ALSO

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

DIAGNOSTICS

Use *help*(1) for explanations.

## NAME

dis − object code disassembler

## SYNOPSIS

**dis** [−**o**] [−**V**] [−**L**] [−**s**] [−**d** sec] [−**da** 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.

| | |
|---|---|
| −**o** | Print numbers in octal. The default is hexadecimal. |
| −**V** | Print, on standard error, the version number of the disassembler being executed. |
| −**L** | Lookup source labels in the symbol table for subsequent printing. This option works only if the file was compiled with additional debugging information [e.g., the −**g** option of *cc*(1)]. |
| −**s** | Perform symbolic disassembly- i.e., specify source symbol names for operands where possible. Symbolic disassembly output will appear on the line following the instruction. For maximal symbolic disassembly to be performed, the file must be compiled with additional debugging information [e.g., the −**g** option of *cc*(1)]. Symbol names will be printed using C syntax. |
| −**d** *sec* | Disassemble the named section as data, printing the offset of the data from the beginning of the section. |
| −**da** *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. |
| −**t** *sec* | Disassemble the named section as text. |
| −**l** *string* | Disassemble the library file specified by *string*. For example, one would issue the command **dis** −**l x** −**l z** to disassemble **libx.a** and **libz.a**. All libraries are assumed to be in *LIBDIR*. |

If the −**d**, −**da** 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]**, represents 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*(1)]. 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 **()**.

FILES

| | |
|---|---|
| *LIBDIR* | usually /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.

## 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 each archive file argument. |
| **−g** | Dump the global symbols in the symbol table of an archive. |
| **−f** | Dump each file header. |
| **−o** | Dump each optional header. |
| **−h** | Dump section headers. |
| **−s** | Dump section contents. |
| **−r** | Dump relocation information. |
| **−l** | Dump line number information. |
| **−t** | Dump symbol table entries. |
| **−z** name | Dump line number entries for the named function. |
| **−c** | Dump the string table. |
| **−L** | Interpret and print the contents of the *.lib* sections. |

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

| | |
|---|---|
| **−d** number | Dump the section number, *number*, or the range of sections starting at *number* and ending at the *number* specified by **+d**. |
| **+d** number | Dump sections in the range either beginning with first section or beginning with section specified by **−d**. |
| **−n** name | Dump information pertaining only to the named entity. This *modifier* applies to **−h**, **−s**, **−r**, **−l**, and **−t**. |
| **−p** | Suppress printing of the headers. |
| **−t** index | Dump only the indexed symbol table entry. The **−t** used in conjunction with **+t**, specifies a range of symbol table entries. |
| **+t** index | Dump the symbol table entries in the range ending with the indexed entry. The range begins at the first symbol table entry or at the entry specified by the **−t** option. |
| **−u** | Underline the name of the file for emphasis. |

**−v** Dump information in symbolic representation rather than numeric (e.g., C_STATIC instead of **0X02**). This *modifier* can be used with all the above options except **−s** and **−o** options of *dump.*

**−z** name,number
Dump line number entry or range of line numbers starting at *number* for the named function.

**+z** number Dump line numbers starting at either function *name* or *number* specified by **−z,** up to *number* specified by **+z**.

Blanks separating an *option* and its *modifier* are optional. The comma separating the name from the number modifying the **−z** option may be replaced by a blank.

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

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

## NAME

gencc − create a front-end to the cc command

## SYNOPSIS

**gencc**

## DESCRIPTION

The *gencc* command is an interactive command designed to aid in the creation of a front-end to the *cc* command. Since hard-coded pathnames have been eliminated from the C Compilation System (CCS), it is possible to move pieces of the CCS to new locations without recompiling the CCS. The new locations of moved pieces can be specified through the **−Y** option to the *cc* command. However, it is inconvenient to supply the proper **−Y** options with every invocation of the *cc* command. Further, if a system administrator moves pieces of the CCS, such movement should be invisible to users.

The front-end to the *cc* command which *gencc* generates is a one-line shell script which calls the *cc* command with the proper **−Y** options specified. The front-end to the *cc* command will also pass all user supplied options to the *cc* command.

*gencc* prompts for the location of each tool and directory which can be respecified by a **−Y** option to the *cc* command. If no location is specified, it assumes that that piece of the CCS has not been relocated. After all the locations have been prompted for, *gencc* will create the front-end to the *cc* command.

*gencc* creates the front-end to the *cc* command in the current working directory and gives the file the same name as the *cc* command. Thus, *gencc* can not be run in the same directory containing the actual *cc* command. Further, if a system administrator has redistributed the CCS, the actual *cc* command should be placed somewhere which is not typically in a user's PATH (e.g., /lib). This will prevent users from accidentally invoking the *cc* command without using the front-end.

## CAVEATS

*gencc* does not produce any warnings if a tool or directory does not exist at the specified location. Also, *gencc* does not actually move any files to new locations.

## FILES

| | |
|---|---|
| ./cc | front-end to cc |

## SEE ALSO

cc(1).

## NAME

get − get a version of an SCCS file

## SYNOPSIS

**get** [**−r**SID] [**−c**cutoff] [**−i**list] [**−x**list] [**−w**string] [**−a**seq-no.] [**−k**] [**−e**] [**−l**[**p**] [**−p**] [**−m**] [**−n**] [**−s**] [**−b**] [**−g**] [**−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. Again, non-SCCS files and unreadable files are silently ignored.

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 *FILES*, 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 applies independently to each named file.

**−r***SID* The *S*CCS *ID*entification string (SID) of the version (delta) of an SCCS file to be retrieved. Table 1 (pg. 47) 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 which 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 various 2-digit pieces of the *cutoff* date-time. This feature allows one to specify a *cutoff* date in the form: "**−c77/2/2 9:22:25**". Note that this implies that one may use the %E% and %U% identification keywords (see below) for nested *gets* within, say the input to a *send*(1C) command:

```
~!get "−c%E% %U%" s.file
```

**−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 *get*s 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.)
Note: 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 *FILES* for the format of 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 which 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.

**−a***seq-no.* The delta sequence number of the SCCS file delta (version) to be retrieved [see *sccsfile*(5)]. This keyletter is used by the *comb*(1) 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 4-character string **@(#)** recognizable by *what*(1). |
| **%W%** | A shorthand notation for constructing *what*(1) strings for UNIX system program files. %W% = %Z%%M%<horizontal-tab>%I% |
| **%A%** | Another shorthand notation for constructing *what*(1) 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.
"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 mode 444.

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*. |
| /usr/bin/bdiff | Program to compute differences between the "gotten" file and the *g-file*. |

SEE ALSO

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

DIAGNOSTICS

Use *help*(1) for explanations.

BUGS

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

infocmp − compare or print out terminfo descriptions

## SYNOPSIS

**infocmp** [−**d**] [−**c**] [−**n**] [−**I**] [−**L**] [−**C**] [−**r**] [−**u**] [−**s d**|**i**|**l**|**c**] [−**v**] [−**V**] [−**1**] [−**w** width] [−**A** directory] [−**B** directory] [termname ...]

## DESCRIPTION

*infocmp* can be used to compare a binary *terminfo*(4) entry with other terminfo entries, rewrite a *terminfo*(4) description to take advantage of the **use=** terminfo field, or print out a *terminfo*(4) description from the binary file (*term*(4)) in a variety of formats. In all cases, the boolean fields will be printed first, followed by the numeric fields, followed by the string fields.

### Default Options

If no options are specified and zero or one *termnames* are specified, the −**I** option will be assumed. If more than one *termname* is specified, the −**d** option will be assumed.

### Comparison Options [−d] [−c] [−n]

*infocmp* compares the *terminfo*(4) description of the first terminal *termname* with each of the descriptions given by the entries for the other terminal's *termnames*. If a capability is defined for only one of the terminals, the value returned will depend on the type of the capability: **F** for boolean variables, −**1** for integer variables, and **NULL** for string variables.

−**d** produce a list of each capability that is different. In this manner, if one has two entries for the same terminal or similar terminals, using *infocmp* will show what is different between the two entries. This is sometimes necessary when more than one person produces an entry for the same terminal and one wants to see what is different between the two.

−**c** produce a list of each capability that is common between the two entries. Capabilities that are not set are ignored. This option can be used as a quick check to see if the −**u** option is worth using.

−**n** produce a list of each capability that is in neither entry. If no *termnames* are given, the environment variable **TERM** will be used for both of the *termnames*. This can be used as a quick check to see if anything was left out of the description.

### Source Listing Options [−I] [−L] [−C] [−r]

The −**I**, −**L**, and −**C** options will produce a source listing for each terminal named.

−**I** use the *terminfo*(4) names

−**L** use the long C variable name listed in <**term.h**>

−**C** use the *termcap* names

−**r** when using −**C**, put out all capabilities in *termcap* form

If no *termnames* are given, the environment variable **TERM** will be used for the terminal name.

The source produced by the **−C** option may be used directly as a *termcap* entry, but not all of the parameterized strings may be changed to the *termcap* format. *infocmp* will attempt to convert most of the parameterized information, but that which it doesn't will be plainly marked in the output and commented out. These should be edited by hand.

All padding information for strings will be collected together and placed at the beginning of the string where *termcap* expects it. Mandatory padding (padding information with a trailing '/') will become optional.

All *termcap* variables no longer supported by *terminfo*(4), but which are derivable from other *terminfo*(4) variables, will be output. Not all *terminfo*(4) capabilities will be translated; only those variables which were part of *termcap* will normally be output. Specifying the **−r** option will take off this restriction, allowing all capabilities to be output in *termcap* form.

Note that because padding is collected to the beginning of the capability, not all capabilities are output, mandatory padding is not supported, and *termcap* strings were not as flexible, it is not always possible to convert a *terminfo*(4) string capability into an equivalent *termcap* format. Not all of these strings will be able to be converted. A subsequent conversion of the *termcap* file back into *terminfo*(4) format will not necessarily reproduce the original *terminfo*(4) source.

Some common *terminfo* parameter sequences, their *termcap* equivalents, and some terminal types which commonly have such sequences, are:

| Terminfo | Termcap | Representative Terminals |
|---|---|---|
| %p1%c | %. | adm |
| %p1%d | %d | hp, ANSI standard, vt100 |
| %p1%'x'%+%c | %+x | concept |
| %i | %i | ANSI standard, vt100 |
| %p1%?%'x'%>%t%p1%'y'%+%; | %>xy | concept |
| %p2 is printed before %p1 | %r | hp |

**Use= Option [−u]**

**−u** produce a *terminfo*(4) source description of the first terminal *termname* which is relative to the sum of the descriptions given by the entries for the other terminals *termnames*. It does this by analyzing the differences between the first *termname* and the other *termnames* and producing a description with **use=** fields for the other terminals. In this manner, it is possible to retrofit generic terminfo entries into a terminal's description. Or, if two similar terminals exist, but were coded at different times or by different people so that each description is a full description, using *infocmp* will show what can be done to change one description to be relative to the other.

A capability will get printed with an at-sign (@) if it no longer exists in the first *termname*, but one of the other *termname* entries contains a value for it. A capability's value gets printed if the value in the first *termname* is not found in any of the other *termname* entries, or if the first of the other *termname* entries that has this capability gives a different value for the capability than that in the first *termname*.

The order of the other *termname* entries is significant. Since the terminfo compiler **tic**(1M) does a left-to-right scan of the capabilities, specifying two **use=** entries that contain differing entries for the same capabilities will produce different results depending on the order that the entries are given in. *infocmp* will flag any such inconsistencies between the other *termname* entries as they are found.

Alternatively, specifying a capability *after* a **use=** entry that contains that capability will cause the second specification to be ignored. Using *infocmp* to recreate a description can be a useful check to make sure that everything was specified correctly in the original source description.

Another error that does not cause incorrect compiled files, but will slow down the compilation time, is specifying extra **use=** fields that are superfluous. *infocmp* will flag any other *termname* **use=** fields that were not needed.

**Other Options [−s d|i|l|c] [−v] [−V] [−1] [−w width]**

**−s** sort the fields within each type according to the argument below:

- **d** leave fields in the order that they are stored in the *terminfo* database.
- **i** sort by *terminfo* name.
- **l** sort by the long C variable name.
- **c** sort by the *termcap* name.

If no **−s** option is given, the fields printed out will be sorted alphabetically by the *terminfo* name within each type, except in the case of the **−C** or the **−L** options, which cause the sorting to be done by the *termcap* name or the long C variable name, respectively.

**−v** print out tracing information on standard error as the program runs.

**−V** print out the version of the program in use on standard error and exit.

**−1** cause the fields to printed out one to a line. Otherwise, the fields will be printed several to a line to a maximum width of 60 characters.

**−w** change the output to width characters.

**Changing Databases [−A directory] [−B directory]**

The location of the compiled *terminfo*(4) database is taken from the environment variable **TERMINFO**. If the variable is not defined, or the terminal is not found in that location, the system *terminfo*(4) database, usually in */usr/lib/terminfo*, will be used. The options **−A** and **−B** may be used to override this location. The **−A** option will set **TERMINFO** for the first *termname* and the **−B** option will set **TERMINFO** for the other *termnames*. With this, it is possible to compare descriptions for a terminal with the same name located in two different databases. This is useful for comparing descriptions for the same terminal created by different people. Otherwise the terminals would have to be named differently in the *terminfo*(4) database for a comparison to be made.

## FILES

/usr/lib/terminfo/?/* compiled terminal description database

## DIAGNOSTICS

malloc is out of space!
: There was not enough memory available to process all the terminal descriptions requested. Run *infocmp* several times, each time including a subset of the desired *termnames.*

use= order dependency found:
: A value specified in one relative terminal specification was different from that in another relative terminal specification.

'use=*term*' did not add anything to the description.
: A relative terminal name did not contribute anything to the final description.

must have at least two terminal names for a comparison to be done.
: The **−u**, **−d** and **−c** options require at least two terminal names.

## SEE ALSO

tic(1M), curses(3X), term(4), terminfo(4) in the *Programmer's Reference Manual.*
captoinfo(1M) in the *System Administrator's Reference Manual.*
Chapter 10 of the *Programmer's Guide.*

## NOTE

The *termcap* database (from earlier releases of UNIX System V) may not be supplied in future releases.

## 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*. Only available to the superuser. |
| **−u** *user* | The owner of the new file is set to *user*. Only available to the superuser. |
| **−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* or */etc/getty*, 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 common object files

## SYNOPSIS

**ld** [options] filename

## DESCRIPTION

The *ld* command combines several object files into one, performs relocation, resolves external symbols, and supports symbol table information for symbolic debugging. In the simplest case, the names of several object programs are given, and *ld* combines the objects, producing an object module that can either be executed or, if the **−r** option is specified, used as input for a subsequent *ld* run. The output of *ld* is left in **a.out**. By default this file is executable if no errors occurred during the load. If any input file, *filename*, is not an object file, *ld* assumes it is either an archive library or a text file containing link editor directives. [See *Link Editor Directives* in the *UNIX System V Programmer's Guide* for a discussion of input directives.]

If any argument is a library, it is searched exactly once at the point it is encountered in the argument list. The library may be either a relocatable archive library or a shared library. [See *Shared Libraries* in the *UNIX System V Programmer's Guide* for a discussion of shared libraries.] Only those routines defining an unresolved external reference are loaded. The library (archive) symbol table [see *ar*(4)] is searched sequentially with as many passes as are necessary to resolve external references which can be satisfied by library members. Thus, the ordering of library members is functionally unimportant, unless there exist multiple library members defining the same external symbol.

The following options are recognized by *ld*:

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

**−f** *fill* Set the default fill pattern for "holes" within an output section as well as initialized *bss* sections. The argument *fill* is a two-byte constant.

**−l***x* Search a library **lib***x***.a,** where *x* is up to nine characters. A library is searched when its name is encountered, so the placement of a **−l** is significant. By default, libraries are located in *LIBDIR* or *LLIBDIR*.

**−m** Produce a map or listing of the input/output sections on the standard output.

**−o** *outfile*
: Produce an output object file by the name *outfile*. The name of the default object file is **a.out**.

**−r** Retain relocation entries in the output object file. Relocation entries must be saved if the output file is to become an input file in a subsequent *ld* run. The link editor will not complain about unresolved references, and the output file will not be executable.

**−a** Create an absolute file. This is the default if the **−r** option is not used. Used with the **−r option, −a** allocates memory for common symbols.

**−s** Strip line number entries and symbol table information 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 a 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 *ld* line is significant; it must be placed before the library which will define the symbol.

**−x** Do not preserve local symbols in the output symbol table; enter external and static symbols only. This option saves some space in the output file.

**−z** Do not bind anything to address zero. This option will allow runtime detection of null pointers.

**−L** *dir* Change the algorithm of searching for **lib***x***.a** to look in *dir* before looking in *LIBDIR* and *LLIBDIR*. This option is effective only if it precedes the **−l** option on the command line.

**−M** Output a message for each multiply-defined external definition.

**−N** Put the text section at the beginning of the text segment rather than after all header information, and put the data section immediately following text in the core image.

**−V** Output a message giving information about the version of ld being used.

**−VS** *num*
Use *num* as a decimal version stamp identifying the **a.out** file that is produced. The version stamp is stored in the optional header.

**−Y***[LU],dir*
Change the default directory used for finding libraries. If **L** is specified the first default directory which *ld* searches, *LIBDIR*, is replaced by *dir*. If **U** is specified and ld has been built with a second default directory, *LLIBDIR*, then that directory is replaced by *dir*. If ld was built with only one default directory and **U** is specified a warning is printed and the option is ignored.

FILES

| | |
|---|---|
| *LIBDIR*/lib*x*.a | libraries |
| *LLIBDIR*/lib*x*.a | libraries |
| a.out | output file |
| *LIBDIR* | usually /lib |
| *LLIBDIR* | usually /usr/lib |

SEE ALSO

as(1), cc(1), mkshlib(1), exit(2), end(3C), a.out(4), ar(4), and *Link Editor Directives* and *Shared Libraries* in the *Programmer's Guide.*

## CAVEATS

Through its options and input directives, the common link editor gives users great flexibility; however, those who use the input directives must assume some added responsibilities. Input directives and options should insure the following properties for programs:

- C defines a zero pointer as null. A pointer to which zero has been assigned must not point to any object. To satisfy this, users must not place any object at virtual address zero in the program's address space.
- When the link editor is called through *cc*(1), a startup routine is linked with the user's program. This routine calls exit( ) [see *exit*(2)] after execution of the main program. If the user calls the link editor directly, then the user must insure that the program always calls exit( ) rather than falling through the end of the entry routine.

The symbols *etext, edata,* and *end* [see *end*(3C)] are reserved and are defined by the link editor. It is incorrect for a user program to redefine them.

If the link editor does not recognize an input file as an object file or an archive file, it will assume that it contains link editor directives and will attempt to parse it. This will occasionally produce an error message complaining about "syntax errors".

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

## NAME

lex − generate programs for simple lexical tasks

## SYNOPSIS

**lex** [ **−rctvn** ] [ 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 strings are found.

A file **lex.yy.c** is generated which, when loaded with the library, copies the input to the output except when a string specified in the file 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 strings in the file. The strings 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. 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. Thus **[a−zA−Z]+** matches a string of letters. 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 subroutines defined as 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 library contains a **main()** which 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(***p***)** pushes back the portion of the string matched beginning at *p*, which should be between *yytext* and *yytext+yyleng*. 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 %% which 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 {}. Note that curly brackets do not imply parentheses; only string substitution is done.

## EXAMPLE

```
D       [0−9]
%%
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");
"/*"      skipcommnts();
%%
 skipcommnts()
 {
        for (;;)
        {
                while (input() != '*')
                        ;
                if (input() != '/')
                        unput(yytext[yyleng-1]);
                else
                        return;
        }
 }
```

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

The flags must appear before any files. The flag **−r** indicates RATFOR actions, **−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 one-line summary of statistics, **−n** will not print out the **−v** summary. Multiple files are treated as a single file. If no files are specified, standard input is used.

Certain 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* (1000) |
| **%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).
*Programmer's Guide.*

## BUGS

The **−r** option is not yet fully operational.

## NAME

lint − a C program checker

## SYNOPSIS

**lint** [ option ] ... file ...

## DESCRIPTION

The *lint* command attempts to detect features of the C program files that are likely to be bugs, non-portable, or wasteful. It also checks type usage more strictly than the compilers. Among the things that are currently detected are unreachable statements, loops not entered at the top, automatic variables declared and not used, and logical expressions whose value is constant. Moreover, the usage of functions is checked to find 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* will take all the **.c**, **.ln**, and **llib-l***x***.ln** (specified by **−l***x*) files and process 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. However, if the **−p** option is used, the portable C lint library (**llib-port.ln**) is appended instead. When the **−c** option is not used, the second pass of *lint* checks this list of files for mutual compatibility. When the **−c** option is used, the **.ln** and the **llib-l***x***.ln** files are ignored.

Any number of *lint* options may be used, in any order, intermixed with file-name 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. (Programs produced by *lex* or *yacc* will often result in many such complaints).

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

**−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:

−l*x* Include additional 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.

**−n** Do not check compatibility against either the standard or the portable lint library.

**−p** Attempt to check portability to other dialects (IBM and GCOS) 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.

**−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** lib Cause *lint* to create a lint library with the name **llib-l*lib*.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*lib*.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 (for example, the way the file **llib-lc** is written). These option settings are also available through the use of "lint comments" (see below).

The **−D**, **−U**, and **−I** options of *cpp*(1) and the **−g** and **−O** options of *cc*(1) are also recognized as separate arguments. The **−g** and **−O** options are ignored, but, by recognizing these options, *lint*'s behavior is closer to that of the *cc*(1) command. Other options are warned about and ignored. The pre-processor symbol "lint" is defined to allow certain questionable code to be altered or removed for *lint*. Therefore, 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*:

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

/*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.

/*ARGSUSED*/
turns on the **−v** option for the next function.

/*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.

*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. 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 file name 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 which 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*(1); 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 *lint*ed.

FILES

| | |
|---|---|
| *LLIBDIR* | the directory where the lint libraries specified by the **−l***x* option must exist, usually /usr/lib |
| *LLIBDIR*/lint[12] | first and second passes |
| *LLIBDIR*/llib-lc.ln | declarations for C Library functions (binary format; source is in *LLIBDIR*/llib-lc ) |
| *LLIBDIR*/llib-port.ln | declarations for portable functions (binary format; source is in *LLIBDIR*/llib-port ) |
| *LLIBDIR*/llib-lm.ln | declarations for Math Library functions (binary format; source is in *LLIBDIR*/llib-lm ) |
| *TMPDIR*/*lint* | temporaries |
| *TMPDIR* | usually /usr/tmp but can be redefined by setting the environment variable **TMPDIR** [see *tempnam*() in *tmpnam*(3S)]. |

SEE ALSO

cc(1), cpp(1), make(1).

BUGS

*exit*(2), *setjmp*(3C), and other functions that do not return are not understood; this causes various lies.

## NAME

list – produce C source listing from a common object file

## SYNOPSIS

**list [ –V ]** [**–h**] [**–F** function] source-file . . . [object-file]

## DESCRIPTION

The *list* command produces a C source listing with line number information attached. If multiple C source files were used to create the object file, *list* will accept multiple file names. The object file is taken to be the last non-C source file argument. If no object file is specified, the default object file, **a.out**, will be used.

Line numbers will be printed for each line marked as breakpoint inserted by the compiler (generally, each executable C statement that begins a new line of source). Line numbering begins anew for each function. Line number 1 is always the line containing the left curly brace ({) that begins the function body. Line numbers will also be supplied for inner block redeclarations of local variables so that they can be distinguished by the symbolic debugger.

The following options are interpreted by *list* and may be given in any order:

**–V** Print, on standard error, the version number of the *list* command executing.

**–h** Suppress heading output.

–F*function* List only the named function. The **–F** option may be specified multiple times on the command line.

## SEE ALSO

as(1), cc(1), ld(1).

## CAVEATS

Object files given to *list* must have been compiled with the **–g** option of *cc*(1).

Since *list* does not use the C preprocessor, it may be unable to recognize function definitions whose syntax has been distorted by the use of C preprocessor macro substitutions.

## DIAGNOSTICS

*list* will produce the error message "list: name: cannot open" if *name* cannot be read. If the source file names do not end in **.c** , the message is "list: name: invalid C source name". An invalid object file will cause the message "list: name: bad magic" to be produced. If some or all of the symbolic debugging information is missing, one of the following messages will be printed: "list: name: symbols have been stripped, cannot proceed", "list: name: cannot read line numbers", and "list: name: not in symbol table". The following messages are produced when *list* has become confused by **#ifdef's** in the source file: "list: name: cannot find function in symbol table", "list: name: out of sync: too many }", and "list: name: unexpected end-of-file". The error message "list: name: missing or inappropriate line numbers" means that either symbol debugging information is missing, or *list* has been confused by C preprocessor statements.

## 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, meaning that 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*(1). Note that the link editor *ld*(1) is capable of multiple passes over an archive in the portable archive format [see *ar*(4)] and does not require that *lorder*(1) be used when building an archive. The usage of the *lorder*(1) command may, however, allow for a slightly 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* is usually /usr/tmp but can be redefined by setting the environment variable **TMPDIR** [see *tempnam*() in *tmpnam*(3S)].

## SEE ALSO

ar(1), ld(1), tsort(1), ar(4).

## CAVEAT

*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

m4 – macro processor

## SYNOPSIS

**m4** [ options ] [ files ]

## DESCRIPTION

The *m4* command is a macro processor intended as a front end for Ratfor, C, 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, these 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 alphabetic letters, digits, 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 which 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. They 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 on UNIX system versions of *m4*. |
| 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), bitwise &, \|, ^, 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

cc(1), cpp(1).
*The m4 Macro Processor* in the *Support Tools Guide.*

## NAME

make − maintain, update, and regenerate groups of programs

## SYNOPSIS

**make** [−**f** makefile] [−**p**] [−**i**] [−**k**] [−**s**] [−**r**] [−**n**] [−**b**] [−**e**] [−**u**] [−**t**] [−**q**] [names]

## DESCRIPTION

The *make* command allows the programmer to maintain, update, and regenerate groups of computer programs. The following is a brief description of all options and some special names:

| | |
|---|---|
| −**f** *makefile* | Description file name. *makefile* is assumed to be the name of a description file. |
| −**p** | Print out the complete set of macro definitions and target descriptions. |
| −**i** | Ignore error codes returned by invoked commands. This mode is entered if the fake target name **.IGNORE** appears in the description file. |
| −**k** | Abandon work on the current entry if it fails, but continue on other branches that do not depend on that entry. |
| −**s** | Silent mode. Do not print command lines before executing. This mode is also entered if the fake target name **.SILENT** appears in the description file. |
| −**r** | Do not use the built-in rules. |
| −**n** | No execute mode. Print commands, but do not execute them. Even lines beginning with an **@** are printed. |
| −**b** | Compatibility mode for old makefiles. |
| −**e** | Environment variables override assignments within makefiles. |
| −**u** | Force an unconditional update. |
| −**t** | Touch the target files (causing them to be up-to-date) rather than issue the usual commands. |
| −**q** | Question. The *make* command returns a zero or non-zero status code depending on whether the target file is or is not up-to-date. |
| **.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. |
| **.PRECIOUS** | Dependents of this target will not be removed when quit or interrupt are hit. |
| **.SILENT** | Same effect as the −**s** option. |
| **.IGNORE** | Same effect as the −**i** option. |

*make* executes commands in *makefile* to update one or more target *names*. *Name* is typically a program. If no −**f** option is present, **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 − *makefile* argument pair may appear.

*make* updates a target only if its dependents are newer than the target (unless the **−u** option is used to force an unconditional update). All prerequisite files of a target are added recursively to the list of targets. Missing files are deemed to be out-of-date.

*makefile* 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 the <backslash><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.

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 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 discussion of the **MAKEFLAGS** macro under *Environment*). 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, or the entry **.IGNORE:** appears in *makefile*, or 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.

The **−b** option allows old makefiles (those written for the old version of *make*) to run without errors.

Interrupt and quit cause the target to be deleted unless the target is a dependent of the special name **.PRECIOUS**.

## Environment

The environment is read by *make*. All variables are assumed to be macro definitions and 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 proves very useful for "super-makes". In fact, as noted above, when the **−n** option is used, the command **$(MAKE)** is executed anyway; hence, one can perform a **make −n** recursively on a whole software system to see what would have been executed. This is because the **−n** is put in **MAKEFLAGS** and passed to further invocations of **$(MAKE)**. This 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 file name 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 under *Libraries*.

## Internal Macros

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

**$*** The macro **$*** stands for the file name 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 which is out-of-date with respect to the target (i.e., 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 out-of-date with respect to the target; essentially, those modules which 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 which 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~ .sh .sh~
.c.o .c.a .c~.o .c~.c .c~.a
.f.o .f.a .f~.o .f~.f .f~.a
.h~.h .s.o .s~.o .s~.s .s~.a .sh~.sh
.l.o .l.c .l~.o .l~.l .l~.c
.y.o .y.c .y~.o .y~.y .y~.c
```

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 −fp − 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 *make*'s 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 (i.e., **.c:**) is the definition of how to build *x* from *x*.**c**. In effect, the other suffix is null. This is useful for building targets from only one source file (e.g., shell procedures, 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˜

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 is 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 **$(LIB)(file.o)** both refer to an archive library which contains **file.o**. (This assumes the **LIB** macro has been previously defined.) The expression **$(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 byproduct 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 file names (inside **lib**) whose C source files are out-of-date. The substitution mode translates the **.o** to **.c**. (Unfortunately, one cannot as yet transform to **.c˜**; however, this may become possible in the future.) Note also, 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.*

## NOTES

Some commands return non-zero status inappropriately; use **−i** to overcome the difficulty.

## BUGS

File names 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**. The macro **$(a:.o=.c˜)** does not work. Named pipes are not handled well.

## NAME

mcs – manipulate the object file comment section

## SYNOPSIS

**mcs** [options] object-file ...

## DESCRIPTION

The *mcs* command manipulates the comment section, normally the ".comment" section, in an object file. It is used to add to, delete, print, and compress the contents of the comment section in a UNIX System object file. *mcs* must be given one or more of the options described below. It takes each of the options given and applies them in order to the *object-files.*

If the object file is an archive, the file is treated as a set of individual object files. For example, if the **–a** option is specified, the string is appended to the comment section of each archive element.

The following options are available.

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

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

**–d** Delete the contents of the comment section from the object file. The object file comment section header is removed also.

**–n** *name*
: Specify the name of the section to access. 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. If more than one name is specified, each entry printed is tagged by the name of the file from which it was extracted, using the format "filename:string."

## 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*/* | temporary files |

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

## SEE ALSO

cpp(1), a.out(4).

## NOTES

*mcs* cannot add new sections or delete existing sections to executable objects with magic number 0413 [see *a.out*(4)].

## NAME

mkshlib − create a shared library

## SYNOPSIS

**mkshlib −s** specfil [**−t** target] [**−h** host] [**−n**] [**−q**]

## DESCRIPTION

The *mkshlib* command builds both the host and target shared libraries. A shared library is similar in function to a normal, non-shared library, except that programs which link with a shared library will share the library code during execution whereas programs which link with a non-shared library will get their own copy of each library routine used.

The host shared library is an archive which is used to link-edit user programs with the shared library [see *ar*(4)]. A host shared library can be treated exactly like a non-shared library and should be included on *cc*(1) command lines in the usual way [see *cc*(1)]. Further, all operations which can be performed on an archive can also be performed on the host shared library.

The target shared library is an executable module which is attached to the user's process during execution of a program using the shared library. The target shared library contains the code for all the routines in the library and must be fully resolved. The target will be brought into memory during execution of a program using the shared library, and subsequent processes which use the shared library will share the copy of code already in memory. The text of the target is always shared, but each process will get its own copy of the data.

The user interface to *mkshlib* consists of command line options and a shared library specification file. The shared library specification file describes the contents of the shared library.

The *mkshlib* command invokes other tools such as the archiver, *ar*(1), the assembler, *as*(1), and the loader, *ld*(1). Tools are invoked through the use of *system*(3S) which searches directories in the user's PATH. Also, prefixes to *mkshlib* are parsed in the same manner as prefixes to the *cc*(1) command, and invoked tools are given the prefix, where appropriate. For example, *3b2mkshlib* will invoke *3b2ld*.

The following command line options are recognized by *mkshlib*:

**−s** specfil
: Specifies the shared library specification file, *specfil*. This file contains the information necessary to build a shared library. Its contents include the branch table specifications for the target, the pathname in which the target should be installed, the start addresses of text and data for the target, the initialization specifications for the host, and the list of object files to be included in the shared library (see details below).

**−t** target
: Specifies the name, *target*, of the target shared library produced on the host machine. When *target* is moved to the target machine, it should be installed at the location given in the specification file (see the **#target** directive below). If the **−n** option is used, then a new target shared library will not be generated.

**−h** host
: Specifies the name of the host shared library, *host*. If this option is not given, then the host shared library will not be produced.

**−n**
: Do not generate a new target shared library. This option is useful when producing only a new host shared library. The **−t** option must still be supplied since a version of the target shared library is needed to build the host shared library.

**−q**
: Quiet warning messages. This option is useful when warning messages are expected but not desired.

The shared library specification file contains all the information necessary to build both the host and target shared libraries. The contents and format of the specification file are given by the following directives:

**#address** sectname address
: Specifies the start address, *address,* of section *sectname* for the target. This directive typically is used to specify the start addresses of the .text and .data sections.

**#target** pathname
: Specifies the absolute pathname, *pathname,* of the target shared library on the target machine. This pathname is copied to **a.out** files and is the location where the operating system will look for the shared library when executing a file which uses it.

**#branch**
: Specifies the start of the branch table specifications. The lines following this directive are taken to be branch table specification lines.

  Branch table specification lines have the following format:

  ```
  funcname <white space> position
  ```

  where *funcname* is the name of the symbol given a branch table entry and *position* specifies the position of *funcname*'s branch table entry. *Position* may be a single integer or a range of integers of the form *position1-position2.* Each *position* must be greater than or equal to one, the same position can not be specified more than once, and every position from one to the highest given position must be accounted for.

  If a symbol is given more than one branch table entry by associating a range of positions with the symbol or by specifying the same symbol on more than one branch table specification line, then the symbol is defined to have the address of the highest associated branch table entry. All other branch table entries for the symbol can be thought of as "empty" slots and can be replaced by new entries in future versions of the shared library.

  Finally, only functions should be given branch table entries, and those functions must be external.

This directive can be specified only once per shared library specification file.

**#objects**

Specifies the names of the object files constituting the target shared library. The lines following this directive are taken to be the list of input object files in the order they are to be loaded into the target. The list simply consists of each filename followed by white space. This list is also used to determine the input object files for the host shared library, but the order for the host is given by running the list through *lorder*(1) and *tsort*(1).

This directive can be specified only once per shared library specification file.

**#init** object

Specifies that the object file, *object*, requires initialization code. The lines following this directive are taken to be initialization specification lines.

Initialization specification lines have the following format:

```
pimport <white space> import
```

*Pimport* is a pointer to the associated imported symbol, *import*, and must be defined in the current specified object file, *object*. The initialization code generated for each such line is of the form:

```
pimport = &import;
```

where *pimpaddr* is the absolute address of *pimport*.

All initializations for a particular object file must be given at once and multiple specifications of the same object file are not allowed.

**#ident** string

Specifies a string, *string*, to be included in the .comment section of the target shared library. This directive can be specified only once per shared library specification file.

**##**

Specifies a comment. All information on a line following this directive is ignored.

All directives which may be followed by multi-line specifications are valid until the next directive or the end of the file.

FILES

| | |
|---|---|
| *TEMPDIR/** | temporary files |

*TEMPDIR* is 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), a.out(4), ar(4).
Chapter 8 ("Shared Libraries") in the *Programmer's Guide.*

## NAME

nm − print name list of common object file

## SYNOPSIS

**nm [−oxhvnefurpVT]** filename ...

## DESCRIPTION

The *nm* command displays the symbol table of each common object file, *filename*. *Filename* may be a relocatable or absolute common object file; or it may be an archive of relocatable or absolute common object files. For each symbol, the following information will be printed:

| | |
|---|---|
| **Name** | The name of the symbol. |
| **Value** | Its value expressed as an offset or an address depending on its storage class. |
| **Class** | Its storage class. |
| **Type** | Its type and derived type. If the symbol is an instance of a structure or of a union then the structure or union tag will be given following the type (e.g., struct-tag). If the symbol is an array, then the array dimensions will be given following the type (e.g., char[ n ][ m ] ). Note that the object file must have been compiled with the **−g** option of the *cc*(1) command for this information to appear. |
| **Size** | Its size in bytes, if available. Note that the object file must have been compiled with the **−g** option of the *cc*(1) command for this information to appear. |
| **Line** | The source line number at which it is defined, if available. Note that the object file must have been compiled with the **−g** option of the *cc*(1) command for this information to appear. |
| **Section** | For storage classes static and external, the object file section containing the symbol (e.g., text, data or bss). |

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 header data. |
| **−v** | Sort external symbols by value before they are printed. |
| **−n** | Sort external symbols by name before they are printed. |
| **−e** | Print only external and static symbols. |
| **−f** | Produce full output. Print redundant symbols (.text, .data, .lib, and .bss), normally suppressed. |
| **−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), |

**A** (absolute), **T** (text segment symbol), **D** (data segment symbol), **S** (user defined segment symbol), **R** (register symbol), **F** (file symbol), or **C** (common symbol). If the symbol is local (non-external), the type letter is in lower case.

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

−T By default, *nm* prints the entire name of the symbols listed. Since object files can have symbols names with an arbitrary number of characters, a name that is longer than the width of the column set aside for names will overflow its column, forcing every column after the name to be misaligned. The −T option causes *nm* to truncate every name which would otherwise overflow its column and place an asterisk as the last character in the displayed name to mark it as truncated.

Options may be used in any order, either singly or in combination, and may appear anywhere in the command line. Therefore, both **nm name −e −v** and **nm −ve name** print the static and external symbols in *name*, with external symbols sorted by value.

FILES

*TMPDIR/** temporary files

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

BUGS

When all the symbols are printed, they must be printed in the order they appear in the symbol table in order to preserve scoping information. Therefore, the **−v** and **−n** options should be used only in conjunction with the **−e** option.

SEE ALSO

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

DIAGNOSTICS

"nm: name: cannot open"
  if *name* cannot be read.

"nm: name: bad magic"
  if *name* is not a common object file.

"nm: name: no symbols"
  if the symbols have been stripped from *name*.

## NAME

prof − display profile data

## SYNOPSIS

**prof** **[−tcan]** **[−ox]** **[−g]** **[−z]** **[−h]** **[−s]** **[−m** mdata] [prog]

## DESCRIPTION

The *prof* command interprets a profile file produced by the *monitor*(3C) 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 following options may be used in any combination:

**−g** Include non-global symbols (static functions).

**−z** Include all symbols in the profile range [see *monitor*(3C)], 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.

A program creates a profile file if it has been loaded with the **−p** option of *cc*(1). This option to the *cc* command arranges for calls to *monitor*(3C) at the beginning and end of execution. It is the call to *monitor* at the end of execution that causes a profile file to be written. 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 environment variable PROFDIR. If PROFDIR does not exist, "mon.out" is produced in the directory that is 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 program's process id. If PROFDIR is the null string, no profiling output is produced.

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

FILES

| | |
|---|---|
| mon.out | for profile |
| a.out | for namelist |

SEE ALSO

cc(1), exit(2), profil(2), monitor(3C), prof(5).

WARNING

The times reported in successive identical runs may show variances of 20% or more, because of varying cache-hit ratios due to sharing of 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.

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, i.e., the static function call counts are not added in with the call counts of the external function.

CAVEATS

Only programs that call *exit*(2) or return from *main* will cause a profile file to be produced, unless a final call to monitor is explicitly coded.

The use of the **−p** option to *cc*(1) to invoke profiling imposes a limit of 600 functions that may have call counters established during program execution. For more counters you must call *monitor*(3C) directly. If this limit is exceeded, other data will be overwritten and the **mon.out** file will be corrupted. The number of call counters used will be reported automatically by the *prof* command whenever the number exceeds 5/6 of the maximum.

## 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* 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 or directory to be processed; non-SCCS files and unreadable files are silently ignored.

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

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

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

−**r***[SID]* Used to specify the *SCCS* ID*entification* (SID) string of a delta for which information is desired. If no SID is specified, the SID of the most recently created delta is assumed.

−**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 −**c**[cutoff**]]** is in the form:

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

−**c***[date-time]* 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 various 2-digit pieces of the *cutoff* date in the form: "−**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 which parts of an SCCS file 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:"

**TABLE 1. SCCS Files Data Keywords**

| *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 |
| :Y: | Module type flag | " | text | S |
| :MF: | MR validation flag | " | *yes*˜or˜*no* | S |

**TABLE 1. SCCS Files Data Keywords (continued)**

| *Keyword* | *Data Item* | *File Section* | *Value* | *Format* |
|---|---|---|---|---|
| :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

```
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
```

```
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
```

As a *special case:*

```
prs s.file
```

may produce 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

/tmp/pr?????

## SEE ALSO

admin(1), delta(1), get(1), sccsfile(4).
help(1) in the *User's Reference Manual.*

## DIAGNOSTICS

Use *help*(1) for explanations.

## NAME

regcmp − regular expression compile

## SYNOPSIS

**regcmp** [ − ] files

## DESCRIPTION

The *regcmp* command performs a function similar to *regcmp*(3X) and, in most cases, precludes the need for calling *regcmp*(3X) from C programs. This 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 will be placed in *file*.**c**. The format of entries in *file* is a name (C variable) followed by one or more blanks followed by a regular expression 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 which uses the *regcmp* output, *regex*(*abc*,*line*) will apply 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"
```

In the C program that uses the *regcmp* output,

```
regex(telno, line, area, exch, rest)
```

will apply the regular expression named *telno* to *line*.

## SEE ALSO

regcmp(3X).

## NAME

relogin — rename login entry to show current layer

## SYNOPSIS

**/usr/lib/layersys/relogin** [−s] [line]

## DESCRIPTION

The *relogin* command changes the terminal *line* field of a user's *utmp*(4) entry to the name of the windowing terminal layer attached to standard input. *write*(1) messages sent to this user are directed to this layer. In addition, the *who*(1) command will show the user associated with this layer. *relogin* may only be invoked under *layers*(1).

*relogin* is invoked automatically by *layers*(1) to set the *utmp*(4) entry to the terminal line of the first layer created upon startup, and to reset the *utmp*(4) entry to the real line on termination. It may be invoked by a user to designate a different layer to receive *write*(1) messages.

| | |
|---|---|
| **−s** | Suppress error messages. |
| *line* | Specifies which *utmp*(4) entry to change. The *utmp*(4) file is searched for an entry with the specified *line* field. That field is changed to the line associated with the standard input. (To learn what lines are associated with a given user, say **jdoe**, type **ps -f -u jdoe** and note the values shown in the **TTY** field (see *ps*(1))). |

## FILES

| | |
|---|---|
| /etc/utmp | database of users versus terminals |

## EXIT STATUS

Returns **0** upon successful completion, **1** otherwise.

## SEE ALSO

utmp(4) in the *Programmer's Reference Manual.*
layers(1), mesg(1), ps(1), who(1), write(1) in the *User's Reference Manual.*

## NOTES

If *line* does not belong to the user issuing the *relogin* command or standard input is not associated with a terminal, *relogin* will fail.

## NAME

rmdel – remove a delta from an SCCS file

## SYNOPSIS

**rmdel** –**r**SID files

## DESCRIPTION

*rmdel* removes the delta specified by the *SID* 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 specified must *not* be that of a version being edited for the purpose of making a delta (i. e., if a *p-file* [see *get*(1)] exists for the named SCCS file, the specified must *not* appear in any entry of the *p-file*).

The –**r** option is used for specifying the *SID* (**S**CCS **ID**entification) 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.

Simply stated, they are either (1) if you make a delta you can remove it; or (2) if you own the file and directory you can remove a delta.

## FILES

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

## SEE ALSO

delta(1), get(1), prs(1), sccsfile(4).
help(1) in the *User's Reference Manual.*

## 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*(1) with the **−e** option has been previously executed without a subsequent execution of *delta*(1). 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), get(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***SID?* | *SID1* and *SID2* specify the deltas of an SCCS file that are to be compared. Versions are passed to *bdiff*(1) in the order given. |
| –**p** | pipe output for each file through *pr*(1). |
| –**s***n* | *n* is the file segment size that *bdiff* will pass to *diff*(1). This is useful when *diff* fails due to a high system load. |

## FILES

/tmp/get????? Temporary files

## SEE ALSO

get(1).
bdiff(1), help(1), pr(1) in the *User's Reference Manual.*

## DIAGNOSTICS

"*file*: No differences" If the two versions are the same.
Use *help*(1) for explanations.

## NAME

sdb − symbolic debugger

## SYNOPSIS

**sdb** [−**w**] [−**W**] [objfil [corfil [directory-list]]]

## DESCRIPTION

The *sdb* command calls a symbolic debugger that can be used with C and F77 programs. It may be used to examine their object files and core files and to provide a controlled environment for their execution.

*Objfil* is an executable program file which has been 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 default for *objfil* is **a.out**. *Corfil* is assumed to be a core image file produced after executing *objfil;* the default for *corfil* is **core**. The core file need not be present. A − in place of *corfil* will force *sdb* to ignore any core image file. The colon separated list of directories (*directory-list*) is used to locate the source files used to build *objfil.*

It is useful to know that at any time there is a *current line* and *current file*. If *corfil* exists then they are initially set to the line and file containing the source statement at which the process terminated. Otherwise, they are set to the first line in *main().* The current line and file may be changed with the source file examination commands.

By default, warnings are provided if the source files used in producing *objfil* cannot be found, or are newer than *objfil*. This checking feature and the accompanying warnings may be disabled by the use of the −**W** flag.

Names of variables are written just as they are in C or F77. *sdb* does not truncate names. 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.

It is also possible to refer to structure members as *variable.member,* pointers to structure members as *variable−>member* and array elements as *variable*[*number*]. Pointers may be dereferenced by using the form *pointer*[0]. Combinations of these forms may also be used. F77 common variables may be referenced by using the name of the common block instead of the structure name. Blank common variables may be named by the form *.variable*. A number may be used in place of a structure variable name, in which case the number is viewed as the address of the structure, and the template used for the structure is that of the last structure referenced by *sdb*. An unqualified structure variable may also be used with various commands. Generally, *sdb* will interpret a structure as a set of variables. Thus, *sdb* will display the values of all the elements of a structure when it is requested to display a structure. An exception to this interpretation occurs when displaying variable addresses. An entire structure does have an address, and it is this value *sdb* displays, not the addresses of individual elements.

Elements of a multidimensional array may be referenced 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. As with structures, *sdb* displays all the values of an array or of the section of an array if trailing subscripts are omitted. It displays only the address of the array itself or of the section specified by the user if subscripts are omitted. A multidimensional parameter in an F77 program cannot be displayed as an array, but it is actually a pointer, whose value is the location of the array. The array itself can be accessed symbolically from the calling function.

A particular instance of a variable on the stack may be referenced by using the form *procedure:variable,number.* All the variations mentioned in naming variables may be used. *Number* is the occurrence of the specified procedure on the stack, counting the top, or most current, as the first. If no procedure is specified, the procedure currently executing is used by default.

It is also possible to specify a variable by its address. All forms of integer constants which are valid in C may be used, so that addresses may be input in decimal, octal or hexadecimal.

Line numbers in the source program are referred to as *file-name:number* or *procedure:number.* In either case the number is relative to the beginning of the file. If no procedure or file name is given, the current file is used by default. If no number is given, the first line of the named procedure or file is used.

While a process is running under *sdb,* all addresses refer to the executing program; otherwise they refer to *objfil* or *corfil.* An initial argument of **−w** permits overwriting locations in *objfil.*

## Addresses

The address in a file associated with a written address is determined by a mapping associated with that file. Each mapping is represented by two triples (*b1, e1, f1*) and (*b2, e2, f2*) and the *file address* corresponding to a written *address* is calculated as follows:

*b1<=address<e1*

*file address=address+f1−b1*

otherwise

*b2<=address<e2*

*file address=address+f2−b2,*

otherwise, the requested *address* is not legal. In some cases (e.g., for programs with separated I and D space) the two segments for a file may overlap.

The initial setting of both mappings is suitable for normal **a.out** and **core** files. If either file is not of the kind expected then, for that file, *b1* is set to 0, *e1* is set to the maximum file size, and *f1* is set to 0; in this way the whole file can be examined with no address translation.

In order for *sdb* to be used on large files, all appropriate values are kept as signed 32-bit integers.

## Commands

The commands for examining data in the program are:

**t** Print a stack trace of the terminated or halted program.

**T** Print the top line of the stack trace.

*variable/clm*
Print the value of *variable* according to length *l* and format *m*. A 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** | decimal |
| **u** | decimal, unsigned |
| **o** | octal |
| **x** | hexadecimal |
| **f** | 32-bit single precision floating point |
| **g** | 64-bit double precision floating point |
| **s** | Assume *variable* is a string pointer and print characters starting at the address pointed to by the variable. |
| **a** | Print characters starting at the variable's address. This format may not be used with register variables. |
| **p** | pointer to procedure |
| **i** | disassemble machine-language instruction with addresses printed numerically and symbolically. |
| **I** | disassemble machine-language instruction with addresses just printed numerically. |

Length specifiers are only effective with the **c**, **d**, **u**, **o** and **x** formats. Any of the specifiers, *c*, *l*, and *m*, may be omitted. If all are omitted, *sdb* chooses a length and a format suitable for the variable's type as declared in the program. If *m* is specified, then this format is used for displaying the variable. A length specifier determines the output length of the value to be displayed, sometimes resulting in truncation. A count specifier *c* tells *sdb* to display that many units of memory, beginning at the address of *variable*. The number of bytes in one such unit of memory is determined by the length specifier *l*, or if no length is given, by the size associated with the *variable*. If a count specifier is used for 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 **./**.

The *sh*(1) metacharacters * and **?** may be used within procedure and variable names, providing a limited form of pattern matching. If no procedure name is given, variables local to the current procedure and global variables are matched; if a procedure name is specified then only variables local to that procedure are matched. To match only global variables, the form :*pattern* is used.

*linenumber?lm*
*variable:?lm*
Print the value at the address from **a.out** or I space given by *linenumber* or *variable* (procedure name), according to the format *lm*. The default format is 'i'.

*variable=lm*
*linenumber=lm*
*number=lm*
Print the address of *variable* or *linenumber*, or the value of *number*, in the format specified by *lm*. If no format is given, then **lx** is used. The last variant of this command provides a convenient way to convert between decimal, octal and hexadecimal.

*variable!value*
Set *variable* to the given *value*. The value may be a number, a character constant or a variable. The value must be well defined; expressions which produce more than one value, such as structures, are not allowed. 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 are viewed as integers. The *variable* may be an expression which indicates more than one variable, such as an array or structure name. 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** Print the machine registers and the current machine-language instruction.

**X** Print the current machine-language instruction.

The commands for examining source files are:

**e** *procedure*
**e** *file-name*
**e** *directory/*
**e** *directory file-name*
The first two forms set the current file to the file containing *procedure* or to *file-name*. The current line is set to the first line in the named procedure or file. Source files are assumed to be in *directory*. The default is the current working directory. The latter two forms change the value of *directory*. If no procedure, file name, or directory is given, the current procedure name and file name are reported.

*/regular expression/*
Search forward from the current line for a line containing a string matching *regular expression* as in *ed*(1). The trailing / may be deleted.

*?regular expression?*
Search backward from the current line for a line containing a string matching *regular expression* as in *ed*(1). The trailing ? may be deleted.

**p** Print the current line.

**z** Print the current line followed by the next 9 lines. Set the current line to the last line printed.

**w** Window. Print the 10 lines around the current line.

*number*
Set the current line to the given line number. Print the new current line.

*count*+
Advance the current line by *count* lines. Print the new current line.

*count*−
Retreat the current line by *count* lines. Print the new current line.

The commands for controlling the execution of the source program are:

*count* **r** *args*
*count* **R**
Run the program with the given arguments. The **r** command with no arguments reuses the previous arguments to the program while the **R** command runs the program with no arguments. An argument beginning with < or > causes redirection for the standard input or output, respectively. If *count* is given, it specifies the number of breakpoints to be ignored.

*linenumber* **c** *count*
*linenumber* **C** *count*
Continue after a breakpoint or interrupt. If *count* is given, the program will stop when *count* breakpoints have been encountered. The signal which caused the program to stop 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 is continued. The breakpoint is deleted when the command finishes.

*linenumber* **g** *count*
Continue after a breakpoint with execution resumed at the given line. If *count* is given, it specifies the number of breakpoints to be ignored.

**s** *count*
**S** *count*
Single step the program through *count* lines. If no count is given then the program is run for one line. **S** is equivalent to **s** except it steps through procedure calls.

**i**
**I** Single step by one machine-language instruction. The signal which caused the program to stop is reactivated with the **I** command and ignored with the **i** command.

*variable*$**m** *count*
*address*:**m** *count*
Single step (as with **s**) until the specified location is modified with a new value. If *count* is omitted, it is effectively infinity. *Variable* must be acces-

sible from the current procedure. Since this command is done by software, it can be very slow.

*level* **v**
: Toggle verbose mode, for use when single stepping with **S**, **s** or **m**. If *level* is omitted, then just the current source file and/or subroutine name is printed when either changes. If *level* is 1 or greater, each C source line is printed before it is executed; if *level* is 2 or greater, each assembler statement is also printed. A **v** turns verbose mode off if it is on for any level.

**k** Kill the program being debugged.

procedure(arg1,arg2,...)
procedure(arg1,arg2,...)/*m*
: Execute the named procedure with the given arguments. Arguments can be 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**. This facility is only available if the program was loaded with the −g option.

*linenumber* **b** *commands*
: Set 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 just before the breakpoint and control is returned to *sdb*. Otherwise the *commands* are executed when the breakpoint is encountered and execution continues. Multiple commands are specified by separating them with semicolons. If **k** is used as a command to execute at a breakpoint, control returns to *sdb*, instead of continuing execution.

**B** Print a list of the currently active breakpoints.

*linenumber* **d**
: Delete 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** Delete all breakpoints.

**l** Print the last executed line.

*linenumber* **a**
: Announce. If *linenumber* is of the form *proc:number*, the command effectively does a *linenumber* **b l**. If *linenumber* is of the form *proc:*, the command effectively does a *proc:* **b T**.

Miscellaneous commands:

!*command*
: The command is interpreted by *sh*(1).

**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.

**end-of-file character**
Scroll. Print 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. When *sdb* is told to display a variable by a command in such a file, the variable name is displayed along with the value. This command may not be nested; < may not appear as a command in a file.

**M** Print the address maps.

**M [?/] [*]** *b e f*
Record new values for the address map. The arguments **?** and **/** specify the text and data maps, respectively. The first segment (*b1, e1, f1*) is changed unless * is specified, in which case the second segment (*b2, e2, f2*) of the mapping is changed. If fewer than three values are given, the remaining map parameters are left unchanged.

" *string*
Print the given string. The C escape sequences of the form \*character* are recognized, where *character* is a nonnumeric character.

**q** Exit the debugger.

The following commands also exist and are intended only for debugging the debugger:

**V** Print the version number.
**Q** Print a list of procedures and files being debugged.
**Y** Toggle debug output.

FILES
a.out
core

SEE ALSO
cc(1), a.out(4), core(4), syms(4).
sh(1) in the *User's Reference Manual.*
f77(1) in the *FORTRAN Programming Language Manual.*

WARNINGS
When *sdb* prints the value of an external variable for which there is no debugging information, a warning is printed before the value. The size is assumed to be **int** (integer).

Data which are stored in text sections are indistinguishable from functions.

Line number information in optimized functions is unreliable, and some information may be missing.

## BUGS

If a procedure is called when the program is *not* stopped at a breakpoint (such as when a core image is being debugged), all variables are initialized before the procedure is started. This makes it impossible to use a procedure which formats data from a core image.

*sdb* cannot print the value of an F77 parameter. It will erroneously print the address.

Tracebacks containing F77 subprograms with multiple entry points may print too many arguments in the wrong order, but their values are correct.

The range of an F77 array subscript is assumed to be *1* to *n*, where *n* is the dimension corresponding to that subscript. This is only significant when the user omits a subscript, or uses * to indicate the full range. There is no problem in general with arrays having subscripts whose lower bounds are not 1.

## NAME

size − print section sizes in bytes of common object files

## SYNOPSIS

**size** [**−n**] [**−f**] [**−o**] [**−x**] [**−V**] files

## DESCRIPTION

The *size* command produces section size information in bytes for each loaded section in the common object files. The size of the text, data, and bss (uninitialized data) sections is printed, as well as the sum of the sizes of these sections. If an archive file is input to the *size* command the information for all archive members is displayed.

The **-n** option includes NOLOAD sections in the size.

The **-f** option produces full output, that is, it prints the size of every loaded section, followed by the section name in parentheses.

Numbers will be printed in decimal unless either the **−o** or the **−x** option is used, in which case they will be printed in octal or in hexadecimal, respectively.

The **−V** flag will supply the version information on the *size* command.

## SEE ALSO

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

## CAVEAT

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.

## DIAGNOSTICS

size: name: cannot open
    if *name* cannot be read.

size: name: bad magic
    if *name* is not an appropriate common object file.

## NAME

strip − strip symbol and line number information from a common object file

## SYNOPSIS

**strip** [**−l**] [**−x**] [**−b**] [**−r**] [**−V**] filename ...

## DESCRIPTION

The *strip* command strips the symbol table and line number information from common object files, including archives. Once this 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.

The amount of information stripped from the symbol table can be controlled by using any of the following options:

| | |
|---|---|
| **−l** | Strip line number information only; do not strip any symbol table information. |
| **−x** | Do not strip static or external symbol information. |
| **−b** | Same as the **−x** option, but also do not strip scoping information (e.g., beginning and end of block delimiters). |
| **−r** | Do not strip static or external symbol information, or relocation information. |
| **−V** | Print the version of the strip command executing on the standard error output. |

If there are any relocation entries in the object file and any symbol table information is to be stripped, *strip* will complain and terminate without stripping *filename* unless the **−r** option is used.

If the *strip* command is executed on a common archive file [see *ar*(4)] the archive symbol table will be removed. The archive symbol table must be restored by executing the *ar*(1) command with the **s** option before the archive can be link-edited by the *ld*(1) command. *strip* will produce appropriate warning messages when this situation arises.

*strip* is used to reduce the file storage overhead taken by the object file.

## FILES

| | |
|---|---|
| *TMPDIR*/strp* | 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), as(1), cc(1), ld(1), tmpnam(3S), a.out(4), ar(4).

## DIAGNOSTICS

strip: name: cannot open
if *name* cannot be read.

strip: name: bad magic
if *name* is not an appropriate common object file.

strip: name: relocation entries present; cannot strip
: if *name* contains relocation entries and the **−r** flag is not used, the symbol table information cannot be stripped.

## NAME

tic – terminfo compiler

## SYNOPSIS

**tic** [−**v**[n]] [−**c**] file

## DESCRIPTION

*tic* translates a *terminfo*(4) file from the source format into the compiled format. The results are placed in the directory */usr/lib/terminfo*. The compiled format is necessary for use with the library routines described in *curses*(3X).

| | |
|---|---|
| −**vn** | (verbose) output to standard error trace information showing *tic*'s progress. The optional integer *n* is a number from 1 to 10, inclusive, indicating the desired level of detail of information. If *n* is omitted, the default level is 1. If *n* is specified and greater than 1, the level of detail is increased. |
| −**c** | only check *file* for errors. Errors in **use=** links are not detected. |
| file | contains one or more *terminfo*(4) terminal descriptions in source format (see *terminfo*(4)). Each description in the file describes the capabilities of a particular terminal. When a **use=***entry-name* field is discovered in a terminal entry currently being compiled, *tic* reads in the binary from */usr/lib/terminfo* to complete the entry. (Entries created from *file* will be used first. If the environment variable **TERMINFO** is set, that directory is searched instead of */usr/lib/terminfo.*) *tic* duplicates the capabilities in *entry-name* for the current entry, with the exception of those capabilities that explicitly are defined in the current entry. |

If the environment variable **TERMINFO** is set, the compiled results are placed there instead of */usr/lib/terminfo.*

## FILES

/usr/lib/terminfo/?/* compiled terminal description data base

## SEE ALSO

curses(3X), term(4), terminfo(4) in the *Programmer's Reference Manual.*
Chapter 10 in the *Programmer's Guide.*

## WARNINGS

Total compiled entries cannot exceed 4096 bytes. The name field cannot exceed 128 bytes.

Terminal names exceeding 14 characters will be truncated to 14 characters and a warning message will be printed.

When the −**c** option is used, duplicate terminal names will not be diagnosed; however, when −**c** is not used, they will be.

## BUGS

To allow existing executables from the previous release of the UNIX System to continue to run with the compiled terminfo entries created by the new terminfo compiler, cancelled capabilities will not be marked as cancelled within the terminfo binary unless the entry name has a '+' within it. (Such terminal names are only used for inclusion within other entries via a **use=** entry. Such names would not be used for real terminal names.)

For example:

```
4415+nl, kf1@, kf2@, ....

4415+base, kf1=\EOc, kf2=\EOd, ....

4415-nl|4415 terminal without keys,
    use=4415+nl, use=4415+base,
```

The above example works as expected; the definitions for the keys do not show up in the *4415−nl* entry. However, if the entry *4415+nl* did not have a plus sign within its name, the cancellations would not be marked within the compiled file and the definitions for the function keys would not be cancelled within *4415−nl*.

## DIAGNOSTICS

Most diagnostic messages produced by *tic* during the compilation of the source file are preceded with the approximate line number and the name of the terminal currently being worked on.

*mkdir* ... returned bad status
: The named directory could not be created.

File does not start with terminal names in column one
: The first thing seen in the file, after comments, must be the list of terminal names.

Token after a *seek*(2) not NAMES
: Somehow the file being compiled changed during the compilation.

Not enough memory for use_list element
or
Out of memory
: Not enough free memory was available (*malloc*(3) failed).

Can't open ...
: The named file could not be created.

Error in writing ...
: The named file could not be written to.

Can't link ... to ...
: A link failed.

Error in re-reading compiled file ...
: The compiled file could not be read back in.

Premature EOF
: The current entry ended prematurely.

Backspaced off beginning of line
: This error indicates something wrong happened within *tic*.

Unknown Capability - "..."
: The named invalid capability was found within the file.

Wrong type used for capability "..."
: For example, a string capability was given a numeric value.

Unknown token type
: Tokens must be followed by '@' to cancel, ',' for booleans, '#' for numbers, or '=' for strings.

"...": bad term name
or
Line ...: Illegal terminal name - "..."
Terminal names must start with a letter or digit
: The given name was invalid. Names must not contain white space or slashes, and must begin with a letter or digit.

"...": terminal name too long.
: An extremely long terminal name was found.

"...": terminal name too short.
: A one-letter name was found.

"..." filename too long, truncating to "..."
: The given name was truncated to 14 characters due to UNIX file name length limitations.

"..." defined in more than one entry. Entry being used is "...".
: An entry was found more than once.

Terminal name "..." synonym for itself
: A name was listed twice in the list of synonyms.

At least one synonym should begin with a letter.
: At least one of the names of the terminal should begin with a letter.

Illegal character - "..."
: The given invalid character was found in the input file.

Newline in middle of terminal name
: The trailing comma was probably left off of the list of names.

Missing comma
: A comma was missing.

Missing numeric value
: The number was missing after a numeric capability.

NULL string value
: The proper way to say that a string capability does not exist is to cancel it.

Very long string found. Missing comma?
: self-explanatory

Unknown option. Usage is:
: An invalid option was entered.

Too many file names. Usage is:
: self-explanatory

"..." non-existant or permission denied
: The given directory could not be written into.

"..." is not a directory
: self-explanatory

"...": Permission denied
: access denied.

"...": Not a directory
: *tic* wanted to use the given name as a directory, but it already exists as a file

SYSTEM ERROR!! Fork failed!!!
: A *fork*(2) failed.

Error in following up use-links. Either there is a loop in the links or they reference non-existant terminals. The following is a list of the entries involved:
: A *terminfo*(4) entry with a **use=***name* capability either referenced a non-existant terminal called *name* or *name* somehow referred back to the given entry.

## 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** [−**r**SID] [−**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 *get*s 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. |

## SEE ALSO

delta(1), get(1), sact(1).
help(1) in the *User's Reference Manual.*

## DIAGNOSTICS

Use *help*(1) for explanations.

## NAME

val – validate 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 upon 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 *ID*entification String) is an SCCS delta number. A check is made to determine if the *SID* is ambiguous (e. g., **r**1 is ambiguous because it physically does not exist but implies 1.1, 1.2, etc., which may exist) or invalid (e. g., **r**1.0 or **r**1.1.0 are invalid because neither case 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 s-1SCCS %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, i. e., 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;

Note that *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), prs(1).
help(1) in the *User's Reference Manual.*

## DIAGNOSTICS

Use *help*(1) for explanations.

## BUGS

*val* can process up to 50 files on a single command line. Any number above 50 will produce a **core** dump.

## NAME

vc — version control

## SYNOPSIS

**vc** [−**a**] [−**t**] [−**c**char] [−**s**] [keyword=value ... keyword=value]

## DESCRIPTION

The *vc* command copies lines from the standard input to the standard output under control of its *arguments* and *control statements* encountered in the standard input. In the process of performing the copy operation, user declared *keywords* 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*(1); 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 \.

### Keyletter Arguments

| | |
|---|---|
| −**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 one is found, all characters up to and including the *tab* are discarded. |
| −**c**char | Specifies a control character to be used in place of :. |
| −**s** | Silences warning messages (not error) that are normally printed on the diagnostic output. |

### Version Control Statements

:dcl keyword[, ..., keyword]
  Used to declare keywords. All keywords must be declared.

:asg keyword=value

Used to assign values to keywords. An **asg** statement overrides the assignment for the corresponding keyword on the *vc* command line and all previous **asg**'s for that keyword. Keywords declared, but not assigned values have null values.

:if condition
.
.
.
:end

Used to 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
: Used for keyword replacement 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
: Prints the given message on the diagnostic output.

:err message
: Prints the given 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

ed(1), help(1) in the *User's Reference Manual*.

EXIT CODES

0 − normal
1 − any error
Use *help*(1) for explanations.

## NAME

what – identify SCCS files

## SYNOPSIS

**what** [**–s**] files

## DESCRIPTION

*what* searches the given files for all occurrences of the pattern that *get*(1) 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

```
char 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
```

will print

```
f.c:
        identification information
f.o:
        identification information
a.out:
        identification information
```

*what* is intended to be used in conjunction with the command *get*(1), 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) in the *User's Reference Manual.*

## DIAGNOSTICS

Exit status is 0 if any matches are found, otherwise 1. Use *help*(1) for explanations.

## BUGS

It is possible that an unintended occurrence of the pattern **@(#)** could be found just by chance, but this causes no harm in nearly all cases.

## NAME

wtinit − object downloader for the 5620 DMD terminal

## SYNOPSIS

**/usr/lib/layersys/wtinit** [**−d**] [**−p**] file

## DESCRIPTION

The *wtinit* utility downloads the named *file* for execution in the AT&T Teletype 5620 DMD terminal connected to its standard output. *file* must be a DMD object file. *wtinit* performs all necessary bootstrap and protocol procedures.

There are two options.

**−d** Prints out the sizes of the text, data, and bss portions of the downloaded *file* on standard error.

**−p** Prints the down-loading protocol statistics and a trace on standard error.

The environment variable **JPATH** is the analog of the shell's **PATH** variable to define a set of directories in which to search for *file*.

If the environment variable **DMDLOAD** has the value **hex**, *wtinit* will use a hexadecimal download protocol that uses only printable characters.

Terminal Feature Packages for specific versions of AT&T windowing terminals will include terminal-specific versions of *wtinit* under those installation subdirectories. */usr/lib/layersys/wtinit* is used for *layers*(1) initialization only when no Terminal Feature Package is in use.

## DIAGNOSTICS

Returns **0** upon successful completion, **1** otherwise.

## WARNING

Standard error should be redirected when using the **−d** or **−p** options.

## SEE ALSO

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

## NAME

xtd − extract and print xt driver link structure

## SYNOPSIS

**xtd** [−**f**] [−n ...]

## DESCRIPTION

The *xtd* command is a debugging tool for the *xt*(7) driver. It performs an **XTIOCDATA** *ioctl*(2) call on its standard input file to extract the *Link* data structure for the attached group of channels. This call will fail if data extraction has not been configured in the driver or the standard input is not attached to an *xt*(7) channel. The data are printed one item per line on the standard output. The output should probably be formatted via **pr -3**.

The optional flags affect output as follows:

−*n* *n* is a number in the range 0 to 7. Channel *n* is included in the list of channels to be printed. The default prints all channels, whereas the occurrence of one or more channel numbers implies a subset.

−**f** Causes a "formfeed" character to be put out at the end of the output, for the benefit of page-display programs.

## DIAGNOSTICS

Returns **0** upon successful completion, **1** otherwise.

## SEE ALSO

xts(1M), xtt(1M), ioctl(2), xtproto(5) in the *Programmer's Reference Manual.*
xt(7) in the *System Administrator's Reference Manual.*
pr(1) in the *User's Reference Manual.*

## NAME

xts – extract and print xt driver statistics

## SYNOPSIS

**xts [–f]**

## DESCRIPTION

The *xts* command is a debugging tool for the *xt*(7) driver. It performs an **XTIOCSTATS** *ioctl*(2) call on its standard input file to extract the accumulated statistics for the attached group of channels. This call will fail if statistics have not been configured in the driver or the standard input is not attached to an *xt*(7) channel. The statistics are printed one item per line on the standard output.

**–f** Causes a "formfeed" character to be put out at the end of the output, for the benefit of page-display programs.

## DIAGNOSTICS

Returns **0** upon successful completion, **1** otherwise.

## SEE ALSO

xtd(1M), xtt(1M), ioctl(2), xtproto(5) in the *Programmer's Reference Manual.*
xt(7) in the *System Administrator's Reference Manual.*

## NAME

xtt – extract and print xt driver packet traces

## SYNOPSIS

**xtt** [**−f**] [**−o**]

## DESCRIPTION

The *xtt* command is a debugging tool for the *xt*(7) driver. It performs an **XTIOCTRACE** *ioctl*(2) call on its standard input file to turn on tracing and extract the circular packet trace buffer for the attached group of channels. This call will fail if tracing has not been configured in the driver, or the standard input is not attached to an *xt*(7) channel. The packets are printed on the standard output.

The optional flags are:

**−f** Causes a "formfeed" character to be put out at the end of the output, for the benefit of page-display programs.

**−o** Turns off further driver tracing.

## DIAGNOSTICS

Returns **0** upon successful completion, **1** otherwise.

## NOTE

If driver tracing has not been turned on for the terminal session by invoking *layers*(1) with the **−t** option, *xtt* will not generate any output the first time it is executed.

## SEE ALSO

xtd(1M), xts(1M), ioctl(2), layers(5) in the *Programmer's Reference Manual.*
xt(7) in the *System Administrator's Reference Manual.*
layers(1) in the *User's Reference Manual.*

## NAME

yacc — yet another compiler-compiler

## SYNOPSIS

**yacc** [ **−vdlt** ] grammar

## DESCRIPTION

The *yacc* command converts a context-free grammar into a set of tables for a simple automaton which executes an LR(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; *lex*(1) is useful for creating lexical analyzers usable by *yacc*.

If the **−v** flag is given, the file **y.output** is prepared, which contains a description of the parsing tables and a report on conflicts generated by ambiguities in the grammar.

If the **−d** flag is used, the file **y.tab.h** is generated with the **#define** statements that associate the *yacc*-assigned "token codes" with the user-declared "token names". This allows source files other than **y.tab.c** to access the token codes.

If the **−l** flag is given, the code produced in **y.tab.c** will *not* contain any **#line** constructs. This should only be used after the grammar and the associated actions are fully debugged.

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. However, when *yacc*'s **−t** option is used, this debugging code will be compiled by default. Independent of whether the **−t** option was 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.

## FILES

| | |
|---|---|
| y.output | |
| y.tab.c | |
| y.tab.h | defines for token names |
| yacc.tmp, | |
| yacc.debug, yacc.acts | temporary files |
| /usr/lib/yaccpar | parser prototype for C programs |

## SEE ALSO

lex(1).
*Programmer's Guide.*

## 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 is also reported.

## CAVEAT

Because file names are fixed, at most one *yacc* process can be active in a given directory at a given time.

## 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
During a STREAMS *open*(2), either no STREAMS queues or no STREAMS head data structures were available.

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*(2) operation,

**shm_dtime**
is the time of the last *shmdt*(2) 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 *driver*s. 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 super-user 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 super-user. |
| [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 path name 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**<br>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, 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 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 ctive. |

## 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.

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 *cstime* [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*(2) 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).

## WARNING

See *WARNING* in *signal*(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 obtained from a *creat, open, dup, fcntl,* or *pipe* system call.

The commands available are:

| | |
|---|---|
| F_DUPFD | Return a new file descriptor as follows:<br>Lowest numbered available file descriptor greater than or equal to *arg*.<br>Same open file (or pipe) as the original file.<br>Same file pointer as the original file (i.e., both file descriptors share one file pointer).<br>Same access mode (read, write or read/write).<br>Same file status flags (i.e., both file descriptors share the same file status flags).<br>The close-on-exec flag 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 the file descriptor *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 *file* status flags. |
| F_SETFL | Set *file* 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, the process will sleep 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 structure *flock* 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* and *write* 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. |
| [EINVAL] | *Cmd* is F_DUPFD. *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 F_GETLK, F_SETLK, or 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 putting the calling-process to sleep, waiting for that lock to become free, would cause a deadlock. |
| [EFAULT] | *Cmd* is F_SETLK, *arg* points 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

close(2), creat(2), dup(2), exec(2), fork(2), open(2), pipe(2), fcntl(5).

## 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 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.

## WARNINGS

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. For a description of this see *dirent*(4).

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*(3X) routine [for a description see *directory*(3X)], 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(3X), dirent(4).

## 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).
*STREAMS Primer*
*STREAMS Programmer's Guide*

## 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:

| | |
|---|---|
| [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 real or effective 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.

## WARNING

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/mount.h>**

**int mount (spec, dir, mflag, fstyp)**
**char *spec, *dir;**
**int mflag, fstyp;**

## 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 the MS_FSS flag bit of *mflag* is off, the file system type will default to the root file system type. Only if the bit is on will *fstyp* be used to indicate the file system type.

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), fs(4).
mount(1M) 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 *nice value* 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. |
| [EINTR] | A signal was caught during the *open* system call. |
| [ENOMEM] | The system is unable to allocate a send descriptor. |
| [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), 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: 0177777 (octal) gives a 1-1 mapping of pc's to entries in *buff*; 077777 (octal) maps each pair of instruction entries 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), monitor(3C).

## DIAGNOSTICS

Not defined.

## 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**.

General Errors

*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. |
| [EAGAIN] | Buffers could not be allocated for the message that was to be created. |
| [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. |
| [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. |
| [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>**

**int semget (key, nsems, semflg)**
**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>**

**int shmget (key, size, shmflg)**
**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 *WARNING* below) |
| **SIGPWR** | power fail (see *WARNING* 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).

## WARNING

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.

## NOTES

**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 special 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 *filedes* 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

sys3b – machine specific functions

## SYNOPSIS

```
#include <sys/sys3b.h>

int sys3b (cmd, arg1, arg2, arg3)
int cmd, arg1, arg2, arg3;
```

## DESCRIPTION

*sys3b* implements machine specific functions. The *cmd* argument determines the function performed. The number of arguments expected is dependent on the function.

### Command GRNFLASH

When *cmd* is GRNFLASH, no arguments are expected. This function starts the green LED flashing. Note that this command is only available to the super-user.

### Command GRNON

When *cmd* is GRNON, no arguments are expected. This function turns the greed LED to a solid on state. Note that this command is only available to the super-user.

### Command RNVR

When *cmd* is RNVR, an argument of type struct nvparams * is expected.

```
struct nvparams{
        char *addr;
        char *data;
        unsigned short cnt;
        }
```

This function reads *cnt* bytes at address *addr* in NVRAM into address *data*. Note that this command is only available to the super-user.

### Command RTODC

When *cmd* is RTODC, an argument of type struct tvdc * is expected.

```
struct tvdc {
        short htenths; short hsecs; short hmins;
        short hhours; short hdays; short hweekday;
        short hmonth; short hyear
}
```

This function reads the hardware time of day clock and returns the data in the structure referred to by the argument. Note that this command is only available to the super-user.

### Command S3BSYM

When *cmd* is S3BSYM, the symbol table created during a self-config boot process may be accessed. The symbols available via this command are defined in one of two places: the driver routines loaded or the variable specifications in the files in the **/etc/master** directory. Two arguments are expected; the first must be a pointer to a buffer into which the symbol table is copied, and the second must be an integer containing the total size of the buffer. The format of the symbol table is:

```
int size;        /* symbol size in bytes */
int count;       /* total number of symbols */

                 /* for each symbol ... */
char name[];     /*     name of symbol, padded with */
                 /*     '\0' to next sizeof(long) */
                 /*     boundary */
long value;      /*     value of symbol */
```

Typically, the symbol table would be retrieved with two calls to *sys3b*. First, the size of the symbol table is obtained by calling *sys3b* with a buffer of one integer. This integer is then used to obtain a buffer large enough to contain the entire symbol table. The second invocation of *sys3b* with this newly obtained buffer retrieves the entire symbol table.

```
#include <sys/sys3b.h>


int   size;                /* size of buffer needed */
struct s3bsym *buffer;     /* buffer pointer */


sys3b( S3BSYM, (struct s3bsym *) &size, sizeof(size) );
buffer = (struct s3bsym *) malloc( size );
sys3b( S3BSYM, buffer, size );
```

Command S3BCONF

When *cmd* is S3BCONF, the configuration table created during a self-config boot process may be accessed. This table contains the names and locations of the devices supported by the currently running UNIX system, the names of all software modules included in the system, and the names of all devices in the EDT that were ignored. Two arguments are expected; the first must be a pointer to a buffer into which the configuration table is copied, and the second must be an integer containing the total size of the buffer. The format of the configuration table is:

```
int     ndev;          /* total number of entries */

                       /* for each entry ... */
long    timestamp;     /*     f_timdat from file header */
char    name[14];      /*     name of device/module */
char    flag;          /*     configuration information */
                       /*         0x80: device ignored */
                       /*         0x40: name[] is a driver */
                       /*         0x20: name[] is a software module */
char    board;         /* local bus address of device */
```

Typically, the configuration table would be retrieved with two calls to *sys3b*. First, the number of entries is obtained by calling *sys3b* with a buffer of one integer. This integer is then used to calculate and obtain a buffer large enough to contain the entire configuration table. The second invocation of *sys3b* with this newly obtained buffer retrieves the configuration table.

```
#include <sys/sys3b.h>


int   count;              /* total number of devices */
int   size;               /* size of buffer needed */
struct s3bconf *buffer;   /* buffer pointer */


sys3b( S3BCONF, (struct s3bconf *) &count, sizeof(count) );
size = sizeof(int);
size += count * sizeof(struct s3bc);
buffer = (struct s3bconf *) malloc( size );
sys3b( S3BCONF, buffer, size );
```

Command S3BBOOT

When *cmd* is S3BBOOT, the timestamp and boot program path name used for a self-config boot process may be accessed. The path name of the a.out format file which was booted, and the timestamp from the file header [see *a.out*(4)] are saved. One argument is expected; a pointer to a buffer into which the information is copied. The format of this information is:

```
long  timestamp;       /* f_timdat from file header */
char  path[100];       /* path name */
```

This information would be retrieved with a single call to *sys3b*.

```
#include <sys/sys3b.h>

struct s3bboot buffer; /* buffer */

sys3b( S3BBOOT, &buffer );
```

Command S3BAUTO

When *cmd* is S3BAUTO, no arguments are expected. This function returns a boolean value in answer to the question, "Was the last boot an auto-config boot, or was a fully configured file booted?" The value returned is zero if a fully configured file (such as **/unix**) was booted. The integer value 1 is returned if the preceeding boot was an auto-config boot. The value is undefined if the system was booted in "magic mode." Note that this command is available only to the super-user.

Command S3BFPHW

When *cmd* is S3BFPHW, an indication of whether or not a MAU is present is returned. (See the *Introduction* to this manual for a description of the MAU.) One argument, the address of an int, is expected. On return from the system call, this int will contain a 1 if a MAU is present or a 0 if a MAU is not present.

If the address of the int is not valid (i.e. not word aligned, nor user accessible, etc.) EFAULT will be returned.

To determine whether a MAU is present, the following should be done:

```
#include <sys/sys3b.h>

int mau_present;
sys3b(S3BFPHW, &mau_present);
```

If this command succeeds, it returns 0 to the calling process. This call will fail, returning -1, if one or more of the following is true:

| | |
|---|---|
| [EFAULT] | mau_present is not an integer, |
| [EFAULT] | &mau_present is an invalid address. |

## Command S3BSWPI

Note: This *cmd* is available only with System V Releases 2.1 and 3.0 software.

When *cmd* is S3BSWPI, individual swapping areas may be added, deleted or the current areas determined. The address of an appropriately primed swap buffer is passed as the only argument. (Refer to *sys/swap.h* header file for details of loading the buffer.)

The format of the swap buffer is:

```
struct swapint {
    char        si_cmd;          /*command: list, add, delete*/
    char        *si_buf;         /*swap file path pointer*/
    int         si_swplo;        /*start block*/
    int         si_nblks;        /*swap size*/
}
```

Note that the add and delete options of the command may only be exercised by the super-user.

Typically, a swap area is added by a single call to *sys3b*. First, the swap buffer is primed with appropriate entries for the structure members. Then *sys3b* is invoked.

```
#include <sys/sys3b.h>
#include <sys/swap.h>

struct swapint swapbuf;                 /*swap into buffer ptr*/

sys3b(S3BSWPI, &swapbuf);
```

If this command succeeds, it returns 0 to the calling process. This command fails, returning -1, if one or more of the following is true:

| | |
|---|---|
| [EFAULT] | *Swapbuf* points to an invalid address |
| [EFAULT] | *Swapbuf.si_buf* points to an invalid address |

| | |
|---|---|
| [ENOTBLK] | Swap area specified is not a block special device |
| [EEXIST] | Swap area specified has already been added |
| [ENOSPC] | Too many swap areas in use (if adding) |
| [ENOMEM] | Tried to delete last remaining swap area |
| [EINVAL] | Bad arguments |
| [ENOMEM] | No place to put swapped pages when deleting a swap area |

### Command STIME

When *cmd* is STIME, an argument of type long is expected. This function sets the system time and date. The argument contains the time as measured in seconds from 00:00:00 GMT January 1, 1970. Note that this command is only available to the super-user.

### Command WNVR

When *cmd* is WNVR, an argument of type struct nvparams * is expected (see command RNVR). This function writes *cnt* bytes into address *addr* in NVRAM from address *data*. Note that this command is only available to the super-user.

## SEE ALSO

sync(2), a.out(4).
swap(1M) in the *System Administrator's Reference Manual.*

## DIAGNOSTICS

Upon successful completion, the value returned depends on *cmd* as follows:

| | |
|---|---|
| S3BSYM | A value of zero. |
| S3BCONF | A value of zero. |
| S3BBOOT | A value of zero. |
| S3BAUTO | A value of zero if a fully-configured file (such as **/unix**) was booted. A value of one if an auto-config boot was performed. |

Otherwise, a value of −1 is returned and *errno* is set to indicate the error. When *cmd* is invalid, *errno* is set to EINVAL on return.

## 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. On a 3B2 Computer clock ticks occur 100 times per second.

## 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)].

## 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. |
| [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).

## WARNING

*wait* fails and its actions are undefined if *stat_loc* points to an invalid address.

See *WARNING* 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. |
| [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.

## 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. 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 loaded by the C compiler, *cc*(1). (For this reason the (3C) and (3S) sections together comprise one section of this manual.) The link editor *ld*(1) searches this library under the **–lc** option. A "shared library" version of *libc* can be searched using the **–lc_s** option, resulting in smaller *a.out*s. Declarations for some of these functions may be obtained from **#include** files indicated on the appropriate pages.

(3S) These functions constitute the "standard I/O package" [see *stdio*(3S)]. These functions are in the library *libc*, already mentioned. Declarations for these functions may be obtained from the **#include** file **<stdio.h>**.

(3M) These functions constitute the Math Library, *libm*. They are automatically loaded as needed by the FORTRAN compiler *f77*(1). They are not automatically loaded by the C compiler, *cc*(1); however, the link editor searches this library under the **–lm** option. Declarations for these functions may be obtained from the **#include** file **<math.h>**. Several generally useful mathematical constants are also defined there [see *math*(5)].

(3N) This contains sets of functions constituting the Network Services library. These sets provide protocol independent interfaces to networking services based on the service definitions of the OSI (Open Systems Interconnection) reference model. Application developers access the function sets that provide services at a particular level.

The function sets contained in the library are:

TRANSPORT INTERFACE (TI) - provide the services of the OSI Transport Layer. These services provide reliable end-to-end data transmission using the services of an underlying network. Applications written using the TI functions are independent of the underlying protocols. Declarations for these functions may be obtained from the **#include** file **<tiuser.h>**. The link editor *ld*(1) searches this library under the **–lnsl_s** option.

(3X) Various specialized libraries. The files in which these libraries are found are given on the appropriate pages.

(3F) These functions constitute the FORTRAN intrinsic function library, *libF77*. These functions are automatically available to the FORTRAN programmer and require no special invocation of the compiler.

## 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, represented in the C language as '\0'. A *character array* is a sequence of characters. A *null-terminated character array* is a sequence of characters, the last of which is the *null character*. A *string* is a designation for a *null-terminated character array*. The *null string* is a character array containing only the null character. A **NULL** pointer is the value that is obtained by casting **0** into a pointer. The C language guarantees that this value will not match that of any legitimate pointer, so many functions that return pointers return it to indicate an error. **NULL** is defined as **0** in **<stdio.h>**; the user can include an appropriate definition if not using **<stdio.h>**.

Many groups of FORTRAN intrinsic functions have *generic* function names that do not require explicit or implicit type declaration. The type of the function will be determined by the type of its argument(s). For example, the generic function *max* will return an integer value if given integer arguments (*max0*), a real value if given real arguments (*amax1*), or a double-precision value if given double-precision arguments (*dmax1*).

**Netbuf** In the Network Services library, *netbuf* is a structure used in various Transport Interface (TI) functions to send and receive data and information. It contains the following members:

```
    unsigned int maxlen;
    unsigned int len;
    char    *buf;
```

*Buf* points to a user input and/or output buffer. *Len* generally specifies the number of bytes contained in the buffer. If the structure is used for both input and output, the function will replace the user value of *len* on return.

*Maxlen* generally has significance only when *buf* is used to receive output from the TI function. In this case, it specifies the physical size of the buffer, the maximum value of *len* that can be set by the function. If *maxlen* is not large enough to hold the returned information, an TBUFOVFLW error will generally result. However, certain functions may return part of the data and not generate an error.

## FILES

LIBDIR usually /lib
LIBDIR/libc.a
LIBDIR/libc_s.a
LIBDIR/libm.a
LIBDIR/lib77.a
/shlib/libc_s
/shlib/libnsl_s (3N)
/usr/lib/libnsl_s.a (3N)

## SEE ALSO

ar(1), cc(1), ld(1), lint(1), nm(1), intro(2), stdio(3S), math(5).
f77(1) in the *FORTRAN Programming Language Manual.*

## DIAGNOSTICS

Functions in the C and Math Libraries (3C and 3M) may return the conventional values **0** or **±HUGE** (the largest-magnitude single-precision floating-point numbers; **HUGE** is defined in the *<math.h>* header file) when the function is undefined for the given arguments or when the value is not representable. In these cases, the external variable *errno* [see *intro*(2)] is set to the value EDOM or ERANGE.

## WARNING

Many of the functions in the libraries call and/or refer to other functions and external variables described in this section and in Section 2 (*System Calls*). If a program inadvertently defines a function or external variable with the same name, the presumed library version of the function or external variable may not be loaded. The *lint*(1) program checker reports name conflicts of this kind as "multiple declarations" of the names in question. Definitions for Sections 2, 3C, and 3S are checked automatically. Other definitions can be included by using the **−l** option. (For example, **−l***m* includes definitions for Section 3M, the Math Library.) Use of *lint* is highly recommended.

## NAME

a64l, l64a – convert between long integer and base-64 ASCII string

## SYNOPSIS

```
long a64l (s)
char *s;

char *l64a (l)
long l;
```

## DESCRIPTION

These functions are used to maintain numbers stored in *base-64* ASCII characters. This is 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, 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.

## CAVEAT

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 IOT fault

## SYNOPSIS

**int abort ( )**

## DESCRIPTION

*abort* does the work of *exit*(2), but instead of just exiting, *abort* causes **SIGABRT** to be sent to the calling process. If **SIGABRT** is neither caught nor ignored, all *stdio*(3S) streams are flushed prior to the signal being sent, and a core dump results.

*abort* returns the value of the *kill*(2) system call.

## SEE ALSO

sdb(1), exit(2), kill(2), signal(2).

## 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.

## NAME

abs — return integer absolute value

## SYNOPSIS

**int abs (i)**
**int i;**

## DESCRIPTION

*abs* returns the absolute value of its integer operand.

## SEE ALSO

floor(3M).

## CAVEAT

In two's-complement representation, the absolute value of the negative integer with largest magnitude is undefined. Some implementations trap this error, but others simply ignore it.

## NAME

bsearch – binary search a sorted table

## SYNOPSIS

**#include <search.h>**

**char *bsearch ((char *) key, (char *) base, nel, sizeof (*key), compar)**
**unsigned nel;**
**int (*compar)( );**

## DESCRIPTION

*bsearch* is a binary search routine generalized from Knuth (6.2.1) Algorithm B. It returns a pointer into a table indicating where a datum may be found. The table must be previously sorted in increasing order according to a provided comparison function. *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. *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 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 code fragment 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 <search.h>

#define TABSIZE        1000

struct node {                  /* these are stored in the table */
        char *string;
        int length;
};
struct node table[TABSIZE];    /* table to be searched */
        .
        .
        .
{
        struct node *node_ptr, node;
        int node_compare( );  /* routine to compare 2 nodes */
        char str_space[20];   /* space to read string into */
        .
        .
        .
```

```
                node.string = str_space;
                while (scanf("%s", node.string) != EOF) {
                        node_ptr = (struct node *)bsearch((char *)(&node),
                                   (char *)table, TABSIZE,
                                   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: %s\n", node.string);
                        }
                }
        }
        /*
                This routine compares two nodes based on an
                alphabetical ordering of the string field.
        */
        int
        node_compare(node1, node2)
        char *node1, *node2;
        {
                return (strcmp(
                                ((struct node *)node1)->string,
                                ((struct node *)node2)->string));
        }
```

NOTES

The pointers to the key and the element at the base of the table should be of type pointer-to-element, and cast to type pointer-to-character.
The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.
Although *bsearch* is declared as type pointer-to-character, the value returned should be cast into type pointer-to-element.

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.

## NAME

clock – report CPU time used

## SYNOPSIS

**long clock ( )**

## DESCRIPTION

*clock* returns the amount of CPU time (in microseconds) used since the first call to *clock*. 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 *wait*(2), *pclose*(3S), or *system*(3S).

The resolution of the clock is 10 milliseconds on AT&T 3B computers.

## SEE ALSO

times(2), wait(2), popen(3S), system(3S).

## BUGS

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).

## NAME

conv: toupper, tolower, _toupper, _tolower, toascii – translate characters

## SYNOPSIS

```
#include <ctype.h>

int toupper (c)
int c;

int tolower (c)
int c;

int _toupper (c)
int c;

int _tolower (c)
int c;

int toascii (c)
int c;
```

## DESCRIPTION

*Toupper* and *tolower* have as domain the range of *getc*(3S): the integers from −1 through 255. 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*, are macros that accomplish the same thing as *toupper* and *tolower* but have restricted domains and are faster. *_toupper* requires a lower-case letter as its argument; its result is the corresponding upper-case letter. The macro *_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 ASCII character; it is intended for compatibility with other systems.

## SEE ALSO

ctype(3C), getc(3S).

## NAME

crypt, setkey, encrypt − generate hashing encryption

## SYNOPSIS

```
char *crypt (key, salt)
char *key, *salt;

void setkey (key)
char *key;

void encrypt (block, ignored)
char *block;
int ignored;
```

## DESCRIPTION

*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 *setkey* and *encrypt* entries 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. If this string is divided into groups of 8, the low-order bit in each group is ignored; this gives a 56-bit key which is set into the machine. This is the key that will be used with the hashing algorithm to encrypt the string *block* with the function *encrypt*.

The argument to the *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 *setkey*. *Ignored* is unused by *encrypt* but it must be present.

## SEE ALSO

getpass(3C), passwd(4).
login(1), passwd(1) in the *User's Reference Manual.*

## CAVEAT

The return value points to static data that are overwritten by each call.

## NAME

ctermid − generate file name for terminal

## SYNOPSIS

**#include <stdio.h>**
**char *ctermid (s)**
**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.

## 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.

## SEE ALSO

ttyname(3C).

## NAME

ctime, localtime, gmtime, asctime, tzset – convert date and time to string

## SYNOPSIS

```
#include <sys/types.h>
#include <time.h>

char *ctime (clock)
time_t *clock;

struct tm *localtime (clock)
time_t *clock;

struct tm *gmtime (clock)
time_t *clock;

char *asctime (tm)
struct tm *tm;

extern long timezone;

extern int daylight;

extern char *tzname[2];

void tzset ( )
```

## DESCRIPTION

*ctime* converts a long integer, pointed to by *clock*, representing the time in seconds since 00:00:00 GMT, January 1, 1970, and returns a pointer to a 26-character string in the following form. All the fields have constant width.

```
Sun Sep 16 01:03:52 1985\n\0
```

*Localtime* and *gmtime* return pointers to "tm" structures, described below. *Localtime* corrects for the time zone and possible Daylight Savings Time; *gmtime* converts directly to Greenwich Mean Time (GMT), which is the time the UNIX system uses.

*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 (0 - 59) */
        int tm_min;        /* minutes (0 - 59) */
        int tm_hour;       /* hours (0 - 23) */
        int tm_mday;       /* day of month (1 - 31) */
        int tm_mon;        /* month of year (0 - 11) */
        int tm_year;       /* year – 1900 */
        int tm_wday;       /* day of week (Sunday = 0) */
        int tm_yday;       /* day of year (0 - 365) */
        int tm_isdst;
};
```

*Tm_isdst* is non-zero if Daylight Savings Time is in effect.

The external **long** variable *timezone* contains the difference, in seconds, between GMT and local standard time (in EST, *timezone* is 5*60*60); the external variable *daylight* is non-zero if and only if the standard U.S.A. Daylight Savings Time conversion should be applied. The program knows about the peculiarities of this conversion in 1974 and 1975; if necessary, a table for these years can be extended.

If an environment variable named **TZ** is present, *asctime* uses the contents of the variable to override the default time zone. The value of **TZ** must be a three-letter time zone name, followed by a number representing the difference between local time and Greenwich Mean Time in hours, followed by an optional three-letter name for a daylight time zone. For example, the setting for New Jersey would be **EST5EDT**. The effects of setting **TZ** are thus to change the values of the external variables *timezone* and *daylight*; in addition, the time zone names contained in the external variable

```
char *tzname[2] = { "EST", "EDT" };
```

are set from the environment variable **TZ**. The function *tzset* sets these external variables from **TZ**; *tzset* is called by *asctime* and may also be called explicitly by the user.

Note that in most installations, **TZ** is set by default when the user logs on, to a value in the local /etc/profile file [see *profile*(4)].

## SEE ALSO

time(2), getenv(3C), profile(4), environ(5).

## CAVEAT

The return values point to static data whose content is overwritten by each call.

## NAME

ctype: isalpha, isupper, islower, isdigit, isxdigit, isalnum, isspace, ispunct, isprint, isgraph, iscntrl, isascii − classify characters

## SYNOPSIS

```
#include <ctype.h>

int isalpha (c)
int c;

. . .
```

## DESCRIPTION

These macros classify character-coded integer values by table lookup. Each is a predicate returning nonzero for true, zero for false. *Isascii* is defined on all integer values; the rest are defined only where *isascii* is true and on the single non-ASCII value **EOF** [−1; see *stdio*(3S)].

| | |
|---|---|
| *isalpha* | *c* is a letter. |
| *isupper* | *c* is an upper-case letter. |
| *islower* | *c* is a lower-case letter. |
| *isdigit* | *c* is a digit [0-9]. |
| *isxdigit* | *c* is a hexadecimal digit [0-9], [A-F] or [a-f]. |
| *isalnum* | *c* is an alphanumeric (letter or digit). |
| *isspace* | *c* is a space, tab, carriage return, newline, vertical tab, or form-feed. |
| *ispunct* | *c* is a punctuation character (neither control nor alphanumeric). |
| *isprint* | *c* is a printing character, code 040 (space) through 0176 (tilde). |
| *isgraph* | *c* is a printing character, like *isprint* except false for space. |
| *iscntrl* | *c* is a delete character (0177) or an ordinary control character (less than 040). |
| *isascii* | *c* is an ASCII character, code less than 0200. |

## SEE ALSO

stdio(3S), ascii(5).

## DIAGNOSTICS

If the argument to any of these 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 (s)**
**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.

## 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]*.

## SEE ALSO

getlogin(3C), getpwent(3C).

## NAME

dial – establish an out-going terminal line connection

## SYNOPSIS

**#include <dial.h>**

**int dial (call)**
**CALL call;**

**void undial (fd)**
**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;    /*Will hold the name of the device used
                                  to make a connection */
        int           dev_len;    /* The length of the device used to make
                                  connection */
} 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 secound 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** 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 *L-devices* file. In this case, the value of the *baud* element need not be specified as it will be determined from the *L-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 symbols described on the *acu*(7). The termination symbol will be supplied by the *dial* function, and should not be included in the *telno* string passed to *dial* in the CALL structure.

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 is often important for certain attributes such as parity and baud-rate.

The CALL element *device* is used to hold the device name (cul..) that establishes the connection.

The CALL element *dev_len* is the length of the device name that is copied into the array device.

## FILES

/usr/lib/uucp/L-devices
/usr/spool/uucp/LCK..*tty-device*

## SEE ALSO

alarm(2), read(2), write(2).
acu(7), 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 LDEVS 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 */
```

## WARNINGS

The *dial* (3C) library function is not compatible with Basic Networking Utilities on UNIX System V Release 2.0.

Including the **<dial.h>** header file automatically includes the **<termio.h>** header file.

The above routine uses **<stdio.h>**, which causes it to increase the size of programs, not otherwise using standard I/O, more than might be expected.

## BUGS

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 *read*s should be checked for **(errno==EINTR)**, and the *read* possibly reissued.

## NAME

drand48, erand48, lrand48, nrand48, mrand48, jrand48, srand48, seed48, lcong48 — generate uniformly distributed pseudo-random numbers

## SYNOPSIS

```
double drand48 ( )

double erand48 (xsubi)
unsigned short xsubi[3];

long lrand48 ( )

long nrand48 (xsubi)
unsigned short xsubi[3];

long mrand48 ( )

long jrand48 (xsubi)
unsigned short xsubi[3];

void srand48 (seedval)
long seedval;

unsigned short *seed48 (seed16v)
unsigned short seed16v[3];

void lcong48 (param)
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

$$X_{n+1} = (aX_n + c)_{\text{mod } m} \qquad n \geqslant 0.$$

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

$$a = \text{5DEECE66D}_{16} = 273673163155_8$$

$c = B_{16} = 13_8$.

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, and 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.

## NOTES

The source code for the portable version can be used on computers which do not have floating-point arithmetic. In such a situation, functions *drand48* and *erand48* are replaced by the two new functions below.

**long irand48 (m)**
**unsigned short m;**

**long krand48 (xsubi, m)**
**unsigned short xsubi[3], m;**

Functions *irand48* and *krand48* return non-negative long integers uniformly distributed over the interval $[0, m-1]$.

## SEE ALSO

rand(3C).

## NAME

dup2 − duplicate an open file descriptor

## SYNOPSIS

**int dup2 (fildes, fildes2)**
**int fildes, fildes2;**

## DESCRIPTION

*Fildes* is a file descriptor referring to an open file, and *fildes2* is a non-negative integer less than NOFILES. *dup2* causes *fildes2* to refer to the same file as *fildes*. If *fildes2* already referred to an open file, it is closed first.

*dup2* will fail if one or more of the following are true:

| | |
|---|---|
| [EBADF] | *Fildes* is not a valid open file descriptor. |
| [EMFILE] | NOFILES file descriptors are currently open. |

## SEE ALSO

creat(2), close(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

ecvt, fcvt, gcvt — convert floating-point number to string

## SYNOPSIS

```
char *ecvt (value, ndigit, decpt, sign)
double value;
int ndigit, *decpt, *sign;

char *fcvt (value, ndigit, decpt, sign)
double value;
int ndigit, *decpt, *sign;

char *gcvt (value, ndigit, buf)
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" (FORTRAN F-format) 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 FORTRAN F-format if possible, otherwise E-format, 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).

## BUGS

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 end;**
**extern etext;**
**extern edata;**

## DESCRIPTION

These names refer neither to routines nor to locations with interesting contents. The address of *etext* is the first address above the program text, *edata* above the initialized data region, and *end* above the uninitialized data region.

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 of *brk*(2), *malloc*(3C), standard input/output [*stdio*(3S)], the profile (−**p**) option of *cc*(1), and so on. Thus, the current value of the program break should be determined by **sbrk (char *)(0)** [see *brk*(2)].

## SEE ALSO

cc(1), brk(2), malloc(3C), stdio(3S).

## NAME

fclose, fflush – close or flush a stream

## SYNOPSIS

**#include <stdio.h>**

**int fclose (stream)**
**FILE *stream;**

**int fflush (stream)**
**FILE *stream;**

## DESCRIPTION

*fclose* causes any buffered data for the named *stream* to be written out, and the *stream* to be closed.

*fclose* is performed automatically for all open files upon calling *exit*(2).

*Fflush* causes any buffered data for the named *stream* to be written to that file. The *stream* remains open.

## SEE ALSO

close(2), exit(2), fopen(3S), setbuf(3S), stdio(3S).

## DIAGNOSTICS

These functions return 0 for success, and **EOF** if any error (such as trying to write to a file that has not been opened for writing) was detected.

## NAME

ferror, feof, clearerr, fileno — stream status inquiries

## SYNOPSIS

**#include <stdio.h>**

**int ferror (stream)**
**FILE *stream;**

**int feof (stream)**
**FILE *stream;**

**void clearerr (stream)**
**FILE *stream;**

**int fileno (stream)**
**FILE *stream;**

## DESCRIPTION

*ferror* returns non-zero when an I/O error has previously occurred reading from or writing to the named *stream,* 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).

## NOTES

All these functions are implemented as macros; they cannot be declared or redeclared.

## SEE ALSO

open(2), fopen(3S), stdio(3S).

## NAME

fopen, freopen, fdopen – open a stream

## SYNOPSIS

```
#include <stdio.h>

FILE *fopen (filename, type)
char *filename, *type;

FILE *freopen (filename, type, stream)
char *filename, *type;
FILE *stream;

FILE *fdopen (fildes, type)
int fildes;
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 having one of the following values:

| | |
|---|---|
| "r" | open for reading |
| "w" | truncate or create for writing |
| "a" | append; open for writing at end of file, or create for writing |
| "r+" | open for update (reading and writing) |
| "w+" | truncate or create for update |
| "a+" | append; open or create for update at end-of-file |

*Freopen* substitutes the named file in place of the open *stream*. The original *stream* is closed, regardless of whether the open ultimately succeeds. *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.

*Fdopen* associates a *stream* with a file descriptor. File descriptors are obtained from *open*, *dup*, *creat*, or *pipe*(2), which open files but do not return pointers to a FILE structure *stream*. Streams are necessary input for many of the Section 3S library routines. The *type* of *stream* must agree with the mode of the open file.

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 *fseek* or *rewind*, and input may not be directly followed by output without an intervening *fseek*, *rewind*, or an input operation which encounters end-of-file.

When a file is opened for append (i.e., when *type* is "a" or "a+"), 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.

## SEE ALSO

creat(2), dup(2), open(2), pipe(2), fclose(3S), fseek(3S), stdio(3S).

## DIAGNOSTICS

*fopen*, *fdopen*, and *freopen* return a NULL pointer on failure.

## NAME

fpgetround, fpsetround, fpgetmask, fpsetmask, fpgetsticky, fpsetsticky – IEEE floating point environment control

## SYNOPSIS

```
#include <ieeefp.h>

typedef enum {
        FP_RN=0,    /* round to nearest */
        FP_RP,      /* round to plus */
        FP_RM,      /* round to minus */
        FP_RZ,      /* round to zero (truncate) */
        } fp_rnd;

        fp_rnd fpgetround();

        fp_rnd fpsetround(rnd_dir)
        fp_rnd rnd_dir;

        #define         fp_except       int
        #define FP_X_INV        0x10    /* invalid operation exception*/
        #define FP_X_OFL        0x08    /* overflow exception*/
        #define FP_X_UFL        0x04    /* underflow exception*/
        #define FP_X_DZ         0x02    /* divide-by-zero exception*/
        #define FP_X_IMP        0x01    /* imprecise (loss of precision)*/

        fp_except fpgetmask();

        fp_except fpsetmask(mask);
        fp_except mask;

        fp_except fpgetsticky();

        fp_except fpsetsticky(sticky);
        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.

*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 on the 3B computer family is:

> Rounding mode set to nearest(FP_RN),
> Divide-by-zero,
> Floating point overflow, and
> Invalid operation traps enabled.

## SEE ALSO

isnan(3C).

## WARNINGS

*fpsetsticky*() modifies all sticky flags. *fpsetmask*() changes all mask bits.

Both C and F77 require truncation (round to zero) for floating point to integral conversions. The current rounding mode has no effect on these conversions.

## CAVEATS

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.

For the same reason, when calling *fpsetmask*() the user should make sure that the sticky bit corresponding to the exception being enabled is cleared.

## NAME

fread, fwrite – binary input/output

## SYNOPSIS

```
#include <stdio.h>
#include <sys/types.h>

int fread (ptr, size, nitems, stream)
char *ptr;
int nitems;
size_t size;
FILE *stream;

int fwrite (ptr, size, nitems, stream)
char *ptr;
int nitems;
size_t size;
FILE *stream;
```

## DESCRIPTION

*fread* copies, into an array pointed to by *ptr, nitems* items of data from the named input *stream,* where an item of data is a sequence of bytes (not necessarily terminated by a null byte) of length *size*. *fread* stops appending bytes if an end-of-file or error condition is encountered while reading *stream,* or if *nitems* items have been read. *fread* leaves the file pointer in *stream,* if defined, pointing to the byte following the last byte read if there is one. *fread* does not change the contents of *stream*.

*fwrite* appends at most *nitems* items of data from the array pointed to by *ptr* to the named output *stream*. *fwrite* stops appending when it has appended *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*.

The argument *size* is typically *sizeof(*ptr)* where the pseudo-function *sizeof* specifies the length of an item pointed to by *ptr*. If *ptr* points to a data type other than *char* it should be cast into a pointer to *char*.

## SEE ALSO

read(2), write(2), fopen(3S), getc(3S), gets(3S), printf(3S), putc(3S), puts(3S), scanf(3S), stdio(3S).

## DIAGNOSTICS

*fread* and *fwrite* return the number of items read or written. If *nitems* is non-positive, no characters are read or written and 0 is returned by both *fread* and *fwrite*.

## NAME

frexp, ldexp, modf – manipulate parts of floating-point numbers

## SYNOPSIS

```
double frexp (value, eptr)
double value;
int *eptr;

double ldexp (value, exp)
double value;
int exp;

double modf (value, iptr)
double value, *iptr;
```

## DESCRIPTION

Every non-zero number can be written uniquely as $x * 2^n$, where the "mantissa" (fraction) $x$ is in the range $0.5 \leqslant |x| < 1.0$, 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* returns the quantity $value * 2^{exp}$.

*Modf* returns the signed fractional part of *value* and stores the integral part indirectly in the location pointed to by *iptr*.

## 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**.

## NAME

fseek, rewind, ftell – reposition a file pointer in a stream

## SYNOPSIS

**#include <stdio.h>**

**int fseek (stream, offset, ptrname)**
**FILE *stream;**
**long offset;**
**int ptrname;**

**void rewind (stream)**
**FILE *stream;**

**long ftell (stream)**
**FILE *stream;**

## DESCRIPTION

*fseek* sets the position of the next input or output operation on the *stream*. 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 as *ptrname* has the value 0, 1, or 2.

*Rewind*(*stream*) is equivalent to *fseek*(*stream*, 0L, 0), except that no value is returned.

*fseek* and *rewind* undo any effects of *ungetc*(3S).

After *fseek* or *rewind*, the next operation on a file opened for update may be either input or output.

*Ftell* returns the offset of the current byte relative to the beginning of the file associated with the named *stream*.

## SEE ALSO

lseek(2), fopen(3S), popen(3S), stdio(3S), ungetc(3S).

## DIAGNOSTICS

*fseek* returns non-zero 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*(3S).

## WARNING

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

ftw − walk a file tree

## SYNOPSIS

**#include <ftw.h>**

**int ftw (path, fn, depth)**
**char *path;**
**int (*fn) ( );**
**int depth;**

## DESCRIPTION

*ftw* recursively descends the directory hierarchy rooted in *path*. For each object in the hierarchy, *ftw* calls *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 for a file, FTW_D for a directory, FTW_DNR for a directory that cannot be read, and FTW_NS for an object for which *stat* could not successfully be executed. If the integer is FTW_DNR, descendants of that directory will not be processed. If the integer is FTW_NS, the **stat** structure will contain garbage. An example of an object that would cause FTW_NS to be passed to *fn* would be a file in a directory with read but without execute (search) permission.

*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, 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.

## SEE ALSO

stat(2), malloc(3C).

## BUGS

Because *ftw* is recursive, it is possible for it to terminate with a memory fault when applied to very deep file structures.

## CAVEAT

*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 (stream)**
**FILE *stream;**

**int getchar ()**

**int fgetc (stream)**
**FILE *stream;**

**int getw (stream)**
**FILE *stream;**

## DESCRIPTION

*getc* returns the next character (i.e., byte) from the named input *stream,* as an integer. 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).

## DIAGNOSTICS

These functions return the constant **EOF** at end-of-file or upon an error. Because **EOF** is a valid integer, *ferror*(3S) should be used to detect *getw* errors.

## WARNING

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 machine-dependent.

## CAVEATS

Because it is implemented as a macro, *getc* evaluates a *stream* argument more than once. In particular, **getc(*f++)** does not work sensibly. *Fgetc* 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.

## NAME

getcwd − get path-name of current working directory

## SYNOPSIS

**char *getcwd (buf, size)**
**char *buf;**
**int size;**

## DESCRIPTION

*getcwd* returns a pointer to the current directory path name. The value of *size* must be at least two greater than the length of the path-name to be returned.

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*.

The function is implemented by using *popen*(3S) to pipe the output of the *pwd*(1) command into the specified string space.

## EXAMPLE

```
void exit(), perror();
 .
 .
 .
if ((cwd = getcwd((char *)NULL, 64)) == NULL) {
        perror("pwd");
        exit(2);
}
printf("%s\n", cwd);
```

## SEE ALSO

malloc(3C), popen(3S).
pwd(1) in the *User's Reference Manual.*

## 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

**char *getenv (name)**
**char *name;**

## DESCRIPTION

*getenv* searches the environment list [see *environ*(5)] for a string of the form *name=value*, and returns a pointer to the *value* in the current environment if such a string is present, otherwise 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 ( )

struct group *getgrgid (gid)
int gid;

struct group *getgrnam (name)
char *name;

void setgrent ( )

void endgrent ( )

struct group *fgetgrent (f)
FILE *f;
```

## DESCRIPTION

*getgrent*, *getgrgid* and *getgrnam* each return pointers to an object with the following structure 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.

```
struct group {
        char    *gr_name;    /* the name of the group */
        char    *gr_passwd;  /* the encrypted group password */
        int     gr_gid;      /* the numerical group ID */
        char    **gr_mem;    /* vector of pointers to member names */
};
```

*getgrent* when first called 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).

## DIAGNOSTICS
A **NULL** pointer is returned on **EOF** or error.

## WARNING
The above routines use **<stdio.h>**, which causes them to increase the size of programs, not otherwise using standard I/O, more than might be expected.

## CAVEAT
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

**char *getlogin ( );**

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 *name* is not found.

CAVEAT

The return values point to static data whose content is overwritten by each call.

NAME

getopt – get option letter from argument vector

SYNOPSIS

**int getopt (argc, argv, optstring)**
**int argc;**
**char **argv, *opstring;**

**extern char *optarg;**
**extern int optind, opterr;**

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)). So all new commands will adhere to the command syntax standard, they should use *getopts*(1) or *getopt*(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 must 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 **–1**. The special option "––" may be used to delimit the end of the options; when it is encountered, **–1** will be returned, and "––" will be skipped.

DIAGNOSTICS

*getopt* prints an error message on standard error and returns a question mark (**?**) when it encounters an option letter not included in *optstring* or no option-argument after an option that expects one. This error message may be disabled by setting **opterr** to **0**.

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 option-argument:

```
main (argc, argv)
int argc;
char **argv;
{
      int c;
      extern char *optarg;
      extern int optind;
      .
      .
      .
```

```
        while ((c = getopt(argc, argv, "abo:")) != -1)
             switch (c) {
             case 'a':
                  if (bflg)
                       errflg++;
                  else
                       aflg++;
                  break;
             case 'b':
                  if (aflg)
                       errflg++;
                  else
                       bproc( );
                  break;
             case 'o':
                  ofile = optarg;
                  break;
             case '?':
                  errflg++;
             }
        if (errflg) {
             (void)fprintf(stderr, "usage: . . . ");
             exit (2);
        }
        for ( ; optind < argc; optind++) {
             if (access(argv[optind], 4)) {
        .
        .
        .
   }
```

This code will accept any of the following as equivalent:

```
        cmd -a -b -o "xxx z yy" file
        cmd -a -b -o "xxx z yy" -- file
        cmd -ab -o xxx,z,yy file
        cmd -ab -o "xxx z yy" file
        cmd -o xxx,z,yy -b -a file
```

WARNING

Although the following command syntax rule (see *intro*(1)) relaxations are permitted under the current implementation, they should not be used because they may not be supported in future releases of the system. As in the **EXAMPLE** section above, **a** and **b** are options, and the option **o** requires an option-argument:

`cmd −aboxxx file` (Rule 5 violation: options with option-arguments must not be grouped with other options)

`cmd −ab −oxxx file` (Rule 6 violation: there must be white space after an option that takes an option-argument)

Changing the value of the variable **optind**, or calling *getopt* with different values of *argv*, may lead to unexpected results.

SEE ALSO

getopts(1), intro(1) in the *User's Reference Manual*.

## NAME

getpass − read a password

## SYNOPSIS

**char *getpass (prompt)**
**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

## WARNING

The above routine uses **<stdio.h>**, which causes it to increase the size of programs not otherwise using standard I/O, more than might be expected.

## CAVEAT

The return value points to static data whose content is overwritten by each call.

## NAME

getpw − get name from UID

## SYNOPSIS

**int getpw (uid, buf)**
**int 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).

## DIAGNOSTICS

*getpw* returns non-zero on error.

## WARNING

The above routine uses **<stdio.h>**, which causes it to increase, more than might be expected, the size of programs not otherwise using standard I/O.

## NAME

getpwent, getpwuid, getpwnam, setpwent, endpwent, fgetpwent – get password file entry

## SYNOPSIS

```
#include <pwd.h>

struct passwd *getpwent ( )

struct passwd *getpwuid (uid)
int uid;

struct passwd *getpwnam (name)
char *name;

void setpwent ( )

void endpwent ( )

struct passwd *fgetpwent (f)
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;
        int     pw_uid;
        int     pw_gid;
        char    *pw_age;
        char    *pw_comment;
        char    *pw_gecos;
        char    *pw_dir;
        char    *pw_shell;
};
```

This structure is declared in <*pwd.h*> so it is not necessary to redeclare it.

The fields have meanings described in *passwd*(4).

*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).

DIAGNOSTICS

A **NULL** pointer is returned on **EOF** or error.

WARNING

The above routines use **<stdio.h>**, which causes them to increase the size of programs, not otherwise using standard I/O, more than might be expected.

CAVEAT

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 (s)
char *s;

char *fgets (s, n, stream)
char *s;
int n;
FILE *stream;
```

## DESCRIPTION

*gets* reads characters from the standard input stream, *stdin,* into the array pointed to by *s*, until a new-line character is read or an end-of-file condition is encountered. The new-line 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 new-line character is read and transferred to *s*, or an end-of-file condition is encountered. The string is then terminated with a null character.

## SEE ALSO

ferror(3S), fopen(3S), fread(3S), getc(3S), scanf(3S), stdio(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. Otherwise *s* is returned.

## NAME

getut: getutent, getutid, getutline, pututline, setutent, endutent, utmpname − access utmp file entry

## SYNOPSIS

**#include <utmp.h>**

**struct utmp *getutent ( )**

**struct utmp *getutid (id)**
**struct utmp *id;**

**struct utmp *getutline (line)**
**struct utmp *line;**

**void pututline (utmp)**
**struct utmp *utmp;**

**void setutent ( )**

**void endutent ( )**

**void utmpname (file)**
**char *file;**

## DESCRIPTION

*getutent, getutid* and *getutline* each return a pointer to a structure of the following type:

```
struct utmp {
        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 {
           short     e_termination;   /* Process termination status */
           short     e_exit;          /* Process exit status */
        } ut_exit;                    /* The exit status of a process
                                       * marked as DEAD_PROCESS. */
        time_t    ut_time;            /* time entry was made */
};
```

*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 which 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.

*Setutent* resets the input stream to the beginning of the file. This 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.

## 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. Each call to either *getutid* or *getutline* sees the routine examine 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 after each success, or *getutline* would just return the same pointer over and over again. There is one exception to the rule about removing 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 (item, action)**
ENTRY **item;**
ACTION **action;**

**int hcreate (nel)**
**unsigned nel;**

**void hdestroy ( )**

## 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. *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 character should be cast to pointer-to-character.) *Action* is a member of an enumeration type ACTION 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. **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*.

## NOTES

*hsearch* uses *open addressing* with a *multiplicative* hash function. However, its source code has many other options available which the user may select by compiling the *hsearch* source with the following symbols defined to the preprocessor:

**DIV** Use the *remainder modulo table size* as the hash function instead of the multiplicative algorithm.

**USCR** Use a User Supplied Comparison Routine for ascertaining table membership. The routine should be named *hcompar* and should behave in a mannner similar to *strcmp* [see *string*(3C)].

**CHAINED** Use a linked list to resolve collisions. If this option is selected, the following other options become available.

**START** Place new entries at the beginning of the linked list (default is at the end).

**SORTUP** Keep the linked list sorted by key in ascending order.

**SORTDOWN** Keep the linked list sorted by key in descending order.

Additionally, there are preprocessor flags for obtaining debugging printout (**−DDEBUG**) and for including a test driver in the calling routine (**−DDRIVER**). The source code should be consulted for further details.

## 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>

struct info {           /* this is the info stored in the 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, *hsearch( );
        /* 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 = (char *)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)
                    }
                }
        }
```

## 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.

## WARNING

*hsearch* and *hcreate* use *malloc*(3C) to allocate space.

## CAVEAT

Only one hash search table may be active at any given time.

## NAME

isnan: isnand, isnanf – test for floating point NaN (Not-A-Number)

## SYNOPSIS

**#include <ieeefp.h>**

**int isnand (dsrc)**
**double dsrc;**

**int isnanf (fsrc)**
**float fsrc;**

## DESCRIPTION

*isnand and isnanf* return true (1) if the argument dsrc or fsrc is a NaN; otherwise they return false (0).

Neither routine generates any exception, even for signaling NaNs.

*isnanf()* is implemented as a macro included in <ieeefp.h>.

## SEE ALSO

fpgetround(3C).

## NAME

l3tol, ltol3 − convert between 3-byte integers and long integers

## SYNOPSIS

```
void l3tol (lp, cp, n)
long *lp;
char *cp;
int n;

void ltol3 (cp, lp, n)
char *cp;
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).

## CAVEAT

Because of possible differences in byte ordering, the numerical values of the long integers are machine-dependent.

## NAME

lockf – record locking on files

## SYNOPSIS

**#include <unistd.h>**

**int lockf (fildes, function, size)**
**long size;**
**int fildes, function;**

## DESCRIPTION

The *lockf* command will allow 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 which 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 lock with this function call.

*Function* is a control value which specifies the action to be taken. The permissible values for *function* are defined in **<unistd.h>** as follows:

```
#define   F_ULOCK   0   /* Unlock a previously locked section */
#define   F_LOCK    1   /* Lock a section for exclusive use */
#define   F_TLOCK   2   /* Test and lock a section for exclusive use */
#define   F_TEST    3   /* Test section for other processes 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 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. When this occurs, or if adjacent sections occur, 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] error 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 [EDEADLK] error is returned and the requested section is not released.

A potential for deadlock occurs if a process controlling a locked resource is put to sleep by accessing 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*(2) command may be used to provide a timeout facility in applications which require this facility.

The *lockf* utility will fail if one or more of the following are true:

[EBADF]
: *Fildes* is not a valid open descriptor.

[EACCES]
: *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. Also the *cmd* is either 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
chmod(2), close(2), creat(2), fcntl(2), intro(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.

## WARNINGS
Unexpected results may occur in processes that do buffering in the user address space. The process may later read/write data which 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 <stdio.h>**
**#include <search.h>**

**char *lsearch ((char *)key, (char *)base, nelp, sizeof(*key), compar)**
**unsigned *nelp;**
**int (*compar)( );**

**char *lfind ((char *)key, (char *)base, nelp, sizeof(*key), compar)**
**unsigned *nelp;**
**int (*compar)( );**

## 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. **Compar** is the name of the comparison function which 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 should be of type pointer-to-element, and cast to type pointer-to-character.
The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.
Although declared as type pointer-to-character, the value returned should be cast into type pointer-to-element.

## EXAMPLE

This fragment will read in less than TABSIZE strings of length less than ELSIZE and store them in a table, eliminating duplicates.

```
#include <stdio.h>
#include <search.h>

#define TABSIZE 50
#define ELSIZE 120

        char line[ELSIZE], tab[TABSIZE][ELSIZE], *lsearch( );
        unsigned nel = 0;
        int strcmp( );
        . . .
```

```
while (fgets(line, ELSIZE, stdin) != NULL &&
   nel < TABSIZE)
        (void) lsearch(line, (char *)tab, &nel,
                    ELSIZE, strcmp);
. . .
```

SEE ALSO

bsearch(3C), hsearch(3C), string(3C), tsearch(3C).

DIAGNOSTICS

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.

BUGS

Undefined results can occur if there is not enough room in the table to add a new item.

## NAME

malloc, free, realloc, calloc – main memory allocator

## SYNOPSIS

**char *malloc (size)**
**unsigned size;**

**void free (ptr)**
**char *ptr;**

**char *realloc (ptr, size)**
**char *ptr;**
**unsigned size;**

**char *calloc (nelem, elsize)**
**unsigned nelem, 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;* after *free* is performed this space is made available for further allocation, but its contents are left undisturbed.

Undefined results will occur if the space assigned by *malloc* is overrun or if some random number is handed to *free.*

*malloc* allocates the first big enough contiguous reach of free space found in a circular search from the last block allocated or freed, coalescing adjacent free blocks as it searches. It calls *sbrk* [see *brk*(2)] to get more memory from the system when there is no suitable space already 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 no free block of *size* bytes is available in the storage arena, then *realloc* will ask *malloc* to enlarge the arena by *size* bytes and will then move the data to the new space.

*Realloc* also works if *ptr* points to a block freed since the last call of *malloc, realloc,* or *calloc;* thus sequences of *free, malloc* and *realloc* can exploit the search strategy of *malloc* to do storage compaction.

*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.

## SEE ALSO

brk(2), malloc(3X).

## DIAGNOSTICS

*malloc, realloc* and *calloc* return a NULL pointer if there is no available memory or if the arena has been detectably corrupted by storing outside the bounds of a block. When this happens the block pointed to by *ptr* may be destroyed.

## NOTES

Search time increases when many objects have been allocated; that is, if a program allocates but never frees, then each successive allocation takes longer. For an alternate, more flexible implementation, see *malloc*(3X).

## NAME

memory: memccpy, memchr, memcmp, memcpy, memset – memory operations

## SYNOPSIS

```
#include <memory.h>

char *memccpy (s1, s2, c, n)
char *s1, *s2;
int c, n;

char *memchr (s, c, n)
char *s;
int c, n;

int memcmp (s1, s2, n)
char *s1, *s2;
int n;

char *memcpy (s1, s2, n)
char *s1, *s2;
int n;

char *memset (s, c, n)
char *s;
int c, n;
```

## DESCRIPTION

These functions operate as efficiently as possible on memory areas (arrays of characters bounded by a count, not terminated by a null character). They do not check for the overflow of any receiving memory area.

*Memccpy* copies characters from memory area **s2** into **s1**, stopping after the first occurrence of character **c** has been copied, or after **n** characters have been copied, whichever comes first. It returns a pointer to the character after the copy of **c** in **s1**, or a NULL pointer if **c** was not found in the first **n** characters of **s2**.

*Memchr* returns a pointer to the first occurrence of character **c** in the first **n** characters of memory area **s**, or a NULL pointer if **c** does not occur.

*Memcmp* compares its arguments, looking at the first **n** characters only, 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**.

*Memcpy* copies **n** characters from memory area **s2** to **s1**. It returns **s1**.

*Memset* sets the first **n** characters in memory area **s** to the value of character **c**. It returns **s**.

For user convenience, all these functions are declared in the optional <*memory.h*> header file.

## CAVEATS

*Memcmp* is implemented by using the most natural character comparison on the machine. Thus the sign of the value returned when one of the characters has its high order bit set is not the same in all implementations and should not be relied upon.

Character movement is performed differently in different implementations. Thus overlapping moves may yield surprises.

## NAME

mktemp − make a unique file name

## SYNOPSIS

**char *mktemp (template)**
**char *template;**

## DESCRIPTION

*mktemp* replaces the contents of the string pointed to by *template* by a unique file name, and returns the address of *template*. The string in *template* should look like a file name with six trailing **X**s; *mktemp* will replace the **X**s with a letter and the current process ID. The letter will be chosen so that the resulting name does not duplicate an existing file.

## SEE ALSO

getpid(2), tmpfile(3S), tmpnam(3S).

## DIAGNOSTIC

*mktemp* will assign to *template* the NULL string if it cannot create a unique name.

## CAVEAT

If called more than 17,576 time in a single process, this function will start recycling previously used names.

## NAME

monitor – prepare execution profile

## SYNOPSIS

```
#include <mon.h>

void monitor (lowpc, highpc, buffer, bufsize, nfunc)
int (*lowpc)( ), (*highpc)( );
WORD *buffer;
int bufsize, nfunc;
```

## DESCRIPTION

An executable program created by **cc –p** automatically includes calls for *monitor* with default parameters; *monitor* need not be called explicitly except to gain fine control over profiling.

*monitor* is an interface to *profil*(2). *Lowpc* and *highpc* are the addresses of two functions; *buffer* is the address of a (user supplied) array of *bufsize* WORDs (defined in the <*mon.h*> header file). *monitor* arranges to record a histogram of periodically sampled values of the program counter, and of counts of calls of certain functions, in the buffer. The lowest address sampled is that of *lowpc* and the highest is just below *highpc*. *Lowpc* may not equal 0 for this use of *monitor*. At most *nfunc* call counts can be kept; only calls of functions compiled with the profiling option **–p** of *cc*(1) are recorded.

For the results to be significant, especially where there are small, heavily used routines, it is suggested that the buffer be no more than a few times smaller than the range of locations sampled.

To profile the entire program, it is sufficient to use

```
extern etext;
...
monitor ((int (*)())2, &etext, buf, bufsize, nfunc);
```

*Etext* lies just above all the program text; see *end*(3C).

To stop execution monitoring and write the results, use

```
monitor ((int (*)())0, 0, 0, 0, 0);
```

*Prof*(1) can then be used to examine the results.

The name of the file written by *monitor* is controlled by the environment variable PROFDIR. If PROFDIR does not exist, "mon.out" is created in the current directory. If PROFDIR exists but has no value, *monitor* does not do any profiling and creates no output file. Otherwise, the value of PROFDIR is used as the name of the directory in which to create the output file. If PROFDIR is *dirname*, then the file written is "*dirname*/*pid*.mon.out" where *pid* is the program's process id. (When *monitor* is called automatically by compiling via **cc –p**, the file created is "*dirname*/*pid.progname*" where *progname* is the name of the program.)

## FILES

mon.out

## SEE ALSO

cc(1), prof(1), profil(2), end(3C).

## BUGS

The *"dirname/pid*.mon.out" form does not work; the *"dirname/pid.progname"* form (automatically called via **cc −p**) does work.

## NAME

nlist – get entries from name list

## SYNOPSIS

**#include <nlist.h>**

**int nlist (filename, nl)**
**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 and value of the name are inserted in the next two fields. The type field will be set to 0 unless the file was compiled with the −g option. If the name is not found, both entries are set to 0. See *a.out*(4) for a discussion of the symbol table structure.

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.

## NOTES

The <*nlist.h*> header file is automatically included by <*a.out.h*> for compatability. However, if the only information needed from <*a.out.h*> is for use of *nlist*, then including <*a.out.h*> is discouraged. If <*a.out.h*> is included, the line "#undef n_name" may need to follow it.

## 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 −1 upon error; otherwise it returns 0.

## NAME

perror, errno, sys_errlist, sys_nerr — system error messages

## SYNOPSIS

```
void perror (s)
char *s;

extern int errno;

extern char *sys_errlist[ ];

extern int sys_nerr;
```

## DESCRIPTION

*perror* produces a message on the standard error output, 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 new-line. (However, if s="" 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.

To simplify variant formatting of messages, the array of message strings *sys_errlist* is provided; *errno* can be used as an index into this table to get the message string without the new-line. *Sys_nerr* is the number of messages in the table; it should be checked because new error codes may be added to the system before they are added to the table.

## SEE ALSO

intro(2).

## NAME

popen, pclose — initiate pipe to/from a process

## SYNOPSIS

**#include <stdio.h>**

**FILE *popen (command, type)**
**char *command, *type;**

**int pclose (stream)**
**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*; 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

A typical call may be:

```
char *cmd = "ls *.c";
FILE *ptr;
if ((ptr = popen(cmd, "r")) != NULL)
     while (fgets(buf, n, ptr) != NULL)
          (void) printf("%s ",buf);
```

This will print in *stdout* [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 "*popen*ed" command.

## WARNING

If the original and "*popen*ed" processes concurrently read or write a common file, neither should use buffered I/O, because the buffering gets all mixed up. Problems with an output filter may be forestalled by careful buffer flushing, e.g. with *fflush* [see *fclose*(3S)].

## NAME

printf, fprintf, sprintf — print formatted output

## SYNOPSIS

```
#include <stdio.h>

int printf (format , arg ... )
char *format;

int fprintf (stream, format , arg ... )
FILE *stream;
char *format;

int sprintf (s, format [ , arg ] ... )
char *s, *format;
```

## DESCRIPTION

*printf* places output on the standard output stream *stdout*. *Fprintf* places output on the named output *stream*. *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 *arg*s under control of the *format*. The *format* is a character string that contains two types of objects: plain characters, which are simply copied to the output stream, and conversion specifications, each of which results in fetching of zero or more *arg*s. The results are undefined if there are insufficient *arg*s for the format. If the format is exhausted while *arg*s remain, the excess *arg*s are simply ignored.

Each conversion specification is introduced by the character **%**. After the **%**, the following appear in sequence:

Zero or more *flags*, which modify the meaning of the conversion specification.

An optional decimal digit string specifying 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. The padding is with blanks unless the field width digit string starts with a zero, in which case the padding is with zeros.

A *precision* that gives the minimum number of digits to appear for the **d**, **i**, **o**, **u**, **x**, or **X** conversions, the number of digits to appear after the decimal point for the **e**, **E**, and **f** conversions, the maximum number of significant digits for the **g** and **G** conversion, 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 **l** (ell) specifying that a following **d**, **i**, **o**, **u**, **x**, or **X** conversion character applies to a long integer *arg*. An **l** before any other conversion character is ignored.

A character that indicates the type of conversion to be applied.

A field width or precision or both may be indicated by an asterisk (*) instead of a digit string. In this case, an integer *arg* supplies the field width or precision. The *arg* that is actually converted is not fetched until the conversion letter is seen, so the *arg*s specifying field width or precision must appear *before* the *arg* (if any) to be converted. A negative field width argument is taken as a '–' flag followed by a positive field width. If the precision argument is negative, it will be changed to zero.

The flag characters and their meanings are:

| | |
|---|---|
| – | The result of the conversion will be left-justified within the field. |
| + | The result of a signed conversion will always begin with a sign (+ or –). |
| blank | If the first character of a signed conversion is not a sign, a blank will be prefixed to the result. This implies that if the blank and + flags both appear, the blank flag will be ignored. |
| # | This flag specifies that the value is to be converted to an "alternate form." For **c**, **d**, **i**, **s**, and **u** conversions, the flag has no effect. For **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** prefixed to it. For **e**, **E**, **f**, **g**, and **G** conversions, the result will always contain a decimal point, 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 zeroes will *not* be removed from the result (which they normally are). |

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**), decimal (**u**), or hexadecimal notation (**x** or **X**), respectively; the letters **abcdef** are used for **x** conversion and the letters **ABCDEF** for **X** conversion. The precision specifies the minimum number of digits to appear; if the value being converted can be represented in fewer digits, it will be expanded with leading zeroes. The default precision is 1. The result of converting a zero value with a precision of zero is a null string. |
| **f** | The float or double *arg* is converted to decimal notation in the style "[–]ddd.ddd," where the number of digits after the decimal point is equal to the precision specification. If the precision is missing, six digits are output; if the precision is explicitly 0, no decimal point appears. |
| **e,E** | The float or double *arg* is converted in the style "[–]d.ddde±dd," where there is one digit before the decimal point 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, no decimal point appears. The **E** format code will produce a number with **E** instead of **e** introducing the exponent. The exponent always contains at least two digits. |

**g,G** The float or double *arg* is printed in style **f** or **e** (or in style **E** in the case of a **G** format code), with the precision specifying the number of significant digits. The style used depends on the value converted: style **e** will be used only if the exponent resulting from the conversion is less than −4 or greater than the precision. Trailing zeroes are removed from the result; a decimal point appears only if it is followed by a digit.

**c** The character *arg* is printed.

**s** The *arg* is taken to be a string (character pointer) and characters from the string are printed until a null character (\**0**) is encountered or the number of characters indicated by the precision specification is reached. If the precision is missing, it is taken to be infinite, so all characters up to the first null character are printed. A NULL value for *arg* will yield undefined results.

**%** Print a %; no argument is converted.

In printing floating point types (float and double), if the exponent is 0x7FF and the mantissa is not equal to zero, then the output is

    [-]NaN0xdddddddd

where 0xdddddddd is the hexadecimal representation of the leftmost 32 bits of the mantissa. If the mantissa is zero, the output is

    [±]inf.

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 *putc*(3S) had been called.

## EXAMPLES

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 $\pi$ to 5 decimal places:

```
printf("pi = %.5f", 4 * atan(1.0));
```

## SEE ALSO

ecvt(3C), putc(3S), scanf(3S), stdio(3S).

## NAME

putc, putchar, fputc, putw — put character or word on a stream

## SYNOPSIS

```
#include <stdio.h>

int putc (c, stream)
int c;
FILE *stream;

int putchar (c)
int c;

int fputc (c, stream)
int c;
FILE *stream;

int putw (w, stream)
int w;
FILE *stream;
```

## DESCRIPTION

*putc* writes the character *c* onto the output *stream* (at the position where the file pointer, if defined, is pointing). *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* (at the position at which 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

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 will occur if the file *stream* is not open for writing or if the output file cannot grow. Because **EOF** is a valid integer, *ferror*(3S) should be used to detect *putw* errors.

## CAVEATS

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.

## NAME

putenv – change or add value to environment

## SYNOPSIS

**int putenv (string)**
**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*.

## 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.

## WARNINGS

*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 *putenv* with an automatic variable as the argument, 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 (p, f)**
**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.

## WARNING

The above routine uses **<stdio.h>**, which causes it to increase the size of programs, not otherwise using standard I/O, more than might be expected.

## NAME

puts, fputs – put a string on a stream

## SYNOPSIS

**#include <stdio.h>**

**int puts (s)**
**char *s;**

**int fputs (s, stream)**
**char *s;**
**FILE *stream;**

## DESCRIPTION

*puts* writes the null-terminated string pointed to by *s* ,followed by a new-line character, to the standard output stream *stdout.*

*Fputs* writes the null-terminated string pointed to by *s* to the named output *stream*.

Neither function writes the terminating null character.

## SEE ALSO

ferror(3S), fopen(3S), fread(3S), printf(3S), putc(3S), stdio(3S).

## DIAGNOSTICS

Both routines return **EOF** on error. This will happen if the routines try to write on a file that has not been opened for writing.

## NOTES

*puts* appends a new-line character while *fputs* does not.

## NAME

qsort — quicker sort

## SYNOPSIS

**void qsort ((char *) base, nel, sizeof (*base), compar)**
**unsigned nel;**
**int (*compar)( );**

## DESCRIPTION

*qsort* is an implementation of the quicker-sort algorithm. It sorts a table of data in place.

*Base* points to the element at the base of the table. *Nel* is the number of elements in the table. *Compar* is the name of the comparison function, which is called with two arguments that point to the elements being compared. As the function must return an integer less than, equal to, or greater than zero, so must the first argument to be considered be less than, equal to, or greater than the second.

## NOTES

The pointer to the base of the table should be of type pointer-to-element, and cast to type pointer-to-character.
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 order in the output of two items which compare as equal is unpredictable.

## SEE ALSO

bsearch(3C), lsearch(3C), string(3C).
sort(1) in the *User's Reference Manual.*

## NAME

rand, srand – simple random-number generator

## SYNOPSIS

**int rand ( )**

**void srand (seed)**
**unsigned 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 $2^{15}-1$.

*Srand* can be called at any time to reset the random-number generator to a random starting point. The generator is initially seeded with a 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

scanf, fscanf, sscanf – convert formatted input

## SYNOPSIS

**#include <stdio.h>**

**int scanf (format** [ , pointer ] ... **)**
**char *format;**

**int fscanf (stream, format** [ , pointer ] ... **)**
**FILE *stream;**
**char *format;**

**int sscanf (s, format** [ , pointer ] ... **)**
**char *s, *format;**

## DESCRIPTION

*scanf* reads from the standard input stream *stdin*. *Fscanf* reads from the named input *stream*. *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. The results are undefined in there are insufficient *args* for the format. If the format is exhausted while *args* remain, the excess *args* 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) which, except in two cases described below, cause input to be read up to the next non-white-space character.
2. An ordinary character (not %), which must match the next character of the input stream.
3. Conversion specifications, consisting of the character %, an optional assignment suppressing character *, an optional numerical maximum field width, an optional **l** (ell) or **h** indicating the size of the receiving variable, and a conversion code.

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 suppression of assignment provides a way of describing an input field which 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 field width, if specified, is exhausted. For all descriptors except "[" and "c", white space leading an input field is ignored.

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 legal:

| | |
|---|---|
| % | a single % is expected in the input at this point; no assignment is done. |
| **d** | a decimal integer is expected; the corresponding argument should be an integer pointer. |

**u** an unsigned decimal integer is expected; the corresponding argument should be an unsigned integer pointer.

**o** an octal integer is expected; the corresponding argument should be an integer pointer.

**x** a hexadecimal integer is expected; the corresponding argument should be an integer pointer.

**i** an integer is expected; the corresponding argument should be an integer pointer. It will store the value of the next input item interpreted according to C conventions: a leading "0" implies octal; a leading "0x" implies hexadecimal; otherwise, decimal.

**n** stores in an integer argument the total number of characters (including white space) that have been scanned so far since the function call. No input is consumed.

**e,f,g** a floating point number is expected; the next field is converted accordingly and stored through the corresponding argument, which should be a pointer to a *float*. The input format for floating point numbers is an optionally signed string of digits, possibly containing a decimal point, followed by an optional exponent field consisting of an **E** or an **e**, followed by an optional +, −, or space, followed by an integer.

**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** a character is expected; the corresponding argument should be a character pointer. The normal skip over white space is suppressed in this case; to read the next non-space character, use **%1s**. If a field width is given, the corresponding argument should refer to a character array; the indicated number of characters is read.

**[** indicates string data and the normal skip over leading white space is suppressed. The left bracket is followed by a set of characters, which we will call the *scanset*, and a right bracket; the input field is the maximal sequence of input characters consisting entirely of characters in the scanset. The circumflex (^), when it appears as the first character in the scanset, serves as a complement operator and redefines the scanset as the set of all characters *not* contained in the remainder of the scanset string. There are some conventions used in the construction of the scanset. A range of characters 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 dash will also stand for itself whenever it is the first or the last character in the scanset. To include the right square bracket as an element of the scanset, it must appear as the first character (possibly preceded by a circumflex) of the scanset, and in this case it will not be syntactically interpreted as the closing bracket. The corresponding argument must point to a character array large enough to hold the data field and the terminating **\0**, which will be added automatically. At least one character must match for this conversion to be considered successful.

The conversion characters **d**, **u**, **o**, **x** and **i** may be preceded by **l** or **h** to indicate that a pointer to **long** or to **short** rather than to **int** is in the argument list. Similarly, the conversion characters **e**, **f**, and **g** may be preceded by **l** to indicate that a pointer to **double** rather than to **float** is in the argument list. The **l** or **h** modifier is ignored for other conversion characters.

*scanf* conversion terminates at **EOF**, at the end of the control string, or when an input character conflicts with the control string. In the latter case, the offending character is left unread in the input stream.

*scanf* returns the number of successfully matched and assigned input items; this number can be zero in the event of an early conflict between an input character and the control string. If the input ends before the first conflict or conversion, **EOF** is returned.

## EXAMPLES

The call:

```
int 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** . Or:

```
int i, j; float x; char name[50];
(void) scanf("%i%2d%f%*d %[0−9] ", &j, &i, &x, name);
```

with input:

```
011 56789 0123 56a72
```

will assign **9** to *j*, **56** to *i*, **789.0** to *x*, skip **0123**, and place the string **56\0** in *name*. The next call to *getchar* [see *getc*(3S)] will return **a**. Or:

```
int i, j, s, e; char name[50];
(void) scanf("%i %i %n%s%n", &i, &j, &s, name, &e);
```

with input:

```
0x11 0xy johnson
```

will assign **17** to *i*, **0** to *j*, **6** to *s*, will place the string **xy\0** in *name*, and will assign **8** to *e*. Thus, the length of *name* is *e* - *s* = 2 . The next call to *getchar* [see *getc*(3S)] will return a blank.

## SEE ALSO

getc(3S), printf(3S), stdio(3S), strtod(3C), strtol(3C).

## DIAGNOSTICS

These functions return **EOF** on end of input and a short count for missing or illegal data items.

## CAVEATS

Trailing white space (including a new-line) is left unread unless matched in the control string.

## NAME

setbuf, setvbuf − assign buffering to a stream

## SYNOPSIS

```
#include <stdio.h>

void setbuf (stream, buf)
FILE *stream;
char *buf;

int setvbuf (stream, buf, type, size)
FILE *stream;
char *buf;
int type, size;
```

## DESCRIPTION

*setbuf* may be used after a stream 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.

A constant **BUFSIZ**, defined in the **<stdio.h>** header file, tells how big an array is needed:

```
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. The constant **BUFSIZ** in **<stdio.h>** is suggested as a good buffer size. If input/output is unbuffered, *buf* and *size* are ignored.

By default, output to a terminal is line buffered and all other input/output is fully buffered.

## SEE ALSO

fopen(3S), getc(3S), malloc(3C), putc(3S), stdio(3S).

## DIAGNOSTICS

If an illegal value for *type* or *size* is provided, *setvbuf* returns a non-zero value. Otherwise, the value returned will be 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.

## NAME

setjmp, longjmp – non-local goto

## SYNOPSIS

**#include <setjmp.h>**

**int setjmp (env)**
**jmp_buf env;**

**void longjmp (env, val)**
**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* (which must not itself have returned in the interim) had just returned the value *val*. *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 accessible data have values as of the time *longjmp* is called. However, global variables will have the expected values, i.e. those as of the time of the *longjmp* (see example).

## EXAMPLE

```
#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).

## WARNING

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 which has since returned, absolute chaos is guaranteed.

## BUGS

The values of the registers on the second return from *setjmp* are the register values at the time of the first call to *setjmp,* not those at the time of the *longjmp*. This means that variables in a given function may behave differently in the presence of *setjmp,* depending on whether they are register or stack variables.

## NAME

sleep – suspend execution for interval

## SYNOPSIS

**unsigned sleep (seconds)**
**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 for two reasons: (1) Because scheduled wakeups occur at fixed 1-second intervals, (on the second, according to an internal clock) and (2) 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 due to 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 due to 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 till 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).

## NAME

ssignal, gsignal — software signals

## SYNOPSIS

**#include <signal.h>**

**int (*ssignal (sig, action))( )**
**int sig, (*action)( );**

**int gsignal (sig)**
**int sig;**

## DESCRIPTION

*ssignal* and *gsignal* implement a software facility similar to *signal*(2). This facility is used by the Standard C Library to enable users to indicate the disposition of error conditions, and is also made available to users for their own purposes.

Software signals made available to users are associated with integers in the inclusive range 1 through 16. 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).

## NOTES

There are some additional signals with numbers outside the range 1 through 16 which are used by the Standard C Library to indicate error conditions. Thus, some signal numbers outside the range 1 through 16 are legal, although their use may interfere with the operation of the Standard C Library.

## 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*(3S) and *putc*(3S) 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* and is declared to be a pointer to a defined type **FILE**. *Fopen*(3S) 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 |

A constant **NULL** (0) designates a nonexistent 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.

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*.

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*(3S) or *setvbuf*() 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 will 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(path, id)
char *path;
char 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. 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 which 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.

## WARNING

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

string: strcat, strdup, strncat, strcmp, strncmp, strcpy, strncpy, strlen, strchr, strrchr, strpbrk, strspn, strcspn, strtok — string operations

## SYNOPSIS

```
#include <string.h>
#include <sys/types.h>

char *strcat (s1, s2)
char *s1, *s2;

char *strdup (s1)
char *s1;

char *strncat (s1, s2, n)
char *s1, *s2;
size_t n;

int strcmp (s1, s2)
char *s1, *s2;

int strncmp (s1, s2, n)
char *s1, *s2;
size_t n;

char *strcpy (s1, s2)
char *s1, *s2;

char *strncpy (s1, s2, n)
char *s1, *s2;
size_t n;

int strlen (s)
char *s;

char *strchr (s, c)
char *s;
int c;

char *strrchr (s, c)
char *s;
int c;

char *strpbrk (s1, s2)
char *s1, *s2;

int strspn (s1, s2)
char *s1, *s2;

int strcspn (s1, s2)
char *s1, *s2;

char *strtok (s1, s2)
char *s1, *s2;
```

## DESCRIPTION

The arguments **s1**, **s2** and **s** point to strings (arrays of characters terminated by a null character). The functions *strcat*, *strncat*, *strcpy*, and *strncpy* all alter **s1**. These functions do not check for overflow of the array pointed to by **s1**.

*Strcat* appends a copy of string **s2** to the end of string **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, null is returned.

*Strncat* appends at most **n** characters. Each returns a pointer to the null-terminated result.

*Strcmp* compares its arguments 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**. *Strncmp* makes the same comparison but looks at at most **n** characters.

*Strcpy* copies string **s2** to **s1**, 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**.

*Strlen* returns the number of characters in **s**, not including the terminating null character.

*Strchr* (*strrchr*) returns a pointer to the first (last) occurrence of character **c** 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* (*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.

For user convenience, all these functions are declared in the optional <*string.h*> header file.

SEE ALSO

malloc(3C), malloc(3X).

## CAVEATS

*Strcmp* and *strncmp* are implemented by using the most natural character comparison on the machine. Thus the sign of the value returned when one of the characters has its high-order bit set not the same in all implementations and should not be relied upon.

Character movement is performed differently in different implementations. Thus overlapping moves may yield surprises.

## NAME

strtod, atof – convert string to double-precision number

## SYNOPSIS

**double strtod (str, ptr)**
**char *str, **ptr;**

**double atof (str)**
**char *str;**

## DESCRIPTION

*strtod* returns as a double-precision floating-point number the value represented by the character string pointed to by *str*. 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, then an optional **e** or **E** followed by an optional sign or space, followed by an integer.

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 number can be formed, **ptr* is set to *str*, and zero is returned.

*Atof(str)* is equivalent to *strtod(str, (char **)NULL)*.

## SEE ALSO

ctype(3C), scanf(3S), strtol(3C).

## DIAGNOSTICS

If the correct value would cause overflow, ±HUGE (as defined in **<math.h>**) 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.

## NAME

strtol, atol, atoi — convert string to integer

## SYNOPSIS

**long strtol (str, ptr, base)**
**char *str, **ptr;**
**int base;**

**long atol (str)**
**char *str;**

**int atoi (str)**
**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 thusly: 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.

*Atol(str)* is equivalent to *strtol(str, (char **)NULL, 10)*.

*Atoi(str)* is equivalent to *(int) strtol(str, (char **)NULL, 10)*.

## SEE ALSO

ctype(3C), scanf(3S), strtod(3C).

## CAVEAT

Overflow conditions are ignored.

## NAME

swab — swap bytes

## SYNOPSIS

```
void swab (from, to, nbytes)
char *from, *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 <stdio.h>

int system (string)
char *string;
```

DESCRIPTION

*system* causes the *string* to be given to *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.

FILES

/bin/sh

SEE ALSO

exec(2).
sh(1) in the *User's Reference Manual.*

DIAGNOSTICS

*system* forks to create a child process that in turn exec's /bin/sh in order to execute *string*. If the fork or exec fails, *system* returns a negative value and sets *errno*.

## NAME

tmpfile − create a temporary file

## SYNOPSIS

**#include <stdio.h>**

**FILE *tmpfile ()**

## DESCRIPTION

*tmpfile* creates a temporary file using a name generated by *tmpnam*(3S), and returns a corresponding FILE pointer. If the file cannot be opened, an error message is printed using *perror*(3C), and a NULL pointer is returned. The file will automatically be deleted when the process using it terminates. The file is opened for update ("w+").

## SEE ALSO

creat(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 (s)
char *s;

char *tempnam (dir, pfx)
char *dir, *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*(3C) 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, i.e. *malloc*(3C) failed, or none of the above mentioned attempts to find an appropriate directory was successful, a NULL pointer will be returned.

## NOTES

These functions generate a different file name each time they are called.

Files created using these functions and either *fopen*(3S) or *creat*(2) 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 use *unlink*(2) to remove the file when its use is ended.

## SEE ALSO

creat(2), unlink(2), fopen(3S), malloc(3C), mktemp(3C), tmpfile(3S).

## CAVEATS

If called more than 17,576 times in a single process, these functions will 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>**

**char *tsearch ((char *) key, (char **) rootp, compar)**
**int (*compar)( );**

**char *tfind ((char *) key, (char **) rootp, compar)**
**int (*compar)( );**

**char *tdelete ((char *) key, (char **) rootp, compar)**
**int (*compar)( );**

**void twalk ((char *) root, action)**
**void (*action)( );**

## 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 <search.h>
#include <stdio.h>

struct node {           /* pointers to these are stored in the tree */
        char *string;
        int length;
};
char string_space[10000];       /* space to store strings */
struct node nodes[500];         /* nodes to store */
struct node *root = NULL;       /* this points to the root */

main( )
{
        char *strptr = string_space;
        struct node *nodeptr = nodes;
        void print_node( ), twalk( );
        int i = 0, node_compare( );

        while (gets(strptr) != NULL && i++ < 500)  {
                /* set node */
                nodeptr->string = strptr;
                nodeptr->length = strlen(strptr);
                /* put node into the tree */
                (void) tsearch((char *)nodeptr, (char **) &root,
                        node_compare);
                /* adjust pointers, so we don't overwrite tree */
                strptr += nodeptr->length + 1;
                nodeptr++;
        }
        twalk((char *)root, print_node);
}
/*
        This routine compares two nodes, based on an
        alphabetical ordering of the string field.
```

```
*/
int
node_compare(node1, node2)
char *node1, *node2;
{
        return strcmp(((struct node *)node1)->string,
        ((struct node *) node2)->string);
}
/*
        This routine prints out a node, the first time
        twalk encounters it.
*/
void
print_node(node, order, level)
char **node;
VISIT order;
int level;
{
        if (order == preorder || order == leaf)  {
                (void)printf("string = %20s,  length = %d\n",
                        (*((struct node **)node))->string,
                        (*((struct node **)node))->length);
        }
}
```

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.

WARNINGS

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 respectively refer to visting 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.

CAVEAT

If the calling function alters the pointer to the root, results are unpredictable.

## NAME

ttyname, isatty — find name of a terminal

## SYNOPSIS

```
char *ttyname (fildes)
int fildes;

int isatty (fildes)
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**.

## CAVEAT

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

**int ttyslot ( )**

## DESCRIPTION

*ttyslot* returns the index of the current user's entry in the **/etc/utmp** file. This is accomplished by actually scanning the file **/etc/inittab** for the name of the terminal associated with the standard input, the standard output, or the error output (0, 1 or 2).

## FILES

/etc/inittab
/etc/utmp

## SEE ALSO

getut(3C), ttyname(3C).

## DIAGNOSTICS

A value of 0 is returned if an error was encountered while searching for the terminal name or if none of the above file descriptors is associated with a terminal device.

## NAME

ungetc – push character back into input stream

## SYNOPSIS

```
#include <stdio.h>

int ungetc (c, stream)
int c;
FILE *stream;
```

## DESCRIPTION

*ungetc* inserts the character *c* into the buffer associated with an input *stream*. That character, *c*, will be returned by the next *getc*(3S) call on that *stream*. *ungetc* returns *c*, and leaves the file *stream* unchanged.

One character of pushback is guaranteed, provided something has already been read from the stream and the stream is actually buffered.

If *c* equals **EOF**, *ungetc* does nothing to the buffer and returns **EOF**.

*Fseek*(3S) erases all memory of inserted characters.

## SEE ALSO

fseek(3S), getc(3S), setbuf(3S), stdio(3S).

## DIAGNOSTICS

*ungetc* returns **EOF** if it cannot insert the character.

## BUGS

When *stream* is *stdin*, one character may be pushed back onto the buffer without a previous read statement.

## NAME

vprintf, vfprintf, vsprintf – print formatted output of a varargs argument list

## SYNOPSIS

```
#include <stdio.h>
#include <varargs.h>

int vprintf (format, ap)
char *format;
va_list ap;

int vfprintf (stream, format, ap)
FILE *stream;
char *format;
va_list ap;

int vsprintf (s, format, ap)
char *s, *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 *varargs*(5).

## EXAMPLE

The following demonstrates the use of *vfprintf* to write an error routine.

```
#include <stdio.h>
#include <varargs.h>
        .
        .
        .
/*
 *      error should be called like
 *       error(function_name, format, arg1, arg2...);  */
/*VARARGS*/
void
error(va_alist)
/* Note that the function_name and format arguments cannot be
 *    separately declared because of the definition of varargs.  */
va_dcl
{
        va_list args;
        char *fmt;

        va_start(args);
        /* print out name of function causing error */
        (void)fprintf(stderr, "ERROR in %s: ", va_arg(args, char *));
        fmt = va_arg(args, char *);
```

```
                /* print out remainder of message */
                (void)vfprintf(stderr, fmt, args);
                va_end(args);
                (void)abort( );
        }
```

SEE ALSO

printf(3S), varargs(5).

## NAME

bessel: j0, j1, jn, y0, y1, yn – Bessel functions

## SYNOPSIS

```
#include <math.h>

double j0 (x)
double x;

double j1 (x)
double x;

double jn (n, x)
int n;
double x;

double y0 (x)
double x;

double y1 (x)
double x;

double yn (n, x)
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 zero and to set *errno* to **ERANGE**. In addition, a message indicating TLOSS error is printed on the standard error output.

These error-handling procedures may be changed with the function *matherr*(3M).

## NAME

erf, erfc – error function and complementary error function

## SYNOPSIS

```
#include <math.h>

double erf (x)
double x;

double erfc (x)
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, log, log10, pow, sqrt – exponential, logarithm, power, square root functions

## SYNOPSIS

```
#include <math.h>

double exp (x)
double x;

double log (x)
double x;

double log10 (x)
double x;

double pow (x, y)
double x, y;

double sqrt (x)
double x;
```

## DESCRIPTION

*exp* returns $e^x$.

*Log* returns the natural logarithm of $x$. The value of $x$ must be positive.

*Log10* returns the logarithm base ten of $x$. The value of $x$ must be positive.

*Pow* returns $x^y$. If $x$ is zero, $y$ must be positive. If $x$ is negative, $y$ must be an integer.

*Sqrt* returns 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* returns **HUGE** when the correct value would overflow, or 0 when the correct value would underflow, and sets *errno* to **ERANGE**.

*Log* and *log10* return –**HUGE** and set *errno* to **EDOM** when $x$ is non-positive. A message indicating DOMAIN error (or SING error when $x$ is 0) is printed on the standard error output.

*Pow* returns 0 and sets *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 the standard error output. When the correct value for *pow* would overflow or underflow, *pow* returns ±**HUGE** or 0 respectively, and sets *errno* to **ERANGE.**

*Sqrt* returns 0 and sets *errno* to **EDOM** when $x$ is negative. A message indicating DOMAIN error is printed on the standard error output.

These error-handling procedures may be changed with the function *matherr*(3M).

## NAME

floor, ceil, fmod, fabs – floor, ceiling, remainder, absolute value functions

## SYNOPSIS

```
#include <math.h>

double floor (x)
double x;

double ceil (x)
double x;

double fmod (x, y)
double x, y;

double fabs (x)
double x;
```

## DESCRIPTION

*floor* returns the largest integer (as a double-precision number) not greater than $x$.

*Ceil* returns the smallest integer not less than $x$.

*Fmod* returns the floating-point remainder of the division of $x$ by $y$: zero if $y$ is zero or if $x/y$ would overflow; otherwise the number $f$ with the same sign as $x$, such that $x = iy + f$ for some integer $i$, and $|f| < |y|$.

*Fabs* returns the absolute value of $x$, $|x|$.

## SEE ALSO

abs(3C).

## NAME

gamma – log gamma function

## SYNOPSIS

```
#include <math.h>

double gamma (x)
double x;

extern int signgam;
```

## DESCRIPTION

*gamma* returns $\ln(|\Gamma(x)|)$, 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*(3M) 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-negative 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* returns **HUGE** and sets *errno* to **ERANGE**.

These error-handling procedures may be changed with the function *matherr*(3M).

## NAME

hypot – Euclidean distance function

## SYNOPSIS

```
#include <math.h>

double hypot (x, y)
double x, 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.**

These error-handling procedures may be changed with the function *matherr*(3M).

## NAME

matherr – error-handling function

## SYNOPSIS

**#include <math.h>**

**int matherr (x)**
**struct exception *x;**

## DESCRIPTION

*matherr* is invoked by functions in the Math Library when errors are detected. 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.

## EXAMPLE

```
#include <math.h>

int
matherr(x)
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 */
}
```

| 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: | – | – | H | 0 | – | – |
| LOG, LOG10: | | | | | | |
| (arg < 0) | M, –H | – | – | – | – | – |
| (arg = 0) | – | M, –H | – | – | – | – |
| POW: | – | – | ±H | 0 | – | – |
| neg ** non-int | M, 0 | – | – | – | – | – |
| 0 ** non-pos | | | | | | |
| SQRT: | M, 0 | – | – | – | – | – |
| GAMMA: | – | M, H | H | – | – | – |
| HYPOT: | – | – | H | – | – | – |
| SINH: | – | – | ±H | – | – | – |
| COSH: | – | – | H | – | – | – |
| SIN, COS, TAN: – | – | – | – | M, 0 | * | |
| ASIN, ACOS, ATAN2: M, 0 | – | – | – | – | – | |

**ABBREVIATIONS**

| | |
|---|---|
| * | As much as possible of the value is returned. |
| M | Message is printed (EDOM error). |
| H | HUGE is returned. |
| –H | –HUGE is returned. |
| ±H | HUGE or –HUGE is returned. |
| 0 | 0 is returned. |

## NAME

sinh, cosh, tanh – hyperbolic functions

## SYNOPSIS

```
#include <math.h>

double sinh (x)
double x;

double cosh (x)
double x;

double tanh (x)
double x;
```

## DESCRIPTION

*sinh, cosh,* and *tanh* return, respectively, the hyberbolic sine, cosine and tangent of their argument.

## SEE ALSO

matherr(3M).

## DIAGNOSTICS

*sinh* and *cosh* return **HUGE** (and *sinh* may return –**HUGE** for negative *x*) when the correct value would overflow and set *errno* to **ERANGE**.

These error-handling procedures may be changed with the function *matherr*(3M).

## NAME

trig: sin, cos, tan, asin, acos, atan, atan2 — trigonometric functions

## SYNOPSIS

```
#include <math.h>

double sin (x)
double x;

double cos (x)
double x;

double tan (x)
double x;

double asin (x)
double x;

double acos (x)
double x;

double atan (x)
double x;

d′ uble atan2 (y, x)
double y, x;
```

## DESCRIPTION

*Sin, cos* and *tan* return respectively the sine, cosine and tangent of their argument, *x*, measured in radians.

*Asin* returns the arcsine of *x*, in the range $[-\pi/2,\pi/2]$.

*Acos* returns the arccosine of *x*, in the range $[0,\pi]$.

*Atan* returns the arctangent of *x*, in the range $[-\pi/2,\pi/2]$.

*Atan2* returns 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

*Sin, cos,* and *tan* lose accuracy when their argument is far from zero. For arguments sufficiently large, these functions return zero when there would otherwise be a complete loss of significance. In this case a message indicating TLOSS error is printed on the standard error output. For less extreme arguments causing partial loss of significance, a PLOSS error is generated but no message is printed. In both cases, *errno* is set to **ERANGE.**

If the magnitude of the argument of *asin* or *acos* is greater than one, or if both arguments of *atan2* are zero, zero is returned and *errno* is set to **EDOM**. In addition, a message indicating DOMAIN error is printed on the standard error output.

These error-handling procedures may be changed with the function *matherr*(3M).

## NAME

t_accept − accept a connect request

## SYNOPSIS

```
#include <tiuser.h>

int t_accept(fd, resfd, call)
int fd;
int resfd;
struct t_call *call;
```

## DESCRIPTION

This function is issued by a transport user to accept a connect request. *Fd* identifies the local transport endpoint where the connect indication arrived, *resfd* specifies the local transport endpoint where the connection is to be established, and *call* contains information required by the transport provider to complete the connection. *Call* points to a *t_call* structure which contains the following members:

```
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
int sequence;
```

*Netbuf* is described in *intro*(3). In *call, addr* is the address of the caller, *opt* indicates any protocol-specific parameters associated with the connection, *udata* points to any user data to be returned to the caller, and *sequence* is the value returned by *t_listen* that uniquely associates the response with a previously received connect indication.

A transport user may accept a connection on either the same, or on a different, local transport endpoint than the one on which the connect indication arrived. If the same endpoint is specified (i.e., *resfd=fd*), the connection can be accepted unless the following condition is true: The user has received other indications on that endpoint but has not responded to them (with *t_accept* or *t_snddis*). For this condition, *t_accept* will fail and set *t_errno* to TBADF.

If a different transport endpoint is specified (*resfd!=fd*), the endpoint must be bound to a protocol address and must be in the T_IDLE state [see *t_getstate*(3N)] before the *t_accept* is issued.

For both types of endpoints, *t_accept* will fail and set *t_errno* to TLOOK if there are indications (e.g., a connect or disconnect) waiting to be received on that endpoint.

The values of parameters specified by *opt* and the syntax of those values are protocol specific. The *udata* argument enables the called transport user to send user data to the caller and the amount of user data must not exceed the limits supported by the transport provider as returned by *t_open* or *t_getinfo*. If the *len* [see *netbuf* in *intro*(3)] field of *udata* is zero, no data will be sent to the caller.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint, or the user is illegally accepting a connection on |

| | |
|---|---|
| | the same transport endpoint on which the connect indication arrived. |
| [TOUTSTATE] | The function was issued in the wrong sequence on the transport endpoint referenced by *fd,* or the transport endpoint referred to by *resfd* is not in the T_IDLE state. |
| [TACCES] | The user does not have permission to accept a connection on the responding transport endpoint or use the specified options. |
| [TBADOPT] | The specified options were in an incorrect format or contained illegal information. |
| [TBADDATA] | The amount of user data specified was not within the bounds allowed by the transport provider. |
| [TBADSEQ] | An invalid sequence number was specified. |
| [TLOOK] | An asynchronous event has occurred on the transport endpoint referenced by *fd* and requires immediate attention. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_connect(3N), t_getstate(3N), t_listen(3N), t_open(3N), t_rcvconnect(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and *t_errno* is set to indicate the error.

## NAME

t_alloc — allocate a library structure

## SYNOPSIS

**#include <tiuser.h>**

**char *t_alloc(fd, struct_type, fields)**
**int fd;**
**int struct_type;**
**int fields;**

## DESCRIPTION

The *t_alloc* function dynamically allocates memory for the various transport function argument structures as specified below. This function will allocate memory for the specified structure, and will also allocate memory for buffers referenced by the structure.

The structure to allocate is specified by *struct_type*, and can be one of the following:

| | |
|---|---|
| T_BIND | struct t_bind |
| T_CALL | struct t_call |
| T_OPTMGMT | struct t_optmgmt |
| T_DIS | struct t_discon |
| T_UNITDATA | struct t_unitdata |
| T_UDERROR | struct t_uderr |
| T_INFO | struct t_info |

where each of these structures may subsequently be used as an argument to one or more transport functions.

Each of the above structures, except T_INFO, contains at least one field of type *struct netbuf*. *Netbuf* is described in *intro*(3). For each field of this type, the user may specify that the buffer for that field should be allocated as well. The *fields* argument specifies this option, where the argument is the bitwise-OR of any of the following:

| | |
|---|---|
| T_ADDR | The *addr* field of the *t_bind, t_call, t_unitdata,* or *t_uderr* structures. |
| T_OPT | The *opt* field of the *t_optmgmt, t_call, t_unitdata,* or *t_uderr* structures. |
| T_UDATA | The *udata* field of the *t_call, t_discon,* or *t_unitdata* structures. |
| T_ALL | All relevant fields of the given structure. |

For each field specified in *fields, t_alloc* will allocate memory for the buffer associated with the field, and initialize the *buf* pointer and *maxlen* [see *netbuf* in *intro*(3) for description of *buf* and *maxlen*] field accordingly. The length of the buffer allocated will be based on the same size information that is returned to the user on *t_open* and *t_getinfo*. Thus, *fd* must refer to the transport endpoint through which the newly allocated structure will be passed, so that the appropriate size information can be accessed. If the size value associated with any specified field is -1 or -2 (see *t_open* or *t_getinfo*), *t_alloc* will be unable to determine the size of the buffer to allocate and will fail, setting *t_errno* to

TSYSERR and *errno* to EINVAL. For any field not specified in *fields*, *buf* will be set to NULL and *maxlen* will be set to zero.

Use of *t_alloc* to allocate structures will help ensure the compatibility of user programs with future releases of the transport interface.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_free(3N), t_getinfo(3N), t_open(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

On successful completion, *t_alloc* returns a pointer to the newly allocated structure. On failure, NULL is returned.

## NAME

t_bind − bind an address to a transport endpoint

## SYNOPSIS

**#include <tiuser.h>**

**int t_bind(fd, req, ret)**
**int fd;**
**struct t_bind *req;**
**struct t_bind *ret;**

## DESCRIPTION

This function associates a protocol address with the transport endpoint specified by *fd* and activates that transport endpoint. In connection mode, the transport provider may begin accepting or requesting connections on the transport endpoint. In connectionless mode, the transport user may send or receive data units through the transport endpoint.

The *req* and *ret* arguments point to a *t_bind* structure containing the following members:

```
struct netbuf addr;
unsigned qlen;
```

*Netbuf* is described in *intro*(3). The *addr* field of the *t_bind* structure specifies a protocol address and the *qlen* field is used to indicate the maximum number of outstanding connect indications.

*Req* is used to request that an address, represented by the *netbuf* structure, be bound to the given transport endpoint. *Len* [see *netbuf* in *intro*(3); also for *buf* and *maxlen*] specifies the number of bytes in the address and *buf* points to the address buffer. *Maxlen* has no meaning for the *req* argument. On return, *ret* contains the address that the transport provider actually bound to the transport endpoint; this may be different from the address specified by the user in *req*. In *ret*, the user specifies *maxlen* which is the maximum size of the address buffer and *buf* which points to the buffer where the address is to be placed. On return, *len* specifies the number of bytes in the bound address and *buf* points to the bound address. If *maxlen* is not large enough to hold the returned address, an error will result.

If the requested address is not available, or if no address is specified in *req* (the *len* field of *addr* in *req* is zero) the transport provider will assign an appropriate address to be bound, and will return that address in the *addr* field of *ret*. The user can compare the addresses in *req* and *ret* to determine whether the transport provider bound the transport endpoint to a different address than that requested.

*Req* may be NULL if the user does not wish to specify an address to be bound. Here, the value of *qlen* is assumed to be zero, and the transport provider must assign an address to the transport endpoint. Similarly, *ret* may be NULL if the user does not care what address was bound by the provider and is not interested in the negotiated value of *qlen*. It is valid to set *req* and *ret* to NULL for the same call, in which case the provider chooses the address to bind to the transport endpoint and does not return that information to the user.

The *qlen* field has meaning only when initializing a connection-mode service. It specifies the number of outstanding connect indications the transport provider should support for the given transport endpoint. An outstanding connect indication is one that has been passed to the transport user by the transport provider. A value of *qlen* greater than zero is only meaningful when issued by a passive transport user that expects other users to call it. The value of *qlen* will be negotiated by the transport provider and may be changed if the transport provider cannot support the specified number of outstanding connect indications. On return, the *qlen* field in *ret* will contain the negotiated value.

This function allows more than one transport endpoint to be bound to the same protocol address (however, the transport provider must support this capability also), but it is not allowable to bind more than one protocol address to the same transport endpoint. If a user binds more than one transport endpoint to the same protocol address, only one endpoint can be used to listen for connect indications associated with that protocol address. In other words, only one *t_bind* for a given protocol address may specify a value of *qlen* greater than zero. In this way, the transport provider can identify which transport endpoint should be notified of an incoming connect indication. If a user attempts to bind a protocol address to a second transport endpoint with a value of *qlen* greater than zero, the transport provider will assign another address to be bound to that endpoint. If a user accepts a connection on the transport endpoint that is being used as the listening endpoint, the bound protocol address will be found to be busy for the duration of that connection. No other transport endpoints may be bound for listening while that initial listening endpoint is in the data transfer phase. This will prevent more than one transport endpoint bound to the same protocol address from accepting connect indications.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TOUTSTATE] | The function was issued in the wrong sequence. |
| [TBADADDR] | The specified protocol address was in an incorrect format or contained illegal information. |
| [TNOADDR] | The transport provider could not allocate an address. |
| [TACCES] | The user does not have permission to use the specified address. |
| [TBUFOVFLW] | The number of bytes allowed for an incoming argument is not sufficient to store the value of that argument. The provider's state will change to T_IDLE and the information to be returned in *ret* will be discarded. |
| [TSYSERR] | A system error has occurred during execution of this function. |

SEE ALSO

intro(3), t_open(3N), t_optmgmt(3N), t_unbind(3N).
*Network Programmer's Guide.*

DIAGNOSTICS

*t_bind* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_close – close a transport endpoint

## SYNOPSIS

**#include <tiuser.h>**

**int t_close(fd)**
**int fd;**

## DESCRIPTION

The *t_close* function informs the transport provider that the user is finished with the transport endpoint specified by *fd,* and frees any local library resources associated with the endpoint. In addition, *t_close* closes the file associated with the transport endpoint.

*t_close* should be called from the T_UNBND state [see *t_getstate* (3N)]. However, this function does not check state information, so it may be called from any state to close a transport endpoint. If this occurs, the local library resources associated with the endpoint will be freed automatically. In addition, *close*(2) will be issued for that file descriptor; the close will be abortive if no other process has that file open, and will break any transport connection that may be associated with that endpoint.

On failure, *t_errno* may be set to the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |

## SEE ALSO

t_getstate(3N), t_open(3N), t_unbind(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_close* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_connect – establish a connection with another transport user

## SYNOPSIS

```
#include <tiuser.h>

int t_connect(fd, sndcall, rcvcall)
int fd;
struct t_call *sndcall;
struct t_call *rcvcall;
```

## DESCRIPTION

This function enables a transport user to request a connection to the specified destination transport user. *Fd* identifies the local transport endpoint where communication will be established, while *sndcall* and *rcvcall* point to a *t_call* structure which contains the following members:

```
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
int sequence;
```

*Sndcall* specifies information needed by the transport provider to establish a connection and *rcvcall* specifies information that is associated with the newly established connection.

*Netbuf* is described in *intro*(3). In *sndcall, addr* specifies the protocol address of the destination transport user, *opt* presents any protocol-specific information that might be needed by the transport provider, *udata* points to optional user data that may be passed to the destination transport user during connection establishment, and *sequence* has no meaning for this function.

On return in *rcvcall, addr* returns the protocol address associated with the responding transport endpoint, *opt* presents any protocol-specific information associated with the connection, *udata* points to optional user data that may be returned by the destination transport user during connection establishment, and *sequence* has no meaning for this function.

The *opt* argument implies no structure on the options that may be passed to the transport provider. The transport provider is free to specify the structure of any options passed to it. These options are specific to the underlying protocol of the transport provider. The user may choose not to negotiate protocol options by setting the *len* field of *opt* to zero. In this case, the provider may use default options.

The *udata* argument enables the caller to pass user data to the destination transport user and receive user data from the destination user during connection establishment. However, the amount of user data must not exceed the limits supported by the transport provider as returned by *t_open* (3N) or *t_getinfo* (3N). If the *len* [see *netbuf* in *intro*(3)] field of *udata* is zero in *sndcall,* no data will be sent to the destination transport user.

On return, the *addr, opt,* and *udata* fields of *rcvcall* will be updated to reflect values associated with the connection. Thus, the *maxlen* [see *netbuf* in *intro*(3)] field of each argument must be set before issuing this function to indicate the maximum size of the buffer for each. However, *rcvcall* may be NULL, in which case no information is given to the user on return from *t_connect*.

By default, *t_connect* executes in synchronous mode, and will wait for the destination user's response before returning control to the local user. A successful return (i.e. return value of zero) indicates that the requested connection has been established. However, if O_NDELAY is set (via *t_open* or *fcntl*), *t_connect* executes in asynchronous mode. In this case, the call will not wait for the remote user's response, but will return control immediately to the local user and return -1 with *t_errno* set to TNODATA to indicate that the connection has not yet been established. In this way, the function simply initiates the connection establishment procedure by sending a connect request to the destination transport user.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TOUTSTATE] | The function was issued in the wrong sequence. |
| [TNODATA] | O_NDELAY was set, so the function successfully initiated the connection establishment procedure, but did not wait for a response from the remote user. |
| [TBADADDR] | The specified protocol address was in an incorrect format or contained illegal information. |
| [TBADOPT] | The specified protocol options were in an incorrect format or contained illegal information. |
| [TBADDATA] | The amount of user data specified was not within the bounds allowed by the transport provider. |
| [TACCES] | The user does not have permission to use the specified address or options. |
| [TBUFOVFLW] | The number of bytes allocated for an incoming argument is not sufficient to store the value of that argument. If executed in synchronous mode, the provider's state, as seen by the user, changes to T_DATAXFER, and the connect indication information to be returned in *rcvcall* is discarded. |
| [TLOOK] | An asynchronous event has occurred on this transport endpoint and requires immediate attention. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_accept(3N), t_getinfo(3N), t_listen(3N), t_open(3N), t_optmgmt(3N), t_rcvconnect(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_connect* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_error – produce error message

## SYNOPSIS

```
#include <tiuser.h>

void t_error(errmsg)
char *errmsg;
extern int t_errno;
extern char *t_errlist[];
extern int t_nerr;
```

## DESCRIPTION

The *t_error* function produces a message on the standard error output which describes the last error encountered during a call to a transport function. The argument string *errmsg* is a user-supplied error message that gives context to the error. *t_error* prints the user-supplied error message followed by a colon and a standard error message for the current error defined in *t_errno*. To simplify variant formatting of messages, the array of message strings *t_errlist* is provided; *t_errno* can be used as an index in this table to get the message string without the newline. *T_nerr* is the largest message number provided for in the *t_errlist* table.

*T_errno* is only set when an error occurs and is not cleared on successful calls.

## EXAMPLE

If a *t_connect* function fails on transport endpoint *fd2* because a bad address was given, the following call might follow the failure:

```
t_error("t_connect failed on fd2");
```

The diagnostic message to be printed would look like:

```
t_connect failed on fd2:  Incorrect transport address format
```

where "Incorrect transport address format" identifies the specific error that occurred, and "t_connect failed on fd2" tells the user which function failed on which transport endpoint.

## SEE ALSO

*Network Programmer's Guide.*

## NAME

t_free – free a library structure

## SYNOPSIS

```
#include <tiuser.h>

int t_free(ptr, struct_type)
char *ptr;
int struct_type;
```

## DESCRIPTION

The *t_free* function frees memory previously allocated by *t_alloc*. This function will free memory for the specified structure, and will also free memory for buffers referenced by the structure.

*Ptr* points to one of the six structure types described for *t_alloc*, and *struct_type* identifies the type of that structure which can be one of the following:

| | |
|---|---|
| T_BIND | struct t_bind |
| T_CALL | struct t_call |
| T_OPTMGMT | struct t_optmgmt |
| T_DIS | struct t_discon |
| T_UNITDATA | struct t_unitdata |
| T_UDERROR | struct t_uderr |
| T_INFO | struct t_info |

where each of these structures is used as an argument to one or more transport functions.

*t_free* will check the *addr*, *opt*, and *udata* fields of the given structure (as appropriate), and free the buffers pointed to by the *buf* field of the *netbuf* [see *intro*(3)] structure. If *buf* is NULL, *t_free* will not attempt to free memory. After all buffers are freed, *t_free* will free the memory associated with the structure pointed to by *ptr*.

Undefined results will occur if *ptr* or any of the *buf* pointers points to a block of memory that was not previously allocated by *t_alloc*.

On failure, *t_errno* may be set to the following:

| | |
|---|---|
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_alloc(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_free* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_getinfo – get protocol-specific service information

## SYNOPSIS

```
#include <tiuser.h>

int t_getinfo(fd, info)
int fd;
struct t_info *info;
```

## DESCRIPTION

This function returns the current characteristics of the underlying transport protocol associated with file descriptor *fd*. The *info* structure is used to return the same information returned by *t_open*. This function enables a transport user to access this information during any phase of communication.

This argument points to a *t_info* structure which contains the following members:

```
long addr;      /* max size of the transport protocol address */
long options;   /* max number of bytes of protocol-specific options */
long tsdu;      /* max size of a transport service data unit (TSDU) */
long etsdu;     /* max size of an expedited transport service data unit (ETSDU) */
long connect;   /* max amount of data allowed on connection establishment
                   functions */
long discon;    /* max amount of data allowed on t_snddis and t_rcvdis functions */
long servtype;  /* service type supported by the transport provider */
```

The values of the fields have the following meanings:

| | |
|---|---|
| *addr* | A value greater than or equal to zero indicates the maximum size of a transport protocol address; a value of -1 specifies that there is no limit on the address size; and a value of -2 specifies that the transport provider does not provide user access to transport protocol addresses. |
| *options* | A value greater than or equal to zero indicates the maximum number of bytes of protocol-specific options supported by the provider; a value of -1 specifies that there is no limit on the option size; and a value of -2 specifies that the transport provider does not support user-settable options. |
| *tsdu* | A value greater than zero specifies the maximum size of a transport service data unit (TSDU); a value of zero specifies that the transport provider does not support the concept of TSDU, although it does support the sending of a data stream with no logical boundaries preserved across a connection; a value of -1 specifies that there is no limit on the size of a TSDU; and a value of -2 specifies that the transfer of normal data is not supported by the transport provider. |
| *etsdu* | A value greater than zero specifies the maximum size of an expedited transport service data unit (ETSDU); a value of zero specifies that the transport provider does not support the concept of ETSDU, although it does support the sending of an expedited |

data stream with no logical boundaries preserved across a connection; a value of -1 specifies that there is no limit on the size of an ETSDU; and a value of -2 specifies that the transfer of expedited data is not supported by the transport provider.

| | |
|---|---|
| *connect* | A value greater than or equal to zero specifies the maximum amount of data that may be associated with connection establishment functions; a value of -1 specifies that there is no limit on the amount of data sent during connection establishment; and a value of -2 specifies that the transport provider does not allow data to be sent with connection establishment functions. |
| *discon* | A value greater than or equal to zero specifies the maximum amount of data that may be associated with the *t_snddis* and *t_rcvdis* functions; a value of -1 specifies that there is no limit on the amount of data sent with these abortive release functions; and a value of -2 specifies that the transport provider does not allow data to be sent with the abortive release functions. |
| *servtype* | This field specifies the service type supported by the transport provider, as described below. |

If a transport user is concerned with protocol independence, the above sizes may be accessed to determine how large the buffers must be to hold each piece of information. Alternatively, the *t_alloc* function may be used to allocate these buffers. An error will result if a transport user exceeds the allowed data size on any function. The value of each field may change as a result of option negotiation, and *t_getinfo* enables a user to retrieve the current characteristics.

The *servtype* field of *info* may specify one of the following values on return:

| | |
|---|---|
| T_COTS | The transport provider supports a connection-mode service but does not support the optional orderly release facility. |
| T_COTS_ORD | The transport provider supports a connection-mode service with the optional orderly release facility. |
| T_CLTS | The transport provider supports a connectionless-mode service. For this service type, *t_open* will return -2 for *etsdu, connect,* and *discon*. |

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

t_open(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_getinfo* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_getstate – get the current state

## SYNOPSIS

```
#include <tiuser.h>

int t_getstate(fd)
int fd;
```

## DESCRIPTION

The *t_getstate* function returns the current state of the provider associated with the transport endpoint specified by *fd*.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TSTATECHNG] | The transport provider is undergoing a state change. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

t_open(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_getstate* returns the current state on successful completion and -1 on failure and *t_errno* is set to indicate the error. The current state may be one of the following:

| | |
|---|---|
| T_UNBND | unbound |
| T_IDLE | idle |
| T_OUTCON | outgoing connection pending |
| T_INCON | incoming connection pending |
| T_DATAXFER | data transfer |
| T_OUTREL | outgoing orderly release (waiting for an orderly release indication) |
| T_INREL | incoming orderly release (waiting for an orderly release request) |

If the provider is undergoing a state transition when *t_getstate* is called, the function will fail.

## NAME

t_listen – listen for a connect request

## SYNOPSIS

```
#include <tiuser.h>

int t_listen(fd, call)
int fd;
struct t_call *call;
```

## DESCRIPTION

This function listens for a connect request from a calling transport user. *Fd* identifies the local transport endpoint where connect indications arrive, and on return, *call* contains information describing the connect indication. *Call* points to a *t_call* structure which contains the following members:

```
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
int sequence;
```

*Netbuf* is described in *intro*(3). In *call, addr* returns the protocol address of the calling transport user, *opt* returns protocol-specific parameters associated with the connect request, *udata* returns any user data sent by the caller on the connect request, and *sequence* is a number that uniquely identifies the returned connect indication. The value of *sequence* enables the user to listen for multiple connect indications before responding to any of them.

Since this function returns values for the *addr, opt,* and *udata* fields of *call,* the *maxlen* [see *netbuf* in *intro*(3)] field of each must be set before issuing the *t_listen* to indicate the maximum size of the buffer for each.

By default, *t_listen* executes in synchronous mode and waits for a connect indication to arrive before returning to the user. However, if O_NDELAY is set (via *t_open* or *fcntl*), *t_listen* executes asynchronously, reducing to a poll for existing connect indications. If none are available, it returns -1 and sets *t_errno* to TNODATA.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TBUFOVFLW] | The number of bytes allocated for an incoming argument is not sufficient to store the value of that argument. The provider's state, as seen by the user, changes to T_INCON, and the connect indication information to be returned in *call* is discarded. |
| [TNODATA] | O_NDELAY was set, but no connect indications had been queued. |
| [TLOOK] | An asynchronous event has occurred on this transport endpoint and requires immediate attention. |

| | |
|---|---|
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## CAVEATS

If a user issues *t_listen* in synchronous mode on a transport endpoint that was not bound for listening (i.e. *qlen* was zero on *t_bind*), the call will wait forever because no connect indications will arrive on that endpoint.

## SEE ALSO

intro(3), t_accept(3N), t_bind(3N), t_connect(3N), t_open(3N), t_rcvconnect(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_listen* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_look — look at the current event on a transport endpoint

## SYNOPSIS

```
#include <tiuser.h>

int t_look(fd)
int fd;
```

## DESCRIPTION

This function returns the current event on the transport endpoint specified by *fd*. This function enables a transport provider to notify a transport user of an asynchronous event when the user is issuing functions in synchronous mode. Certain events require immediate notification of the user and are indicated by a specific error, TLOOK, on the current or next function to be executed.

This function also enables a transport user to poll a transport endpoint periodically for asynchronous events.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

t_open(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

Upon success, *t_look* returns a value that indicates which of the allowable events has occurred, or returns zero if no event exists. One of the following events is returned:

| | |
|---|---|
| T_LISTEN | connection indication received |
| T_CONNECT | connect confirmation received |
| T_DATA | normal data received |
| T_EXDATA | expedited data received |
| T_DISCONNECT | disconnect received |
| T_ERROR | fatal error indication |
| T_UDERR | datagram error indication |
| T_ORDREL | orderly release indication |

On failure, -1 is returned and *t_errno* is set to indicate the error.

## NAME

t_open − establish a transport endpoint

## SYNOPSIS

```
#include <tiuser.h>

int t_open(path, oflag, info)
char *path;
int oflag;
struct t_info *info;
```

## DESCRIPTION

*t_open* must be called as the first step in the initialization of a transport endpoint. This function establishes a transport endpoint by opening a UNIX file that identifies a particular transport provider (i.e. transport protocol) and returning a file descriptor that identifies that endpoint. For example, opening the file */dev/iso_cots* identifies an OSI connection-oriented transport layer protocol as the transport provider.

*Path* points to the path name of the file to open, and *oflag* identifies any open flags [as in *open*(2)]. *t_open* returns a file descriptor that will be used by all subsequent functions to identify the particular local transport endpoint.

This function also returns various default characteristics of the underlying transport protocol by setting fields in the *t_info* structure. This argument points to a *t_info* which contains the following members:

```
long addr;        /* max size of the transport protocol address */
long options;     /* max number of bytes of protocol-specific options */
long tsdu;        /* max size of a transport service data unit (TSDU) */
long etsdu;       /* max size of an expedited transport service
                     data unit (ETSDU) */
long connect;     /* max amount of data allowed on connection
                     establishment functions */
long discon;      /* max amount of data allowed on t_snddis
                     and t_rcvdis functions */
long servtype;    /* service type supported by the transport provider */
```

The values of the fields have the following meanings:

*addr* A value greater than or equal to zero indicates the maximum size of a transport protocol address; a value of -1 specifies that there is no limit on the address size; and a value of -2 specifies that the transport provider does not provide user access to transport protocol addresses.

*options* A value greater than or equal to zero indicates the maximum number of bytes of protocol-specific options supported by the provider; a value of -1 specifies that there is no limit on the option size; and a value of -2 specifies that the transport provider does not support user-settable options.

*tsdu* A value greater than zero specifies the maximum size of a transport service data unit (TSDU); a value of zero specifies that the transport provider does not support the concept of TSDU, although it does support the sending of a data stream with no logical boundaries preserved across a connection; a value of -1 specifies that there is no limit on the size of a TSDU; and a value of -2 specifies that the transfer of normal data is not supported by the transport provider.

| | |
|---|---|
| *etsdu* | A value greater than zero specifies the maximum size of an expedited transport service data unit (ETSDU); a value of zero specifies that the transport provider does not support the concept of ETSDU, although it does support the sending of an expedited data stream with no logical boundaries preserved across a connection; a value of -1 specifies that there is no limit on the size of an ETSDU; and a value of -2 specifies that the transfer of expedited data is not supported by the transport provider. |
| *connect* | A value greater than or equal to zero specifies the maximum amount of data that may be associated with connection establishment functions; a value of -1 specifies that there is no limit on the amount of data sent during connection establishment; and a value of -2 specifies that the transport provider does not allow data to be sent with connection establishment functions. |
| *discon* | A value greater than or equal to zero specifies the maximum amount of data that may be associated with the *t_snddis* and *t_rcvdis* functions; a value of -1 specifies that there is no limit on the amount of data sent with these abortive release functions; and a value of -2 specifies that the transport provider does not allow data to be sent with the abortive release functions. |
| *servtype* | This field specifies the service type supported by the transport provider, as described below. |

If a transport user is concerned with protocol independence, the above sizes may be accessed to determine how large the buffers must be to hold each piece of information. Alternatively, the *t_alloc* function may be used to allocate these buffers. An error will result if a transport user exceeds the allowed data size on any function.

The *servtype* field of *info* may specify one of the following values on return:

| | |
|---|---|
| T_COTS | The transport provider supports a connection-mode service but does not support the optional orderly release facility. |
| T_COTS_ORD | The transport provider supports a connection-mode service with the optional orderly release facility. |
| T_CLTS | The transport provider supports a connectionless-mode service. For this service type, *t_open* will return -2 for *etsdu, connect,* and *discon.* |

A single transport endpoint may support only one of the above services at one time.

If *info* is set to NULL by the transport user, no protocol information is returned by *t_open*.

On failure, *t_errno* may be set to the following:

| | |
|---|---|
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

open(2).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_open* returns a valid file descriptor on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_optmgmt – manage options for a transport endpoint

## SYNOPSIS

```
#include <tiuser.h>

int t_optmgmt(fd, req, ret)
int fd;
struct t_optmgmt *req;
struct t_optmgmt *ret;
```

## DESCRIPTION

The *t_optmgmt* function enables a transport user to retrieve, verify, or negotiate protocol options with the transport provider. *Fd* identifies a bound transport endpoint.

The *req* and *ret* arguments point to a *t_optmgmt* structure containing the following members:

```
struct netbuf opt;
long   flags;
```

The *opt* field identifies protocol options and the *flags* field is used to specify the action to take with those options.

The options are represented by a *netbuf* [see *intro*(3); also for *len, buf* and *maxlen*] structure in a manner similar to the address in *t_bind*. *Req* is used to request a specific action of the provider and to send options to the provider. *Len* specifies the number of bytes in the options, *buf* points to the options buffer, and *maxlen* has no meaning for the *req* argument. The transport provider may return options and flag values to the user through *ret*. For *ret, maxlen* specifies the maximum size of the options buffer and *buf* points to the buffer where the options are to be placed. On return, *len* specifies the number of bytes of options returned. *Maxlen* has no meaning for the *req* argument, but must be set in the *ret* argument to specify the maximum number of bytes the options buffer can hold. The actual structure and content of the options is imposed by the transport provider.

The *flags* field of *req* can specify one of the following actions:

| | |
|---|---|
| T_NEGOTIATE | This action enables the user to negotiate the values of the options specified in *req* with the transport provider. The provider will evaluate the requested options and negotiate the values, returning the negotiated values through *ret*. |
| T_CHECK | This action enables the user to verify whether the options specified in *req* are supported by the transport provider. On return, the *flags* field of *ret* will have either T_SUCCESS or T_FAILURE set to indicate to the user whether the options are supported. These flags are only meaningful for the T_CHECK request. |

| | |
|---|---|
| T_DEFAULT | This action enables a user to retrieve the default options supported by the transport provider into the *opt* field of *ret*. In *req*, the *len* field of *opt* must be zero and the *buf* field may be NULL. |

If issued as part of the connectionless-mode service, *t_optmgmt* may block due to flow control constraints. The function will not complete until the transport provider has processed all previously sent data units.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TOUTSTATE] | The function was issued in the wrong sequence. |
| [TACCES] | The user does not have permission to negotiate the specified options. |
| [TBADOPT] | The specified protocol options were in an incorrect format or contained illegal information. |
| [TBADFLAG] | An invalid flag was specified. |
| [TBUFOVFLW] | The number of bytes allowed for an incoming argument is not sufficient to store the value of that argument. The information to be returned in *ret* will be discarded. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_getinfo(3N), t_open(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_optmgmt* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_rcv – receive data or expedited data sent over a connection

## SYNOPSIS

```
int t_rcv(fd, buf, nbytes, flags)
int fd;
char *buf;
unsigned nbytes;
int *flags;
```

## DESCRIPTION

This function receives either normal or expedited data. *Fd* identifies the local transport endpoint through which data will arrive, *buf* points to a receive buffer where user data will be placed, and *nbytes* specifies the size of the receive buffer. *Flags* may be set on return from *t_rcv* and specifies optional flags as described below.

By default, *t_rcv* operates in synchronous mode and will wait for data to arrive if none is currently available. However, if O_NDELAY is set (via *t_open* or *fcntl*), *t_rcv* will execute in asynchronous mode and will fail if no data is available. (See TNODATA below.)

On return from the call, if T_MORE is set in *flags* this indicates that there is more data and the current transport service data unit (TSDU) or expedited transport service data unit (ETSDU) must be received in multiple *t_rcv* calls. Each *t_rcv* with the T_MORE flag set indicates that another *t_rcv* must follow immediately to get more data for the current TSDU. The end of the TSDU is identified by the return of a *t_rcv* call with the T_MORE flag not set. If the transport provider does not support the concept of a TSDU as indicated in the *info* argument on return from *t_open* or *t_getinfo*, the T_MORE flag is not meaningful and should be ignored.

On return, the data returned is expedited data if T_EXPEDITED is set in *flags*. If the number of bytes of expedited data exceeds *nbytes*, *t_rcv* will set T_EXPEDITED and T_MORE on return from the initial call. Subsequent calls to retrieve the remaining ETSDU will not have T_EXPEDITED set on return. The end of the ETSDU is identified by the return of a *t_rcv* call with the T_MORE flag not set.

If expedited data arrives after part of a TSDU has been retrieved, receipt of the remainder of the TSDU will be suspended until the ETSDU has been processed. Only after the full ETSDU has been retrieved (T_MORE not set) will the remainder of the TSDU be available to the user.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TNODATA] | O_NDELAY was set, but no data is currently available from the transport provider. |
| [TLOOK] | An asynchronous event has occurred on this transport endpoint and requires immediate attention. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |

| | |
|---|---|
| [TSYSERR] | A system error has occurred during execution of this function. |

SEE ALSO

t_open(3N), t_snd(3N).
*Network Programmer's Guide.*

DIAGNOSTICS

On successful completion, *t_rcv* returns the number of bytes received, and it returns -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_rcvconnect – receive the confirmation from a connect request

## SYNOPSIS

**#include <tiuser.h>**

```
int t_rcvconnect(fd, call)
int fd;
struct t_call *call;
```

## DESCRIPTION

This function enables a calling transport user to determine the status of a previously sent connect request and is used in conjunction with *t_connect* to establish a connection in asynchronous mode. The connection will be established on successful completion of this function.

*Fd* identifies the local transport endpoint where communication will be established, and *call* contains information associated with the newly established connection. *Call* points to a *t_call* structure which contains the following members:

```
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
int sequence;
```

*Netbuf* is described in *intro*(3). In *call, addr* returns the protocol address associated with the responding transport endpoint, *opt* presents any protocol-specific information associated with the connection, *udata* points to optional user data that may be returned by the destination transport user during connection establishment, and *sequence* has no meaning for this function.

The *maxlen* [see *netbuf* in *intro*(3)] field of each argument must be set before issuing this function to indicate the maximum size of the buffer for each. However, *call* may be NULL, in which case no information is given to the user on return from *t_rcvconnect*. By default, *t_rcvconnect* executes in synchronous mode and waits for the connection to be established before returning. On return, the *addr, opt,* and *udata* fields reflect values associated with the connection.

If O_NDELAY is set (via *t_open* or *fcntl*), *t_rcvconnect* executes in asynchronous mode, and reduces to a poll for existing connect confirmations. If none are available, *t_rcvconnect* fails and returns immediately without waiting for the connection to be established. (See TNODATA below.) *t_rcvconnect* must be re-issued at a later time to complete the connection establishment phase and retrieve the information returned in *call*.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TBUFOVFLW] | The number of bytes allocated for an incoming argument is not sufficient to store the value of that argument and the connect information to be returned in *call* will be discarded. The provider's state, as seen by the user, will be changed to DATAXFER. |

| | |
|---|---|
| [TNODATA] | O_NDELAY was set, but a connect confirmation has not yet arrived. |
| [TLOOK] | An asynchronous event has occurred on this transport connection and requires immediate attention. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_accept(3N), t_bind(3N), t_connect(3N), t_listen(3N), t_open(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_rcvconnect* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_rcvdis − retrieve information from disconnect

## SYNOPSIS

**#include <tiuser.h>**

**t_rcvdis(fd, discon)**
**int fd;**
**struct t_discon *discon;**

## DESCRIPTION

This function is used to identify the cause of a disconnect, and to retrieve any user data sent with the disconnect. *Fd* identifies the local transport endpoint where the connection existed, and *discon* points to a *t_discon* structure containing the following members:

```
struct netbuf udata;
int reason;
int sequence;
```

*Netbuf* is described in *intro*(3). *Reason* specifies the reason for the disconnect through a protocol-dependent reason code, *udata* identifies any user data that was sent with the disconnect, and *sequence* may identify an outstanding connect indication with which the disconnect is associated. *Sequence* is only meaningful when *t_rcvdis* is issued by a passive transport user who has executed one or more *t_listen* functions and is processing the resulting connect indications. If a disconnect indication occurs, *sequence* can be used to identify which of the outstanding connect indications is associated with the disconnect.

If a user does not care if there is incoming data and does not need to know the value of *reason* or *sequence, discon* may be NULL and any user data associated with the disconnect will be discarded. However, if a user has retrieved more than one outstanding connect indication (via *t_listen*) and *discon* is NULL, the user will be unable to identify with which connect indication the disconnect is associated.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TNODIS] | No disconnect indication currently exists on the specified transport endpoint. |
| [TBUFOVFLW] | The number of bytes allocated for incoming data is not sufficient to store the data. The provider's state, as seen by the user, will change to T_IDLE, and the disconnect indication information to be returned in *discon* will be discarded. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_connect(3N), t_listen(3N), t_open(3N), t_snddis(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_rcvdis* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_rcvrel – acknowledge receipt of an orderly release indication

## SYNOPSIS

**#include <tiuser.h>**

**t_rcvrel(fd)**
**int fd;**

## DESCRIPTION

This function is used to acknowledge receipt of an orderly release indication. *Fd* identifies the local transport endpoint where the connection exists. After receipt of this indication, the user may not attempt to receive more data because such an attempt will block forever. However, the user may continue to send data over the connection if *t_sndrel* has not been issued by the user.

This function is an optional service of the transport provider, and is only supported if the transport provider returned service type T_COTS_ORD on *t_open* or *t_getinfo*.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TNOREL] | No orderly release indication currently exists on the specified transport endpoint. |
| [TLOOK] | An asynchronous event has occurred on this transport endpoint and requires immediate attention. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

t_open(3N), t_sndrel(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_rcvrel* returns 0 on success and -1 on failure *t_errno* is set to indicate the error.

## NAME

t_rcvudata − receive a data unit

## SYNOPSIS

**#include <tiuser.h>**

**int t_rcvudata(fd, unitdata, flags)**
**int fd;**
**struct t_unitdata *unitdata;**
**int *flags;**

## DESCRIPTION

This function is used in connectionless mode to receive a data unit from another transport user. *Fd* identifies the local transport endpoint through which data will be received, *unitdata* holds information associated with the received data unit, and *flags* is set on return to indicate that the complete data unit was not received. *Unitdata* points to a *t_unitdata* structure containing the following members:

```
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
```

The *maxlen* [see *netbuf*in *intro*(3)] field of *addr, opt,* and *udata* must be set before issuing this function to indicate the maximum size of the buffer for each.

On return from this call, *addr* specifies the protocol address of the sending user, *opt* identifies protocol-specific options that were associated with this data unit, and *udata* specifies the user data that was received.

By default, *t_rcvudata* operates in synchronous mode and will wait for a data unit to arrive if none is currently available. However, if O_NDELAY is set (via *t_open* or *fcntl*), *t_rcvudata* will execute in asynchronous mode and will fail if no data units are available.

If the buffer defined in the *udata* field of *unitdata* is not large enough to hold the current data unit, the buffer will be filled and T_MORE will be set in *flags* on return to indicate that another *t_rcvudata* should be issued to retrieve the rest of the data unit. Subsequent *t_rcvudata* call(s) will return zero for the length of the address and options until the full data unit has been received.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TNODATA] | O_NDELAY was set, but no data units are currently available from the transport provider. |
| [TBUFOVFLW] | The number of bytes allocated for the incoming protocol address or options is not sufficient to store the information. The unit data information to be returned in *unitdata* will be discarded. |
| [TLOOK] | An asynchronous event has occurred on this transport endpoint and requires immediate attention. |

| | |
|---|---|
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_rcvuderr(3N), t_sndudata(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_rcvudata* returns 0 on successful completion and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_rcvuderr – receive a unit data error indication

## SYNOPSIS

**#include <tiuser.h>**

**int t_rcvuderr(fd, uderr)**
**int fd;**
**struct t_uderr *uderr;**

## DESCRIPTION

This function is used in connectionless mode to receive information concerning an error on a previously sent data unit, and should only be issued following a unit data error indication. It informs the transport user that a data unit with a specific destination address and protocol options produced an error. *Fd* identifies the local transport endpoint through which the error report will be received, and *uderr* points to a *t_uderr* structure containing the following members:

```
    struct netbuf addr;        struct netbuf opt;        long    error;
```

*Netbuf* is described in *intro*(3). The *maxlen* [see *netbuf* in *intro*(3)] field of *addr* and *opt* must be set before issuing this function to indicate the maximum size of the buffer for each.

On return from this call, the *addr* structure specifies the destination protocol address of the erroneous data unit, the *opt* structure identifies protocol-specific options that were associated with the data unit, and *error* specifies a protocol-dependent error code.

If the user does not care to identify the data unit that produced an error, *uderr* may be set to NULL and *t_rcvuderr* will simply clear the error indication without reporting any information to the user.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TNOUDERR] | No unit data error indication currently exists on the specified transport endpoint. |
| [TBUFOVFLW] | The number of bytes allocated for the incoming protocol address or options is not sufficient to store the information. The unit data error information to be returned in *uderr* will be discarded. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_rcvudata(3N), t_sndudata(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_rcvuderr* returns 0 on successful completion and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_snd − send data or expedited data over a connection

## SYNOPSIS

```
#include <tiuser.h>

int t_snd(fd, buf, nbytes, flags)
int fd;
char *buf;
unsigned nbytes;
int flags;
```

## DESCRIPTION

This function is used to send either normal or expedited data. *Fd* identifies the local transport endpoint over which data should be sent, *buf* points to the user data, *nbytes* specifies the number of bytes of user data to be sent, and *flags* specifies any optional flags described below.

By default, *t_snd* operates in synchronous mode and may wait if flow control restrictions prevent the data from being accepted by the local transport provider at the time the call is made. However, if O_NDELAY is set (via *t_open* or *fcntl*), *t_snd* will execute in asynchronous mode, and will fail immediately if there are flow control restrictions.

On successful completion, *t_snd* returns the number of bytes accepted by the transport provider. Normally this will equal the number of bytes specified in *nbytes*. However, if O_NDELAY is set, it is possible that only part of the data will be accepted by the transport provider. In this case, *t_snd* will set T_MORE for the data that was sent (see below) and will return a value less than *nbytes*. If *nbytes* is zero, no data will be passed to the provider and *t_snd* will return zero.

If T_EXPEDITED is set in *flags*, the data will be sent as expedited data, and will be subject to the interpretations of the transport provider.

If T_MORE is set in *flags*, or set as described above, an indication is sent to the transport provider that the transport service data unit (TSDU) (or expedited transport service data unit - ETSDU) is being sent through multiple *t_snd* calls. Each *t_snd* with the T_MORE flag set indicates that another *t_snd* will follow with more data for the current TSDU. The end of the TSDU (or ETSDU) is identified by a *t_snd* call with the T_MORE flag not set. Use of T_MORE enables a user to break up large logical data units without losing the boundaries of those units at the other end of the connection. The flag implies nothing about how the data is packaged for transfer below the transport interface. If the transport provider does not support the concept of a TSDU as indicated in the *info* argument on return from *t_open* or *t_getinfo*, the T_MORE flag is not meaningful and should be ignored.

The size of each TSDU or ETSDU must not exceed the limits of the transport provider as returned by *t_open* or *t_getinfo*. Failure to comply will result in protocol error EPROTO. (See TSYSERR below.)

If *t_snd* is issued from the T_IDLE state, the provider may silently discard the data. If *t_snd* is issued from any state other than T_DATAXFER or T_IDLE, the provider will generate an EPROTO error.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TFLOW] | O_NDELAY was set, but the flow control mechanism prevented the transport provider from accepting data at this time. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

t_open(3N), t_rcv(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

On successful completion, *t_snd* returns the number of bytes accepted by the transport provider, and it returns -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_snddis — send user-initiated disconnect request

## SYNOPSIS

**#include <tiuser.h>**

**int t_snddis(fd, call)**
**int fd;**
**struct t_call *call;**

## DESCRIPTION

This function is used to initiate an abortive release on an already established connection or to reject a connect request. *Fd* identifies the local transport endpoint of the connection, and *call* specifies information associated with the abortive release. *Call* points to a *t_call* structure which contains the following members:

```
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
int sequence;
```

*Netbuf* is described in *intro*(3). The values in *call* have different semantics, depending on the context of the call to *t_snddis*. When rejecting a connect request, *call* must be non-NULL and contain a valid value of *sequence* to uniquely identify the rejected connect indication to the transport provider. The *addr* and *opt* fields of *call* are ignored. In all other cases, *call* need only be used when data is being sent with the disconnect request. The *addr*, *opt*, and *sequence* fields of the *t_call* structure are ignored. If the user does not wish to send data to the remote user, the value of *call* may be NULL.

*Udata* specifies the user data to be sent to the remote user. The amount of user data must not exceed the limits supported by the transport provider as returned by *t_open* or *t_getinfo*. If the *len* field of *udata* is zero, no data will be sent to the remote user.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TOUTSTATE] | The function was issued in the wrong sequence. The transport provider's outgoing queue may be flushed, so data may be lost. |
| [TBADDATA] | The amount of user data specified was not within the bounds allowed by the transport provider. The transport provider's outgoing queue will be flushed, so data may be lost. |
| [TBADSEQ] | An invalid sequence number was specified, or a NULL call structure was specified when rejecting a connect request. The transport provider's outgoing queue will be flushed, so data may be lost. |

| | |
|---|---|
| [TLOOK] | An asynchronous event has occurred on this transport endpoint and requires immediate attention. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_connect(3N), t_getinfo(3N), t_listen(3N), t_open(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_snddis* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_sndrel – initiate an orderly release

## SYNOPSIS

**#include <tiuser.h>**

**int t_sndrel(fd)**
**int fd;**

## DESCRIPTION

This function is used to initiate an orderly release of a transport connection and indicates to the transport provider that the transport user has no more data to send. *Fd* identifies the local transport endpoint where the connection exists. After issuing *t_sndrel,* the user may not send any more data over the connection. However, a user may continue to receive data if an orderly release indication has been received.

This function is an optional service of the transport provider, and is only supported if the transport provider returned service type T_COTS_ORD on *t_open* or *t_getinfo*.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TFLOW] | O_NDELAY was set, but the flow control mechanism prevented the transport provider from accepting the function at this time. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

t_open(3N), t_rcvrel(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_sndrel* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

t_sndudata – send a data unit

## SYNOPSIS

**#include <tiuser.h>**

**int t_sndudata(fd, unitdata)**
**int fd;**
**struct t_unitdata *unitdata;**

## DESCRIPTION

This function is used in connectionless mode to send a data unit to another transport user. *Fd* identifies the local transport endpoint through which data will be sent, and *unitdata* points to a *t_unitdata* structure containing the following members:

```
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
```

*Netbuf* is described in *intro*(3). In *unitdata, addr* specifies the protocol address of the destination user, *opt* identifies protocol-specific options that the user wants associated with this request, and *udata* specifies the user data to be sent. The user may choose not to specify what protocol options are associated with the transfer by setting the *len* field of *opt* to zero. In this case, the provider may use default options.

If the *len* field of *udata* is zero, no data unit will be passed to the transport provider; *t_sndudata* will not send zero-length data units.

By default, *t_sndudata* operates in synchronous mode and may wait if flow control restrictions prevent the data from being accepted by the local transport provider at the time the call is made. However, if O_NDELAY is set (via *t_open* or *fcntl*), *t_sndudata* will execute in asynchronous mode and will fail under such conditions.

If *t_sndudata* is issued from an invalid state, or if the amount of data specified in *udata* exceeds the TSDU size as returned by *t_open* or *t_getinfo*, the provider will generate an EPROTO protocol error. (See TSYSERR below.)

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TFLOW] | O_NDELAY was set, but the flow control mechanism prevented the transport provider from accepting data at this time. |
| [TNOTSUPPORT] | This function is not supported by the underlying transport provider. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

intro(3), t_rcvudata(3N), t_rcvuderr(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_sndudata* returns 0 on successful completion and -1 on failure *t_errno* is set to indicate the error.

## NAME

t_sync − synchronize transport library

## SYNOPSIS

**#include <tiuser.h>**

**int t_sync(fd)**
**int fd;**

## DESCRIPTION

For the transport endpoint specified by *fd, t_sync* synchronizes the data structures managed by the transport library with information from the underlying transport provider. In doing so, it can convert a raw file descriptor [obtained via *open*(2), *dup*(2), or as a result of a *fork*(2) and *exec*(2)] to an initialized transport endpoint, assuming that file descriptor referenced a transport provider. This function also allows two cooperating processes to synchronize their interaction with a transport provider.

For example, if a process *forks* a new process and issues an *exec,* the new process must issue a *t_sync* to build the private library data structure associated with a transport endpoint and to synchronize the data structure with the relevant provider information.

It is important to remember that the transport provider treats all users of a transport endpoint as a single user. If multiple processes are using the same endpoint, they should coordinate their activities so as not to violate the state of the provider. *t_sync* returns the current state of the provider to the user, thereby enabling the user to verify the state before taking further action. This coordination is only valid among cooperating processes; it is possible that a process or an incoming event could change the provider's state *after* a *t_sync* is issued.

If the provider is undergoing a state transition when *t_sync* is called, the function will fail.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor is a valid open file descriptor but does not refer to a transport endpoint. |
| [TSTATECHNG] | The transport provider is undergoing a state change. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

dup(2), exec(2), fork(2), open(2).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_sync* returns the state of the transport provider on successful completion and -1 on failure and *t_errno* is set to indicate the error. The state returned may be one of the following:

| | |
|---|---|
| T_UNBND | unbound |
| T_IDLE | idle |

| | |
|---|---|
| T_OUTCON | outgoing connection pending |
| T_INCON | incoming connection pending |
| T_DATAXFER | data transfer |
| T_OUTREL | outgoing orderly release (waiting for an orderly release indication) |
| T_INREL | incoming orderly release (waiting for an orderly release request) |

## NAME

t_unbind – disable a transport endpoint

## SYNOPSIS

**#include <tiuser.h>**

**int t_unbind(fd)**
**int fd;**

## DESCRIPTION

The *t_unbind* function disables the transport endpoint specified by *fd* which was previously bound by *t_bind* (3N). On completion of this call, no further data or events destined for this transport endpoint will be accepted by the transport provider.

On failure, *t_errno* may be set to one of the following:

| | |
|---|---|
| [TBADF] | The specified file descriptor does not refer to a transport endpoint. |
| [TOUTSTATE] | The function was issued in the wrong sequence. |
| [TLOOK] | An asynchronous event has occurred on this transport endpoint. |
| [TSYSERR] | A system error has occurred during execution of this function. |

## SEE ALSO

t_bind(3N).
*Network Programmer's Guide.*

## DIAGNOSTICS

*t_unbind* returns 0 on success and -1 on failure and *t_errno* is set to indicate the error.

## NAME

assert – verify program assertion

## SYNOPSIS

**#include <assert.h>**

**assert (expression)**
**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.

Compiling with the preprocessor option **–DNDEBUG** [see *cpp*(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

cpp(1), abort(3C).

## CAVEAT

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

char *crypt (key, salt)
char *key, *salt;

void setkey (key)
char *key;

void encrypt (block, flag)
char *block;
int flag;

char *des_crypt (key, salt)
char *key, *salt;

void des_setkey (key)
char *key;

void des_encrypt (block, flag)
char *block;
int flag;

int run_setkey (p, key)
int p[2];
char *key;

int run_crypt (offset, buffer, count, p)
long offset;
char *buffer;
unsigned int count;
int p[2];

int crypt_close(p)
int p[2];
```

## 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; this gives a 56-bit key which is set into the machine. This 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 *edflag* is zero, the argument is encrypted; if non-zero, it is decrypted.

Note that decryption is not provided in the international version of *crypt*(3X). The international version is part of the *C Programming Language Utilities,* 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 *crypt*(1), 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 *crypt*(1). *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 *crypt*(1).

*Run_setkey* returns -1 if a connection with *crypt*(1) cannot be established. This will occur on international versions of UNIX where *crypt*(1) 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.

## DIAGNOSTICS

In the international version of *crypt*(3X), a flag argument of 1 to *des_encrypt* is not accepted, and an error message is printed.

## SEE ALSO

getpass(3C), passwd(4).
crypt(1), login(1), passwd(1) in the *User's Reference Manual.*

## CAVEAT

The return value in *crypt* points to static data that are overwritten by each call.

## NAME

curses — terminal screen handling and optimization package

## SYNOPSIS

The *curses* manual page is organized as follows:

In SYNOPSIS
- compiling information
- summary of parameters used by *curses* routines
- alphabetical list of curses routines, showing their parameters

In DESCRIPTION:
- An overview of how *curses* routines should be used

In ROUTINES, descriptions of each *curses* routines, are grouped under the appropriate topics:
- Overall Screen Manipulation
- Window and Pad Manipulation
- Output
- Input
- Output Options Setting
- Input Options Setting
- Environment Queries
- Soft Labels
- Low-level Curses Access
- Terminfo-Level Manipulations
- Termcap Emulation
- Miscellaneous
- Use of **curscr**

Then come sections on:
- ATTRIBUTES
- FUNCTION CALLS
- LINE GRAPHICS

**cc** [flag ...] file ... **−lcurses** [library ...]

**#include <curses.h>** (automatically includes **<stdio.h>**, **<termio.h>**, and **<unctrl.h>**).

The parameters in the following list are not global variables, but rather this is a summary of the parameters used by the *curses* library routines. All routines return the **int** values **ERR** or **OK** unless otherwise noted. Routines that return pointers always return **NULL** on error. (**ERR**, **OK**, and **NULL** are all defined in **<curses.h>**.) Routines that return integers are not listed in the parameter list below.

**bool** bf

**char** **area,*boolnames[], *boolcodes[], *boolfnames[], *bp
**char** *cap, *capname, codename[2], erasechar, *filename, *fmt

**char** *keyname, killchar, *label, *longname
**char** *name, *numnames[ ], *numcodes[ ], *numfnames[ ]
**char** *slk_label, *str, *strnames[ ], *strcodes[ ], *strfnames[ ]
**char** *term, *tgetstr, *tigetstr, *tgoto, *tparm, *type

**chtype** attrs, ch, horch, vertch

**FILE** *infd, *outfd

**int** begin_x, begin_y, begline, bot, c, col, count
**int** dmaxcol, dmaxrow, dmincol, dminrow, *errret, fildes
**int** (*init( )), labfmt, labnum, line
**int** ms, ncols, new, newcol, newrow, nlines, numlines
**int** oldcol, oldrow, overlay
**int** p1, p2, p9, pmincol, pminrow, (*putc( )), row
**int** smaxcol, smaxrow, smincol, sminrow, start
**int** tenths, top, visibility, x, y

**SCREEN** *new, *newterm, *set_term

**TERMINAL** *cur_term, *nterm, *oterm

**va_list** varglist

**WINDOW** *curscr, *dstwin, *initscr, *newpad, *newwin, *orig
**WINDOW** *pad, *srcwin, *stdscr, *subpad, *subwin, *win

**addch**(ch)
**addstr**(str)
**attroff**(attrs)
**attron**(attrs)
**attrset**(attrs)
**baudrate**( )
**beep**( )
**box**(win, vertch, horch)
**cbreak**( )
**clear**( )
**clearok**(win, bf)
**clrtobot**( )
**clrtoeol**( )
**copywin**(srcwin, dstwin, sminrow, smincol, dminrow, dmincol,
    dmaxrow, dmaxcol, overlay)"
**curs_set**(visibility)
**def_prog_mode**( )
**def_shell_mode**( )
**del_curterm**(oterm)
**delay_output**(ms)
**delch**( )
**deleteln**( )
**delwin**(win)
**doupdate**( )
**draino**(ms)
**echo**( )
**echochar**(ch)
**endwin**( )

**erase**( )
**erasechar**( )
**filter**( )
**flash**( )
**flushinp**( )
**garbagedlines**(win, begline, numlines)
**getbegyx**(win, y, x)
**getch**( )
**getmaxyx**(win, y, x)
**getstr**(str)
**getsyx**(y, x)
**getyx**(win, y, x)
**halfdelay**(tenths)
**has_ic**( )
**has_il**( )
**idlok**(win, bf)
**inch**( )
**initscr**( )
**insch**(ch)
**insertln**( )
**intrflush**(win, bf)
**isendwin**( )
**keyname**(c)
**keypad**(win, bf)
**killchar**( )
**leaveok**(win, bf)
**longname**( )
**meta**(win, bf)
**move**(y, x)
**mvaddch**(y, x, ch)
**mvaddstr**(y, x, str)
**mvcur**(oldrow, oldcol, newrow, newcol)
**mvdelch**(y, x)
**mvgetch**(y, x)
**mvgetstr**(y, x, str)
**mvinch**(y, x)
**mvinsch**(y, x, ch)
**mvprintw**(y, x, fmt [, arg...])
**mvscanw**(y, x, fmt [, arg...])
**mvwaddch**(win, y, x, ch)
**mvwaddstr**(win, y, x, str)
**mvwdelch**(win, y, x)
**mvwgetch**(win, y, x)
**mvwgetstr**(win, y, x, str)
**mvwin**(win, y, x)
**mvwinch**(win, y, x)
**mvwinsch**(win, y, x, ch)
**mvwprintw**(win, y, x, fmt [, arg...])
**mvwscanw**(win, y, x, fmt [, arg...])

**napms**(ms)
**newpad**(nlines, ncols)
**newterm**(type, outfd, infd)
**newwin**(nlines, ncols, begin_y, begin_x)
**nl**( )
**nocbreak**( )
**nodelay**(win, bf)
**noecho**( )
**nonl**( )
**noraw**( )
**notimeout**(win, bf)
**overlay**(srcwin, dstwin)
**overwrite**(srcwin, dstwin)
**pechochar**(pad, ch)
**pnoutrefresh**(pad, pminrow, pmincol, sminrow, smincol, smaxrow, smaxcol)
**prefresh**(pad, pminrow, pmincol, sminrow, smincol, smaxrow, smaxcol)
**printw**(fmt [, arg...])
**putp**(str)
**raw**( )
**refresh**( )
**reset_prog_mode**( )
**reset_shell_mode**( )
**resetty**( )
**restartterm**(term, fildes, errret)
**ripoffline**(line, init)
**savetty**( )
**scanw**(fmt [, arg...])
**scr_dump**(filename)
**scr_init**(filename)
**scr_restore**(filename)
**scroll**(win)
**scrollok**(win, bf)
**set_curterm**(nterm)
**set_term**(new)
**setscrreg**(top, bot)
**setsyx**(y, x)
**setupterm**(term, fildes, errret)
**slk_clear**( )
**slk_init**(fmt)
**slk_label**(labnum)
**slk_noutrefresh**( )
**slk_refresh**( )
**slk_restore**( )
**slk_set**(labnum, label, fmt)
**slk_touch**( )
**standend**( )
**standout**( )
**subpad**(orig, nlines, ncols, begin_y, begin_x)
**subwin**(orig, nlines, ncols, begin_y, begin_x)

**tgetent**(bp, name)
**tgetflag**(codename)
**tgetnum**(codename)
**tgetstr**(codename, area)
**tgoto**(cap, col, row)
**tigetflag**(capname)
**tigetnum**(capname)
**tigetstr**(capname)
**touchline**(win, start, count)
**touchwin**(win)
**tparm**(str, p1, p2, ..., p9)
**tputs**(str, count, putc)
**traceoff**( )
**traceon**( )
**typeahead**(fildes)
**unctrl**(c)
**ungetch**(c)
**vidattr**(attrs)
**vidputs**(attrs, putc)
**vwprintw**(win, fmt, varglist)
**vwscanw**(win, fmt, varglist)
**waddch**(win, ch)
**waddstr**(win, str)
**wattroff**(win, attrs)
**wattron**(win, attrs)
**wattrset**(win, attrs)
**wclear**(win)
**wclrtobot**(win)
**wclrtoeol**(win)
**wdelch**(win)
**wdeleteln**(win)
**wechochar**(win, ch)
**werase**(win)
**wgetch**(win)
**wgetstr**(win, str)
**winch**(win)
**winsch**(win, ch)
**winsertln**(win)
**wmove**(win, y, x)
**wnoutrefresh**(win)
**wprintw**(win, fmt [, arg...])
**wrefresh**(win)
**wscanw**(win, fmt [, arg...])
**wsetscrreg**(win, top, bot)
**wstandend**(win)
**wstandout**(win)

DESCRIPTION

The *curses* routines give the user a terminal-independent method of updating screens with reasonable optimization.

In order to initialize the routines, the routine **initscr**() or **newterm**() must be called before any of the other routines that deal with windows and screens are used. (Three exceptions are noted where they apply.) The routine **endwin**() must be called before exiting. To get character-at-a-time input without echoing, (most interactive, screen oriented programs want this) after calling **initscr**() you should call "**cbreak**(); **noecho**();" Most programs would additionally call "**nonl**(); **intrflush (stdscr, FALSE); keypad(stdscr, TRUE);**".

Before a *curses* program is run, a terminal's tab stops should be set and its initialization strings, if defined, must be output. This can be done by executing the **tput init** command after the shell environment variable **TERM** has been exported. For further details, see *profile*(4), *tput*(1), and the "Tabs and Initialization" subsection of *terminfo*(4).

The *curses* library contains routines that manipulate data structures called *windows* that can be thought of as two-dimensional arrays of characters representing all or part of a terminal screen. A default window called **stdscr** is supplied, which is the size of the terminal screen. Others may be created with **newwin**(). Windows are referred to by variables declared as **WINDOW ***; the type **WINDOW** is defined in **<curses.h>** to be a C structure. These data structures are manipulated with routines described below, among which the most basic are **move**() and **addch**(). (More general versions of these routines are included with names beginning with **w**, allowing you to specify a window. The routines not beginning with **w** usually affect **stdscr**.) Then **refresh**() is called, telling the routines to make the user's terminal screen look like **stdscr**. The characters in a window are actually of type **chtype**, so that other information about the character may also be stored with each character.

Special windows called *pads* may also be manipulated. These are windows which are not constrained to the size of the screen and whose contents need not be displayed completely. See the description of **newpad**( ) under "Window and Pad Manipulation" for more information.

In addition to drawing characters on the screen, video attributes may be included which cause the characters to show up in modes such as underlined or in reverse video on terminals that support such display enhancements. Line drawing characters may be specified to be output. On input, *curses* is also able to translate arrow and function keys that transmit escape sequences into single values. The video attributes, line drawing characters, and input values use names, defined in **<curses.h>**, such as **A_REVERSE, ACS_HLINE,** and **KEY_LEFT.**

*curses* also defines the **WINDOW *** variable, **curscr**, which is used only for certain low-level operations like clearing and redrawing a garbaged screen. **curscr** can be used in only a few routines. If the window argument to **clearok**() is **curscr**, the next call to **wrefresh**() with any window will cause the screen to be cleared and repainted from scratch. If the window argument to **wrefresh**() is **curscr**, the screen in immediately cleared and repainted from scratch. This is how most programs would implement a "repaint-screen" function. More information on using **curscr** is provided where its use is appropriate.

The environment variables **LINES** and **COLUMNS** may be set to override **terminfo**'s idea of how large a screen is. These may be used in an AT&T Teletype 5620 layer, for example, where the size of a screen is changeable.

If the environment variable **TERMINFO** is defined, any program using *curses* will check for a local terminal definition before checking in the standard place. For example, if the environment variable **TERM** is set to **att4425**, then the compiled terminal definition is found in */usr/lib/terminfo/a/att4425*. (The **a** is copied from the first letter of **att4425** to avoid creation of huge directories.) However, if **TERMINFO** is set to *$HOME/myterms*, *curses* will first check *$HOME/myterms/a/att4425*, and, if that fails, will then check */usr/lib/terminfo/a/att4425*. This is useful for developing experimental definitions or when write permission on */usr/lib/terminfo* is not available.

The integer variables **LINES** and **COLS** are defined in **<curses.h>**, and will be filled in by **initscr**() with the size of the screen. (For more information, see the subsection "Terminfo-Level Manipulations".) The constants **TRUE** and **FALSE** have the values **1** and **0**, respectively. The constants **ERR** and **OK** are returned by routines to indicate whether the routine successfully completed. These constants are also defined in **<curses.h>**.

## ROUTINES

Many of the following routines have two or more versions. The routines prefixed with **w** require a *window* argument. The routines prefixed with **p** require a *pad* argument. Those without a prefix generally use **stdscr**.

The routines prefixed with **mv** require *y* and *x* coordinates to move to before performing the appropriate action. The **mv**() routines imply a call to **move**() before the call to the other routine. The window argument is always specified before the coordinates. *y* always refers to the row (of the window), and *x* always refers to the column. The upper left corner is always (**0**,**0**), not (**1**,**1**). The routines prefixed with **mvw** take both a *window* argument and *y* and *x* coordinates.

In each case, *win* is the window affected and *pad* is the pad affected. (**win** and **pad** are always of type **WINDOW** *.) Option-setting routines require a boolean flag *bf* with the value **TRUE** or **FALSE.** (*bf* is always of type **bool**.) The types **WINDOW**, **bool**, and **chtype** are defined in **<curses.h>**. See the SYNOPSIS for a summary of what types all variables are.

All routines return either the integer **ERR** or the integer **OK**, unless otherwise noted. Routines that return pointers always return **NULL** on error.

### Overall Screen Manipulation

**WINDOW *initscr**() — The first routine called should almost always be **initscr**(). (The exceptions are **slk_init**(), **filter**(), and **ripoffline**().) This will determine the terminal type and initialize all *curses* data structures. **initscr**() also arranges that the first call to **refresh**() will clear the screen. If errors occur, **initscr**() will write an appropriate error message to standard error and exit; otherwise, a pointer to **stdscr** is returned. If the program wants an indication of error conditions, **newterm**() should be used instead of **initscr**(). **initscr**() should only be called once per application.

**endwin**() — A program should always call **endwin**() before exiting or escaping from *curses* mode temporarily, to do a shell escape or *system*(3S) call, for example. This routine will restore *tty*(7) modes, move the cursor to the lower left corner of the screen and reset the terminal into the proper non-visual mode. To resume after a temporary escape, call **wrefresh**( ) or **doupdate**( ).

**isendwin**( )
Returns **TRUE** if **endwin**( ) has been called without any subsequent calls to **wrefresh**( ).

SCREEN ***newterm**(type, outfd, infd)
A program that outputs to more than one terminal must use **newterm**( ) for each terminal instead of **initscr**( ). A program that wants an indication of error conditions, so that it may continue to run in a line-oriented mode if the terminal cannot support a screen-oriented program, must also use this routine. **newterm**( ) should be called once for each terminal. It returns a variable of type **SCREEN*** that should be saved as a reference to that terminal. The arguments are the *type* of the terminal to be used in place of the environment variable **TERM**; *outfd*, a *stdio*(3S) file pointer for output to the terminal; and *infd*, another file pointer for input from the terminal. When it is done running, the program must also call **endwin**( ) for each terminal being used. If **newterm**( ) is called more than once for the same terminal, the first terminal referred to must be the last one for which **endwin**( ) is called.

SCREEN ***set_term**(new)
This routine is used to switch between different terminals. The screen reference *new* becomes the new current terminal. A pointer to the screen of the previous terminal is returned by the routine. This is the only routine which manipulates **SCREEN** pointers; all other routines affect only the current terminal.

## Window and Pad Manipulation

**refresh**( )
**wrefresh** (win)
These routines (or **prefresh**( ), **pnoutrefresh**( ), **wnoutrefresh**( ), or **doupdate**( )) must be called to write output to the terminal, as most other routines merely manipulate data structures. **wrefresh**( ) copies the named window to the physical terminal screen, taking into account what is already there in order to minimize the amount of information that's sent to the terminal (called optimization). **refresh**( ) does the same thing, except it uses **stdscr** as a default window. Unless **leaveok**( ) has been enabled, the physical cursor of the terminal is left at the location of the window's cursor. The number of characters output to the terminal is returned.

Note that **refresh**( ) is a macro.

**wnoutrefresh**(win)
**doupdate**()
These two routines allow multiple updates to the physical terminal screen with more efficiency than **wrefresh**() alone. How this is accomplished is described in the next paragraph.

*curses* keeps two data structures representing the terminal screen: a *physical* terminal screen, describing what is actually on the screen, and a *virtual* terminal screen, describing what the programmer wants to have on the screen. **wrefresh**() works by first calling **wnoutrefresh**(), which copys the named window to the virtual screen, and then by calling **doupdate**(), which compares the virtual screen to the physical screen and does the actual update. If the programmer wishes to output several windows at once, a series of calls to **wrefresh**() will result in alternating calls to **wnoutrefresh**() and **doupdate**(), causing several bursts of output to the screen. By first calling **wnoutrefresh**() for each window, it is then possible to call **doupdate**() once, resulting in only one burst of output, with probably fewer total characters transmitted and certainly less processor time used.

WINDOW ***newwin**(nlines, ncols, begin_y, begin_x)
Create and return a pointer to a new window with the given number of lines (or rows), *nlines*, and columns, *ncols*. The upper left corner of the window is at line *begin_y*, column *begin_x*. If either *nlines* or *ncols* is **0**, they will be set to the value of **lines**—*begin_y* and **cols**—*begin_x*. A new full-screen window is created by calling **newwin(0,0,0,0)**.

**mvwin**(win, y, x)
Move the window so that the upper left corner will be at position (*y*, *x*). If the move would cause the window to be off the screen, it is an error and the window is not moved.

WINDOW ***subwin**(orig, nlines, ncols, begin_y, begin_x)
Create and return a pointer to a new window with the given number of lines (or rows), *nlines*, and columns, *ncols*. The window is at position (*begin_y*, *begin_x*) on the screen. (This position is relative to the screen, and not to the window *orig*.) The window is made in the middle of the window *orig*, so that changes made to one window will affect both windows. When using this routine, often it will be necessary to call **touchwin**() or **touchline**() on *orig* before calling **wrefresh**().

**delwin**(win)
Delete the named window, freeing up all memory associated with it. In the case of overlapping windows, subwindows should be deleted before the main window.

WINDOW ***newpad**(nlines, ncols)

Create and return a pointer to a new pad data structure with the given number of lines (or rows), *nlines*, and columns, *ncols*. A pad is a window that is not restricted by the screen size and is not necessarily associated with a particular part of the screen. Pads can be used when a large window is needed, and only a part of the window will be on the screen at one time. Automatic refreshes of pads (e.g. from scrolling or echoing of input) do not occur. It is not legal to call **wrefresh**() with a pad as an argument; the routines **prefresh**() or **pnoutrefresh**() should be called instead. Note that these routines require additional parameters to specify the part of the pad to be displayed and the location on the screen to be used for display.

WINDOW ***subpad**(orig, nlines, ncols, begin_y, begin_x)

Create and return a pointer to a subwindow within a pad with the given number of lines (or rows), *nlines*, and columns, *ncols*. Unlike **subwin**(), which uses screen coordinates, the window is at position (*begin_y, begin_x*) on the pad. The window is made in the middle of the window *orig*, so that changes made to one window will affect both windows. When using this routine, often it will be necessary to call **touchwin**() or **touchline**() on *orig* before calling **prefresh**().

**prefresh**(pad, pminrow, pmincol, sminrow, smincol, smaxrow, smaxcol)
**pnoutrefresh**(pad, pminrow, pmincol, sminrow, smincol, smaxrow, smaxcol)

These routines are analogous to **wrefresh**() and **wnoutrefresh**() except that pads, instead of windows, are involved. The additional parameters are needed to indicate what part of the pad and screen are involved. *pminrow* and *pmincol* specify the upper left corner, in the pad, of the rectangle to be displayed. *sminrow, smincol, smaxrow,* and *smaxcol* specify the edges, on the screen, of the rectangle to be displayed in. The lower right corner in the pad of the rectangle to be displayed is calculated from the screen coordinates, since the rectangles must be the same size. Both rectangles must be entirely contained within their respective structures. Negative values of *pminrow, pmincol, sminrow,* or *smincol* are treated as if they were zero.

## Output

These routines are used to "draw" text on windows.

**addch**(ch)
**waddch**(win, ch)
**mvaddch**(y, x, ch)
**mvwaddch**(win, y, x, ch)

The character *ch* is put into the window at the current cursor position of the window and the position of the window cursor is advanced. Its function is similar to that of *putchar* (see *putc*(3S)). At the right margin, an automatic newline is performed. At the bottom of the scrolling region, if **scrollok**( ) is enabled, the scrolling region will be scrolled up one line.

If *ch* is a tab, newline, or backspace, the cursor will be moved appropriately within the window. A newline also does a **clrtoeol**( ) before moving. Tabs are considered to be at every eighth column. If *ch* is another control character, it will be drawn in the ^X notation. (Calling **winch**( ) after adding a control character will not return the control character, but instead will return the representation of the control character.)

Video attributes can be combined with a character by or-ing them into the parameter. This will result in these attributes also being set. (The intent here is that text, including attributes, can be copied from one place to another using **inch**( ) and **addch**( ).) See **standout**( ), below.

Note that *ch* is actually of type **chtype**, not a character.

Note that **addch**( ), **mvaddch**( ), and **mvwaddch**( ), are macros.

**echochar**(ch)
**wechochar**(win, ch)
**pechochar**(pad, ch)

These routines are functionally equivalent to a call to **addch**(ch) followed by a call to **refresh**( ), a call to **waddch**(win, ch) followed by a call to **wrefresh**(win), or a call to **waddch**(pad, ch) followed by a call to **prefresh**(pad). The knowledge that only a single character is being output is taken into consideration and, for non-control characters, a considerable performance gain can be seen by using these routines instead of their equivalents. In the case of **pechochar**( ), the last location of the pad on the screen is reused for the arguments to **prefresh**( ).

Note that *ch* is actually of type **chtype**, not a character.

Note that **echochar**( ) is a macro.

**addstr**(str)
**waddstr**(win, str)
**mvwaddstr**(win, y, x, str)
**mvaddstr**(y, x, str)

These routines write all the characters of the null-terminated character string *str* on the given window. This is equivalent to calling **waddch**( ) once for each character in the string.

Note that **addstr**( ), **mvaddstr**( ), and **mvwaddstr**( ) are macros.

**attroff**(attrs)
**wattroff**(win, attrs)
**attron**(attrs)
**wattron**(win, attrs)
**attrset**(attrs)
**wattrset**(win, attrs)
**standend**( )
**wstandend**(win)
**standout**( )
**wstandout**(win)

These routines manipulate the current attributes of the named window. These attributes can be any combination of **A_STANDOUT, A_REVERSE, A_BOLD, A_DIM, A_BLINK, A_UNDERLINE,** and **A_ALTCHARSET**. These constants are defined in **<curses.h>** and can be combined with the C logical OR ( | ) operator.

The current attributes of a window are applied to all characters that are written into the window with **waddch**( ). Attributes are a property of the character, and move with the character through any scrolling and insert/delete line/character operations. To the extent possible on the particular terminal, they will be displayed as the graphic rendition of the characters put on the screen.

**attrset**(attrs) sets the current attributes of the given window to *attrs*. **attroff**(attrs) turns off the named attributes without turning on or off any other attributes. **attron**(attrs) turns on the named attributes without affecting any others. **standout**( ) is the same as **attron(A_STANDOUT)**. **standend**( ) is the same as **attrset (0),** that is, it turns off all attributes.

Note that *attrs* is actually of type **chtype**, not a character.

Note that **attroff**( ), **attron**( ), **attrset**( ), **standend**( ), and **standout**( ) are macros.

**beep**( )
**flash**( )

These routines are used to signal the terminal user. **beep**( ) will sound the audible alarm on the terminal, if possible, and if not, will flash the screen (visible bell), if that is possible. **flash**( ) will flash the screen, and if that is not possible, will sound the audible signal. If neither signal is possible, nothing will happen. Nearly all terminals have an audible signal (bell or beep) but only some can flash the screen.

**box**(win, vertch, horch)
A box is drawn around the edge of the window, *win*. *vertch* and *horch* are the characters the box is to be drawn with. If *vertch* and *horch* are **0**, then appropriate default characters, **ACS_VLINE** and **ACS_HLINE**, will be used.

Note that *vertch* and *horch* are actually of type **chtype**, not characters.

**erase**()
**werase**(win)
These routines copy blanks to every position in the window.

Note that **erase**() is a macro.

**clear**()
**wclear**(win)
These routines are like **erase**() and **werase**(), but they also call **clearok**(), arranging that the screen will be cleared completely on the next call to **wrefresh**() for that window, and repainted from scratch.

Note that **clear**() is a macro.

**clrtobot**()
**wclrtobot**(win)
All lines below the cursor in this window are erased. Also, the current line to the right of the cursor, inclusive, is erased.

Note that **clrtobot**() is a macro.

**clrtoeol**()
**wclrtoeol**(win)
The current line to the right of the cursor, inclusive, is erased.

Note that **clrtoeol**() is a macro.

**delay_output**(ms)
Insert a *ms* millisecond pause in the output. It is not recommended that this routine be used extensively, because padding characters are used rather than a processor pause.

**delch**()
**wdelch**(win)
**mvdelch**(y, x)
**mvwdelch**(win, y, x)
The character under the cursor in the window is deleted. All characters to the right on the same line are moved to the left one position and the last character on the line is filled with a blank. The cursor position does not change (after moving to (*y*, *x*), if specified). (This does not imply use of the hardware "delete-character" feature.)

Note that **delch**(), **mvdelch**(), and **mvwdelch**() are macros.

**deleteln**()
**wdeleteln**(win)

The line under the cursor in the window is deleted. All lines below the current line are moved up one line. The bottom line of the window is cleared. The cursor position does not change. (This does not imply use of the hardware "delete-line" feature.)

Note that **deleteln**() is a macro.

**getyx**(win, y, x)

The cursor position of the window is placed in the two integer variables *y* and *x*. This is implemented as a macro, so no **"&"** is necessary before the variables.

**getbegyx**(win, y, x)
**getmaxyx**(win, y, x)

Like **getyx**(), these routines store the current beginning coordinates and size of the specified window.

Note that **getbegyx**() and **getmaxyx**() are macros.

**insch**(ch)
**winsch**(win, ch)
**mvwinsch**(win, y, x, ch)
**mvinsch**(y, x, ch)

The character *ch* is inserted before the character under the cursor. All characters to the right are moved one space to the right, possibly losing the rightmost character of the line. The cursor position does not change (after moving to (*y*, *x*), if specified). (This does not imply use of the hardware "insert-character" feature.)

Note that *ch* is actually of type **chtype**, not a character.

Note that **insch**(), **mvinsch**(), and **mvwinsch**() are macros.

**insertln**()
**winsertln**(win)

A blank line is inserted above the current line and the bottom line is lost. (This does not imply use of the hardware "insert-line" feature.)

Note that **insertln**() is a macro.

**move**(y, x)
**wmove**(win, y, x)

The cursor associated with the window is moved to line (row) *y*, column *x*. This does not move the physical cursor of the terminal until **refresh**() is called. The position specified is relative to the upper left corner of the window, which is (**0**, **0**).

Note that **move**() is a macro.

**overlay**(srcwin, dstwin)

**overwrite**(srcwin, dstwin)
: These routines overlay *srcwin* on top of *dstwin;* that is, all text in *srcwin* is copied into *dstwin*. *scrwin* and *dstwin* need not be the same size; only text where the two windows overlap is copied. The difference is that **overlay**( ) is non-destructive (blanks are not copied), while **overwrite**( ) is destructive.

**copywin**(srcwin, dstwin, sminrow, smincol, dminrow, dmincol, dmaxrow, dmaxcol, overlay)
: This routine provides a finer grain of control over the **overlay**( ) and **overwrite**( ) routines. Like in the **prefresh**( ) routine, a rectangle is specified in the destination window, (*dminrow, dmincol*) and (*dmaxrow, dmaxcol*), and the upper-left-corner coordinates of the source window, (*sminrow, smincol*). If the argument *overlay* is true, then copying is non-destructive, as in **overlay**( ).

**printw**(fmt [, arg...])
**wprintw**(win, fmt [, arg...])
**mvprintw**(y, x, fmt [, arg...])
**mvwprintw**(win, y, x, fmt [, arg...])
: These routines are analogous to **printf**(3). The string which would be output by **printf**(3) is instead output using **waddstr**( ) on the given window.

**vwprintw**(win, fmt, varglist)
: This routine corresponds to *vfprintf*(3S). It performs a **wprintw**( ) using a variable argument list. The third argument is a *va_list*, a pointer to a list of arguments, as defined in **<varargs.h>**. See the *vprintf*(3S) and *varargs*(5) manual pages for a detailed description on how to use variable argument lists.

**scroll**(win)
: The window is scrolled up one line. This involves moving the lines in the window data structure. As an optimization, if the window is **stdscr** and the scrolling region is the entire window, the physical screen will be scrolled at the same time.

**touchwin**(win)
**touchline**(win, start, count)
: Throw away all optimization information about which parts of the window have been touched, by pretending that the entire window has been drawn on. This is sometimes necessary when using overlapping windows, since a change to one window will affect the other window, but the records of which lines have been changed in the other window will not reflect the change. **touchline**( ) only pretends that *count* lines have been changed, beginning with line *start* .

**Input**

**getch**()
**wgetch**(win)
**mvgetch**(y, x)
**mvwgetch**(win, y, x) A character is read from the terminal associated with the window. In NODELAY mode, if there is no input waiting, the value **ERR** is returned. In DELAY mode, the program will hang until the system passes text through to the program. Depending on the setting of **cbreak**(), this will be after one character (CBREAK mode), or after the first newline (NOCBREAK mode). In HALF-DELAY mode, the program will hang until a character is typed or the specified timeout has been reached. Unless **noecho**() has been set, the character will also be echoed into the designated window. No **refresh**() will occur between the **move**() and the **getch**() done within the routines **mvgetch**() and **mvwgetch**().

When using **getch**(), **wgetch**(), **mvgetch**(), or **mvwgetch**(), do not set both NOCBREAK mode (**nocbreak**()) and ECHO mode (**echo**()) at the same time. Depending on the state of the *tty*(7) driver when each character is typed, the program may produce undesirable results.

If **keypad**(win, **TRUE**) has been called, and a function key is pressed, the token for that function key will be returned instead of the raw characters. (See **keypad**() under "Input Options Setting.") Possible function keys are defined in **<curses.h>** with integers beginning with **0401**, whose names begin with **KEY_**. If a character is received that could be the beginning of a function key (such as escape), *curses* will set a timer. If the remainder of the sequence is not received within the designated time, the character will be passed through, otherwise the function key value will be returned. For this reason, on many terminals, there will be a delay after a user presses the escape key before the escape is returned to the program. (Use by a programmer of the escape key for a single character routine is discouraged. Also see **notimeout**() below.)

Note that **getch**(), **mvgetch**(), and **mvwgetch**() are macros.

**getstr**(str)
**wgetstr**(win, str)
**mvgetstr**(y, x, str)
**mvwgetstr**(win, y, x, str)

A series of calls to **getch**() is made, until a newline, carriage return, or enter key is received. The resulting value is placed in the area pointed at by the character pointer *str*. The user's erase and kill characters are interpreted. As in **mvgetch**(), no **refresh**() is done between the **move**() and **getstr**() within the routines **mvgetstr**() and **mvwgetstr**().

Note that **getstr**(), **mvgetstr**(), and **mvwgetstr**() are macros.

**flushinp**()
Throws away any typeahead that has been typed by the user and has not yet been read by the program.

**ungetch**(c)
Place *c* back onto the input queue to be returned by the next call to **wgetch**().

**inch**()
**winch**(win)
**mvinch**(y, x)
**mvwinch**(win, y, x)
The character, of type **chtype**, at the current position in the named window is returned. If any attributes are set for that position, their values will be OR'ed into the value returned. The predefined constants **A_CHARTEXT** and **A_ATTRIBUTES**, defined in **<curses.h>**, can be used with the C logical AND (&) operator to extract the character or attributes alone.

Note that **inch**(), **winch**(), **mvinch**(), and **mvwinch**() are macros.

**scanw**(fmt [, arg...])
**wscanw**(win, fmt [, arg...])
**mvscanw**(y, x, fmt [, arg...])
**mvwscanw**(win, y, x, fmt [, arg...])
These routines correspond to *scanf*(3S), as do their arguments and return values. **wgetstr**() is called on the window, and the resulting line is used as input for the scan.

**vwscanw**(win, fmt, ap)
This routine is similar to **vwprintw**() above in that performs a **wscanw**() using a variable argument list. The third argument is a *va_list*, a pointer to a list of arguments, as defined in **<varargs.h>**. See the *vprintf*(3S) and *varargs*(5) manual pages for a detailed description on how to use variable argument lists.

## Output Options Setting

These routines set options within *curses* that deal with output. All options are initially FALSE, unless otherwise stated. It is not necessary to turn these options off before calling **endwin**().

**clearok**(win, bf)
If enabled (*bf* is **TRUE**), the next call to **wrefresh**() with this window will clear the screen completely and redraw the entire screen from scratch. This is useful when the

contents of the screen are uncertain, or in some cases for a more pleasing visual effect.

**idlok**(win, bf)
: If enabled (*bf* is **TRUE**), *curses* will consider using the hardware "insert/delete-line" feature of terminals so equipped. If disabled (*bf* is FALSE), *curses* will very seldom use this feature. (The "insert/delete-character" feature is always considered.) This option should be enabled only if your application needs "insert/delete-line", for example, for a screen editor. It is disabled by default because "insert/delete-line" tends to be visually annoying when used in applications where it isn't really needed. If "insert/delete-line" cannot be used, *curses* will redraw the changed portions of all lines.

**leaveok**(win, bf)
: Normally, the hardware cursor is left at the location of the window cursor being refreshed. This option allows the cursor to be left wherever the update happens to leave it. It is useful for applications where the cursor is not used, since it reduces the need for cursor motions. If possible, the cursor is made invisible when this option is enabled.

**setscrreg**(top, bot)
**wsetscrreg**(win, top, bot)
: These routines allow the user to set a software scrolling region in a window. *top* and *bot* are the line numbers of the top and bottom margin of the scrolling region. (Line 0 is the top line of the window.) If this option and **scrollok**( ) are enabled, an attempt to move off the bottom margin line will cause all lines in the scrolling region to scroll up one line. (Note that this has nothing to do with use of a physical scrolling region capability in the terminal, like that in the DEC VT100. Only the text of the window is scrolled; if **idlok**( ) is enabled and the terminal has either a scrolling region or "insert/delete-line" capability, they will probably be used by the output routines.)

: Note that **setscrreg**( ) and **wsetscrreg**( ) are macros.

**scrollok**(win, bf)
: This option controls what happens when the cursor of a window is moved off the edge of the window or scrolling region, either from a newline on the bottom line, or typing the last character of the last line. If disabled (*bf* is **FALSE**), the cursor is left on the bottom line at the location where the offending character was entered. If enabled (*bf* is **TRUE**), **wrefresh**( ) is called on the window, and then the physical terminal and window are scrolled up one line. (Note that in order to get the physical scrolling effect on the terminal, it is also necessary to call **idlok**( ).)

**nl()**
**nonl()** These routines control whether newline is translated into carriage return and linefeed on output, and whether return is translated into newline on input. Initially, the translations do occur. By disabling these translations using **nonl()**, *curses* is able to make better use of the linefeed capability, resulting in faster cursor motion.

### Input Options Setting

These routines set options within *curses* that deal with input. The options involve using *ioctl*(2) and therefore interact with *curses* routines. It is not necessary to turn these options off before calling **endwin()**.

For more information on these options, see Chapter 10 of the *Programmer's Guide*.

**cbreak()**
**nocbreak()** These two routines put the terminal into and out of CBREAK mode, respectively. In CBREAK mode, characters typed by the user are immediately available to the program and erase/kill character processing is not performed. When in NOCBREAK mode, the tty driver will buffer characters typed until a newline or carriage return is typed. Interrupt and flow-control characters are unaffected by this mode (see *termio*(7)). Initially the terminal may or may not be in CBREAK mode, as it is inherited, therefore, a program should call **cbreak()** or **nocbreak()** explicitly. Most interactive programs using *curses* will set CBREAK mode.

Note that **cbreak()** overrides **raw()**. See **getch()** under "Input" for a discussion of how these routines interact with **echo()** and **noecho()**.

**echo()**
**noecho()** These routines control whether characters typed by the user are echoed by **getch()** as they are typed. Echoing by the tty driver is always disabled, but initially **getch()** is in ECHO mode, so characters typed are echoed. Authors of most interactive programs prefer to do their own echoing in a controlled area of the screen, or not to echo at all, so they disable echoing by calling **noecho()**. See **getch()** under "Input" for a discussion of how these routines interact with **cbreak()** and **nocbreak()**.

**halfdelay**(tenths) Half-delay mode is similar to CBREAK mode in that characters typed by the user are immediately available to the program. However, after blocking for *tenths* tenths of seconds, ERR will be returned if nothing has been typed. *tenths* must be a number between 1 and 255. Use **nocbreak()** to leave half-delay mode.

**intrflush**(win, bf) If this option is enabled, when an interrupt key is pressed on the keyboard (interrupt, break, quit) all output in the tty driver queue will be flushed, giving the effect of faster response to the interrupt, but causing *curses* to have the wrong idea of what is on the screen. Disabling the option prevents the flush. The default for the option is inherited from the tty driver settings. The window argument is ignored.

**keypad**(win, bf) This option enables the keypad of the user's terminal. If enabled, the user can press a function key (such as an arrow key) and **wgetch**( ) will return a single value representing the function key, as in **KEY_LEFT**. If disabled, *curses* will not treat function keys specially and the program would have to interpret the escape sequences itself. If the keypad in the terminal can be turned on (made to transmit) and off (made to work locally), turning on this option will cause the terminal keypad to be turned on when **wgetch**( ) is called.

**meta**(win, bf) If enabled, characters returned by **wgetch**( ) are transmitted with all 8 bits, instead of with the highest bit stripped. In order for **meta**( ) to work correctly, the **km** (has_meta_key) capability has to be specified in the terminal's **terminfo**(4) entry.

**nodelay**(win, bf) This option causes **wgetch**( ) to be a non-blocking call. If no input is ready, **wgetch**( ) will return ERR. If disabled, **wgetch**( ) will hang until a key is pressed.

**notimeout**(win, bf) While interpreting an input escape sequence, **wgetch**( ) will set a timer while waiting for the next character. If **notimeout**(win, **TRUE**) is called, then **wgetch**( ) will not set a timer. The purpose of the timeout is to differentiate between sequences received from a function key and those typed by a user.

**raw**( )
**noraw**( ) The terminal is placed into or out of raw mode. RAW mode is similar to CBREAK mode, in that characters typed are immediately passed through to the user program. The differences are that in RAW mode, the interrupt, quit, suspend, and flow control characters are passed through uninterpreted, instead of generating a signal. RAW mode also causes 8-bit input and output. The behavior of the BREAK key depends on other bits in the *tty*(7) driver that are not set by *curses*.

**typeahead**(fildes) *curses* does "line-breakout optimization" by looking for typeahead periodically while updating the screen. If input is found, and it is coming from a tty, the current update will be postponed until **refresh**( ) or **doupdate**( ) is called again. This allows faster response to commands typed in advance. Normally, the file descriptor for the input FILE pointer passed to **newterm**(), or **stdin** in the case that **initscr**() was used, will be used to do this typeahead checking. The **typeahead**() routine specifies that the file descriptor *fildes* is to be used to check for typeahead instead. If *fildes* is **−1**, then no typeahead checking will be done.

Note that *fildes* is a file descriptor, not a **<stdio.h>** FILE pointer.

Environment Queries

**baudrate**() — Returns the output speed of the terminal. The number returned is in bits per second, for example, 9600, and is an integer.

**char erasechar**() — The user's current erase character is returned.

**has_ic**() — True if the terminal has insert- and delete-character capabilities.

**has_il**() — True if the terminal has insert- and delete-line capabilities, or can simulate them using scrolling regions. This might be used to check to see if it would be appropriate to turn on physical scrolling using **scrollok**().

**char killchar**() — The user's current line-kill character is returned.

**char *longname**() — This routine returns a pointer to a static area containing a verbose description of the current terminal. The maximum length of a verbose description is 128 characters. It is defined only after the call to **initscr**() or **newterm**(). The area is overwritten by each call to **newterm**() and is not restored by **set_term**(), so the value should be saved between calls to **newterm**() if **longname**() is going to be used with multiple terminals.

**Soft Labels**

If desired, *curses* will manipulate the set of soft function-key labels that exist on many terminals. For those terminals that do not have soft labels, if you want to simulate them, *curses* will take over the bottom line of **stdscr**, reducing the size of **stdscr** and the variable **LINES**. *curses* standardizes on 8 labels of 8 characters each.

**slk_init**(labfmt) — In order to use soft labels, this routine must be called before **initscr**() or **newterm**() is called. If **initscr**() winds up using a line from **stdscr** to emulate the soft labels, then *labfmt* determines how the labels are arranged on the screen. Setting *labfmt* to **0** indicates that the labels are to be arranged in a 3-2-3 arrangement; **1** asks for a 4-4 arrangement.

**slk_set**(labnum, label, labfmt)

*labnum* is the label number, from 1 to 8. *label* is the string to be put on the label, up to 8 characters in length. A

NULL string or a NULL pointer will put up a blank label. *labfmt* is one of **0**, **1** or **2**, to indicate whether the label is to be left-justified, centered, or right-justified within the label.

**slk_refresh**( )
**slk_noutrefresh**( ) These routines correspond to the routines **wrefresh**( ) and **wnoutrefresh**( ). Most applications would use **slk_noutrefresh**( ) because a **wrefresh**( ) will most likely soon follow.

**char *slk_label**(labnum)
The current label for label number *labnum*, with leading and trailing blanks stripped, is returned.

**slk_clear**( ) The soft labels are cleared from the screen.

**slk_restore**( ) The soft labels are restored to the screen after a **slk_clear**( ).

**slk_touch**( ) All of the soft labels are forced to be output the next time a **slk_noutrefresh**( ) is performed.

**Low-Level** *curses* **Access**

The following routines give low-level access to various *curses* functionality. These routines typically would be used inside of library routines.

**def_prog_mode**( )
**def_shell_mode**( ) Save the current terminal modes as the "program" (in **curses**) or "shell" (not in **curses**) state for use by the **reset_prog_mode**( ) and **reset_shell_mode**( ) routines. This is done automatically by **initscr**( ).

**reset_prog_mode**( )
**reset_shell_mode**( ) Restore the terminal to "program" (in **curses**) or "shell" (out of *curses*) state. These are done automatically by **endwin**( ) and **doupdate**( ) after an **endwin**( ), so they normally would not be called.

**resetty**( )
**savetty**( ) These routines save and restore the state of the terminal modes. **savetty**( ) saves the current state of the terminal in a buffer and **resetty**( ) restores the state to what it was at the last call to **savetty**( ).

**getsyx**(y, x) The current coordinates of the virtual screen cursor are returned in *y* and *x*. Like **getyx**( ), the variables *y* and *x* do not take an "**&**" before them. If **leaveok**( ) is currently **TRUE**, then **−1**,**−1** will be returned. If lines may have been removed from the top of the screen using **ripoffline**( ) and the values are to be used beyond just passing them on to **setsyx**( ), the value *y*+**stdscr−>_yoffset** should be used for those other uses.

Note that **getsyx**( ) is a macro.

**setsyx**(y, x) — The virtual screen cursor is set to *y*, *x*. If *y* and *x* are both **−1**, then **leaveok**( ) will be set. The two routines **getsyx**( ) and **setsyx**( ) are designed to be used by a library routine which manipulates curses windows but does not want to mess up the current position of the program's cursor. The library routine would call **getsyx**( ) at the beginning, do its manipulation of its own windows, do a **wnoutrefresh**( ) on its windows, call **setsyx**( ), and then call **doupdate**( ).

**ripoffline**(line, init) — This routine provides access to the same facility that **slk_init**( ) uses to reduce the size of the screen. **ripoffline**( ) must be called before **initscr**( ) or **newterm**( ) is called. If *line* is positive, a line will be removed from the top of **stdscr**; if negative, a line will be removed from the bottom. When this is done inside **initscr**( ), the routine *init*( ) is called with two arguments: a window pointer to the 1-line window that has been allocated and an integer with the number of columns in the window. Inside this initialization routine, the integer variables **LINES** and **COLS** (defined in **<curses.h>**) are not guaranteed to be accurate and **wrefresh**( ) or **doupdate**( ) must not be called. It is allowable to call **wnoutrefresh**( ) during the initialization routine.

**ripoffline**( ) can be called up to five times before calling **initscr**( ) or **newterm**( ).

**scr_dump**(filename) — The current contents of the virtual screen are written to the file *filename*.

**scr_restore**(filename) — The virtual screen is set to the contents of *filename*, which must have been written using **scr_dump**( ). The next call to **doupdate**( ) will restore the screen to what it looked like in the dump file.

**scr_init**(filename) — The contents of *filename* are read in and used to initialize the *curses* data structures about what the terminal currently has on its screen. If the data is determined to be valid, *curses* will base its next update of the screen on this information rather than clearing the screen and starting from scratch. **scr_init**( ) would be used after **initscr**( ) or a *system*(3S) call to share the screen with another process which has done a **scr_dump**( ) after its **endwin**( ) call. The data will be declared invalid if the time-stamp of the tty is old or the *terminfo*(4) capability **nrrmc** is true.

**curs_set**(visibility) — The cursor is set to invisible, normal, or very visible for *visibility* equal to **0**, **1** or **2**.

**draino**(ms) — Wait until the output has drained enough that it will only take *ms* more milliseconds to drain completely.

**garbagedlines**(win, begline, numlines)
This routine indicates to *curses* that a screen line is garbaged and should be thrown away before having anything written over the top of it. It could be used for programs such as editors which want a command to redraw just a single line. Such a command could be used in cases where there is a noisy communications line and redrawing the entire screen would be subject to even more communication noise. Just redrawing the single line gives some semblance of hope that it would show up unblemished. The current location of the window is used to determine which lines are to be redrawn.

**napms**(ms) Sleep for *ms* milliseconds.

### Terminfo-Level Manipulations

These low-level routines must be called by programs that need to deal directly with the *terminfo*(4) database to handle certain terminal capabilities, such as programming function keys. For all other functionality, *curses* routines are more suitable and their use is recommended.

Initially, **setupterm**( ) should be called. (Note that **setupterm**( ) is automatically called by **initscr**( ) and **newterm**( ).) This will define the set of terminal-dependent variables defined in the *terminfo*(4) database. The *terminfo*(4) variables **lines** and **columns** (see *terminfo*(4)) are initialized by **setupterm**( ) as follows: if the environment variables **LINES** and **COLUMNS** exist, their values are used. If the above environment variables do not exist and the program is running in a layer (see *layers*(1)), the size of the current layer is used. Otherwise, the values for **lines** and **columns** specified in the *terminfo*(4) database are used.

The header files **<curses.h>** and **<term.h>** should be included, in this order, to get the definitions for these strings, numbers, and flags. Parameterized strings should be passed through **tparm**( ) to instantiate them. All *terminfo*(4) strings (including the output of **tparm**( )) should be printed with **tputs**( ) or **putp**( ). Before exiting, **reset_shell_mode**( ) should be called to restore the tty modes. Programs which use cursor addressing should output **enter_ca_mode** upon startup and should output **exit_ca_mode** before exiting (see *terminfo*(4)). (Programs desiring shell escapes should call **reset_shell_mode**( ) and output **exit_ca_mode** before the shell is called and should output **enter_ca_mode** and call **reset_prog_mode**( ) after returning from the shell. Note that this is different from the *curses* routines (see **endwin**( )).

**setupterm**(term, fildes, errret)
Reads in the *terminfo*(4) database, initializing the *terminfo*(4) structures, but does not set up the output virtualization structures used by *curses*. The terminal type is in the character string *term;* if *term* is **NULL**, the environment variable **TERM** will be used. All output is to the file descriptor *fildes*. If *errret* is not **NULL**, then **setupterm**( ) will return **OK** or **ERR** and store a status value in the integer pointed to by *errret*. A status of **1** in *errret* is normal, **0** means that the terminal could not be found, and

**−1** means that the *terminfo*(4) database could not be found. If *errret* is **NULL, setupterm**( ) will print an error message upon finding an error and exit. Thus, the simplest call is **setupterm ((char *)0, 1, (int *)0)**, which uses all the defaults.

The *terminfo*(4) boolean, numeric and string variables are stored in a structure of type **TERMINAL**. After **setupterm**( ) returns successfully, the variable **cur_term** (of type **TERMINAL ***) is initialized with all of the information that the *terminfo*(4) boolean, numeric and string variables refer to. The pointer may be saved before calling **setupterm**( ) again. Further calls to **setupterm**( ) will allocate new space rather than reuse the space pointed to by **cur_term**.

**set_curterm**(nterm) *nterm* is of type **TERMINAL ***. **set_curterm**( ) sets the variable **cur_term** to *nterm*, and makes all of the *terminfo*(4) boolean, numeric and string variables use the values from *nterm*.

**del_curterm**(oterm) *oterm* is of type **TERMINAL ***. **del_curterm**( ) frees the space pointed to by *oterm* and makes it available for further use. If *oterm* is the same as **cur_term**, then references to any of the *terminfo*(4) boolean, numeric and string variables thereafter may refer to invalid memory locations until another **setupterm**( ) has been called.

**restartterm**(term, fildes, errret)
Like **setupterm**( ) after a memory restore.

**char *tparm**(str, $p_1$, $p_2$, ..., $p_9$)
Instantiate the string *str* with parms $p_i$. A pointer is returned to the result of *str* with the parameters applied.

**tputs**(str, count, putc)
Apply padding to the string *str* and output it. *str* must be a *terminfo*(4) string variable or the return value from **tparm**( ), **tgetstr**( ), **tigetstr**( ) or **tgoto**( ). *count* is the number of lines affected, or **1** if not applicable. *putc*( ) is a *putchar*(3S)-like routine to which the characters are passed, one at a time.

**putp**(str) A routine that calls **tputs** (*str*, **1**, **putchar**( )).

**vidputs**(attrs, putc) Output a string that puts the terminal in the video attribute mode *attrs*, which is any combination of the attributes listed below. The characters are passed to the *putchar*(3S)-like routine *putc*( ).

**vidattr**(attrs) Like **vidputs**( ), except that it outputs through *putchar*(3S).

**mvcur**(oldrow, oldcol, newrow, newcol)
Low-level cursor motion.

The following routines return the value of the capability corresponding to the *terminfo*(4) *capname* passed to them, such as **xenl**.

**tigetflag**(capname) The value **−1** is returned if *capname* is not a boolean capability.

**tigetnum**(capname) The value **−2** is returned if *capname* is not a numeric capability.

**tigetstr**(capname) The value (char *) **−1** is returned if *capname* is not a string capability.

**char *boolnames[], *boolcodes[], *boolfnames[]**
**char *numnames[], *numcodes[], *numfnames[]**
**char *strnames[], *strcodes[], *strfnames[]**

These null-terminated arrays contain the *capnames*, the *termcap* codes, and the full C names, for each of the *terminfo*(4) variables.

## Termcap Emulation

These routines are included as a conversion aid for programs that use the *termcap* library. Their parameters are the same and the routines are emulated using the *terminfo*(4) database.

**tgetent**(bp, name) Look up *termcap* entry for *name*. The emulation ignores the buffer pointer *bp*.

**tgetflag**(codename) Get the boolean entry for *codename*.

**tgetnum**(codes) Get numeric entry for *codename*.

**char *tgetstr**(codename, area)

Return the string entry for *codename*. If *area* is not **NULL**, then also store it in the buffer pointed to by *area* and advance *area*. **tputs**() should be used to output the returned string.

**char *tgoto**(cap, col, row)

Instantiate the parameters into the given capability. The output from this routine is to be passed to **tputs**().

**tputs**(str, affcnt, putc)

See **tputs**() above, under "Terminfo-Level Manipulations".

## Miscellaneous

**traceoff**()
**traceon**() Turn off and on debugging trace output when using the debug version of the *curses* library, */usr/lib/libdcurses.a*. This facility is available only to customers with a source license.

**unctrl**(c) This macro expands to a character string which is a printable representation of the character *c*. Control characters are displayed in the ^X notation. Printing characters are displayed as is.

| | |
|---|---|
| | **unctrl**( ) is a macro, defined in <**unctrl.h**>, which is automatically included by <**curses.h**>. |
| **char *keyname**(c) | A character string corresponding to the key *c* is returned. |
| **filter**( ) | This routine is one of the few that is to be called before **initscr**( ) or **newterm**( ) is called. It arranges things so that *curses* thinks that there is a 1-line screen. *curses* will not use any terminal capabilities that assume that they know what line on the screen the cursor is on. |

### Use of curscr

The special window **curscr** can be used in only a few routines. If the window argument to **clearok**( ) is **curscr**, the next call to **wrefresh**( ) with any window will cause the screen to be cleared and repainted from scratch. If the window argument to **wrefresh**( ) is **curscr**, the screen is immediately cleared and repainted from scratch. (This is how most programs would implement a "repaint-screen" routine.) The source window argument to **overlay**( ), **overwrite**( ), and **copywin**( ) may be **curscr**, in which case the current contents of the virtual terminal screen will be accessed.

### Obsolete Calls

Various routines are provided to maintain compatibility in programs written for older versions of the curses library. These routines are all emulated as indicated below.

| | |
|---|---|
| **crmode**( ) | Replaced by **cbreak**( ). |
| **fixterm**( ) | Replaced by **reset_prog_mode**( ). |
| **gettmode**( ) | A no-op. |
| **nocrmode**( ) | Replaced by **nocbreak**( ). |
| **resetterm**( ) | Replaced by **reset_shell_mode**( ). |
| **saveterm**( ) | Replaced by **def_prog_mode**( ). |
| **setterm**( ) | Replaced by **setupterm**( ). |

## ATTRIBUTES

The following video attributes, defined in <**curses.h**>, can be passed to the routines **attron**( ), **attroff**( ), and **attrset**( ), or OR'ed with the characters passed to **addch**( ).

| | |
|---|---|
| A_STANDOUT | Terminal's best highlighting mode |
| A_UNDERLINE | Underlining |
| A_REVERSE | Reverse video |
| A_BLINK | Blinking |
| A_DIM | Half bright |
| A_BOLD | Extra bright or bold |
| A_ALTCHARSET | Alternate character set |
| A_CHARTEXT | Bit-mask to extract character (described under **winch**( )) |

| | |
|---|---|
| A_ATTRIBUTES | Bit-mask to extract attributes (described under **winch**( )) |
| A_NORMAL | Bit mask to reset all attributes off (for example: **attrset (A_NORMAL)** |

FUNCTION-KEYS

The following function keys, defined in **<curses.h>**, might be returned by **getch**( ) if **keypad**( ) has been enabled. Note that not all of these may be supported on a particular terminal if the terminal does not transmit a unique code when the key is pressed or the definition for the key is not present in the *terminfo*(4) database.

| *Name* | *Value* | *Key name* |
|---|---|---|
| KEY_BREAK | 0401 | break key (unreliable) |
| KEY_DOWN | 0402 | The four arrow keys ... |
| KEY_UP | 0403 | |
| KEY_LEFT | 0404 | |
| KEY_RIGHT | 0405 | ... |
| KEY_HOME | 0406 | Home key (upward+left arrow) |
| KEY_BACKSPACE | 0407 | backspace (unreliable) |
| KEY_F0 | 0410 | Function keys. Space for 64 keys is reserved. |
| KEY_F(n) | (KEY_F0+(n)) | Formula for $f_n$. |
| KEY_DL | 0510 | Delete line |
| KEY_IL | 0511 | Insert line |
| KEY_DC | 0512 | Delete character |
| KEY_IC | 0513 | Insert char or enter insert mode |
| KEY_EIC | 0514 | Exit insert char mode |
| KEY_CLEAR | 0515 | Clear screen |
| KEY_EOS | 0516 | Clear to end of screen |
| KEY_EOL | 0517 | Clear to end of line |
| KEY_SF | 0520 | Scroll 1 line forward |
| KEY_SR | 0521 | Scroll 1 line backwards (reverse) |
| KEY_NPAGE | 0522 | Next page |
| KEY_PPAGE | 0523 | Previous page |
| KEY_STAB | 0524 | Set tab |
| KEY_CTAB | 0525 | Clear tab |
| KEY_CATAB | 0526 | Clear all tabs |
| KEY_ENTER | 0527 | Enter or send |
| KEY_SRESET | 0530 | soft (partial) reset |
| KEY_RESET | 0531 | reset or hard reset |
| KEY_PRINT | 0532 | print or copy |
| KEY_LL | 0533 | home down or bottom (lower left) keypad is arranged like this:<br>A1 up A3<br>left B2 right<br>C1 down C3 |
| KEY_A1 | 0534 | Upper left of keypad |
| KEY_A3 | 0535 | Upper right of keypad |
| KEY_B2 | 0536 | Center of keypad |
| KEY_C1 | 0537 | Lower left of keypad |

| | | |
|---|---|---|
| KEY_C3 | 0540 | Lower right of keypad |
| KEY_BTAB | 0541 | Back tab key |
| KEY_BEG | 0542 | beg(inning) key |
| KEY_CANCEL | 0543 | cancel key |
| KEY_CLOSE | 0544 | close key |
| KEY_COMMAND | 0545 | cmd (command) key |
| KEY_COPY | 0546 | copy key |
| KEY_CREATE | 0547 | create key |
| KEY_END | 0550 | end key |
| KEY_EXIT | 0551 | exit key |
| KEY_FIND | 0552 | find key |
| KEY_HELP | 0553 | help key |
| KEY_MARK | 0554 | mark key |
| KEY_MESSAGE | 0555 | message key |
| KEY_MOVE | 0556 | move key |
| KEY_NEXT | 0557 | next object key |
| KEY_OPEN | 0560 | open key |
| KEY_OPTIONS | 0561 | options key |
| KEY_PREVIOUS | 0562 | previous object key |
| KEY_REDO | 0563 | redo key |
| KEY_REFERENCE | 0564 | ref(erence) key |
| KEY_REFRESH | 0565 | refresh key |
| KEY_REPLACE | 0566 | replace key |
| KEY_RESTART | 0567 | restart key |
| KEY_RESUME | 0570 | resume key |
| KEY_SAVE | 0571 | save key |
| KEY_SBEG | 0572 | shifted beginning key |
| KEY_SCANCEL | 0573 | shifted cancel key |
| KEY_SCOMMAND | 0574 | shifted command key |
| KEY_SCOPY | 0575 | shifted copy key |
| KEY_SCREATE | 0576 | shifted create key |
| KEY_SDC | 0577 | shifted delete char key |
| KEY_SDL | 0600 | shifted delete line key |
| KEY_SELECT | 0601 | select key |
| KEY_SEND | 0602 | shifted end key |
| KEY_SEOL | 0603 | shifted clear line key |
| KEY_SEXIT | 0604 | shifted exit key |
| KEY_SFIND | 0605 | shifted find key |
| KEY_SHELP | 0606 | shifted help key |
| KEY_SHOME | 0607 | shifted home key |
| KEY_SIC | 0610 | shifted input key |
| KEY_SLEFT | 0611 | shifted left arrow key |
| KEY_SMESSAGE | 0612 | shifted message key |
| KEY_SMOVE | 0613 | shifted move key |
| KEY_SNEXT | 0614 | shifted next key |
| KEY_SOPTIONS | 0615 | shifted options key |
| KEY_SPREVIOUS | 0616 | shifted prev key |
| KEY_SPRINT | 0617 | shifted print key |
| KEY_SREDO | 0620 | shifted redo key |

| | | |
|---|---|---|
| KEY_SREPLACE | 0621 | shifted replace key |
| KEY_SRIGHT | 0622 | shifted right arrow |
| KEY_SRSUME | 0623 | shifted resume key |
| KEY_SSAVE | 0624 | shifted save key |
| KEY_SSUSPEND | 0625 | shifted suspend key |
| KEY_SUNDO | 0626 | shifted undo key |
| KEY_SUSPEND | 0627 | suspend key |
| KEY_UNDO | 0630 | undo key |

LINE GRAPHICS

The following variables may be used to add line-drawing characters to the screen with **waddch**(). When defined for the terminal, the variable will have the **A_ALTCHARSET** bit turned on. Otherwise, the default charcter listed below will be stored in the variable. The names were chosen to be consistent with the DEC VT100 nomenclature.

| *Name* | *Default* | *Glyph Description* |
|---|---|---|
| ACS_ULCORNER | + | upper left corner |
| ACS_LLCORNER | + | lower left corner |
| ACS_URCORNER | + | upper right corner |
| ACS_LRCORNER | + | lower right corner |
| ACS_RTEE | + | right tee (┤) |
| ACS_LTEE | + | left tee (├) |
| ACS_BTEE | + | bottom tee (┴) |
| ACS_TTEE | + | top tee (┬) |
| ACS_HLINE | − | horizontal line |
| ACS_VLINE | \| | vertical line |
| ACS_PLUS | + | plus |
| ACS_S1 | − | scan line 1 |
| ACS_S9 | _ | scan line 9 |
| ACS_DIAMOND | + | diamond |
| ACS_CKBOARD | : | checker board (stipple) |
| ACS_DEGREE | ' | degree symbol |
| ACS_PLMINUS | # | plus/minus |
| ACS_BULLET | o | bullet |
| ACS_LARROW | < | arrow pointing left |
| ACS_RARROW | > | arrow pointing right |
| ACS_DARROW | v | arrow pointing down |
| ACS_UARROW | ^ | arrow pointing up |
| ACS_BOARD | # | board of squares |
| ACS_LANTERN | # | lantern symbol |
| ACS_BLOCK | # | solid square block |

DIAGNOSTICS

All routines return the integer **OK** upon successful completion and the integer **ERR** upon failure, unless otherwise noted in the preceding routine descriptions.

All macros return the value of their **w** version, except **setscrreg**( ), **wsetscrreg**( ), **getsyx**( ), **getyx**( ), **getbegy**( ), **getmaxyx**( ). For these macros, no useful value is returned.

Routines that return pointers always return **(type *) NULL** on error.

## BUGS

Currently typeahead checking is done using a nodelay read followed by an **ungetch**( ) of any character that may have been read. Typeahead checking is done only if **wgetch**( ) has been called at least once. This will be changed when proper kernel support is available. Programs which use a mixture of their own input routines with *curses* input routines may wish to call **typeahead(−1)** to turn off typeahead checking.

The argument to **napms**( ) is currently rounded up to the nearest second.

**draino** (ms) only works for *ms* equal to **0**.

## WARNINGS

To use the new *curses* features, use the Release 3.0 version of *curses* on UNIX System Release 3.0. All programs that ran with System V Release 2 *curses* will run with System V Release 3.0. You may link applications with object files based on the Release 2 *curses/terminfo* with the Release 3.0 *libcurses.a* library. You may link applications with object files based on the Release 3.0 *curses/terminfo* with the Release 2 *libcurses.a* library, so long as the application does not use the new features in the Release 3.0 *curses/terminfo.*

The plotting library *plot*(3X) and the curses library *curses*(3X) both use the names **erase**( ) and **move**( ). The *curses* versions are macros. If you need both libraries, put the *plot*(3X) code in a different source file than the *curses*(3X) code, and/or **#undef move**( ) and **erase()** in the *plot*(3X) code.

Between the time a call to **initscr**( ) and **endwin**( ) has been issued, use only the routines in the *curses* library to generate output. Using system calls or the "standard I/O package" (see *stdio*(3S)) for output during that time can cause unpredictable results.

## SEE ALSO

cc(1), ld(1), ioctl(2), plot(3X), putc(3S), scanf(3S), stdio(3S), system(3S), vprintf(3S), profile(4), term(4), terminfo(4), varargs(5).
termio(7), tty(7) in the *System Administrator's Reference Manual.*
Chapter 10 of the *Programmer's Guide.*

## NAME

directory: opendir, readdir, telldir, seekdir, rewinddir, closedir − directory operations

## SYNOPSIS

```
#include <sys/types.h>
#include <dirent.h>

DIR *opendir (filename)
char *filename;

struct dirent *readdir (dirp)
DIR *dirp;

long telldir (dirp)
DIR *dirp;

void seekdir (dirp, loc)
DIR *dirp;
long loc;

void rewinddir (dirp)
DIR *dirp;

void closedir(dirp)
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 pointer NULL is returned if *filename* cannot be accessed or is not a directory, or if it cannot *malloc*(3X) enough memory to hold a DIR structure or a buffer for the directory entries.

*Readdir* returns a pointer to the next active directory 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.

*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 one associated with the *directory stream* when the *telldir* operation from which *loc* was obtained was performed. Values returned by *telldir* are good only if the directory has not changed due to compaction or expansion. This is not a problem with System V, but it may be with some file system types.

*Rewinddir* resets the position of the named *directory stream* to the beginning of the directory.

*Closedir* closes the named *directory stream* and frees the DIR structure.

The following errors can occur as a result of these operations.

*opendir:*

| | |
|---|---|
| [ENOTDIR] | A component of *filename* is not a directory. |
| [EACCES] | A component of *filename* denies search permission. |
| [EMFILE] | The maximum number of file descriptors are currently open. |
| [EFAULT] | *Filename* points outside the allocated address space. |

*readdir:*

| | |
|---|---|
| [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 results if the DIR stream has been closed. |

*telldir, seekdir,* and *closedir:*

| | |
|---|---|
| [EBADF] | The file descriptor determined by the DIR stream is no longer valid. This results if the DIR stream has been closed. |

EXAMPLE

Sample code which searches a directory for entry *name*:

```
dirp = opendir( "." );
while ( (dp = readdir( dirp )) != NULL )
        if ( strcmp( dp->d_name, name ) == 0 )
                {
                closedir( dirp );
                return FOUND;
                }
closedir( dirp );
return NOT_FOUND;
```

SEE ALSO

getdents(2), dirent(4).

WARNINGS

*Rewinddir* is implemented as a macro, so its function address cannot be taken.

NAME

ldahread – read the archive header of a member of an archive file

SYNOPSIS

```
#include <stdio.h>
#include <ar.h>
#include <filehdr.h>
#include <ldfcn.h>

int ldahread (ldptr, arhead)
LDFILE *ldptr;
ARCHDR *arhead;
```

## DESCRIPTION

If **TYPE(*ldptr*)** is the archive file magic number, *ldahread* reads the archive header of the common object file currently associated with *ldptr* into the area of memory beginning at *arhead*.

*ldahread* returns **SUCCESS** or **FAILURE**. *ldahread* will fail if **TYPE(*ldptr*)** does not represent an archive file, or if it cannot read the archive header.

The program must be loaded with the object file access routine library **libld.a.**

## SEE ALSO

ldclose(3X), ldopen(3X), ldfcn(4), ar(4).

## NAME

ldclose, ldaclose – close a common object file

## SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <ldfcn.h>**

**int ldclose (ldptr)**
**LDFILE *ldptr;**

**int ldaclose (ldptr)**
**LDFILE *ldptr;**

## DESCRIPTION

*Ldopen*(3X) and *ldclose* are designed to provide uniform access to both simple object files and object files that are members of archive files. Thus an archive of common object files can be processed as if it were a series of simple common object files.

If **TYPE(***ldptr***)** does not represent an archive file, *ldclose* will close the file and free the memory allocated to the **LDFILE** structure associated with *ldptr*. If **TYPE(***ldptr***)** is the magic number of an archive file, and if there are any more files in the archive, *ldclose* will reinitialize **OFFSET(***ldptr***)** to the file address of the next archive member and return **FAILURE**. The **LDFILE** structure is prepared for a subsequent *ldopen*(3X). In all other cases, *ldclose* returns **SUCCESS**.

*Ldaclose* closes the file and frees the memory allocated to the **LDFILE** structure associated with *ldptr* regardless of the value of **TYPE**(*ldptr*). *Ldaclose* always returns **SUCCESS**. The function is often used in conjunction with *ldaopen*.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

fclose(3S), ldopen(3X), ldfcn(4).

NAME

ldfhread – read the file header of a common object file

SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <ldfcn.h>**

**int ldfhread (ldptr, filehead)**
**LDFILE *ldptr;**
**FILHDR *filehead;**

DESCRIPTION

*ldfhread* reads the file header of the common object file currently associated with *ldptr* into the area of memory beginning at *filehead*.

*ldfhread* returns **SUCCESS** or **FAILURE**. *ldfhread* will fail if it cannot read the file header.

In most cases the use of *ldfhread* can be avoided by using the macro **HEADER(***ldptr***)** defined in **ldfcn.h** [see ldfcn (4)]. The information in any field, *fieldname*, of the file header may be accessed using **HEADER(ldptr).fieldname**.

The program must be loaded with the object file access routine library **libld.a**.

SEE ALSO

ldclose(3X), ldopen(3X), ldfcn(4).

## NAME

ldgetname — retrieve symbol name for common object file symbol table entry

## SYNOPSIS

```
#include <stdio.h>
#include <filehdr.h>
#include <syms.h>
#include <ldfcn.h>

char *ldgetname (ldptr, symbol)
LDFILE *ldptr;
SYMENT *symbol;
```

## DESCRIPTION

*ldgetname* returns a pointer to the name associated with **symbol** as a string. The string is contained in a static buffer local to *ldgetname* that is overwritten by each call to *ldgetname*, and therefore must be copied by the caller if the name is to be saved.

*ldgetname* can be used to retrieve names from object files without any backward compatibility problems. *ldgetname* will return NULL (defined in **stdio.h**) for an object file if the name cannot be retrieved. This situation can occur:

- if the "string table" cannot be found,
- if not enough memory can be allocated for the string table,
- if the string table appears not to be a string table (for example, if an auxiliary entry is handed to *ldgetname* that looks like a reference to a name in a nonexistent string table), or
- if the name's offset into the string table is past the end of the string table.

Typically, *ldgetname* will be called immediately after a successful call to *ldtbread* to retrieve the name associated with the symbol table entry filled by *ldtbread*.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

ldclose(3X), ldopen(3X), ldtbread(3X), ldtbseek(3X), ldfcn(4).

## NAME

ldlread, ldlinit, ldlitem – manipulate line number entries of a common object file function

## SYNOPSIS

```
#include <stdio.h>
#include <filehdr.h>
#include <linenum.h>
#include <ldfcn.h>

int ldlread(ldptr, fcnindx, linenum, linent)
LDFILE *ldptr;
long fcnindx;
unsigned short linenum;
LINENO *linent;

int ldlinit(ldptr, fcnindx)
LDFILE *ldptr;
long fcnindx;

int ldlitem(ldptr, linenum, linent)
LDFILE *ldptr;
unsigned short linenum;
LINENO *linent;
```

## DESCRIPTION

*ldlread* searches the line number entries of the common object file currently associated with *ldptr*. *ldlread* begins its search with the line number entry for the beginning of a function and confines its search to the line numbers associated with a single function. The function is identified by *fcnindx*, the index of its entry in the object file symbol table. *ldlread* reads the entry with the smallest line number equal to or greater than *linenum* into the memory beginning at *linent*.

*Ldlinit* and *ldlitem* together perform exactly the same function as *ldlread.* After an initial call to *ldlread* or *ldlinit, ldlitem* may be used to retrieve a series of line number entries associated with a single function. *Ldlinit* simply locates the line number entries for the function identified by *fcnindx. Ldlitem* finds and reads the entry with the smallest line number equal to or greater than *linenum* into the memory beginning at *linent*.

*ldlread, ldlinit,* and *ldlitem* each return either **SUCCESS** or **FAILURE**. *ldlread* will fail if there are no line number entries in the object file, if *fcnindx* does not index a function entry in the symbol table, or if it finds no line number equal to or greater than *linenum*. *Ldlinit* will fail if there are no line number entries in the object file or if *fcnindx* does not index a function entry in the symbol table. *Ldlitem* will fail if it finds no line number equal to or greater than *linenum*.

The programs must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

ldclose(3X), ldopen(3X), ldtbindex(3X), ldfcn(4).

## NAME

ldlseek, ldnlseek – seek to line number entries of a section of a common object file

## SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <ldfcn.h>**

**int ldlseek (ldptr, sectindx)**
**LDFILE *ldptr;**
**unsigned short sectindx;**

**int ldnlseek (ldptr, sectname)**
**LDFILE *ldptr;**
**char *sectname;**

## DESCRIPTION

*ldlseek* seeks to the line number entries of the section specified by *sectindx* of the common object file currently associated with *ldptr*.

*Ldnlseek* seeks to the line number entries of the section specified by *sectname*.

*ldlseek* and *ldnlseek* return **SUCCESS** or **FAILURE**. *ldlseek* will fail if *sectindx* is greater than the number of sections in the object file; *ldnlseek* will fail if there is no section name corresponding with **sectname*. Either function will fail if the specified section has no line number entries or if it cannot seek to the specified line number entries.

Note that the first section has an index of *one*.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

ldclose(3X), ldopen(3X), ldshread(3X), ldfcn(4).

## NAME

ldohseek – seek to the optional file header of a common object file

## SYNOPSIS

```
#include <stdio.h>
#include <filehdr.h>
#include <ldfcn.h>

int ldohseek (ldptr)
LDFILE *ldptr;
```

## DESCRIPTION

*ldohseek* seeks to the optional file header of the common object file currently associated with *ldptr*.

*ldohseek* returns **SUCCESS** or **FAILURE**. *ldohseek* will fail if the object file has no optional header or if it cannot seek to the optional header.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

ldclose(3X), ldopen(3X), ldfhread(3X), ldfcn(4).

## NAME

ldopen, ldaopen − open a common object file for reading

## SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <ldfcn.h>**

**LDFILE *ldopen (filename, ldptr)**
**char *filename;**
**LDFILE *ldptr;**

**LDFILE *ldaopen (filename, oldptr)**
**char *filename;**
**LDFILE *oldptr;**

## DESCRIPTION

*ldopen* and *ldclose*(3X) are designed to provide uniform access to both simple object files and object files that are members of archive files. Thus an archive of common object files can be processed as if it were a series of simple common object files.

If *ldptr* has the value **NULL**, then *ldopen* will open *filename* and allocate and initialize the **LDFILE** structure, and return a pointer to the structure to the calling program.

If *ldptr* is valid and if **TYPE(***ldptr***)** is the archive magic number, *ldopen* will reinitialize the **LDFILE** structure for the next archive member of *filename*.

*ldopen* and *ldclose*(3X) are designed to work in concert. *Ldclose* will return **FAILURE** only when **TYPE(***ldptr***)** is the archive magic number and there is another file in the archive to be processed. Only then should *ldopen* be called with the current value of *ldptr*. In all other cases, in particular whenever a new *filename* is opened, *ldopen* should be called with a **NULL** *ldptr* argument.

The following is a prototype for the use of *ldopen* and *ldclose*(3X).

```
/* for each filename to be processed */

ldptr = NULL;
do
{
        if ( (ldptr = ldopen(filename, ldptr)) != NULL )
        {
                /* check magic number */
                /* process the file */
        }
} while (ldclose(ldptr) == FAILURE );
```

If the value of *oldptr* is not **NULL**, *ldaopen* will open *filename* anew and allocate and initialize a new **LDFILE** structure, copying the **TYPE**, **OFFSET**, and **HEADER** fields from *oldptr*. *Ldaopen* returns a pointer to the new **LDFILE** structure. This new pointer is independent of the old pointer, *oldptr*. The two pointers may be used concurrently to read separate parts of the object file. For example, one pointer may be used to step sequentially through the relocation information, while the other is used to read indexed symbol table entries.

Both *ldopen* and *ldaopen* open *filename* for reading. Both functions return **NULL** if *filename* cannot be opened, or if memory for the **LDFILE** structure cannot be allocated. A successful open does not insure that the given file is a common object file or an archived object file.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

fopen(3S), ldclose(3X), ldfcn(4).

## NAME

ldrseek, ldnrseek – seek to relocation entries of a section of a common object file

## SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <ldfcn.h>**

**int ldrseek (ldptr, sectindx)**
**LDFILE *ldptr;**
**unsigned short sectindx;**

**int ldnrseek (ldptr, sectname)**
**LDFILE *ldptr;**
**char *sectname;**

## DESCRIPTION

*ldrseek* seeks to the relocation entries of the section specified by *sectindx* of the common object file currently associated with *ldptr*.

*Ldnrseek* seeks to the relocation entries of the section specified by *sectname*.

*ldrseek* and *ldnrseek* return **SUCCESS** or **FAILURE**. *ldrseek* will fail if *sectindx* is greater than the number of sections in the object file; *ldnrseek* will fail if there is no section name corresponding with *sectname*. Either function will fail if the specified section has no relocation entries or if it cannot seek to the specified relocation entries.

Note that the first section has an index of *one*.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

ldclose(3X), ldopen(3X), ldshread(3X), ldfcn(4).

## NAME

ldshread, ldnshread − read an indexed/named section header of a common object file

## SYNOPSIS

```
#include <stdio.h>
#include <filehdr.h>
#include <scnhdr.h>
#include <ldfcn.h>

int ldshread (ldptr, sectindx, secthead)
LDFILE *ldptr;
unsigned short sectindx;
SCNHDR *secthead;

int ldnshread (ldptr, sectname, secthead)
LDFILE *ldptr;
char *sectname;
SCNHDR *secthead;
```

## DESCRIPTION

*ldshread* reads the section header specified by *sectindx* of the common object file currently associated with *ldptr* into the area of memory beginning at *secthead*.

*Ldnshread* reads the section header specified by *sectname* into the area of memory beginning at *secthead*.

*ldshread* and *ldnshread* return **SUCCESS** or **FAILURE**. *ldshread* will fail if *sectindx* is greater than the number of sections in the object file; *ldnshread* will fail if there is no section name corresponding with *sectname*. Either function will fail if it cannot read the specified section header.

Note that the first section header has an index of *one*.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

ldclose(3X), ldopen(3X), ldfcn(4).

## NAME

ldsseek, ldnsseek – seek to an indexed/named section of a common object file

## SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <ldfcn.h>**

**int ldsseek (ldptr, sectindx)**
**LDFILE *ldptr;**
**unsigned short sectindx;**

**int ldnsseek (ldptr, sectname)**
**LDFILE *ldptr;**
**char *sectname;**

## DESCRIPTION

*ldsseek* seeks to the section specified by *sectindx* of the common object file currently associated with *ldptr*.

*Ldnsseek* seeks to the section specified by *sectname*.

*ldsseek* and *ldnsseek* return **SUCCESS** or **FAILURE**. *ldsseek* will fail if *sectindx* is greater than the number of sections in the object file; *ldnsseek* will fail if there is no section name corresponding with *sectname*. Either function will fail if there is no section data for the specified section or if it cannot seek to the specified section.

Note that the first section has an index of *one*.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

ldclose(3X), ldopen(3X), ldshread(3X), ldfcn(4).

## NAME

ldtbindex – compute the index of a symbol table entry of a common object file

## SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <syms.h>**
**#include <ldfcn.h>**

**long ldtbindex (ldptr)**
**LDFILE *ldptr;**

## DESCRIPTION

*ldtbindex* returns the **(long)** index of the symbol table entry at the current position of the common object file associated with *ldptr*.

The index returned by *ldtbindex* may be used in subsequent calls to *ldtbread*(3X). However, since *ldtbindex* returns the index of the symbol table entry that begins at the current position of the object file, if *ldtbindex* is called immediately after a particular symbol table entry has been read, it will return the index of the next entry.

*ldtbindex* will fail if there are no symbols in the object file, or if the object file is not positioned at the beginning of a symbol table entry.

Note that the first symbol in the symbol table has an index of *zero*.

The program must be loaded with the object file access routine library **libld.a.**

## SEE ALSO

ldclose(3X), ldopen(3X), ldtbread(3X), ldtbseek(3X), ldfcn(4).

## NAME

ldtbread – read an indexed symbol table entry of a common object file

## SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <syms.h>**
**#include <ldfcn.h>**

**int ldtbread (ldptr, symindex, symbol)**
**LDFILE *ldptr;**
**long symindex;**
**SYMENT *symbol;**

## DESCRIPTION

*ldtbread* reads the symbol table entry specified by *symindex* of the common object file currently associated with *ldptr* into the area of memory beginning at **symbol**.

*ldtbread* returns **SUCCESS** or **FAILURE**. *ldtbread* will fail if *symindex* is greater than or equal to the number of symbols in the object file, or if it cannot read the specified symbol table entry.

Note that the first symbol in the symbol table has an index of *zero*.

The program must be loaded with the object file access routine library **libld.a.**

## SEE ALSO

ldclose(3X), ldopen(3X), ldtbseek(3X), ldgetname(3X), ldfcn(4).

## NAME

ldtbseek – seek to the symbol table of a common object file

## SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <ldfcn.h>**

**int ldtbseek (ldptr)**
**LDFILE *ldptr;**

## DESCRIPTION

*ldtbseek* seeks to the symbol table of the common object file currently associated with *ldptr*.

*ldtbseek* returns **SUCCESS** or **FAILURE**. *ldtbseek* will fail if the symbol table has been stripped from the object file, or if it cannot seek to the symbol table.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

ldclose(3X), ldopen(3X), ldtbread(3X), ldfcn(4).

## NAME

libwindows − windowing terminal function library

## SYNOPSIS

cc [flag ...] file ... **−lwindows** [library ...]

```
int     cntlfd, fd
int     chan
int     origin_x, origin_y, corner_x, corner_y
char    *command
```

**cntlfd = openagent ( )**

**chan = New (cntlfd, origin_x, origin_y, corner_x, corner_y)**

**chan = Newlayer (cntlfd, origin_x, origin_y, corner_x, corner_y)**

**fd = openchan (chan)**

**Runlayer (chan, command)**

**Current (cntlfd, chan)**

**Delete (cntlfd, chan)**

**Top (cntlfd, chan)**

**Bottom (cntlfd, chan)**

**Move (cntlfd, chan, origin_x, origin_y)**

**Reshape (cntlfd, chan, origin_x, origin_y, corner_x, corner_y)**

**Exit (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, *cntlfd,* that can be passed to any of the other *libwindows* routines except **openchan**( ) and **Runlayer**( ). (*cntlfd* can also be passed to *close*(2).) 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*. Any processes currently attached to this layer will be killed, and the new process will have the environment of the *layers*(1) 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**(1) program to exit, killing all processes associated with it.

RETURN VALUE

Upon successful completion, **Runlayer**( ), **Current**( ), **Delete**( ), **Top**( ), **Bottom**( ), **Move**( ), **Reshape**( ), and **Exit**( ) return a **0**, while **openagent**( ), **New**( ), **Newlayer**( ), and **openchan**( ) return values as described above under each routine. If an error occurs, **−1** is returned.

FILES

/usr/lib/libwindows.a windowing terminal function library

NOTE

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 Teletype 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*. In addition, the minimum layer size is 28 by 28 pixels and the maximum layer size is 784 by 1008 pixels.

SEE ALSO

close(2), jagent(5), write(2).
layers(1) in the *User's Reference Manual.*
xt(7) in the *System Administrator's Reference Manual.*

## NAME

logname – return login name of user

## SYNOPSIS

**char *logname( )**

## DESCRIPTION

*logname* returns a pointer to the null-terminated login name; it extracts the **LOGNAME** environment variable from the user's environment.

This routine is kept in **/lib/libPW.a**.

## FILES

/etc/profile

## SEE ALSO

getenv(3C), profile(4), environ(5).
env(1), login(1) in the *User's Reference Manual.*

## CAVEATS

The return values point to static data whose content is overwritten by each call.

This method of determining a login name is subject to forgery.

## NAME

malloc, free, realloc, calloc, mallopt, mallinfo – fast main memory allocator

## SYNOPSIS

**#include <malloc.h>**

**char *malloc (size)**
**unsigned size;**

**void free (ptr)**
**char *ptr;**

**char *realloc (ptr, size)**
**char *ptr;**
**unsigned size;**

**char *calloc (nelem, elsize)**
**unsigned nelem, elsize;**

**int mallopt (cmd, value)**
**int cmd, value;**

**struct mallinfo mallinfo()**

## DESCRIPTION

*malloc* and *free* provide a simple general-purpose memory allocation package, which runs considerably faster than the *malloc*(3C) package. It is found in the library "malloc", and is loaded if the option "–lmalloc" is used with *cc*(1) or *ld*(1).

*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).

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.

*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 which 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.

## WARNINGS

This package usually uses more data space than *malloc*(3C).
The code size is also bigger than *malloc*(3C).
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.

## NAME

plot – graphics interface subroutines

## SYNOPSIS

**openpl ()**

**erase ()**

**label (s)**
**char *s;**

**line (x1, y1, x2, y2)**
**int x1, y1, x2, y2;**

**circle (x, y, r)**
**int x, y, r;**

**arc (x, y, x0, y0, x1, y1)**
**int x, y, x0, y0, x1, y1;**

**move (x, y)**
**int x, y;**

**cont (x, y)**
**int x, y;**

**point (x, y)**
**int x, y;**

**linemod (s)**
**char *s;**

**space (x0, y0, x1, y1)**
**int x0, y0, x1, y1;**

**closepl ()**

## DESCRIPTION

These subroutines generate graphic output in a relatively device-independent manner. *Space* must be used before any of these functions to declare the amount of space necessary [see *plot*(4)]. *Openpl* must be used before any of the others to open the device for writing. *Closepl* flushes the output.

*Circle* draws a circle of radius *r* with center at the point *(x, y)*.

*Arc* draws an arc of a circle with center at the point *(x, y)* between the points *(x0, y0)* and *(x1, y1)*.

String arguments to *label* and *linemod* are terminated by nulls and do not contain new-lines.

See *plot*(4) for a description of the effect of the remaining functions.

The library files listed below provide several flavors of these routines.

## FILES

| | |
|---|---|
| **LIBDIR**/libplot.a | produces output for *tplot*(1G) filters |
| **LIBDIR**/lib300.pa | for DASI 300 |
| **LIBDIR**/lib300.a | for DASI 300s |

| | |
|---|---|
| **LIBDIR**/lib450.a | for DASI 450 |
| **LIBDIR**/lib4014.a | for TEKTRONIX 4014 |
| **LIBDIR**usually /usr/lib | |

SEE ALSO

plot(4).
graph(1G), stat(1G), tplot(1G) in the *User's Reference Manual.*

WARNINGS

In order to compile a program containing these functions in *file.c* it is necessary to use "cc *file.c* −lplot".

In order to execute it, it is necessary to use "a.out | tplot".

The above routines use **<stdio.h>**, which causes them to increase the size of programs, not otherwise using standard I/O more than might be expected.

## NAME

regcmp, regex — compile and execute regular expression

## SYNOPSIS

**char *regcmp (string1 [, string2, ...], (char *)0)**
**char *string1, *string2, ...;**

**char *regex (re, subject[, ret0, ...])**
**char *re, *subject, *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 their associated meanings.

**[]*.^** These symbols retain their meaning in *ed*(1).

**$** Matches the end of the string; **\n** matches a new-line.

**–** 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 (e.g., {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

Example 1:

```
char *cursor, *newcursor, *ptr;
      ...
newcursor = regex((ptr = regcmp("^\n", (char *)0)), cursor);
free(ptr);
```

This example will match a leading new-line in the subject string pointed at by cursor.

Example 2:

```
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);
```

This example will match through the string "Testing3" and will return the address of the character after the last matched character (the "4"). The string "Testing3" will be copied to the character array *ret0*.

Example 3:

```
#include "file.i"
char *string, *newcursor;
      ...
newcursor = regex(name, string);
```

This example applies a precompiled regular expression in **file.i** [see *regcmp*(1)] against *string*.

These routines are kept in **/lib/libPW.a**.

## SEE ALSO

regcmp(1), malloc(3C).
ed(1) in the *User's Reference Manual*.

## BUGS

The user program may run out of memory if *regcmp* is called iteratively without freeing the vectors no longer required.

## NAME

abort – terminate Fortran program

## SYNOPSIS

**call abort ( )**

## DESCRIPTION

*abort* terminates the program which calls it, closing all open files truncated to the current position of the file pointer. The abort usually results in a core dump.

## DIAGNOSTICS

When invoked, *abort* prints "Fortran abort routine called" on the standard error output. The shell prints the message "abort - core dumped" if a core dump results.

## SEE ALSO

abort(3C).
sh(1) in the *User's Reference Manual.*

## NAME

abs, iabs, dabs, cabs, zabs – Fortran absolute value

## SYNOPSIS

```
integer i1, i2
real r1, r2
double precision dp1, dp2
complex cx1, cx2
double complex dx1, dx2

r2 = abs(r1)

i2 = iabs(i1)
i2 = abs(i1)

dp2 = dabs(dp1)
dp2 = abs(dp1)

cx2 = cabs(cx1)
cx2 = abs(cx1)

dx2 = zabs(dx1)
dx2 = abs(dx1)
```

## DESCRIPTION

*abs* is the family of absolute value functions. *Iabs* returns the integer absolute value of its integer argument. *Dabs* returns the double-precision absolute value of its double-precision argument. *Cabs* returns the complex absolute value of its complex argument. *Zabs* returns the double-complex absolute value of its double-complex argument. The generic form *abs* returns the type of its argument.

## SEE ALSO

floor(3M).

## NAME

acos, dacos — Fortran arccosine intrinsic function

## SYNOPSIS

**real r1, r2**
**double precision dp1, dp2**

**r2 = acos(r1)**

**dp2 = dacos(dp1)**
**dp2 = acos(dp1)**

## DESCRIPTION

*acos* returns the real arccosine of its real argument. *Dacos* returns the double-precision arccosine of its double-precision argument. The generic form *acos* may be used with impunity as its argument will determine the type of the returned value.

## SEE ALSO

trig(3M).

## NAME

aimag, dimag – Fortran imaginary part of complex argument

## SYNOPSIS

**real r**
**complex cxr**
**double precision dp**
**double complex cxd**

**r = aimag(cxr)**

**dp = dimag(cxd)**

## DESCRIPTION

*aimag* returns the imaginary part of its single-precision complex argument. *Dimag* returns the double-precision imaginary part of its double-complex argument.

## NAME

aint, dint — Fortran integer part intrinsic function

## SYNOPSIS

```
real r1, r2
double precision dp1, dp2

r2 = aint(r1)

dp2 = dint(dp1)
dp2 = aint(dp1)
```

## DESCRIPTION

*aint* returns the truncated value of its real argument in a real. *Dint* returns the truncated value of its double-precision argument as a double-precision value. *aint* may be used as a generic function name, returning either a real or double-precision value depending on the type of its argument.

## NAME

asin, dasin – Fortran arcsine intrinsic function

## SYNOPSIS

```
real r1, r2
double precision dp1, dp2

r2 = asin(r1)

dp2 = dasin(dp1)
dp2 = asin(dp1)
```

## DESCRIPTION

*asin* returns the real arcsine of its real argument. *Dasin* returns the double-precision arcsine of its double-precision argument. The generic form *asin* may be used with impunity as it derives its type from that of its argument.

## SEE ALSO

trig(3M).

## NAME

atan, datan – Fortran arctangent intrinsic function

## SYNOPSIS

**real r1, r2**
**double precision dp1, dp2**

**r2 = atan(r1)**

**dp2 = datan(dp1)**
**dp2 = atan(dp1)**

## DESCRIPTION

*atan* returns the real arctangent of its real argument. *Datan* returns the double-precision arctangent of its double-precision argument. The generic form *atan* may be used with a double-precision argument returning a double-precision value.

## SEE ALSO

trig(3M).

## NAME

atan2, datan2 – Fortran arctangent intrinsic function

## SYNOPSIS

```
real r1, r2, r3
double precision dp1, dp2, dp3

r3 = atan2(r1, r2)

dp3 = datan2(dp1, dp2)
dp3 = atan2(dp1, dp2)
```

## DESCRIPTION

*atan2* returns the arctangent of *arg1/arg2* as a real value. *Datan2* returns the double-precision arctangent of its double-precision arguments. The generic form *atan2* may be used with impunity with double-precision arguments.

## SEE ALSO

trig(3M).

## NAME

bool: and, or, xor, not, lshift, rshift – Fortran Bitwise Boolean functions

## SYNOPSIS

```
integer i, j, k
real a, b, c

k = and(i, j)
c = or(a, b)
j = xor(i, a)
j = not(i)
k = lshift(i, j)
k = rshift(i, j)
```

## DESCRIPTION

The generic intrinsic Boolean functions *and, or* and *xor* return the value of the binary operations on their arguments. *Not* is a unary operator returning the one's complement of its argument. *Lshift* and *rshift* return the value of the first argument shifted left or right, respectively, the number of times specified by the second (integer) argument.

While it is recommended that Boolean functions be used only on integer data, these functions are generic; that is, they are defined for all data types as arguments and return values. Where required, the compiler generates appropriate type conversions. However, when the functions are not used with integer data, the results are unpredictable.

## BUGS

The implementation of the shift functions may cause large shift values to deliver weird results.

## SEE ALSO

mil(3F).

## NAME

conjg, dconjg – Fortran complex conjugate intrinsic function

## SYNOPSIS

```
complex cx1, cx2
double complex dx1, dx2

cx2 = conjg(cx1)

dx2 = dconjg(dx1)
```

## DESCRIPTION

*conjg* returns the complex conjugate of its complex argument. *Dconjg* returns the double-complex conjugate of its double-complex argument.

## NAME

cos, dcos, ccos — Fortran cosine intrinsic function

## SYNOPSIS

```
real r1, r2
double precision dp1, dp2
complex cx1, cx2

r2 = cos(r1)

dp2 = dcos(dp1)
dp2 = cos(dp1)

cx2 = ccos(cx1)
cx2 = cos(cx1)
```

## DESCRIPTION

*cos* returns the real cosine of its real argument. *Dcos* returns the double-precision cosine of its double-precision argument. *Ccos* returns the complex cosine of its complex argument. The generic form *cos* may be used with impunity as its returned type is determined by that of its argument.

## SEE ALSO

trig(3M).

## NAME

cosh, dcosh – Fortran hyperbolic cosine intrinsic function

## SYNOPSIS

```
real r1, r2
double precision dp1, dp2

r2 = cosh(r1)

dp2 = dcosh(dp1)
dp2 = cosh(dp1)
```

## DESCRIPTION

*cosh* returns the real hyperbolic cosine of its real argument. *Dcosh* returns the double-precision hyperbolic cosine of its double-precision argument. The generic form *cosh* may be used to return the hyperbolic cosine in the type of its argument.

## SEE ALSO

sinh(3M).

## NAME

dim, ddim, idim – positive difference intrinsic functions

## SYNOPSIS

**integer a1, a2, a3**
**a3 = idim(a1, a2)**

**real a1, a2, a3**
**a3 = dim(a1, a2)**

**double precision a1, a2, a3**
**a3 = ddim(a1, a2)**

## DESCRIPTION

These functions return:

```
a1−a2  if a1 > a2
0      if a1 <= a2
```

NAME

dprod – double precision product intrinsic function

SYNOPSIS

```
real a1, a2

double precision a3

a3 = dprod(a1, a2)
```

DESCRIPTION

Dprod returns the double precision product of its real arguments.

## NAME

exp, dexp, cexp — Fortran exponential intrinsic function

## SYNOPSIS

```
real r1, r2
double precision dp1, dp2
complex cx1, cx2

r2 = exp(r1)

dp2 = dexp(dp1)
dp2 = exp(dp1)

cx2 = cexp(cx1)
cx2 = exp(cx1)
```

## DESCRIPTION

*exp* returns the real exponential function $e^x$ of its real argument. *Dexp* returns the double-precision exponential function of its double-precision argument. *Cexp* returns the complex exponential function of its complex argument. The generic function *exp* becomes a call to *dexp* or *cexp* as required, depending on the type of its argument.

## SEE ALSO

exp(3M).

## NAME

ftype: int, ifix, idint, real, float, sngl, dble, cmplx, dcmplx, ichar, char – explicit Fortran type conversion

## SYNOPSIS

```
integer i, j
real r, s
double precision dp, dq
complex cx
double complex dcx
character*1 ch

i = int(r)
i = int(dp)
i = int(cx)
i = int(dcx)
i = ifix(r)
i = idint(dp)

r = real(i)
r = real(dp)
r = real(cx)
r = real(dcx)
r = float(i)
r = sngl(dp)

dp = dble(i)
dp = dble(r)
dp = dble(cx)
dp = dble(dcx)

cx = cmplx(i)
cx = cmplx(i, j)
cx = cmplx(r)
cx = cmplx(r, s)
cx = cmplx(dp)
cx = cmplx(dp, dq)
cx = cmplx(dcx)

dcx = dcmplx(i)
dcx = dcmplx(i, j)
dcx = dcmplx(r)
dcx = dcmplx(r, s)
dcx = dcmplx(dp)
dcx = dcmplx(dp, dq)
dcx = dcmplx(cx)

i = ichar(ch)
ch = char(i)
```

## DESCRIPTION

These functions perform conversion from one data type to another.

The function **int** converts to *integer* form its *real, double precision, complex,* or *double complex* argument. If the argument is *real* or *double precision,* **int** returns the integer whose magnitude is the largest integer that does not exceed the magnitude of the argument and whose sign is the same as the sign of the argument (i.e. truncation). For complex types, the above rule is applied to the real part. **ifix** and **idint** convert only *real* and *double precision* arguments respectively.

The function **real** converts to *real* form an *integer, double precision, complex,* or *double complex* argument. If the argument is *double precision* or *double complex,* as much precision is kept as is possible. If the argument is one of the complex types, the real part is returned. **float** and **sngl** convert only *integer* and *double precision* arguments respectively.

The function **dble** converts any *integer, real, complex,* or *double complex* argument to *double precision* form. If the argument is of a complex type, the real part is returned.

The function **cmplx** converts its *integer, real, double precision,* or *double complex* argument(s) to *complex* form.

The function **dcmplx** converts to *double complex* form its *integer, real, double precision,* or *complex* argument(s).

Either one or two arguments may be supplied to **cmplx** and **dcmplx** . If there is only one argument, it is taken as the real part of the complex type and an imaginary part of zero is supplied. If two arguments are supplied, the first is taken as the real part and the second as the imaginary part.

The function **ichar** converts from a character to an integer depending on the character's position in the collating sequence.

The function **char** returns the character in the *i*th position in the processor collating sequence where *i* is the supplied argument.

For a processor capable of representing *n* characters,

**ichar**(**char**(i)) = i for $0 \leqslant i < n$, and

**char**(**ichar**(ch)) = ch for any representable character *ch.*

## NAME

getarg — return Fortran command-line argument

## SYNOPSIS

**character*N c**
**integer i**

**call getarg(i, c)**

## DESCRIPTION

*getarg* returns the *i*-th command-line argument of the current process. Thus, if a program were invoked via

```
foo arg1 arg2 arg3
```

*getarg(2, c)* would return the string "arg2" in the character variable *c*.

## SEE ALSO

getopt(3C).

## NAME

getenv – return Fortran environment variable

## SYNOPSIS

**character*N c**

**call getenv("VARIABLE_NAME", c)**

## DESCRIPTION

*getenv* returns the character-string value of the environment variable represented by its first argument into the character variable of its second argument. If no such environment variable exists, all blanks will be returned.

## SEE ALSO

getenv(3C), environ(5).

## NAME

iargc − return the number of command line arguments

## SYNOPSIS

```
integer i

i = iargc( )
```

## DESCRIPTION

The *iargc* function returns the number of command line arguments passed to the program. Thus, if a program were invoked via

```
foo arg1 arg2 arg3
```

*iargc( )* would return 3.

## SEE ALSO

getarg(3F).

## NAME

index – return location of Fortran substring

## SYNOPSIS

**character*N1 ch1**
**character*N2 ch2**
**integer i**

**i = index(ch1, ch2)**

## DESCRIPTION

*index* returns the location of substring *ch2* in string *ch1*. The value returned is the position at which substring *ch2* starts, or 0 if it is not present in string *ch1*. If N2 is greater than N1, a zero is returned.

## NAME

len – return length of Fortran string

## SYNOPSIS

```
character*N ch
integer i

i = len(ch)
```

## DESCRIPTION

*len* returns the length of string *ch*.

## NAME

log, alog, dlog, clog — Fortran natural logarithm intrinsic function

## SYNOPSIS

```
real r1, r2
double precision dp1, dp2
complex cx1, cx2

r2 = alog(r1)
r2 = log(r1)

dp2 = dlog(dp1)
dp2 = log(dp1)

cx2 = clog(cx1)
cx2 = log(cx1)
```

## DESCRIPTION

*Alog* returns the real natural logarithm of its real argument. *Dlog* returns the double-precision natural logarithm of its double-precision argument. *Clog* returns the complex logarithm of its complex argument. The generic function *log* becomes a call to *alog, dlog,* or *clog* depending on the type of its argument.

## SEE ALSO

exp(3M).

## NAME

log10, alog10, dlog10 – Fortran common logarithm intrinsic function

## SYNOPSIS

```
real r1, r2
double precision dp1, dp2

r2 = alog10(r1)
r2 = log10(r1)

dp2 = dlog10(dp1)
dp2 = log10(dp1)
```

## DESCRIPTION

*Alog10* returns the real common logarithm of its real argument. *Dlog10* returns the double-precision common logarithm of its double-precision argument. The generic function *log10* becomes a call to *alog10* or *dlog10* depending on the type of its argument.

## SEE ALSO

exp(3M).

## NAME

max, max0, amax0, max1, amax1, dmax1 − Fortran maximum-value functions

## SYNOPSIS

**integer i, j, k, l**
**real a, b, c, d**
**double precision dp1, dp2, dp3**

**l = max(i, j, k)**
**c = max(a, b)**
**dp = max(a, b, c)**
**k = max0(i, j)**
**a = amax0(i, j, k)**
**i = max1(a, b)**
**d = amax1(a, b, c)**
**dp3 = dmax1(dp1, dp2)**

## DESCRIPTION

The maximum-value functions return the largest of their arguments (of which there may be any number). *max* is the generic form which can be used for all data types and takes its return type from that of its arguments (which must all be of the same type). *max0* returns the integer form of the maximum value of its integer arguments; *amax0,* the real form of its integer arguments; *max1,* the integer form of its real arguments; *amax1,* the real form of its real arguments; and *dmax1,* the double-precision form of its double-precision arguments.

## SEE ALSO

min(3F).

## NAME

mclock – return Fortran time accounting

## SYNOPSIS

**integer i**

**i = mclock( )**

## DESCRIPTION

*mclock* returns time accounting information about the current process and its child processes. The value returned is the sum of the current process's user time and the user and system times of all child processes.

## SEE ALSO

times(2), clock(3C), system(3F).

## NAME

mil: ior, iand, not, ieor, ishft, ishftc, ibits, btest, ibset, ibclr, mvbits – Fortran Military Standard functions

## SYNOPSIS

```
integer i, k, l, m, n, len
logical b

i = ior(m, n)
i = iand(m, n)
i = not(m)
i = ieor(m, n)
i = ishft(m, k)
i = ishftc(m, k, len)
i = ibits(m, k, len)
b = btest(n, k)
i = ibset(n, k)
i = ibclr(n, k)
call mvbits(m, k, len, n, l)
```

## DESCRIPTION

*mil* is the general name for the bit field manipulation intrinsic functions and subroutines from the Fortran Military Standard (MIL-STD-1753). *ior, iand, not, ieor* – return the same results as *and, or, not, xor* as defined in *bool*(3F).

*ishft, ishftc* – **m** specifies the integer to be shifted. **k** specifies the shift count. **k** > 0 indicates a left shift. **k** = 0 indicates no shift. **k** < 0 indicates a right shift. In *ishft*, zeros are shifted in. In *ishftc*, the rightmost **len** bits are shifted circularly **k** bits. If **k** is greater than the machine word-size, *ishftc* will not shift.

Bit fields are numbered from right to left and the rightmost bit position is zero. The length of the **len** field must be greater than zero.

*ibits* – extract a subfield of **len** bits from **m** starting with bit position **k** and extending left for **len** bits. The result field is right justified and the remaining bits are set to zero.

*btest* – The **k**th bit of argument **n** is tested. The value of the function is **.TRUE.** if the bit is a 1 and **.FALSE.** if the bit is 0.

*ibset* – the result is the value of **n** with the **k**th bit set to 1.

*ibclr* – the result is the value of **n** with the **k**th bit set to 0.

*mvbits* – **len** bits are moved beginning at position **k** of argument **m** to position **l** of argument **n**.

## SEE ALSO

bool(3F).

## NAME

min, min0, amin0, min1, amin1, dmin1 — Fortran minimum-value functions

## SYNOPSIS

```
integer i, j, k, l
real a, b, c, d
double precision dp1, dp2, dp3

l = min(i, j, k)
c = min(a, b)
dp = min(a, b, c)
k = min0(i, j)
a = amin0(i, j, k)
i = min1(a, b)
d = amin1(a, b, c)
dp3 = dmin1(dp1, dp2)
```

## DESCRIPTION

The minimum-value functions return the minimum of their arguments (of which there may be any number). *min* is the generic form which can be used for all data types and takes its return type from that of its arguments (which must all be of the same type). *min0* returns the integer form of the minimum value of its integer arguments; *amin0,* the real form of its integer arguments; *min1,* the integer form of its real arguments; *amin1,* the real form of its real arguments; and *dmin1,* the double-precision form of its double-precision arguments.

## SEE ALSO

max(3F).

## NAME

mod, amod, dmod — Fortran remaindering intrinsic functions

## SYNOPSIS

**integer i, j, k**
**real r1, r2, r3**
**double precision dp1, dp2, dp3**

**k = mod(i, j)**

**r3 = amod(r1, r2)**
**r3 = mod(r1, r2)**

**dp3 = dmod(dp1, dp2)**
**dp3 = mod(dp1, dp2)**

## DESCRIPTION

*mod* returns the integer remainder of its first argument divided by its second argument. *Amod* and *dmod* return, respectively, the real and double-precision whole number remainder of the integer division of their two arguments. The generic version *mod* will return the data type of its arguments.

## NAME

rand, irand, srand – random number generator

## SYNOPSIS

**integer iseed, i, irand**
**double precision x, rand**

**call srand(iseed)**

**i = irand( )**

**x = rand( )**

## DESCRIPTION

*Irand* generates successive pseudo-random integers in the range from 0 to 2**15–1. *rand* generates pseudo-random numbers distributed in [0, 1.0]. *Srand* uses its integer argument to re-initialize the seed for successive invocations of *irand* and *rand*.

## SEE ALSO

rand(3C).

## NAME

round: anint, dnint, nint, idnint – Fortran nearest integer functions

## SYNOPSIS

```
integer i
real r1, r2
double precision dp1, dp2

r2 = anint(r1)
i = nint(r1)

dp2 = anint(dp1)
dp2 = dnint(dp1)

i = nint(dp1)
i = idnint(dp1)
```

## DESCRIPTION

*Anint* returns the nearest whole real number to its real argument (i.e., int(a+0.5) if a $\geqslant$ 0, int(a−0.5) otherwise). *Dnint* does the same for its double-precision argument. *Nint* returns the nearest integer to its real argument. *Idnint* is the double-precision version. *Anint* is the generic form of *anint* and *dnint* , performing the same operation and returning the data type of its argument. *Nint* is also the generic form of *idnint.*

NAME

sign, isign, dsign – Fortran transfer-of-sign intrinsic function

SYNOPSIS

```
integer i, j, k
real r1, r2, r3
double precision dp1, dp2, dp3

k = isign(i, j)
k = sign(i, j)

r3 = sign(r1, r2)

dp3 = dsign(dp1, dp2)
dp3 = sign(dp1, dp2)
```

DESCRIPTION

*Isign* returns the magnitude of its first argument with the sign of its second argument. *sign* and *dsign* are its real and double-precision counterparts, respectively. The generic version is *sign* and will devolve to the appropriate type depending on its arguments.

## NAME

signal – specify Fortran action on receipt of a system signal

## SYNOPSIS

**integer i, intfc**
**external intfc**

**call signal(i, intfc)**

## DESCRIPTION

The argument **i** specifies the signal to be caught. *signal* allows a process to specify a function to be invoked upon receipt of a specific signal. The first argument specifies which fault or exception. The second argument specifies the function to be invoked.
**NOTE:** The interrupt processing function, *intfc,* does not take an argument.

## SEE ALSO

kill(2), signal(2).

## NAME

sin, dsin, csin — Fortran sine intrinsic function

## SYNOPSIS

```
real r1, r2
double precision dp1, dp2
complex cx1, cx2

r2 = sin(r1)

dp2 = dsin(dp1)
dp2 = sin(dp1)

cx2 = csin(cx1)
cx2 = sin(cx1)
```

## DESCRIPTION

*sin* returns the real sine of its real argument. *Dsin* returns the double-precision sine of its double-precision argument. *Csin* returns the complex sine of its complex argument. The generic *sin* function becomes *dsin* or *csin* as required by argument type.

## SEE ALSO

trig(3M).

## NAME

sinh, dsinh – Fortran hyperbolic sine intrinsic function

## SYNOPSIS

**real r1, r2**
**double precision dp1, dp2**

**r2 = sinh(r1)**

**dp2 = dsinh(dp1)**
**dp2 = sinh(dp1)**

## DESCRIPTION

*sinh* returns the real hyperbolic sine of its real argument. *Dsinh* returns the double-precision hyperbolic sine of its double-precision argument. The generic form *sinh* may be used to return a double-precision value when given a double-precision argument.

## SEE ALSO

sinh(3M).

## NAME

sqrt, dsqrt, csqrt — Fortran square root intrinsic function

## SYNOPSIS

**real r1, r2**
**double precision dp1, dp2**
**complex cx1, cx2**

**r2 = sqrt(r1)**

**dp2 = dsqrt(dp1)**
**dp2 = sqrt(dp1)**

**cx2 = csqrt(cx1)**
**cx2 = sqrt(cx1)**

## DESCRIPTION

*sqrt* returns the real square root of its real argument. *Dsqrt* returns the double-precision square root of its double-precision argument. *Csqrt* returns the complex square root of its complex argument. *sqrt,* the generic form, will become *dsqrt* or *csqrt* as required by its argument type.

## SEE ALSO

exp(3M).

## NAME

strcmp: lge, lgt, lle, llt – string comparison intrinsic functions

## SYNOPSIS

```
character*N a1, a2
logical l

l = lge(a1, a2)
l = lgt(a1, a2)
l = lle(a1, a2)
l = llt(a1, a2)
```

## DESCRIPTION

These functions return .TRUE. if the inequality holds and .FALSE. otherwise.

## NAME

system – issue a shell command from Fortran

## SYNOPSIS

**character*N c**

**call system(c)**

## DESCRIPTION

*system* causes its character argument to be given to *sh*(1) as input, as if the string had been typed at a terminal. The current process waits until the shell has completed.

## SEE ALSO

exec(2), system(3S).
sh(1) in the *User's Reference Manual.*

## NAME

tan, dtan — Fortran tangent intrinsic function

## SYNOPSIS

**real r1, r2**
**double precision dp1, dp2**

**r2 = tan(r1)**

**dp2 = dtan(dp1)**
**dp2 = tan(dp1)**

## DESCRIPTION

*tan* returns the real tangent of its real argument. *Dtan* returns the double-precision tangent of its double-precision argument. The generic *tan* function becomes *dtan* as required with a double-precision argument.

## SEE ALSO

trig(3M).

## NAME

tanh, dtanh – Fortran hyperbolic tangent intrinsic function

## SYNOPSIS

**real r1, r2**
**double precision dp1, dp2**

**r2 = tanh(r1)**

**dp2 = dtanh(dp1)**
**dp2 = tanh(dp1)**

## DESCRIPTION

*tanh* returns the real hyperbolic tangent of its real argument. *Dtanh* returns the double-precision hyperbolic tangent of its double-precision argument. The generic form *tanh* may be used to return a double-precision value given a double-precision argument.

## SEE ALSO

sinh(3M).

## 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 − common assembler and link editor output

## SYNOPSIS

**#include <a.out.h>**

## DESCRIPTION

The file name **a.out** is the default output file name from the link editor *ld*(1). The link editor will make *a.out* executable if there were no errors in linking. The output file of the assembler *as*(1), also follows the common object file format of the *a.out* file although the default file name is different.

A common object file consists of a file header, a UNIX system header (if the file is link editor output), a table of section headers, relocation information, (optional) line numbers, a symbol table, and a string table. The order is given below.

```
File header.
UNIX system header.
Section 1 header.
...
Section n header.
Section 1 data.
...
Section n data.
Section 1 relocation.
...
Section n relocation.
Section 1 line numbers.
...
Section n line numbers.
Symbol table.
String table.
```

The last three parts of an object file (line numbers, symbol table and string table) may be missing if the program was linked with the **−s** option of *ld*(1) or if they were removed by *strip*(1). Also note that the relocation information will be absent after linking unless the **−r** option of *ld*(1) was used. The string table exists only if the symbol table contains symbols with names longer than eight characters.

The sizes of each section (contained in the header, discussed below) are in bytes.

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. On the 3B2 computer the text segment starts at location 0x80800000.

The **a.out** file produced by *ld*(1) has the magic number 0413 in the first field of the UNIX system header. The headers (file header, UNIX system header, and section headers) are loaded at the beginning of the text segment and the text immediately follows the headers in the user address space. The first text address will equal 0x80800000 plus the size of the headers, and will vary depending upon the number of section headers in the **a.out** file. In an **a.out** file with three sections (.text, .data, and .bss), the first text address is at 0x808000A8 on the 3B2 computer. 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 512K boundary past the last text address. The first data address is determined by the following: If an **a.out** file were split into 8K chunks, one of the chunks would contain both the end of text and the beginning of data. When the core image is created, that chunk will appear twice; once at the end of text and once at the beginning of data (with some unused space in between). 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 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 segment boundary past the end of text plus the remainder of the last text address divided by 8K. If the last text address is a multiple of 8K no duplication is necessary.

On the 3B2 computer the stack begins at location 0xC0020000 and grows toward higher addresses. The stack is automatically extended as required. The data segment is extended only as requested by the *brk*(2) system call.

For relocatable files the value of a word in the text or data portions that is not a reference to an undefined external symbol is exactly the value that will appear in memory when the file is executed. If a word in the text involves a reference to an undefined external symbol, there will be a relocation entry for the word, the storage class of the symbol-table entry for the symbol will be marked as an "external symbol", and the value and section number of the symbol-table entry will be undefined. When the file is processed by the link editor and the external symbol becomes defined, the value of the symbol will be added to the word in the file.

## File Header

The format of the **filehdr** header is

```
struct filehdr
{
        unsigned short  f_magic;   /* magic number */
        unsigned short  f_nscns;   /* number of sections */
        long            f_timdat;  /* time and date stamp */
        long            f_symptr;  /* file ptr to symtab */
        long            f_nsyms;   /* # symtab entries */
        unsigned short  f_opthdr;  /* sizeof(opt hdr) */
        unsigned short  f_flags;   /* flags */
};
```

## UNIX System Header

The format of the UNIX system header is

```
typedef struct aouthdr
{
        short     magic;           /* magic number */
        short   vstamp;       /* version stamp */
        long    tsize;        /* text size in bytes, padded */
        long    dsize;        /* initialized data (.data) */
        long    bsize;        /* uninitialized data (.bss) */
        long    entry;        /* entry point */
        long    text_start;   /* base of text used for this file */
        long    data_start;   /* base of data used for this file */
} AOUTHDR;
```

**Section Header**

The format of the section header is

```
struct scnhdr
{
        char            s_name[SYMNMLEN];/* section name */
        long            s_paddr;    /* physical address */
        long            s_vaddr;    /* virtual address */
        long            s_size;     /* section size */
        long            s_scnptr;   /* file ptr to raw data */
        long            s_relptr;   /* file ptr to relocation */
        long            s_lnnoptr;  /* file ptr to line numbers */
        unsigned short  s_nreloc;   /* # reloc entries */
        unsigned short  s_nlnno;    /* # line number entries */
        long            s_flags;    /* flags */
};
```

**Relocation**

Object files have one relocation entry for each relocatable reference in the text or data. If relocation information is present, it will be in the following format:

```
struct reloc
{
        long     r_vaddr;    /* (virtual) address of reference */
        long     r_symndx;   /* index into symbol table */
        ushort   r_type;     /* relocation type */
};
```

The start of the relocation information is *s_relptr* from the section header. If there is no relocation information, *s_relptr* is 0.

## Symbol Table

The format of each symbol in the symbol table is

```
#define SYMNMLEN 8
#define FILNMLEN 14
#define DIMNUM   4

struct syment
{
   union                           /* all ways to get a symbol name */
   {
      char          _n_name[SYMNMLEN]; /* name of symbol */
      struct
      {
         long       _n_zeroes;     /* == 0L if in string table */
         long       _n_offset;     /* location in string table */
      } _n_n;
      char          *_n_nptr[2];   /* allows overlaying */
   } _n;
   long             n_value;       /* value of symbol */
   short            n_scnum;       /* section number */
   unsigned short   n_type;        /* type and derived type */
   char             n_sclass;      /* storage class */
   char             n_numaux;      /* number of aux entries */
};

#define n_name     _n._n_name
#define n_zeroes   _n._n_n._n_zeroes
#define n_offset   _n._n_n._n_offset
#define n_nptr     _n._n_nptr[1]
```

Some symbols require more information than a single entry; they are followed by *auxiliary entries* that are the same size as a symbol entry. The format follows.

```
union auxent {
        struct {
                long    x_tagndx;
                union {
                        struct {
                                unsigned short  x_lnno;
                                unsigned short  x_size;
                        } x_lnsz;
                        long     x_fsize;
                } x_misc;
                union {
                        struct {
                                long    x_lnnoptr;
                                long    x_endndx;
                        }  x_fcn;
                        struct {
                                unsigned short  x_dimen[DIMNUM];
                        } x_ary;
                } x_fcnary;
                unsigned short  x_tvndx;
        } x_sym;

        struct {
                char    x_fname[FILNMLEN];
        } x_file;

        struct {
                long        x_scnlen;
                unsigned short  x_nreloc;
                unsigned short  x_nlinno;
        } x_scn;

        struct {
                long            x_tvfill;
                unsigned short  x_tvlen;
                unsigned short  x_tvran[2];
        } x_tv;
};
```

Indexes of symbol table entries begin at *zero*. The start of the symbol table is *f_symptr* (from the file header) bytes from the beginning of the file. If the symbol table is stripped, *f_symptr* is 0. The string table (if one exists) begins at *f_symptr* + (*f_nsyms* * SYMESZ) bytes from the beginning of the file.

SEE ALSO

as(1), cc(1), ld(1), brk(2), filehdr(4), ldfcn(4), linenum(4), reloc(4), scnhdr(4), syms(4).

## NAME

acct − per-process accounting file format

## SYNOPSIS

**#include <sys/acct.h>**

## DESCRIPTION

Files produced as a result of calling *acct*(2) have records in the form defined by **<sys/acct.h>**, whose contents are:

```
typedef  ushort comp_t; /* "floating point" */
                /* 13-bit fraction, 3-bit exponent  */

struct   acct
{
         char    ac_flag;       /* Accounting flag */
         char    ac_stat;       /* Exit status */
         ushort  ac_uid;
         ushort  ac_gid;
         dev_t   ac_tty;
         time_t  ac_btime;      /* Beginning time */
         comp_t  ac_utime;      /* acctng user time in clock ticks */
         comp_t  ac_stime;      /* acctng system time in clock ticks */
         comp_t  ac_etime;      /* acctng elapsed time in clock ticks */
         comp_t  ac_mem;        /* memory usage in clicks */
         comp_t  ac_io;         /* chars trnsfrd by read/write */
         comp_t  ac_rw;         /* number of block reads/writes */
         char    ac_comm[8];    /* command name */
};

extern   struct  acct           acctbuf;
extern   struct  inode          *acctp;  /* inode of accounting file */

#define  AFORK   01             /* has executed fork, but no exec */
#define  ASU     02             /* used super-user privileges */
#define  ACCTF   0300           /* record type: 00 = acct */
```

In *ac_flag*, the AFORK flag is turned on by each *fork*(2) and turned off by an *exec*(2). The *ac_comm* field is inherited from the parent process and is reset by any *exec*. Each time the system charges the process with a clock tick, it also adds to *ac_mem* the current process size, computed as follows:

(data size) + (text size) / (number of in-core processes using text)

The value of *ac_mem/(ac_stime+ac_utime)* can be viewed as an approximation to the mean process size, as modified by text-sharing.

The structure **tacct.h**, which resides with the source files of the accounting commands, represents the total accounting format used by the various accounting commands:

```
/*
 * total accounting (for acct period), also for day
 */

struct tacct {
      uid_t            ta_uid;       /* userid */
      char             ta_name[8];   /* login name */
      float            ta_cpu[2];    /* cum. cpu time, p/np (mins) */
      float            ta_kcore[2];  /* cum kcore-minutes, p/np */
      float            ta_con[2];    /* cum. connect time, p/np, mins */
      float            ta_du;        /* cum. disk usage */
      long             ta_pc;        /* count of processes */
      unsigned short   ta_sc;        /* count of login sessions */
      unsigned short   ta_dc;        /* count of disk samples */
      unsigned short   ta_fee;       /* fee for special services */
};
```

SEE ALSO

acct(2), exec(2), fork(2).
acct(1M) in the *System Administrator's Reference Manual.*
acctcom(1) in the *User's Reference Manual.*

BUGS

The *ac_mem* value for a short-lived command gives little information about the actual size of the command, because *ac_mem* may be incremented while a different command (e.g., the shell) is being executed by the process.

## NAME

ar − common 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 */
```

Each archive which contains common 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*.

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.

The *ar_name* field is blank-padded and slash (/) terminated. 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. Conversion tools such as *convert*(1) exist to aid in the transportation of non-common format archives to this format.

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.

If the archive symbol table exists, the first file in the archive has a zero length name (i.e., **ar_name[0] == '/'** ). The contents of this file are as follows:

- The number of symbols. Length: 4 bytes.
- The array of offsets into the archive file. Length: 4 bytes * "the number of symbols".
- The name string table. Length: *ar_size* − (4 bytes * ("the number of symbols" + 1)).

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).

## WARNINGS

*Strip*(1) will remove all archive symbol entries from the header. The archive symbol entries must be restored via the **ts** option of the *ar*(1) command before the archive can be used with the link editor *ld*(1).

## NAME

checklist – list of file systems processed by fsck and ncheck

## DESCRIPTION

*checklist* resides in directory **/etc** and contains a list of, at most, 15 *special file* names. Each *special file* name is contained on a separate line and corresponds to a file system. Each file system will then be automatically processed by the *fsck*(1M) command.

## FILES

/etc/checklist

## SEE ALSO

fsck(1M), ncheck(1M) in the *System Administrator's Reference Manual.*

## 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

cpio − format of cpio archive

## DESCRIPTION

The *header* structure, when the **−c** option of *cpio*(1) is not used, is:

```
struct {
        short   h_magic,
                h_dev;
        ushort  h_ino,
                h_mode,
                h_uid,
                h_gid;
        short   h_nlink,
                h_rdev,
                h_mtime[2],
                h_namesize,
                h_filesize[2];
        char    h_name[h_namesize rounded to word];
} Hdr;
```

When the **−c** option is used, the *header* information is described by:

```
sscanf(Chdr,"%6o%6o%6o%6o%6o%6o%6o%6o%11lo%6o%11lo%s",
        &Hdr.h_magic, &Hdr.h_dev, &Hdr.h_ino, &Hdr.h_mode,
        &Hdr.h_uid, &Hdr.h_gid, &Hdr.h_nlink, &Hdr.h_rdev,
        &Longtime, &Hdr.h_namesize,&Longfile,Hdr.h_name);
```

*Longtime* and *Longfile* are equivalent to *Hdr.h_mtime* and *Hdr.h_filesize*, respectively. The contents of each file are recorded in an element of the array of varying length structures, *archive*, together with other items describing the file. Every instance of *h_magic* contains the constant 070707 (octal). The items *h_dev* through *h_mtime* have meanings explained in *stat*(2). The length of the null-terminated path name *h_name*, including the null byte, is given by *h_namesize*.

The last record of the *archive* always contains the name TRAILER!!!. Special files, directories, and the trailer are recorded with *h_filesize* equal to zero.

## SEE ALSO

stat(2).
cpio(1), find(1) in the *User's Reference Manual*.

## NAME

dir − format of directories

## SYNOPSIS

**#include <sys/dir.h>**

## DESCRIPTION

A directory behaves exactly like an ordinary file, save that no user may write into a directory. The fact that a file is a directory is indicated by a bit in the flag word of its i-node entry [see *fs*(4)]. The structure of a directory entry as given in the include file is:

```
#ifndef  DIRSIZ
#define  DIRSIZ14
#endif
struct   direct
{
         ushort d_ino;
         char   d_name[DIRSIZ];
};
```

By convention, the first two entries in each directory are for . and ... The first is an entry for the directory itself. The second is for the parent directory. The meaning of .. is modified for the root directory of the master file system; there is no parent, so .. has the same meaning as ..

## SEE ALSO

fs(4).

## NAME

dirent − file system independent directory entry

## SYNOPSIS

**#include <sys/dirent.h>**
**#include <sys/types.h>**

## DESCRIPTION

Different file system types may have different directory entries. The *dirent* structure defines a file system independent directory entry, which contains information common to directory entries in different file system types. A set of these structures is returned by the *getdents*(2) system call.

The *dirent* structure is defined below.

```
struct  dirent {
                        long                    d_ino;
                        off_t                   d_off;
                        unsigned short          d_reclen;
                        char                    d_name[1];
          };
```

The *d_ino* is a number which is unique for each file in the file system. The field *d_off* is the offset of that directory entry in the actual file system directory. The field *d_name* is the beginning of the character array giving the name of the directory entry. This name is null terminated and may have at most MAXNAMLEN characters. This results in file system independent directory entries being variable length entities. The value of *d_reclen* is the record length of this entry. This length is defined to be the number of bytes between the current entry and the next one, so that it will always result in the next entry being on a long boundary.

## FILES

/usr/include/sys/dirent.h

## SEE ALSO

getdents(2).

## NAME

.edt_swapp – software application file

## DESCRIPTION

The *.edt_swapp* file is read by *filledt(8)* on its second pass during the self-configuration process to rename specified Equipped Device Table (EDT) entries. The file has the following format:

```
SLOT   SWNAME      HWNAME
 .        .           .
 .        .           .
 .        .           .
FF
```

The number in the slot field specifies the entry in the EDT to be updated. The *SWNAME* column contains the new name which will be associated with this board. The *HWNAME* field contains the name which the board was associated with generically. The last line contains 'FF' for the slot number to signal the end of the data to the firmware. This file can be displayed by the *editsa -l* command.

## WARNINGS

This file is not to be edited directly. Updates to it must be done through editsa.

## SEE ALSO

editsa(1M), filledt(8) in the *System Administrator's Reference Manual.*

## NAME

filehdr — file header for common object files

## SYNOPSIS

**#include <filehdr.h>**

## DESCRIPTION

Every common object file begins with a 20-byte header. The following C **struct** declaration is used:

```
struct  filehdr
{
        unsigned short  f_magic ;    /* magic number */
        unsigned short  f_nscns ;    /* number of sections */
        long            f_timdat ;   /* time & date stamp */
        long            f_symptr ;   /* file ptr to symtab */
        long            f_nsyms ;    /* # symtab entries */
        unsigned short  f_opthdr ;   /* sizeof(opt hdr) */
        unsigned short  f_flags ;    /* flags */
} ;
```

*F_symptr* is the byte offset into the file at which the symbol table can be found. Its value can be used as the offset in *fseek*(3S) to position an I/O stream to the symbol table. The UNIX system optional header is 28-bytes. The valid magic numbers are given below:

```
#define FBOMAGIC     0560    /* 3B2 and 3B5 computers */
#define N3BMAGIC     0550    /* 3B20 computer */
#define NTVMAGIC     0551    /* 3B20 computer */

#define VAXWRMAGIC  0570    /* VAX writable text segments */
#define VAXROMAGIC  0575    /* VAX read only sharable
                                text segments */
```

The value in *f_timdat* is obtained from the *time*(2) system call. Flag bits currently defined are:

```
#define F_RELFLG    0000001    /* relocation entries stripped */
#define F_EXEC      0000002    /* file is executable */
#define F_LNNO      0000004    /* line numbers stripped */
#define F_LSYMS     0000010    /* local symbols stripped */
#define F_MINMAL    0000020    /* minimal object file */
#define F_UPDATE    0000040    /* update file, ogen produced */
#define F_SWABD     0000100    /* file is "pre-swabbed" */
#define F_AR16WR    0000200    /* 16-bit DEC host */
#define F_AR32WR    0000400    /* 32-bit DEC host */
#define F_AR32W     0001000    /* non-DEC host */
#define F_PATCH     0002000    /* "patch" list in opt hdr */
#define F_BM32ID    0160000    /* WE32000 family ID field */
#define F_BM32B     0020000    /* file contains WE 32100 code */
#define F_BM32MAU   0040000    /* file reqs MAU to execute */
#define F_BM32RST   0010000    /* this object file contains restore
                                  work around [3B5/3B2 only] */
```

## SEE ALSO

time(2), fseek(3S), a.out(4).

## NAME

fs: file system — format of system volume

## SYNOPSIS

**#include <sys/filsys.h>**
**#include <sys/types.h>**
**#include <sys/param.h>**

## DESCRIPTION

Every file system storage volume has a common format for certain vital information. Every such volume is divided into a certain number of 512-byte long sectors. Sector 0 is unused and is available to contain a bootstrap program or other information.

Sector 1 is the *super-block*. The format of a super-block is:

```
struct  filsys
{
        ushort    s_isize;            /* size in blocks of i-list */
        daddr_t   s_fsize;            /* size in blocks of entire volume */
        short     s_nfree;            /* number of addresses in s_free */
        daddr_t   s_free[NICFREE];    /* free block list */
        short     s_ninode;           /* number of i-nodes in s_inode */
        ushort    s_inode[NICINOD];   /* free i-node list */
        char      s_flock;            /* lock during free list manipulation */
        char      s_ilock;            /* lock during i-list manipulation */
        char      s_fmod;             /* super block modified flag */
        char      s_ronly;            /* mounted read-only flag */
        time_t    s_time;             /* last super block update */
        short     s_dinfo[4];         /* device information */
        daddr_t   s_tfree;            /* total free blocks*/
        ushort    s_tinode;           /* total free i-nodes */
        char      s_fname[6];         /* file system name */
        char      s_fpack[6];         /* file system pack name */
        long      s_fill[12];         /* ADJUST to make sizeof filsys
                                      be 512 */
        long      s_state;            /* file system state */
        long      s_magic;            /* magic number to denote new
                                      file system */
        long      s_type;             /* type of new file system */
};

#define FsMAGIC   0xfd187e20          /* s_magic number */

#define Fs1b      1                   /* 512-byte block */
#define Fs2b      2                   /* 1024-byte block */

#define FsOKAY    0x7c269d38          /* s_state: clean */
#define FsACTIVE  0x5e72d81a          /* s_state: active */
#define FsBAD     0xcb096f43          /* s_state: bad root */
#define FsBADBLK  0xbadbc14b          /* s_state: bad block corrupted it */
```

*S_type* indicates the file system type. Currently, two types of file systems are supported: the original 512-byte logical block and the improved 1024-byte logical block. *S_magic* is used to distinguish the original 512-byte oriented file systems from the newer file systems. If this field is not equal to the magic number, *fsMAGIC*, the type is assumed to be *fs1b*, otherwise the *s_type* field is used. In the following description, a block is then determined by the type. For the original 512-byte oriented file system, a block is 512-bytes. For the 1024-byte oriented file system, a block is 1024-bytes or two sectors. The operating system takes care of all conversions from logical block numbers to physical sector numbers.

*S_state* indicates the state of the file system. A cleanly unmounted, not damaged file system is indicated by the FsOKAY state. After a file system has been mounted for update, the state changes to FsACTIVE. A special case is used for the root file system. If the root file system appears damaged at boot time, it is mounted but marked FsBAD. Lastly, after a file system has been unmounted, the state reverts to FsOKAY.

*S_isize* is the address of the first data block after the i-list; the i-list starts just after the super-block, namely in block 2; thus the i-list is *s_isize*−2 blocks long. *S_fsize* is the first block not potentially available for allocation to a file. These numbers are used by the system to check for bad block numbers; if an "impossible" block number is allocated from the free list or is freed, a diagnostic is written on the on-line console. Moreover, the free array is cleared, so as to prevent further allocation from a presumably corrupted free list.

The free list for each volume is maintained as follows. The *s_free* array contains, in *s_free*[1], ..., *s_free*[*s_nfree*−1], up to 49 numbers of free blocks. *S_free*[0] is the block number of the head of a chain of blocks constituting the free list. The first long in each free-chain block is the number (up to 50) of free-block numbers listed in the next 50 longs of this chain member. The first of these 50 blocks is the link to the next member of the chain. To allocate a block: decrement *s_nfree*, and the new block is *s_free*[*s_nfree*]. If the new block number is 0, there are no blocks left, so give an error. If *s_nfree* became 0, read in the block named by the new block number, replace *s_nfree* by its first word, and copy the block numbers in the next 50 longs into the *s_free* array. To free a block, check if *s_nfree* is 50; if so, copy *s_nfree* and the *s_free* array into it, write it out, and set *s_nfree* to 0. In any event set *s_free*[*s_nfree*] to the freed block's number and increment *s_nfree*.

*S_tfree* is the total free blocks available in the file system.

*S_ninode* is the number of free i-numbers in the *s_inode* array. To allocate an i-node: if *s_ninode* is greater than 0, decrement it and return *s_inode*[*s_ninode*]. If it was 0, read the i-list and place the numbers of all free i-nodes (up to 100) into the *s_inode* array, then try again. To free an i-node, provided *s_ninode* is less than 100, place its number into *s_inode*[*s_ninode*] and increment *s_ninode*. If *s_ninode* is already 100, do not bother to enter the freed i-node into any table. This list of i-nodes is only to speed up the allocation process; the information as to whether the i-node is really free or not is maintained in the i-node itself.

*S_tinode* is the total free i-nodes available in the file system.

*S_flock* and *s_ilock* are flags maintained in the core copy of the file system while it is mounted and their values on disk are immaterial. The value of *s_fmod* on disk is likewise immaterial; it is used as a flag to indicate that the super-block has changed and should be copied to the disk during the next periodic update of file system information.

*S_ronly* is a read-only flag to indicate write-protection.

*S_time* is the last time the super-block of the file system was changed, and is the number of seconds that have elapsed since 00:00 Jan. 1, 1970 (GMT). During a reboot, the *s_time* of the super-block for the root file system is used to set the system's idea of the time.

*S_fname* is the name of the file system and *s_fpack* is the name of the pack.

I-numbers begin at 1, and the storage for i-nodes begins in block 2. Also, i-nodes are 64 bytes long. I-node 1 is reserved for future use. I-node 2 is reserved for the root directory of the file system, but no other i-number has a built-in meaning. Each i-node represents one file. For the format of an i-node and its flags, see *inode*(4).

## SEE ALSO

mount(2), inode(4).
fsck(1M), fsdb(1M), mkfs(1M) in the *System Administrator's Reference Manual.*

## NAME

fspec — format specification in text files

## DESCRIPTION

It is sometimes convenient to maintain text files on the UNIX system with non-standard tabs, (i.e., tabs which are not set at every eighth column). Such files must generally be converted to a standard format, frequently by replacing all tabs with the appropriate number of spaces, before they can be processed by UNIX system commands. A format specification occurring in the first line of a text file specifies how tabs are to be expanded in the remainder of the file.

A format specification consists of a sequence of parameters separated by blanks and surrounded by the brackets <: and :>. Each parameter consists of a keyletter, possibly followed immediately by a value. The following parameters are recognized:

**t***tabs* The **t** parameter specifies the tab settings for the file. The value of *tabs* must be one of the following:

1. a list of column numbers separated by commas, indicating tabs set at the specified columns;
2. a — followed immediately by an integer *n*, indicating tabs at intervals of *n* columns;
3. a — followed by the name of a "canned" tab specification.

Standard tabs are specified by **t—8**, or equivalently, **t1,9,17,25,**etc. The canned tabs which are recognized are defined by the *tabs*(1) command.

**s***size* The **s** parameter specifies a maximum line size. The value of *size* must be an integer. Size checking is performed after tabs have been expanded, but before the margin is prepended.

**m***margin* The **m** parameter specifies a number of spaces to be prepended to each line. The value of *margin* must be an integer.

**d** The **d** parameter takes no value. Its presence indicates that the line containing the format specification is to be deleted from the converted file.

**e** The **e** parameter takes no value. Its presence indicates that the current format is to prevail only until another format specification is encountered in the file.

Default values, which are assumed for parameters not supplied, are **t—8** and **m0**. If the **s** parameter is not specified, no size checking is performed. If the first line of a file does not contain a format specification, the above defaults are assumed for the entire file. The following is an example of a line containing a format specification:

```
* <:t5,10,15 s72:> *
```

If a format specification can be disguised as a comment, it is not necessary to code the **d** parameter.

SEE ALSO

ed(1), newform(1), tabs(1) in the *User's Reference Manual.*

## NAME

fstab — file-system-table

## DESCRIPTION

The **/etc/fstab** file contains information about file systems for use by **mount (1M)** and **mountall(1M).** Each entry in **/etc/fstab** has the following format:

| | |
|---|---|
| column 1 | block special file name of file system or advertised remote resource |
| column 2 | mount-point directory |
| column 3 | "−r" if to be mounted read-only; "−d[r]" if remote |
| column 4 | (optional) file system type string |
| column 5+ | ignored |

White-space separates columns. Lines beginning with "# " are comments. Empty lines are ignored.

A file-system-table might read:

```
/dev/dsk/c1d0s2 /usr  S51K
/dev/dsk/c1d1s2 /usr/src -r
adv_resource /mnt -d
```

## FILES

/etc/fstab

## SEE ALSO

mount(1M), mountall(1M), rmountall(1M) in the *System Administrator's Reference Manual.*

## NAME

gettydefs – speed and terminal settings used by getty

## DESCRIPTION

The **/etc/gettydefs** file contains information used by *getty*(1M) to set up the speed and terminal settings for a line. It supplies information on what the *login* prompt should look like. It also supplies the speed to try next if the user indicates the current speed is not correct by typing a <*break*> character.

Each entry in **/etc/gettydefs** has the following format:

label# initial-flags # final-flags # login-prompt #next-label

Each entry is followed by a blank line. The various fields can contain quoted characters of the form **b**, **n**, **c**, etc., as well as *nnn*, where *nnn* is the octal value of the desired character. The various fields are:

*label* This is the string against which *getty* tries to match its second argument. It is often the speed, such as **1200**, at which the terminal is supposed to run, but it need not be (see below).

*initial-flags* These flags are the initial *ioctl*(2) settings to which the terminal is to be set if a terminal type is not specified to *getty*. The flags that *getty* understands are the same as the ones listed in **/usr/include/sys/termio.h** [see *termio*(7)]. Normally only the speed flag is required in the *initial-flags*. *Getty* automatically sets the terminal to raw input mode and takes care of most of the other flags. The *initial-flag* settings remain in effect until *getty* executes *login*(1).

*final-flags* These flags take the same values as the *initial-flags* and are set just prior to *getty* executes *login*. The speed flag is again required. The composite flag **SANE** takes care of most of the other flags that need to be set so that the processor and terminal are communicating in a rational fashion. The other two commonly specified *final-flags* are **TAB3**, so that tabs are sent to the terminal as spaces, and **HUPCL**, so that the line is hung up on the final close.

*login-prompt* This entire field is printed as the *login-prompt*. Unlike the above fields where white space is ignored (a space, tab or new-line), they are included in the *login-prompt* field.

*next-label* If this entry does not specify the desired speed, indicated by the user typing a <*break*> character, then *getty* will search for the entry with *next-label* as its *label* field and set up the terminal for those settings. Usually, a series of speeds are linked together in this fashion, into a closed set; For instance, **2400** linked to **1200**, which in turn is linked to **300**, which finally is linked to **2400**.

If *getty* is called without a second argument, then the first entry of **/etc/gettydefs** is used, thus making the first entry of **/etc/gettydefs** the default entry. It is also used if *getty* can not find the specified *label*. If **/etc/gettydefs** itself is missing, there is one entry built into the command which will bring up a terminal at **300** baud.

It is strongly recommended that after making or modifying **/etc/gettydefs**, it be run through *getty* with the check option to be sure there are no errors.

FILES

/etc/gettydefs

SEE ALSO

ioctl(2).
getty(1M), termio(7) in the *System Administrator's Reference Manual.*
login(1) in the *User's Reference Manual.*

## NAME

gps − graphical primitive string, format of graphical files

## DESCRIPTION

GPS is a format used to store graphical data. Several routines have been developed to edit and display GPS files on various devices. Also, higher level graphics programs such as *plot* [in *stat*(1G)] and *vtoc* [in *toc*(1G)] produce GPS format output files.

A GPS is composed of five types of graphical data or primitives.

### GPS PRIMITIVES

**lines** The *lines* primitive has a variable number of points from which zero or more connected line segments are produced. The first point given produces a *move* to that location. (A *move* is a relocation of the graphic cursor without drawing.) Successive points produce line segments from the previous point. Parameters are available to set *color, weight,* and *style* (see below).

**arc** The *arc* primitive has a variable number of points to which a curve is fit. The first point produces a *move* to that point. If only two points are included, a line connecting the points will result; if three points a circular arc through the points is drawn; and if more than three, lines connect the points. (In the future, a spline will be fit to the points if they number greater than three.) Parameters are available to set *color, weight,* and *style.*

**text** The *text* primitive draws characters. It requires a single point which locates the center of the first character to be drawn. Parameters are *color, font, textsize,* and *textangle.*

**hardware** The *hardware* primitive draws hardware characters or gives control commands to a hardware device. A single point locates the beginning location of the *hardware* string.

**comment** A *comment* is an integer string that is included in a GPS file but causes nothing to be displayed. All GPS files begin with a comment of zero length.

### GPS PARAMETERS

**color** *Color* is an integer value set for *arc, lines,* and *text* primitives.

**weight** *Weight* is an integer value set for *arc* and *lines* primitives to indicate line thickness. The value **0** is narrow weight, **1** is bold, and **2** is medium weight.

**style** *Style* is an integer value set for *lines* and *arc* primitives to give one of the five different line styles that can be drawn on TEKTRONIX 4010 series storage tubes. They are:

| | |
|---|---|
| **0** | solid |
| **1** | dotted |
| **2** | dot dashed |
| **3** | dashed |
| **4** | long dashed |

| | |
|---|---|
| **font** | An integer value set for *text* primitives to designate the text font to be used in drawing a character string. (Currently *font* is expressed as a four-bit *weight* value followed by a four-bit *style* value.) |
| **textsize** | *Textsize* is an integer value used in *text* primitives to express the size of the characters to be drawn. *Textsize* represents the height of characters in absolute *universe-units* and is stored at one-fifth this value in the size-orientation (*so*) word (see below). |
| **textangle** | *Textangle* is a signed integer value used in *text* primitives to express rotation of the character string around the beginning point. *Textangle* is expressed in degrees from the positive x-axis and can be a positive or negative value. It is stored in the size-orientation (*so*) word as a value 256/360 of it's absolute value. |

**ORGANIZATION**

GPS primitives are organized internally as follows:

| | |
|---|---|
| **lines** | *cw points sw* |
| **arc** | *cw points sw* |
| **text** | *cw point sw so* [*string*] |
| **hardware** | *cw point* [*string*] |
| **comment** | *cw* [*string*] |

| | |
|---|---|
| **cw** | *Cw* is the control word and begins all primitives. It consists of four bits that contain a primitive-type code and twelve bits that contain the word-count for that primitive. |
| **point(s)** | *Point*(*s*) is one or more pairs of integer coordinates. *Text* and *hardware* primitives only require a single *point*. *Point*(*s*) are values within a Cartesian plane or *universe* having 64K (−32K to +32K) points on each axis. |
| **sw** | *Sw* is the style-word and is used in *lines, arc,* and *text* primitives. For all three, eight bits contain *color* information. In *arc* and *lines* eight bits are divided as four bits *weight* and four bits *style*. In the *text* primitive eight bits of *sw* contain the *font*. |
| **so** | *So* is the size-orientation word used in *text* primitives. Eight bits contain text size and eight bits contain text rotation. |
| **string** | *String* is a null-terminated character string. If the string does not end on a word boundary, an additional null is added to the GPS file to insure word-boundary alignment. |

**SEE ALSO**

graphics(1G), stat(1G), toc(1G) in the *User's Reference Manual*.

## NAME

group – group file

## DESCRIPTION

*group* contains for each group the following information:

group name
encrypted password
numerical group ID
comma-separated list of all users allowed in the group

This is an ASCII file. The fields are separated by colons; each group is separated from the next by a new-line. If the password field is null, no password is demanded.

This file resides in directory **/etc**. Because of the encrypted passwords, it can and does have general read permission and can be used, for example, to map numerical group ID's to names.

## FILES

/etc/group

## SEE ALSO

passwd(4).
passwd(1) in the *User's Reference Manual.*
newgrp(1M) in the *System Administrator's Reference Manual.*

## NAME

inittab – script for the init process

## DESCRIPTION

The *inittab* file supplies the script to *init*'s role as a general process dispatcher. The process that constitutes the majority of *init*'s process dispatching activities is the line process **/etc/getty** that initiates individual terminal lines. Other processes typically dispatched by *init* are daemons and the shell.

The *inittab* file is composed of entries that are position dependent and have the following format:

```
id:rstate:action:process
```

Each entry is delimited by a newline, however, a backslash (\) preceding a newline indicates a continuation of the entry. Up to 512 characters per entry are permitted. Comments may be inserted in the *process* field using the *sh*(1) convention for comments. Comments for lines that spawn *getty*s are displayed by the *who*(1) command. It is expected that they will contain some information about the line such as the location. There are no limits (other than maximum entry size) imposed on the number of entries within the *inittab* file. The entry fields are:

*id* This is one or two characters used to uniquely identify an entry.

*rstate* This defines the *run-level* in which this entry is to be processed. *Run-levels* effectively correspond to a configuration of processes in the system. That is, each process spawned by *init* is assigned a *run-level* or *run-levels* in which it is allowed to exist. The *run-levels* are represented by a number ranging from **0** through **6**. As an example, if the system is in *run-level* **1**, only those entries having a **1** in the *rstate* field will be processed. When *init* is requested to change *run-levels,* all processes which do not have an entry in the *rstate* field for the target *run-level* will be sent the warning signal (**SIGTERM**) and allowed a 20-second grace period before being forcibly terminated by a kill signal (**SIGKILL**). The *rstate* field can define multiple *run-levels* for a process by selecting more than one *run-level* in any combination from **0–6**. If no *run-level* is specified, then the process is assumed to be valid at all *run-levels* **0–6**. There are three other values, **a**, **b** and **c**, which can appear in the *rstate* field, even though they are not true *run-levels*. Entries which have these characters in the *rstate* field are processed only when the *telinit* [see *init*(1M)] process requests them to be run (regardless of the current *run-level* of the system). They differ from *run-levels* in that *init* can never enter *run-level* **a**, **b** or **c**. Also, a request for the execution of any of these processes does not change the current *run-level*. Furthermore, a process started by an **a**, **b** or **c** command is not killed when *init* changes levels. They are only killed if their line in **/etc/inittab** is marked **off** in the *action* field, their line is deleted entirely from **/etc/inittab**, or *init* goes into the *SINGLE USER* state.

*action* Key words in this field tell *init* how to treat the process specified in the *process* field. The actions recognized by *init* are as follows:

**respawn** If the process does not exist then start the process, do not wait for its termination (continue scanning the *inittab* file), and when it dies restart the process. If the process currently exists then do nothing and continue scanning the *inittab* file.

**wait** Upon *init*'s entering the *run-level* that matches the entry's *rstate*, start the process and wait for its termination. All subsequent reads of the *inittab* file while *init* is in the same *run-level* will cause *init* to ignore this entry.

**once** Upon *init*'s entering a *run-level* that matches the entry's *rstate*, start the process, do not wait for its termination. When it dies, do not restart the process. If upon entering a new *run-level*, where the process is still running from a previous *run-level* change, the program will not be restarted.

**boot** The entry is to be processed only at *init*'s boot-time read of the *inittab* file. *Init* is to start the process, not wait for its termination; and when it dies, not restart the process. In order for this instruction to be meaningful, the *rstate* should be the default or it must match *init*'s *run-level* at boot time. This action is useful for an initialization function following a hardware reboot of the system.

**bootwait** The entry is to be processed the first time *init* goes from single-user to multi-user state after the system is booted. (If **initdefault** is set to **2**, the process will run right after the boot.) *Init* starts the process, waits for its termination and, when it dies, does not restart the process.

**powerfail** Execute the process associated with this entry only when *init* receives a power fail signal [**SIGPWR** see *signal*(2)].

**powerwait** Execute the process associated with this entry only when *init* receives a power fail signal (**SIGPWR**) and wait until it terminates before continuing any processing of *inittab*.

**off** If the process associated with this entry is currently running, send the warning signal (**SIGTERM**) and wait 20 seconds before forcibly terminating the process via the kill signal (**SIGKILL**). If the process is nonexistent, ignore the entry.

**ondemand** This instruction is really a synonym for the **respawn** action. It is functionally identical to **respawn** but is given a different keyword in order to divorce its association with *run-levels*. This is used only with the **a**, **b** or **c** values described in the *rstate* field.

**initdefault** An entry with this *action* is only scanned when *init* initially invoked. *Init* uses this entry, if it exists, to determine which *run-level* to enter initially. It does this by taking the highest *run-level* specified in the **rstate** field and using that as its initial state. If the *rstate* field is empty, this is interpreted as **0123456** and so *init* will enter *run-level* **6**. Additionally, if *init* does not find an **initdefault** entry in **/etc/inittab**, then it will request an initial *run-level* from the user at reboot time.

**sysinit** Entries of this type are executed before *init* tries to access the console (i.e., before the **Console Login:** prompt). It is expected that this entry will be only used to initialize devices on which *init* might try to ask the *run-level* question. These entries are executed and waited for before continuing.

*process* This is a *sh* command to be executed. The entire **process** field is prefixed with *exec* and passed to a forked *sh* as **sh −c** '**exec** *command*'. For this reason, any legal *sh* syntax can appear in the *process* field. Comments can be inserted with the **;** **#***comment* syntax.

## FILES

/etc/inittab

## SEE ALSO

exec(2), open(2), signal(2).
getty(1M), init(1M) in the *System Administrator's Reference Manual.*
sh(1), who(1) in the *User's Reference Manual.*

## NAME

inode – format of an i-node

## SYNOPSIS

**#include <sys/types.h>**
**#include <sys/ino.h>**

## DESCRIPTION

An i-node for a plain file or directory in a file system has the following structure defined by **<sys/ino.h>**.

```
/* Inode structure as it appears on a disk block. */
struct dinode
{
        ushort  di_mode;      /* mode and type of file */
        short   di_nlink;     /* number of links to file */
        ushort  di_uid;       /* owner's user id */
        ushort  di_gid;       /* owner's group id */
        off_t   di_size;      /* number of bytes in file */
        char    di_addr[40];  /* disk block addresses */
        time_t  di_atime;     /* time last accessed */
        time_t  di_mtime;     /* time last modified */
        time_t  di_ctime;     /* time of last file status change */
};
/*
 * the 40 address bytes:
 *     39 used; 13 addresses
 *     of 3 bytes each.
 */
```

For the meaning of the defined types *off_t* and *time_t* see *types*(5).

## SEE ALSO

stat(2), fs(4), types(5).

## NAME

issue – issue identification file

## DESCRIPTION

The file **/etc/issue** contains the *issue* or project identification to be printed as a login prompt. This is an ASCII file which is read by program *getty* and then written to any terminal spawned or respawned from the *lines* file.

## FILES

/etc/issue

## SEE ALSO

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

## NAME

ldfcn − common object file access routines

## SYNOPSIS

**#include <stdio.h>**
**#include <filehdr.h>**
**#include <ldfcn.h>**

## DESCRIPTION

The common object file access routines are a collection of functions for reading common object files and archives containing common object files. Although the calling program must know the detailed structure of the parts of the object file that it processes, the routines effectively insulate the calling program from knowledge of the overall structure of the object file.

The interface between the calling program and the object file access routines is based on the defined type LDFILE, defined as **struct ldfile**, declared in the header file **ldfcn.h**. The primary purpose of this structure is to provide uniform access to both simple object files and to object files that are members of an archive file.

The function *ldopen*(3X) allocates and initializes the LDFILE structure and returns a pointer to the structure to the calling program. The fields of the LDFILE structure may be accessed individually through macros defined in **ldfcn.h** and contain the following information:

| | |
|---|---|
| LDFILE | *ldptr; |
| TYPE(ldptr) | The file magic number used to distinguish between archive members and simple object files. |
| IOPTR(ldptr) | The file pointer returned by *fopen* and used by the standard input/output functions. |
| OFFSET(ldptr) | The file address of the beginning of the object file; the offset is non-zero if the object file is a member of an archive file. |
| HEADER(ldptr) | The file header structure of the object file. |

The object file access functions themselves may be divided into four categories:

(1) functions that open or close an object file

*ldopen*(3X) and *ldaopen*[see *ldopen*(3X)]
    open a common object file
*ldclose*(3X) and *ldaclose*[see *ldclose*(3X)]
    close a common object file

(2) functions that read header or symbol table information

*ldahread*(3X)
    read the archive header of a member of an archive file
*ldfhread*(3X)
    read the file header of a common object file
*ldshread*(3X) and *ldnshread*[see *ldshread*(3X)]
    read a section header of a common object file

*ldtbread*(3X)
read a symbol table entry of a common object file

*ldgetname*(3X)
retrieve a symbol name from a symbol table entry or from the string table

(3) functions that position an object file at (seek to) the start of the section, relocation, or line number information for a particular section.

*ldohseek*(3X)
seek to the optional file header of a common object file

*ldsseek*(3X) and *ldnsseek*[see *ldsseek*(3X)]
seek to a section of a common object file

*ldrseek*(3X) and *ldnrseek*[see *ldrseek*(3X)]
seek to the relocation information for a section of a common object file

*ldlseek*(3X) and *ldnlseek*[see *ldlseek*(3X)]
seek to the line number information for a section of a common object file

*ldtbseek*(3X)
seek to the symbol table of a common object file

(4) the function *ldtbindex*(3X) which returns the index of a particular common object file symbol table entry.

These functions are described in detail on their respective manual pages.

All the functions except *ldopen*(3X), *ldgetname*(3X), *ldtbindex*(3X) return either **SUCCESS** or **FAILURE**, both constants defined in **ldfcn.h**. *Ldopen*(3X) and *ldaopen*[(see *ldopen*(3X)] both return pointers to an **LDFILE** structure.

Additional access to an object file is provided through a set of macros defined in **ldfcn.h**. These macros parallel the standard input/output file reading and manipulating functions, translating a reference of the **LDFILE** structure into a reference to its file descriptor field.

The following macros are provided:

```
GETC(ldptr)
FGETC(ldptr)
GETW(ldptr)
UNGETC(c, ldptr)
FGETS(s, n, ldptr)
FREAD((char *) ptr, sizeof (*ptr), nitems, ldptr)
FSEEK(ldptr, offset, ptrname)
FTELL(ldptr)
REWIND(ldptr)
FEOF(ldptr)
FERROR(ldptr)
FILENO(ldptr)
SETBUF(ldptr, buf)
STROFFSET(ldptr)
```

The STROFFSET macro calculates the address of the string table. See the manual entries for the corresponding standard input/output library functions for details on the use of the rest of the macros.

The program must be loaded with the object file access routine library **libld.a**.

## SEE ALSO

fseek(3S), ldahread(3X), ldclose(3X), ldgetname(3X), ldfhread(3X), ldlread(3X), ldlseek(3X), ldohseek(3X), ldopen(3X), ldrseek(3X), ldlseek(3X), ldshread(3X), ldtbindex(3X), ldtbread(3X), ldtbseek(3X), stdio(3S), intro(5).

## WARNING

The macro **FSEEK** defined in the header file **ldfcn.h** translates into a call to the standard input/output function *fseek*(3S). **FSEEK** should not be used to seek from the end of an archive file since the end of an archive file may not be the same as the end of one of its object file members!

## NAME

limits – file header for implementation-specific constants

## SYNOPSIS

**#include <limits.h>**

## DESCRIPTION

The header file *<limits.h>* is a list of magnitude limitations imposed by a specific implementation of the operating system. All values are specified in decimal.

```
#define ARG_MAX      5120    /* max length of arguments to exec */
#define CHAR_BIT     8       /* # of bits in a "char" */
#define CHAR_MAX     127     /* max integer value of a "char" */
#define CHAR_MIN     -128    /* min integer value of a "char" */
#define CHILD_MAX    25      /* max # of processes per user id */
#define CLK_TCK      100     /* # of clock ticks per second */
#define DBL_DIG      16      /* digits of precision of a "double" */
#define DBL_MAX      1.79769313486231470e+308 /*max decimal value of a "double"*/
#define DBL_MIN      4.94065645841246544e-324 /*min decimal value of a "double"*/
#define FCHR_MAX     1048576        /* max size of a file in bytes */
#define FLT_DIG      7       /* digits of precision of a "float" */
#define FLT_MAX      3.40282346638528860e+38 /*max decimal value of a "float" */
#define FLT_MIN      1.40129846432481707e-45 /*min decimal value of a "float" */
#define HUGE_VAL     3.40282346638528860e+38 /*error value returned by Math lib*/
#define INT_MAX      2147483647     /* max decimal value of an "int" */
#define INT_MIN      -2147483648    /* min decimal value of an "int" */
#define LINK_MAX     32767   /* max # of links to a single file */
#define LONG_MAX     2147483647     /* max decimal value of a "long" */
#define LONG_MIN     -2147483648    /* min decimal value of a "long" */
#define NAME_MAX     14      /* max # of characters in a file name */
#define OPEN_MAX     20      /* max # of files a process can have open */
#define PASS_MAX     8       /* max # of characters in a password */
#define PATH_MAX     256     /* max # of characters in a path name */
#define PID_MAX      30000   /* max value for a process ID */
#define PIPE_BUF     5120    /* max # bytes atomic in write to a pipe */
#define PIPE_MAX     5120    /* max # bytes written to a pipe in a write */
#define SHRT_MAX     32767   /* max decimal value of a "short" */
#define SHRT_MIN     -32767  /* min decimal value of a "short" */
#define STD_BLK      1024    /* # bytes in a physical I/O block */
#define SYS_NMLN     9       /* # of chars in uname-returned strings */
#define UID_MAX      30000   /* max value for a user or group ID */
#define USI_MAX      4294967296     /* max decimal value of an "unsigned" */
#define WORD_BIT     32      /* # of bits in a "word" or "int" */
```

## NAME

linenum − line number entries in a common object file

## SYNOPSIS

**#include <linenum.h>**

## DESCRIPTION

The *cc* command generates an entry in the object file for each C source line on which a breakpoint is possible [when invoked with the **−g** option; see *cc*(1)]. Users can then reference line numbers when using the appropriate software test system [see *sdb*(1)]. The structure of these line number entries appears below.

```
struct  lineno
{
        union
        {
                long     l_symndx ;
                long     l_paddr ;
        }                l_addr ;
        unsigned short l_lnno ;
} ;
```

Numbering starts with one for each function. The initial line number entry for a function has *l_lnno* equal to zero, and the symbol table index of the function's entry is in *l_symndx*. Otherwise, *l_lnno* is non-zero, and *l_paddr* is the physical address of the code for the referenced line. Thus the overall structure is the following:

```
l_addr                  l_lnno

function symtab index   0
physical address        line
physical address        line
...

function symtab index   0
physical address        line
physical address        line
...
```

## SEE ALSO

cc(1), sdb(1), a.out(4).

## NAME

master – master configuration database

## DESCRIPTION

The *master* configuration database is a collection of files. Each file contains configuration information for a device or module that may be included in the system. A file is named with the module name to which it applies. This collection of files is maintained in a directory called **/etc/master.d**. Each individual file has an identical format. For convenience, this collection of files will be referred to as the *master* file, as though it was a single file. This will allow a reference to the *master* file to be understood to mean the *individual file* in the **master.d** directory that corresponds to the name of a device or module. The file is used by the *mkboot*(1M) program to obtain device information to generate the device driver and configurable module files. It is also used by the *sysdef*(1M) program to obtain the names of supported devices. *master* consists of two parts; they are separated by a line with a dollar sign ($) in column 1. Part 1 contains device information for both hardware and software devices, and loadable modules. Part 2 contains parameter declarations used in part 1. Any line with an asterisk (*) in column 1 is treated as a comment.

### Part 1, Description

Hardware devices, software drivers and loadable modules are defined with a line containing the following information. Field 1 must begin in the left most position on the line. Fields are separated by white space (tab or blank).

Field 1: element characteristics:

| | |
|---|---|
| **o** | specify only once |
| **r** | required device |
| **b** | block device |
| **c** | character device |
| **a** | generate segment descriptor array |
| **t** | initialize cdevsw[].d_ttys |
| **s** | software driver |
| **f** | STREAMS driver |
| **m** | STREAMS module |
| **x** | not a driver; a loadable module |
| **number** | The first interrupt vector for an integral device |

Field 2: number of interrupt vectors required by a hardware device: "–" if none.

Field 3: handler prefix (4 chars. maximum)

Field 4: software driver external major number; "–" if not a software driver, or to be assigned during execution of *drvinstall*(1M)

Field 5: number of sub-devices per device; "–" if none

Field 6: interrupt priority level of the device; "–" if none

Field 7: dependency list (optional); this is a comma separated list of other drivers or modules that must be present in the configuration if this module is to be included

For each module, two classes of information are required by *mkboot*(1M): external routine references and variable definitions. Routine and variable definition lines begin with white space and immediately follow the initial module specification line. These lines are free form, thus they may be continued arbitrarily between non-blank tokens as long as the first character of a line is white space.

**Part 1, Routine Reference Lines**

If the UNIX system kernel or other dependent module contains external references to a module, but the module is not configured, then these external references would be undefined. Therefore, the *routine reference* lines are used to provide the information necessary to generate appropriate dummy functions at boot time when the driver is not loaded.
*Routine references* are defined as follows:

| | |
|---|---|
| Field 1: | routine name () |
| Field 2: | the routine type: one of |

| | |
|---|---|
| {} | routine_name(){} |
| {**nosys**} | routine_name(){return nosys();} |
| {**nodev**} | routine_name(){return nodev();} |
| {**false**} | routine_name(){return 0;} |
| {**true**} | routine_name(){return 1;} |

**Part 1, Variable Definition Lines**

*Variable definition lines* are used to generate all variables required by the module. The variable generated may be of arbitrary size, be initialized or not, or be arrays containing an arbitrary number of elements.
*variable references* are defined as follows:

| | |
|---|---|
| Field 1: | variable_name |
| Field 2: | [ expr ] – optional field used to indicate array size |
| Field 3: | (length) – required field indicating the size of the variable |
| Field 4: | ={ expr,... } – optional field used to initialize individual elements of a variable |

The *length* field is mandatory. It is an arbitrary sequence of length specifiers, each of which may be one of the following:

| | |
|---|---|
| %i | an integer |
| %l | a long integer |
| %s | a short integer |
| %c | a single character |
| %number | a field which is *number* bytes long |
| %number c | a character string which is *number* bytes long |

For example, the length field

```
( %8c %l %0x58 %l %c %c )
```

could be used to identify a variable consisting of a character string 8-bytes long, a long integer, a 0x58 byte structure of any type, another long integer, and two characters. Appropriate alignment of each % specification is performed

(%number is word aligned) and the variable length is rounded up to the next word boundary during processing.
The expressions for the optional array size and initialization are infix expressions consisting of the usual operators for addition, subtraction, multiplication, and division: +, −, *, and /. Multiplication and division have the higher precedence, but parentheses may be used to override the default order. The builtin functions *min* and *max* accept a pair of expressions, and return the appropriate value. The operands of the expression may be any mixture of the following:

| | |
|---|---|
| &name | address of name where *name* is any symbol defined by the kernel, any module loaded or any variable definition line of any module loaded |
| #name | sizeof name where *name* is any variable name defined by a variable definition for any module loaded; the size is that of the individual variable--not the size of an entire array |
| #C | number of controllers present; this number is determined by the EDT for hardware devices, or by the number provided in the system file for non-hardware drivers or modules |
| #C(name) | number of controllers present for the module *name*; this number is determined by the EDT for hardware devices, or by the number provided in the system file for non-hardware drivers or modules |
| #D | number of devices per controller taken directly from the current master file entry |
| #D(name) | number of devices per controller taken directly from the master file entry for the module *name* |
| #M | the internal major number assigned to the current module if it is a device driver; zero of this module is not a device driver |
| #M(name) | the internal major number assigned to the module *name* if it is a device driver: zero if that module is not a device driver |
| name | value of a parameter as defined in the second part of *master* |
| number | arbitrary number (octal, decimal, or hex allowed) |
| string | a character string enclosed within double quotes (all of the character string conventions supported by the C language are allowed); this operand has a value which is the address of a character array containing the specified string |

When initializing a variable, one initialization expression should be provided for each %i, %l, %s, or %c of the length field. The only initializers allowed for a '%number c' are either a character string (the string may not be longer than *number*), or an explicit zero. Initialization expressions must be separated by commas, and variable initialization will proceed element by element. Note that %number specification cannot be initialized--they are set to zero. Only the first element of an array can be initialized, the other elements are set to zero. If there are more initializers than size specifications, it is an error and execution of the *mkboot*(1M) program will be aborted. If there are fewer initializations than size specifications, zeros will be used to pad the variable. For example:

```
={ "V2.L1", #C*#D, max(10,#D), #C(OTHER), #M(OTHER) }
```

would be a possible initialization of the variable whose length field was given in the preceding example.

## Part 2, Description

*Parameter* declarations may be used to define a value symbolically. Values can be associated with identifiers and these identifiers may be used in the *variable definition* lines.

Parameters are defined as follows:

| | |
|---|---|
| Field 1: | identifier (8 characters maximum) |
| Field 2: | = |
| Field 3: | value, the value may be a number (decimal, octal, or hex allowed), or a string |

## EXAMPLE

A sample *master* file for a tty device driver would be named "**atty**" if the device appeared in the EDT as "**ATTY**". The driver is a character device, the driver prefix is **at**, two interrupt vectors are used, and the interrupt priority is 6. In addition, another driver named "*ATLOG*" is necessary for the correct operation of the software associated with this device.

```
*FLAG #VEC PREFIX SOFT #DEV IPL DEPENDENCIES/VARIABLES
 tca     2    at     -     2   6  ATLOG
                                  atpoint(){false}
                                  at_tty[#C*#D] (%0x58)
                                  at_cnt(%i) ={ #C*#D }
                                  at_logmaj(%i) ={ #M(ATLOG) }
                                  at_id(%8c) ={ ATID }
                                  at_table(%i%l%31%s)
                                      ={ max(#C,ATMAX),
                                          &at_tty,
                                          #C }
$
ATID = "fred"
ATMAX = 6
```

This *master* file will cause a routine named *atpoint* to be generated by the boot program if the **ATTY** driver is not loaded, and there is a reference to this routine from any other module loaded. When the driver is loaded, the variables *at_tty*, *at_cnt*, *at_logmaj*, *at_id*, and *at_table* will be allocated and initialized as specified. Due to the **t** flag, the *d_ttys* field in the character device switch table will be initialized to point to **at_tty** (the first variable definition line contains the variable whose address will be stored in *d_ttys*). The ATTY driver would reference these variables by coding:

```
extern struct tty at_tty[];
extern int at_cnt;
extern int at_logmaj;
extern char at_id[8];
extern struct {
        int member1;
        struct tty *member2;
        char junk[31];
        short member3;
        } at_table;
```

FILES

/etc/master.d/*

SEE ALSO

system(4).
drvinstall(1M), mkboot(1M), sysdef(1M) in the *System Administrator's Reference Manual.*

## NAME

mnttab – mounted file system table

## SYNOPSIS

**#include <mnttab.h>**

## DESCRIPTION

*mnttab* resides in directory **/etc** and contains a table of devices, mounted by the *mount*(1M) command, in the following structure as defined by **<mnttab.h>**:

```
struct   mnttab {
         char      mt_dev[32];
         char      mt_filsys[32];
         short     mt_ro_flg;
         time_t    mt_time;
};
```

Each entry is 70 bytes in length; the first 32 bytes are the null-padded name of the place where the *special file* is mounted; the next 32 bytes represent the null-padded root name of the mounted special file; the remaining 6 bytes contain the mounted *special file*'s read/write permissions and the date on which it was mounted.

The maximum number of entries in *mnttab* is based on the system parameter **NMOUNT** located in **/etc/master.d/kernel,** which defines the number of allowable mounted special files.

## SEE ALSO

mount(1M), setmnt(1M) in the *System Administrator's Reference Manual.*

## NAME

passwd – password file

## DESCRIPTION

*passwd* contains for each user the following information:

login name
encrypted password
numerical user ID
numerical group ID
GCOS job number, box number, optional GCOS user ID
initial working directory
program to use as shell

This is an ASCII file. Each field within each user's entry is separated from the next by a colon. The GCOS field is used only when communicating with that system, and in other installations can contain any desired information. Each user is separated from the next by a new-line. If the password field is null, no password is demanded; if the shell field is null, the shell itself is used.

This file resides in directory **/etc**. Because of the encrypted passwords, it can and does have general read permission and can be used, for example, to map numerical user IDs to names.

The encrypted password consists of 13 characters chosen from a 64-character alphabet (**.**, **/**, **0–9**, **A–Z**, **a–z**), except when the password is null, in which case the encrypted password is also null. Password aging is effected for a particular user if his encrypted password in the password file is followed by a comma and a non-null string of characters from the above alphabet. (Such a string must be introduced in the first instance by the super-user.)

The first character of the age, $M$ say, denotes the maximum number of weeks for which a password is valid. A user who attempts to login after his password has expired will be forced to supply a new one. The next character, $m$ say, denotes the minimum period in weeks which must expire before the password may be changed. The remaining characters define the week (counted from the beginning of 1970) when the password was last changed. (A null string is equivalent to zero.) $M$ and $m$ have numerical values in the range 0–63 that correspond to the 64-character alphabet shown above (i.e., **/** = 1 week; **z** = 63 weeks). If $m = M = 0$ (derived from the string **.** or **..**) the user will be forced to change his password the next time he logs in (and the "age" will disappear from his entry in the password file). If $m > M$ (signified, e.g., by the string **./**) only the super-user will be able to change the password.

## FILES

/etc/passwd

## SEE ALSO

a64l(3C), getpwent(3C), group(4).
login(1), passwd(1) in the *User's Reference Manual.*

## NAME

plot − graphics interface

## DESCRIPTION

Files of this format are produced by routines described in *plot*(3X) and are interpreted for various devices by commands described in *tplot*(1G). A graphics file is a stream of plotting instructions. Each instruction consists of an ASCII letter usually followed by bytes of binary information. The instructions are executed in order. A point is designated by four bytes representing the **x** and **y** values; each value is a signed integer. The last designated point in an **l, m, n,** or **p** instruction becomes the "current point" for the next instruction.

Each of the following descriptions begins with the name of the corresponding routine in *plot*(3X).

**m** move: The next four bytes give a new current point.

**n** cont: Draw a line from the current point to the point given by the next four bytes [see *tplot*(1G)].

**p** point: Plot the point given by the next four bytes.

**l** line: Draw a line from the point given by the next four bytes to the point given by the following four bytes.

**t** label: Place the following ASCII string so that its first character falls on the current point. The string is terminated by a new-line.

**e** erase: Start another frame of output.

**f** linemod: Take the following string, up to a new-line, as the style for drawing further lines. The styles are "dotted", "solid", "longdashed", "shortdashed", and "dotdashed". Effective only for the **−T4014** and **−Tver** options of *tplot*(1G) (TEKTRONIX 4014 terminal and Versatec plotter).

**s** space: The next four bytes give the lower left corner of the plotting area; the following four give the upper right corner. The plot will be magnified or reduced to fit the device as closely as possible.

Space settings that exactly fill the plotting area with unity scaling appear below for devices supported by the filters of *tplot*(1G). The upper limit is just outside the plotting area. In every case the plotting area is taken to be square; points outside may be displayable on devices whose face is not square.

| | |
|---|---|
| DASI 300 | space(0, 0, 4096, 4096); |
| DASI 300s | space(0, 0, 4096, 4096); |
| DASI 450 | space(0, 0, 4096, 4096); |
| TEKTRONIX 4014 | space(0, 0, 3120, 3120); |
| Versatec plotter | space(0, 0, 2048, 2048); |

## SEE ALSO

plot(3X), gps(4), term(5).
graph(1G), tplot(1G) in the *User's Reference Manual.*

## WARNING

The plotting library *plot*(3X) and the curses library *curses*(3X) both use the names erase() and move(). The curses versions are macros. If you need both libraries, put the *plot*(3X) code in a different source file than the *curses*(3X) code, and/or #undef move() and erase() in the *plot*(3X) code.

## NAME

pnch − file format for card images

## DESCRIPTION

The PNCH format is a convenient representation for files consisting of card images in an arbitrary code.

A PNCH file is a simple concatenation of card records. A card record consists of a single control byte followed by a variable number of data bytes. The control byte specifies the number (which must lie in the range 0-80) of data bytes that follow. The data bytes are 8-bit codes that constitute the card image. If there are fewer than 80 data bytes, it is understood that the remainder of the card image consists of trailing blanks.

## NAME

profile – setting up an environment at login time

## SYNOPSIS

**/etc/profile**
**$HOME/.profile**

## DESCRIPTION

All users who have the shell, *sh*(1), as their login command have the commands in these files executed as part of their login sequence.

*/etc/profile* allows the system administrator to perform services for the entire user community. Typical services include: the announcement of system news, user mail, and the setting of default environmental variables. It is not unusual for */etc/profile* to execute special actions for the **root** login or the *su*(1) command. Computers running outside the Eastern time zone should have the line

```
. /etc/TIMEZONE
```

included early in */etc/profile* (see timezone(4)).

The file *$HOME/.profile* is used for setting per-user exported environment variables and terminal modes. The following example is typical (except for the comments):

```
# Make some environment variables global
export MAIL PATH TERM
# Set file creation mask
umask 027
# Tell me when new mail comes in
MAIL=/usr/mail/$LOGNAME
# Add my /bin directory to the shell search sequence
PATH=$PATH:$HOME/bin
# Set terminal type
while :
do          echo "terminal: \c"
            read TERM
            if [ -f ${TERMINFO:-/usr/lib/terminfo}/?/$TERM ]
            then break
            elif [ -f /usr/lib/terminfo/?/$TERM ]
            then break
            else echo "invalid term $TERM" 1>&2
            fi
done
# Initialize the terminal and set tabs
# The environmental variable TERM must have been exported
# before the "tput init" command is executed.
tput init
# Set the erase character to backspace
stty erase '^H' echoe
```

## FILES

| | |
|---|---|
| /etc/TIMEZONE | timezone environment |
| $HOME/.profile | user-specific environment |
| /etc/profile | system-wide environment |

## SEE ALSO

terminfo(4), timezone(4), environ(5), term(5).
env(1), login(1), mail(1), sh(1), stty(1), su(1), tput(1) in the *User's Reference Manual.*
su(1M) in the *System Administrator's Reference Manual.*
*User's Guide.*
Chapter 10 in the *Programmer's Guide.*

## NOTES

Care must be taken in providing system-wide services in */etc/profile.* Personal *.profile* files are better for serving all but the most global needs.

## NAME

reloc – relocation information for a common object file

## SYNOPSIS

**#include <reloc.h>**

## DESCRIPTION

Object files have one relocation entry for each relocatable reference in the text or data. If relocation information is present, it will be in the following format.

```
struct  reloc
{
        long        r_vaddr ;    /* (virtual) address of reference */
        long        r_symndx ;   /* index into symbol table */
        ushort      r_type ;     /* relocation type */
};

#define R_ABS       0
#define R_DIR32     06
#define R_DIR32S    012
```

As the link editor reads each input section and performs relocation, the relocation entries are read. They direct how references found within the input section are treated.

| | |
|---|---|
| R_ABS | The reference is absolute and no relocation is necessary. The entry will be ignored. |
| R_DIR32 | A direct 32-bit reference to the symbol's virtual address. |
| R_DIR32S | A direct 32-bit reference to the symbol's virtual address, with the 32-bit value stored in the reverse order in the object file. |

More relocation types exist for other processors. Equivalent relocation types on different processors have equal values and meanings. New relocation types will be defined (with new values) as they are needed.

Relocation entries are generated automatically by the assembler and automatically used by the link editor. Link editor options exist for both preserving and removing the relocation entries from object files.

## SEE ALSO

as(1), ld(1), a.out(4), syms(4).

## NAME

rfmaster – Remote File Sharing name server master file

## DESCRIPTION

The **rfmaster** file is an ASCII file that identifies the hosts that are responsible for providing primary and secondary domain name service for Remote File Sharing domains. This file contains a series of records, each terminated by a newline; a record may be extended over more than one line by escaping the newline character with a backslash ("\"). The fields in each record are separated by one or more tabs or spaces. Each record has three fields:

*name type data*

The type field, which defines the meaning of the *name* and *data* fields, has three possible values:

**p** The **p** type defines the primary domain name server. For this type, *name* is the domain name and *data* is the full host name of the machine that is the primary name server. The full host name is specified as *domain.nodename*. There can be only one primary name server per domain.

**s** The **s** type defines a secondary name server for a domain. *Name* and *data* are the same as for the **p** type. The order of the **s** entries in the **rfmaster** file determines the order in which secondary name servers take over when the current domain name server fails.

**a** The **a** type defines a network address for a machine. *Name* is the full domain name for the machine and *data* is the network address of the machine. The network address can be in plain ASCII text or it can be preceded by a \x to be interpreted as hexadecimal notation. (See the documentation for the particular network you are using to determine the network addresses you need.)

There are at least two lines in the **rfmaster** file per domain name server: one **p** and one **a** line, to define the primary and its network address. There should also be at least one secondary name server in each domain.

This file is created and maintained on the primary domain name server. When a machine other than the primary tries to start Remote File Sharing, this file is read to determine the address of the primary. If **rfmaster** is missing, the **-p** option of **rfstart** must be used to identify the primary. After that, a copy of the primary's **rfmaster** file is automatically placed on the machine.

Domains not served by the primary can also be listed in the **rfmaster** file. By adding primary, secondary, and address information for other domains on a network, machines served by the primary will be able to share resources with machines in other domains.

A primary name server may be a primary for more than one domain. However, the secondaries must then also be the same for each domain served by the primary.

**Example**

An example of an **rfmaster** file is shown below. (The network address examples, *comp1.serve* and *comp2.serve,* are STARLAN network addresses.)

```
ccs          p    ccs.comp1
ccs          s    ccs.comp2
ccs.comp2    a    comp2.serve
ccs.comp1    a    comp1.serve
```

NOTE: If a line in the **rfmaster** file begins with a # character, the entire line will be treated as a comment.

FILES

/usr/nserve/rfmaster

SEE ALSO

rfstart(1M) in the *System Administrator's Reference Manual.*

## 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 which 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:

```
@hDDDDD
```

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.

*Delta table*

The delta table consists of a variable number of entries of the form:

```
@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 (currently, normal: **D**, and 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 will cause 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 [*get*(1) with the **−e** keyletter]. The **q** flag defines the replacement for the %Q% identification keyword. The **z** flag is used in certain specialized interface programs. *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).

## NAME

scnhdr – section header for a common object file

## SYNOPSIS

**#include <scnhdr.h>**

## DESCRIPTION

Every common object file has a table of section headers to specify the layout of the data within the file. Each section within an object file has its own header. The C structure appears below.

```
struct  scnhdr
{
        char            s_name[SYMNMLEN]; /* section name */
        long            s_paddr;     /* physical address */
        long            s_vaddr;     /* virtual address */
        long            s_size;      /* section size */
        long            s_scnptr;    /* file ptr to raw data */
        long            s_relptr;    /* file ptr to relocation */
        long            s_lnnoptr;   /* file ptr to line numbers */
        unsigned short  s_nreloc;    /* # reloc entries */
        unsigned short  s_nlnno;     /* # line number entries */
        long            s_flags;     /* flags */
};
```

File pointers are byte offsets into the file; they can be used as the offset in a call to FSEEK [see *ldfcn*(4)]. If a section is initialized, the file contains the actual bytes. An uninitialized section is somewhat different. It has a size, symbols defined in it, and symbols that refer to it. But it can have no relocation entries, line numbers, or data. Consequently, an uninitialized section has no raw data in the object file, and the values for *s_scnptr*, *s_relptr*, *s_lnnoptr*, *s_nreloc*, and *s_nlnno* are zero.

## SEE ALSO

ld(1), fseek(3S), a.out(4).

NAME

scr_dump – format of curses screen image file.

SYNOPSIS

**scr_dump**(file)

DESCRIPTION

The *curses*(3X) function *scr_dump*() will copy the contents of the screen into a file. The format of the screen image is as described below.

The name of the tty is 20 characters long and the modification time (the *mtime* of the tty that this is an image of) is of the type *time_t*. All other numbers and characters are stored as *chtype* (see **<curses.h>**). No newlines are stored between fields.

```
<magic number:  octal 0433>
<name of tty>
<mod time of tty>
<columns> <lines>
<line length> <chars in line>       for each line on the screen
<line length> <chars in line>
  .
  .
  .
<labels?>                           1, if soft screen labels are present
<cursor row> <cursor column>
```

Only as many characters as are in a line will be listed. For example, if the *<line length>* is **0**, there will be no characters following *<line length>*. If *<labels?>* is TRUE, following it will be

```
<number of labels>
<label width>
<chars in label 1>
<chars in label 2>
  .
  .
  .
```

SEE ALSO

curses(3X).

## NAME

syms − common object file symbol table format

## SYNOPSIS

**#include <syms.h>**

## DESCRIPTION

Common object files contain information to support symbolic software testing [see *sdb*(1)]. Line number entries, *linenum*(4), and extensive symbolic information permit testing at the C *source* level. Every object file's symbol table is organized as shown below.

```
File name 1.
        Function 1.
                Local symbols for function 1.
        Function 2.
                Local symbols for function 2.
        ...
        Static externs for file 1.

File name 2.
        Function 1.
                Local symbols for function 1.
        Function 2.
                Local symbols for function 2.
        ...
        Static externs for file 2.
...

Defined global symbols.
Undefined global symbols.
```

The entry for a symbol is a fixed-length structure. The members of the structure hold the name (null padded), its value, and other information. The C structure is given below.

```
#define  SYMNMLEN    8
#define  FILNMLEN    14
#define  DIMNUM      4

struct  syment
{
   union                                 /* all ways to get symbol name */
   {
      char          _n_name[SYMNMLEN]; /* symbol name */
      struct
      {
         long       _n_zeroes;      /* == 0L when in string table */
         long       _n_offset;      /* location of name in table */
      } _n_n;
      char          *_n_nptr[2];    /* allows overlaying */
   } _n;
```

```
        long            n_value;    /* value of symbol */
        short           n_scnum;    /* section number */
        unsigned short  n_type;     /* type and derived type */
        char            n_sclass;   /* storage class */
        char            n_numaux;   /* number of aux entries */
    };

    #define n_name     _n._n_name
    #define n_zeroes   _n._n_n._n_zeroes
    #define n_offset   _n._n_n._n_offset
    #define n_nptr     _n._n_nptr[1]
```

Meaningful values and explanations for them are given in both **syms.h** and *Common Object File Format*. Anyone who needs to interpret the entries should seek more information in these sources. Some symbols require more information than a single entry; they are followed by *auxiliary entries* that are the same size as a symbol entry. The format follows.

```
    union auxent
    {
        struct
        {
            long            x_tagndx;
            union
            {
                struct
                {
                    unsigned short  x_lnno;
                    unsigned short  x_size;
                } x_lnsz;
                long    x_fsize;
            } x_misc;
            union
            {
                struct
                {
                    long    x_lnnoptr;
                    long    x_endndx;
                }           x_fcn;
                struct
                {
                    unsigned short  x_dimen[DIMNUM];
                }           x_ary;
            }               x_fcnary;
            unsigned short  x_tvndx;
        }       x_sym;
        struct
        {
            char    x_fname[FILNMLEN];
        }       x_file;
```

```
                struct
                {
                      long    x_scnlen;
                      unsigned short  x_nreloc;
                      unsigned short  x_nlinno;
                }     x_scn;

                struct
                {
                      long            x_tvfill;
                      unsigned short  x_tvlen;
                      unsigned short  x_tvran[2];
                }     x_tv;
          };
```

Indexes of symbol table entries begin at *zero*.

SEE ALSO

sdb(1), a.out(4), linenum(4).
"Common Object File Format" in the *Programming Guide*.

WARNINGS

On machines on which **int**s are equivalent to **long**s, all **long**s have their type changed to **int.** Thus the information about which symbols are declared as **long**s and which, as **int**s, does not show up in the symbol table.

## NAME

system – system configuration information table

## DESCRIPTION

This file is used by the **boot** program to obtain configuration information that cannot be obtained from the equipped device table (EDT) at system boot time. This file generally contains a list of software drivers to include in the load, the assignment of system devices such as *pipedev* and *swapdev,* as well as instructions for manually overriding the drivers selected by the self-configuring boot process.

The syntax of the system file is given below. The parser for the **/etc/system** file is case sensitive. All upper case strings in the syntax below should be upper case in the **/etc/system** file as well. Nonterminal symbols are enclosed in angle brackets "<>" while optional arguments are enclosed in square brackets "[]". Ellipses "..." indicate optional repetition of the argument for that line.

```
<fname> ::= pathname
<string> ::= driver file name from /boot or EDT entry name
<device> ::= special device name | DEV(<major>,<minor>)
<major> ::= <number>
<minor> ::= <number>
<number> ::= decimal, octal or hex literal
```

The lines listed below may appear in any order. Blank lines may be inserted at any point. Comment lines must begin with an asterisk. Entries for EXCLUDE and INCLUDE are cumulative. For all other entries, the last line to appear in the file is used -- any earlier entries are ignored.

BOOT: <fname>
: specifies the kernel a.out file to be booted; if the file is fully resolved [such as that produced by the *mkunix*(1M) program] then all other lines in the *system* file have no effect.

EXCLUDE: [ <string> ] ...
: specifies drivers to exclude from the load even if the device is found in the EDT.

INCLUDE: [ <string>[(<number>)] ] ...
: specifies software drivers or loadable modules to be included in the load. This is necessary to include the drivers for software "devices". The optional <number> (parenthesis required) specifies the number of "devices" to be controlled by the driver (defaults to 1). This number corresponds to the builtin variable *#c* which may be referred to by expressions in part one of the **/etc/master** file.

ROOTDEV: <device>
: identifies the device containing the root file system.

SWAPDEV: <device> <number> <number>
: identifies the device to be used as swap space, the block number the swap space starts at, and the number of swap blocks available.

PIPEDEV: <device>
: identifies the device to be used for pipe space.

## FILES

/etc/system

## SEE ALSO

master(4).
crash(1M), mkunix(1M), mkboot(1M) in the *System Administrator's Reference Manual.*

## NAME

term — format of compiled term file.

## SYNOPSIS

**/usr/lib/terminfo/?/***

## DESCRIPTION

Compiled *terminfo*(4) descriptions are placed under the directory */usr/lib/terminfo*. In order to avoid a linear search of a huge UNIX system directory, a two-level scheme is used: */usr/lib/terminfo/c/name* where *name* is the name of the terminal, and *c* is the first character of *name*. Thus, **att4425** can be found in the file */usr/lib/terminfo/a/att4425*. Synonyms for the same terminal are implemented by multiple links to the same compiled file.

The format has been chosen so that it will be the same on all hardware. An 8-bit byte is assumed, but no assumptions about byte ordering or sign extension are made. Thus, these binary *terminfo*(4) files can be transported to other hardware with 8-bit bytes.

Short integers are stored in two 8-bit bytes. The first byte contains the least significant 8 bits of the value, and the second byte contains the most significant 8 bits. (Thus, the value represented is 256*second+first.) The value **−1** is represented by **0377,0377**, and the value **−2** is represented by **0376,0377**; other negative values are illegal. Computers where this does not correspond to the hardware read the integers as two bytes and compute the result, making the compiled entries portable between machine types. The **−1** generally means that a capability is missing from this terminal. The **−2** means that the capability has been cancelled in the *terminfo*(4) source and also is to be considered missing.

The compiled file is created from the source file descriptions of the terminals (see the **−I** option of *infocmp*(1M)) by using the *terminfo*(4) compiler, *tic*(1M), and read by the routine **setupterm**(). (See *curses*(3X).) The file is divided into six parts: the header, terminal names, boolean flags, numbers, strings, and string table.

The header section begins the file. This section contains six short integers in the format described below. These integers are (1) the magic number (octal **0432**); (2) the size, in bytes, of the names section; (3) the number of bytes in the boolean section; (4) the number of short integers in the numbers section; (5) the number of offsets (short integers) in the strings section; (6) the size, in bytes, of the string table.

The terminal names section comes next. It contains the first line of the *terminfo*(4) description, listing the various names for the terminal, separated by the bar ( | ) character (see *term*(5)). The section is terminated with an ASCII NUL character.

The boolean flags have one byte for each flag. This byte is either **0** or **1** as the flag is present or absent. The value of **2** means that the flag has been cancelled. The capabilities are in the same order as the file **<term.h>**.

Between the boolean section and the number section, a null byte will be inserted, if necessary, to ensure that the number section begins on an even byte. All short integers are aligned on a short word boundary.

The numbers section is similar to the boolean flags section. Each capability takes up two bytes, and is stored as a short integer. If the value represented is **−1** or **−2**, the capability is taken to be missing.

The strings section is also similar. Each capability is stored as a short integer, in the format above. A value of **−1** or **−2** means the capability is missing. Otherwise, the value is taken as an offset from the beginning of the string table. Special characters in ^X or \c notation are stored in their interpreted form, not the printing representation. Padding information ($<nn>) and parameter information (%x) are stored intact in uninterpreted form.

The final section is the string table. It contains all the values of string capabilities referenced in the string section. Each string is null terminated.

Note that it is possible for **setupterm**( ) to expect a different set of capabilities than are actually present in the file. Either the database may have been updated since **setupterm**( ) has been recompiled (resulting in extra unrecognized entries in the file) or the program may have been recompiled more recently than the database was updated (resulting in missing entries). The routine **setupterm**( ) must be prepared for both possibilities – this is why the numbers and sizes are included. Also, new capabilities must always be added at the end of the lists of boolean, number, and string capabilities.

As an example, an octal dump of the description for the AT&T Model 37 KSR is included:

```
37¦tty37¦AT&T model 37 teletype,
    hc, os, xon,
    bel=^G, cr=\r, cub1=\b, cud1=\n, cuu1=\E7, hd=\E9,
    hu=\E8, ind=\n,
```

```
0000000 032 001      \0 032  \0 013  \0 021 001   3  \0   3   7   ¦   t
0000020   t   y   3   7   ¦   A   T   &   T       m   o   d   e   l
0000040   3   7       t   e   l   e   t   y   p   e  \0  \0  \0  \0  \0
0000060  \0  \0  \0 001  \0  \0  \0  \0  \0  \0  \0 001  \0  \0  \0  \0
0000100 001  \0  \0  \0  \0  \0 377 377 377 377 377 377 377 377 377 377
0000120 377 377 377 377 377 377 377 377 377 377 377 377 377 377   &  \0
0000140      \0 377 377 377 377 377 377 377 377 377 377 377 377 377 377
0000160 377 377   "  \0 377 377 377 377   (  \0 377 377 377 377 377 377
0000200 377 377   0  \0 377 377 377 377 377 377 377 377   -  \0 377 377
0000220 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377
*
0000520 377 377 377 377 377 377 377 377 377 377 377 377 377 377   $  \0
0000540 377 377 377 377 377 377 377 377 377 377 377 377 377 377   *  \0
0000560 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377
*
0001160 377 377 377 377 377 377 377 377 377 377 377 377 377 377   3   7
0001200   ¦   t   t   y   3   7   ¦   A   T   &   T       m   o   d   e
0001220   l       3   7       t   e   l   e   t   y   p   e  \0  \r  \0
0001240  \n  \0  \n  \0 007  \0  \b  \0 033   8  \0 033   9  \0 033   7
0001260  \0  \0
0001261
```

Some limitations: total compiled entries cannot exceed 4096 bytes; all entries in the name field cannot exceed 128 bytes.

FILES

| | |
|---|---|
| /usr/lib/terminfo/?/* | compiled terminal description database |
| /usr/include/term.h | *terminfo*(4) header file |

SEE ALSO

curses(3X), terminfo(4), term(5).
infocmp(1M) in the *System Administrator's Reference Manual*.
Chapter 10 of the *Programmer's Guide.*

## NAME

terminfo – terminal capability data base

## SYNOPSIS

**/usr/lib/terminfo/?/***

## DESCRIPTION

*terminfo* is a compiled database (see *tic*(1M)) describing the capabilities of terminals. Terminals are described in *terminfo* source descriptions by giving a set of capabilities which they have, by describing how operations are performed, by describing padding requirements, and by specifying initialization sequences. This database is used by applications programs, such as *vi*(1) and *curses*(3X), so they can work with a variety of terminals without changes to the programs. To obtain the source description for a terminal, use the **–I** option of *infocmp*(1M).

Entries in *terminfo* source files consist of a number of comma-separated fields. White space after each comma is ignored. The first line of each terminal description in the *terminfo* database gives the name by which *terminfo* knows the terminal, separated by bar ( | ) characters. The first name given is the most common abbreviation for the terminal (this is the one to use to set the environment variable **TERM** in *$HOME/.profile;* see *profile*(4)), the last name given should be a long name fully identifying the terminal, and all others are understood as synonyms for the terminal name. All names but the last should contain no blanks and must be unique in the first 14 characters; the last name may contain blanks for readability.

Terminal names (except for the last, verbose entry) should be chosen using the following conventions. The particular piece of hardware making up the terminal should have a root name chosen, for example, for the AT&T 4425 terminal, **att4425**. Modes that the hardware can be in, or user preferences, should be indicated by appending a hyphen and an indicator of the mode. See *term*(5) for examples and more information on choosing names and synonyms.

## CAPABILITIES

In the table below, the **Variable** is the name by which the C programmer (at the *terminfo* level) accesses the capability. The **Capname** is the short name for this variable used in the text of the database. It is used by a person updating the database and by the *tput*(1) command when asking what the value of the capability is for a particular terminal. The **Termcap Code** is a two-letter code that corresponds to the old *termcap* capability name.

Capability names have no hard length limit, but an informal limit of 5 characters has been adopted to keep them short. Whenever possible, names are chosen to be the same as or similar to the ANSI X3.64-1979 standard. Semantics are also intended to match those of the specification.

All string capabilities listed below may have padding specified, with the exception of those used for input. Input capabilities, listed under the **Strings** section in the table below, have names beginning with **key_**. The following indicators may appear at the end of the **Description** for a variable.

(G) indicates that the string is passed through **tparm**() with parameters (parms) as given ($\#_i$).

(*) indicates that padding may be based on the number of lines affected.

($\#_i$) indicates the $i^{th}$ parameter.

| Variable | Cap-name | Termcap Code | Description |
|---|---|---|---|
| **Booleans:** | | | |
| auto_left_margin | bw | bw | **cub1** wraps from column 0 to last column |
| auto_right_margin | am | am | Terminal has automatic margins |
| no_esc_ctlc | xsb | xb | Beehive (f1=escape, f2=ctrl C) |
| ceol_standout_glitch | xhp | xs | Standout not erased by overwriting (hp) |
| eat_newline_glitch | xenl | xn | Newline ignored after 80 cols (*Concept*) |
| erase_overstrike | eo | eo | Can erase overstrikes with a blank |
| generic_type | gn | gn | Generic line type (e.g. dialup, switch). |
| hard_copy | hc | hc | Hardcopy terminal |
| hard_cursor | chts | HC | Cursor is hard to see. |
| has_meta_key | km | km | Has a meta key (shift, sets parity bit) |
| has_status_line | hs | hs | Has extra "status line" |
| insert_null_glitch | in | in | Insert mode distinguishes nulls |
| memory_above | da | da | Display may be retained above the screen |
| memory_below | db | db | Display may be retained below the screen |
| move_insert_mode | mir | mi | Safe to move while in insert mode |
| move_standout_mode | msgr | ms | Safe to move in standout modes |
| needs_xon_xoff | nxon | nx | Padding won't work, xon/xoff required |
| non_rev_rmcup | nrrmc | NR | **smcup** does not reverse **rmcup** |
| no_pad_char | npc | NP | Pad character doesn't exist |
| over_strike | os | os | Terminal overstrikes on hard-copy terminal |
| prtr_silent | mc5i | 5i | Printer won't echo on screen. |
| status_line_esc_ok | eslok | es | Escape can be used on the status line |
| dest_tabs_magic_smso | xt | xt | Destructive tabs, magic **smso** char (t1061) |
| tilde_glitch | hz | hz | Hazeltine; can't print tildes(~) |
| transparent_underline | ul | ul | Underline character overstrikes |
| xon_xoff | xon | xo | Terminal uses xon/xoff handshaking |
| **Numbers:** | | | |
| columns | cols | co | Number of columns in a line |
| init_tabs | it | it | Tabs initially every # spaces. |
| label_height | lh | lh | Number of rows in each label |
| label_width | lw | lw | Number of cols in each label |
| lines | lines | li | Number of lines on screen or page |
| lines_of_memory | lm | lm | Lines of memory if > **lines**; **0** means varies |
| magic_cookie_glitch | xmc | sg | Number blank chars left by **smso** or **rmso** |
| num_labels | nlab | Nl | Number of labels on screen (start at 1) |
| padding_baud_rate | pb | pb | Lowest baud rate where padding needed |
| virtual_terminal | vt | vt | Virtual terminal number (UNIX system) |
| width_status_line | wsl | ws | Number of columns in status line |

**Strings:**

| | | | |
|---|---|---|---|
| acs_chars | acsc | ac | Graphic charset pairs aAbBcC - def=vt100+ |
| back_tab | cbt | bt | Back tab |
| bell | bel | bl | Audible signal (bell) |
| carriage_return | cr | cr | Carriage return (*) |
| change_scroll_region | csr | cs | Change to lines #1 thru #2 (vt100) (G) |
| char_padding | rmp | rP | Like **ip** but when in replace mode |
| clear_all_tabs | tbc | ct | Clear all tab stops |
| clear_margins | mgc | MC | Clear left and right soft margins |
| clear_screen | clear | cl | Clear screen and home cursor (*) |
| clr_bol | el1 | cb | Clear to beginning of line, inclusive |
| clr_eol | el | ce | Clear to end of line |
| clr_eos | ed | cd | Clear to end of display (*) |
| column_address | hpa | ch | Horizontal position absolute (G) |
| command_character | cmdch | CC | Term. settable cmd char in prototype |
| cursor_address | cup | cm | Cursor motion to row #1 col #2 (G) |
| cursor_down | cud1 | do | Down one line |
| cursor_home | home | ho | Home cursor (if no **cup**) |
| cursor_invisible | civis | vi | Make cursor invisible |
| cursor_left | cub1 | le | Move cursor left one space. |
| cursor_mem_address | mrcup | CM | Memory relative cursor addressing (G) |
| cursor_normal | cnorm | ve | Make cursor appear normal (undo **vs/vi**) |
| cursor_right | cuf1 | nd | Non-destructive space (cursor right) |
| cursor_to_ll | ll | ll | Last line, first column (if no **cup**) |
| cursor_up | cuu1 | up | Upline (cursor up) |
| cursor_visible | cvvis | vs | Make cursor very visible |
| delete_character | dch1 | dc | Delete character (*) |
| delete_line | dl1 | dl | Delete line (*) |
| dis_status_line | dsl | ds | Disable status line |
| down_half_line | hd | hd | Half-line down (forward 1/2 linefeed) |
| ena_acs | enacs | eA | Enable alternate char set |
| enter_alt_charset_mode | smacs | as | Start alternate character set |
| enter_am_mode | smam | SA | Turn on automatic margins |
| enter_blink_mode | blink | mb | Turn on blinking |
| enter_bold_mode | bold | md | Turn on bold (extra bright) mode |
| enter_ca_mode | smcup | ti | String to begin programs that use **cup** |
| enter_delete_mode | smdc | dm | Delete mode (enter) |
| enter_dim_mode | dim | mh | Turn on half-bright mode |
| enter_insert_mode | smir | im | Insert mode (enter); |
| enter_protected_mode | prot | mp | Turn on protected mode |
| enter_reverse_mode | rev | mr | Turn on reverse video mode |
| enter_secure_mode | invis | mk | Turn on blank mode (chars invisible) |
| enter_standout_mode | smso | so | Begin standout mode |
| enter_underline_mode | smul | us | Start underscore mode |
| enter_xon_mode | smxon | SX | Turn on xon/xoff handshaking |
| erase_chars | ech | ec | Erase #1 characters (G) |
| exit_alt_charset_mode | rmacs | ae | End alternate character set |
| exit_am_mode | rmam | RA | Turn off automatic margins |
| exit_attribute_mode | sgr0 | me | Turn off all attributes |

| | | | |
|---|---|---|---|
| exit_ca_mode | rmcup | te | String to end programs that use **cup** |
| exit_delete_mode | rmdc | ed | End delete mode |
| exit_insert_mode | rmir | ei | End insert mode; |
| exit_standout_mode | rmso | se | End standout mode |
| exit_underline_mode | rmul | ue | End underscore mode |
| exit_xon_mode | rmxon | RX | Turn off xon/xoff handshaking |
| flash_screen | flash | vb | Visible bell (may not move cursor) |
| form_feed | ff | ff | Hardcopy terminal page eject (*) |
| from_status_line | fsl | fs | Return from status line |
| init_1string | is1 | i1 | Terminal initialization string |
| init_2string | is2 | is | Terminal initialization string |
| init_3string | is3 | i3 | Terminal initialization string |
| init_file | if | if | Name of initialization file containing **is** |
| init_prog | iprog | iP | Path name of program for init. |
| insert_character | ich1 | ic | Insert character |
| insert_line | il1 | al | Add new blank line (*) |
| insert_padding | ip | ip | Insert pad after character inserted (*) |
| key_a1 | ka1 | K1 | KEY_A1, 0534, Upper left of keypad |
| key_a3 | ka3 | K3 | KEY_A3, 0535, Upper right of keypad |
| key_b2 | kb2 | K2 | KEY_B2, 0536, Center of keypad |
| key_backspace | kbs | kb | KEY_BACKSPACE, 0407, Sent by backspace key |
| key_beg | kbeg | @1 | KEY_BEG, 0542, Sent by beg(inning) key |
| key_btab | kcbt | kB | KEY_BTAB, 0541, Sent by back-tab key |
| key_c1 | kc1 | K4 | KEY_C1, 0537, Lower left of keypad |
| key_c3 | kc3 | K5 | KEY_C3, 0540, Lower right of keypad |
| key_cancel | kcan | @2 | KEY_CANCEL, 0543, Sent by cancel key |
| key_catab | ktbc | ka | KEY_CATAB, 0526, Sent by clear-all-tabs key |
| key_clear | kclr | kC | KEY_CLEAR, 0515, Sent by clear-screen or erase key |
| key_close | kclo | @3 | KEY_CLOSE, 0544, Sent by close key |
| key_command | kcmd | @4 | KEY_COMMAND, 0545, Sent by cmd (command) key |
| key_copy | kcpy | @5 | KEY_COPY, 0546, Sent by copy key |
| key_create | kcrt | @6 | KEY_CREATE, 0547, Sent by create key |
| key_ctab | kctab | kt | KEY_CTAB, 0525, Sent by clear-tab key |
| key_dc | kdch1 | kD | KEY_DC, 0512, Sent by delete-character key |
| key_dl | kdl1 | kL | KEY_DL, 0510, Sent by delete-line key |
| key_down | kcud1 | kd | KEY_DOWN, 0402, Sent by terminal down-arrow key |
| key_eic | krmir | kM | KEY_EIC, 0514, Sent by **rmir** or **smir** in insert mode |
| key_end | kend | @7 | KEY_END, 0550, Sent by end key |
| key_enter | kent | @8 | KEY_ENTER, 0527, Sent by enter/send key |
| key_eol | kel | kE | KEY_EOL, 0517, Sent by clear-to-end-of-line key |
| key_eos | ked | kS | KEY_EOS, 0516, Sent by clear-to-end-of-screen key |
| key_exit | kext | @9 | KEY_EXIT, 0551, Sent by exit key |
| key_f0 | kf0 | k0 | KEY_F(0), 0410, Sent by function key f0 |
| key_f1 | kf1 | k1 | KEY_F(1), 0411, Sent by function key f1 |
| key_f2 | kf2 | k2 | KEY_F(2), 0412, Sent by function key f2 |
| key_f3 | kf3 | k3 | KEY_F(3), 0413, Sent by function key f3 |
| key_f4 | kf4 | k4 | KEY_F(4), 0414, Sent by function key f4 |
| key_f5 | kf5 | k5 | KEY_F(5), 0415, Sent by function key f5 |
| key_f6 | kf6 | k6 | KEY_F(6), 0416, Sent by function key f6 |

| | | | |
|---|---|---|---|
| key_f7 | kf7 | k7 | KEY_F(7), 0417, Sent by function key f7 |
| key_f8 | kf8 | k8 | KEY_F(8), 0420, Sent by function key f8 |
| key_f9 | kf9 | k9 | KEY_F(9), 0421, Sent by function key f9 |
| key_f10 | kf10 | k; | KEY_F(10), 0422, Sent by function key f10 |
| key_f11 | kf11 | F1 | KEY_F(11), 0423, Sent by function key f11 |
| key_f12 | kf12 | F2 | KEY_F(12), 0424, Sent by function key f12 |
| key_f13 | kf13 | F3 | KEY_F(13), 0425, Sent by function key f13 |
| key_f14 | kf14 | F4 | KEY_F(14), 0426, Sent by function key f14 |
| key_f15 | kf15 | F5 | KEY_F(15), 0427, Sent by function key f15 |
| key_f16 | kf16 | F6 | KEY_F(16), 0430, Sent by function key f16 |
| key_f17 | kf17 | F7 | KEY_F(17), 0431, Sent by function key f17 |
| key_f18 | kf18 | F8 | KEY_F(18), 0432, Sent by function key f18 |
| key_f19 | kf19 | F9 | KEY_F(19), 0433, Sent by function key f19 |
| key_f20 | kf20 | FA | KEY_F(20), 0434, Sent by function key f20 |
| key_f21 | kf21 | FB | KEY_F(21), 0435, Sent by function key f21 |
| key_f22 | kf22 | FC | KEY_F(22), 0436, Sent by function key f22 |
| key_f23 | kf23 | FD | KEY_F(23), 0437, Sent by function key f23 |
| key_f24 | kf24 | FE | KEY_F(24), 0440, Sent by function key f24 |
| key_f25 | kf25 | FF | KEY_F(25), 0441, Sent by function key f25 |
| key_f26 | kf26 | FG | KEY_F(26), 0442, Sent by function key f26 |
| key_f27 | kf27 | FH | KEY_F(27), 0443, Sent by function key f27 |
| key_f28 | kf28 | FI | KEY_F(28), 0444, Sent by function key f28 |
| key_f29 | kf29 | FJ | KEY_F(29), 0445, Sent by function key f29 |
| key_f30 | kf30 | FK | KEY_F(30), 0446, Sent by function key f30 |
| key_f31 | kf31 | FL | KEY_F(31), 0447, Sent by function key f31 |
| key_f32 | kf32 | FM | KEY_F(32), 0450, Sent by function key f32 |
| key_f33 | kf33 | FN | KEY_F(13), 0451, Sent by function key f13 |
| key_f34 | kf34 | FO | KEY_F(34), 0452, Sent by function key f34 |
| key_f35 | kf35 | FP | KEY_F(35), 0453, Sent by function key f35 |
| key_f36 | kf36 | FQ | KEY_F(36), 0454, Sent by function key f36 |
| key_f37 | kf37 | FR | KEY_F(37), 0455, Sent by function key f37 |
| key_f38 | kf38 | FS | KEY_F(38), 0456, Sent by function key f38 |
| key_f39 | kf39 | FT | KEY_F(39), 0457, Sent by function key f39 |
| key_f40 | kf40 | FU | KEY_F(40), 0460, Sent by function key f40 |
| key_f41 | kf41 | FV | KEY_F(41), 0461, Sent by function key f41 |
| key_f42 | kf42 | FW | KEY_F(42), 0462, Sent by function key f42 |
| key_f43 | kf43 | FX | KEY_F(43), 0463, Sent by function key f43 |
| key_f44 | kf44 | FY | KEY_F(44), 0464, Sent by function key f44 |
| key_f45 | kf45 | FZ | KEY_F(45), 0465, Sent by function key f45 |
| key_f46 | kf46 | Fa | KEY_F(46), 0466, Sent by function key f46 |
| key_f47 | kf47 | Fb | KEY_F(47), 0467, Sent by function key f47 |
| key_f48 | kf48 | Fc | KEY_F(48), 0470, Sent by function key f48 |
| key_f49 | kf49 | Fd | KEY_F(49), 0471, Sent by function key f49 |
| key_f50 | kf50 | Fe | KEY_F(50), 0472, Sent by function key f50 |
| key_f51 | kf51 | Ff | KEY_F(51), 0473, Sent by function key f51 |
| key_f52 | kf52 | Fg | KEY_F(52), 0474, Sent by function key f52 |
| key_f53 | kf53 | Fh | KEY_F(53), 0475, Sent by function key f53 |
| key_f54 | kf54 | Fi | KEY_F(54), 0476, Sent by function key f54 |
| key_f55 | kf55 | Fj | KEY_F(55), 0477, Sent by function key f55 |

| | | | |
|---|---|---|---|
| key_f56 | kf56 | Fk | KEY_F(56), 0500, Sent by function key f56 |
| key_f57 | kf57 | Fl | KEY_F(57), 0501, Sent by function key f57 |
| key_f58 | kf58 | Fm | KEY_F(58), 0502, Sent by function key f58 |
| key_f59 | kf59 | Fn | KEY_F(59), 0503, Sent by function key f59 |
| key_f60 | kf60 | Fo | KEY_F(60), 0504, Sent by function key f60 |
| key_f61 | kf61 | Fp | KEY_F(61), 0505, Sent by function key f61 |
| key_f62 | kf62 | Fq | KEY_F(62), 0506, Sent by function key f62 |
| key_f63 | kf63 | Fr | KEY_F(63), 0507, Sent by function key f63 |
| key_find | kfnd | @0 | KEY_FIND, 0552, Sent by find key |
| key_help | khlp | %1 | KEY_HELP, 0553, Sent by help key |
| key_home | khome | kh | KEY_HOME, 0406, Sent by home key |
| key_ic | kich1 | kI | KEY_IC, 0513, Sent by ins-char/enter ins-mode key |
| key_il | kil1 | kA | KEY_IL, 0511, Sent by insert-line key |
| key_left | kcub1 | kl | KEY_LEFT, 0404, Sent by terminal left-arrow key |
| key_ll | kll | kH | KEY_LL, 0533, Sent by home-down key |
| key_mark | kmrk | %2 | KEY_MARK, 0554, Sent by mark key |
| key_message | kmsg | %3 | KEY_MESSAGE, 0555, Sent by message key |
| key_move | kmov | %4 | KEY_MOVE, 0556, Sent by move key |
| key_next | knxt | %5 | KEY_NEXT, 0557, Sent by next-object key |
| key_npage | knp | kN | KEY_NPAGE, 0522, Sent by next-page key |
| key_open | kopn | %6 | KEY_OPEN, 0560, Sent by open key |
| key_options | kopt | %7 | KEY_OPTIONS, 0561, Sent by options key |
| key_ppage | kpp | kP | KEY_PPAGE, 0523, Sent by previous-page key |
| key_previous | kprv | %8 | KEY_PREVIOUS, 0562, Sent by previous-object key |
| key_print | kprt | %9 | KEY_PRINT, 0532, Sent by print or copy key |
| key_redo | krdo | %0 | KEY_REDO, 0563, Sent by redo key |
| key_reference | kref | &1 | KEY_REFERENCE, 0564, Sent by ref(erence) key |
| key_refresh | krfr | &2 | KEY_REFRESH, 0565, Sent by refresh key |
| key_replace | krpl | &3 | KEY_REPLACE, 0566, Sent by replace key |
| key_restart | krst | &4 | KEY_RESTART, 0567, Sent by restart key |
| key_resume | kres | &5 | KEY_RESUME, 0570, Sent by resume key |
| key_right | kcuf1 | kr | KEY_RIGHT, 0405, Sent by terminal right-arrow key |
| key_save | ksav | &6 | KEY_SAVE, 0571, Sent by save key |
| key_sbeg | kBEG | &9 | KEY_SBEG, 0572, Sent by shifted beginning key |
| key_scancel | kCAN | &0 | KEY_SCANCEL, 0573, Sent by shifted cancel key |
| key_scommand | kCMD | *1 | KEY_SCOMMAND, 0574, Sent by shifted command key |
| key_scopy | kCPY | *2 | KEY_SCOPY, 0575, Sent by shifted copy key |
| key_screate | kCRT | *3 | KEY_SCREATE, 0576, Sent by shifted create key |
| key_sdc | kDC | *4 | KEY_SDC, 0577, Sent by shifted delete-char key |
| key_sdl | kDL | *5 | KEY_SDL, 0600, Sent by shifted delete-line key |
| key_select | kslt | *6 | KEY_SELECT, 0601, Sent by select key |
| key_send | kEND | *7 | KEY_SEND, 0602, Sent by shifted end key |
| key_seol | kEOL | *8 | KEY_SEOL, 0603, Sent by shifted clear-line key |
| key_sexit | kEXT | *9 | KEY_SEXIT, 0604, Sent by shifted exit key |
| key_sf | kind | kF | KEY_SF, 0520, Sent by scroll-forward/down key |
| key_sfind | kFND | *0 | KEY_SFIND, 0605, Sent by shifted find key |
| key_shelp | kHLP | #1 | KEY_SHELP, 0606, Sent by shifted help key |
| key_shome | kHOM | #2 | KEY_SHOME, 0607, Sent by shifted home key |
| key_sic | kIC | #3 | KEY_SIC, 0610, Sent by shifted input key |

| | | | |
|---|---|---|---|
| key_sleft | kLFT | #4 | KEY_SLEFT, 0611, Sent by shifted left-arrow key |
| key_smessage | kMSG | %a | KEY_SMESSAGE, 0612, Sent by shifted message key |
| key_smove | kMOV | %b | KEY_SMOVE, 0613, Sent by shifted move key |
| key_snext | kNXT | %c | KEY_SNEXT, 0614, Sent by shifted next key |
| key_soptions | kOPT | %d | KEY_SOPTIONS, 0615, Sent by shifted options key |
| key_sprevious | kPRV | %e | KEY_SPREVIOUS, 0616, Sent by shifted prev key |
| key_sprint | kPRT | %f | KEY_SPRINT, 0617, Sent by shifted print key |
| key_sr | kri | kR | KEY_SR, 0521, Sent by scroll-backward/up key |
| key_sredo | kRDO | %g | KEY_SREDO, 0620, Sent by shifted redo key |
| key_sreplace | kRPL | %h | KEY_SREPLACE, 0621, Sent by shifted replace key |
| key_sright | kRIT | %i | KEY_SRIGHT, 0622, Sent by shifted right-arrow key |
| key_srsume | kRES | %j | KEY_SRSUME, 0623, Sent by shifted resume key |
| key_ssave | kSAV | !1 | KEY_SSAVE, 0624, Sent by shifted save key |
| key_ssuspend | kSPD | !2 | KEY_SSUSPEND, 0625, Sent by shifted suspend key |
| key_stab | khts | kT | KEY_STAB, 0524, Sent by set-tab key |
| key_sundo | kUND | !3 | KEY_SUNDO, 0626, Sent by shifted undo key |
| key_suspend | kspd | &7 | KEY_SUSPEND, 0627, Sent by suspend key |
| key_undo | kund | &8 | KEY_UNDO, 0630, Sent by undo key |
| key_up | kcuu1 | ku | KEY_UP, 0403, Sent by terminal up-arrow key |
| keypad_local | rmkx | ke | Out of "keypad-transmit" mode |
| keypad_xmit | smkx | ks | Put terminal in "keypad-transmit" mode |
| lab_f0 | lf0 | l0 | Labels on function key f0 if not f0 |
| lab_f1 | lf1 | l1 | Labels on function key f1 if not f1 |
| lab_f2 | lf2 | l2 | Labels on function key f2 if not f2 |
| lab_f3 | lf3 | l3 | Labels on function key f3 if not f3 |
| lab_f4 | lf4 | l4 | Labels on function key f4 if not f4 |
| lab_f5 | lf5 | l5 | Labels on function key f5 if not f5 |
| lab_f6 | lf6 | l6 | Labels on function key f6 if not f6 |
| lab_f7 | lf7 | l7 | Labels on function key f7 if not f7 |
| lab_f8 | lf8 | l8 | Labels on function key f8 if not f8 |
| lab_f9 | lf9 | l9 | Labels on function key f9 if not f9 |
| lab_f10 | lf10 | la | Labels on function key f10 if not f10 |
| label_off | rmln | LF | Turn off soft labels |
| label_on | smln | LO | Turn on soft labels |
| meta_off | rmm | mo | Turn off "meta mode" |
| meta_on | smm | mm | Turn on "meta mode" (8th bit) |
| newline | nel | nw | Newline (behaves like **cr** followed by **lf**) |
| pad_char | pad | pc | Pad character (rather than null) |
| parm_dch | dch | DC | Delete #1 chars (G*) |
| parm_delete_line | dl | DL | Delete #1 lines (G*) |
| parm_down_cursor | cud | DO | Move cursor down #1 lines. (G*) |
| parm_ich | ich | IC | Insert #1 blank chars (G*) |
| parm_index | indn | SF | Scroll forward #1 lines. (G) |
| parm_insert_line | il | AL | Add #1 new blank lines (G*) |
| parm_left_cursor | cub | LE | Move cursor left #1 spaces (G) |
| parm_right_cursor | cuf | RI | Move cursor right #1 spaces. (G*) |
| parm_rindex | rin | SR | Scroll backward #1 lines. (G) |
| parm_up_cursor | cuu | UP | Move cursor up #1 lines. (G*) |
| pkey_key | pfkey | pk | Prog funct key #1 to type string #2 |

| | | | |
|---|---|---|---|
| pkey_local | pfloc | pl | Prog funct key #1 to execute string #2 |
| pkey_xmit | pfx | px | Prog funct key #1 to xmit string #2 |
| plab_norm | pln | pn | Prog label #1 to show string #2 |
| print_screen | mc0 | ps | Print contents of the screen |
| prtr_non | mc5p | pO | Turn on the printer for #1 bytes |
| prtr_off | mc4 | pf | Turn off the printer |
| prtr_on | mc5 | po | Turn on the printer |
| repeat_char | rep | rp | Repeat char #1 #2 times (G*) |
| req_for_input | rfi | RF | Send next input char (for ptys) |
| reset_1string | rs1 | r1 | Reset terminal completely to sane modes |
| reset_2string | rs2 | r2 | Reset terminal completely to sane modes |
| reset_3string | rs3 | r3 | Reset terminal completely to sane modes |
| reset_file | rf | rf | Name of file containing reset string |
| restore_cursor | rc | rc | Restore cursor to position of last sc |
| row_address | vpa | cv | Vertical position absolute (G) |
| save_cursor | sc | sc | Save cursor position. |
| scroll_forward | ind | sf | Scroll text up |
| scroll_reverse | ri | sr | Scroll text down |
| set_attributes | sgr | sa | Define the video attributes #1-#9 (G) |
| set_left_margin | smgl | ML | Set soft left margin |
| set_right_margin | smgr | MR | Set soft right margin |
| set_tab | hts | st | Set a tab in all rows, current column. |
| set_window | wind | wi | Current window is lines #1-#2 cols #3-#4 (G) |
| tab | ht | ta | Tab to next 8 space hardware tab stop. |
| to_status_line | tsl | ts | Go to status line, col #1 (G) |
| underline_char | uc | uc | Underscore one char and move past it |
| up_half_line | hu | hu | Half-line up (reverse 1/2 linefeed) |
| xoff_character | xoffc | XF | X-off character |
| xon_character | xonc | XN | X-on character |

## SAMPLE ENTRY

The following entry, which describes the *Concept*—100 terminal, is among the more complex entries in the *terminfo* file as of this writing.

```
concept100|c100|concept|c104|c100-4p|concept 100,
    am, db, eo, in, mir, ul, xenl,
    cols#80, lines#24, pb#9600, vt#8,
    bel=^G, blank=\EH, blink=\EC, clear=^L$<2*>,
    cnorm=\Ew, cr=^M$<9>, cub1=^H, cud1=^J,
    cuf1=\E=, cup=\Ea%p1%' '%+%c%p2%' '%+%c,
    cuu1=\E;, cvvis=\EW, dch1=\E^A$<16*>, dim=\EE,
    dl1=\E^B$<3*>, ed=\E^C$<16*>, el=\E^U$<16>,
    flash=\Ek$<20>\EK, ht=\t$<8>, il1=\E^R$<3*>,
    ind=^J, .ind=^J$<9>, ip=$<16*>,
    is2=\EU\Ef\E7\E5\E8\El\ENH\EK\E\0\Eo&\0\Eo\47\E,
    kbs=^h, kcub1=\E>, kcud1=\E<, kcuf1=\E=, kcuu1=\E;,
    kf1=\E5, kf2=\E6, kf3=\E7, khome=\E?,
    prot=\EI, rep=\Er%p1%c%p2%' '%+%c$<.2*>,
    rev=\ED, rmcup=\Ev\s\s\s\s$<6>\Ep\r\n,
    rmir=\E\0, rmkx=\Ex, rmso=\Ed\Ee, rmul=\Eg,
    rmul=\Eg, sgr0=\EN\0, smcup=\EU\Ev\s\s8p\Ep\r,
    smir=\E^P, smkx=\EX, smso=\EE\ED, smul=\EG,
```

Entries may continue onto multiple lines by placing white space at the beginning of each line except the first. Lines beginning with "#" are taken as comment lines. Capabilities in *terminfo* are of three types: boolean capabilities which indicate that the terminal has some particular feature, numeric capabilities giving the size of the terminal or particular features, and string capabilities, which give a sequence which can be used to perform particular terminal operations.

## Types of Capabilities

All capabilities have names. For instance, the fact that the *Concept* has *automatic margins* (i.e., an automatic return and linefeed when the end of a line is reached) is indicated by the capability **am**. Hence the description of the *Concept* includes **am**. Numeric capabilities are followed by the character '#' and then the value. Thus **cols**, which indicates the number of columns the terminal has, gives the value **80** for the *Concept*. The value may be specified in decimal, octal or hexadecimal using normal C conventions.

Finally, string-valued capabilities, such as **el** (clear to end of line sequence) are given by the two- to five-character capname, an '=', and then a string ending at the next following comma. A delay in milliseconds may appear anywhere in such a capability, enclosed in **$<..>** brackets, as in **el=\EK$<3>**, and padding characters are supplied by **tputs**( ) (see *curses*(3X)) to provide this delay. The delay can be either a number, e.g., **20**, or a number followed by an '*' (i.e., **3***), a '/' (i.e., **5/**), or both (i.e., **10*/**). A '*' indicates that the padding required is proportional to the number of lines affected by the operation, and the amount given is the per-affected-unit padding required. (In the case of insert character, the factor is still the number of lines affected. This is always one unless the terminal has **in** and the software uses it.) When a '*' is specified, it is sometimes useful to give a delay of the form **3.5** to specify a delay per unit to tenths of milliseconds. (Only one decimal place is allowed.) A '/' indicates that the padding is mandatory. Otherwise, if the terminal has **xon** defined, the padding information is advisory and will only be used for cost estimates or when the terminal is in raw mode. Mandatory padding will be transmitted regardless of the setting of **xon**.

A number of escape sequences are provided in the string valued capabilities for easy encoding of characters there. Both **\E** and **\e** map to an ESCAPE character, ^*x* maps to a control−*x* for any appropriate *x*, and the sequences **\n, \l, \r, \t, \b, \f,** and **\s** give a newline, linefeed, return, tab, backspace, formfeed, and space, respectively. Other escapes include: \^ for caret (^); \\ for backslash (\); \, for comma (,); \: for colon (:); and \0 for null. (\0 will actually produce \200, which does not terminate a string but behaves as a null character on most terminals.) Finally, characters may be given as three octal digits after a backslash (e.g., \123).

Sometimes individual capabilities must be commented out. To do this, put a period before the capability name. For example, see the second **ind** in the example above. Note that capabilities are defined in a left-to-right order and, therefore, a prior definition will override a later definition.

## Preparing Descriptions

The most effective way to prepare a terminal description is by imitating the description of a similar terminal in *terminfo* and to build up a description gradually, using partial descriptions with **vi**(1) to check that they are correct. Be aware that a very unusual terminal may expose deficiencies in the ability of the **terminfo** file to describe it or the inability of **vi**(1) to work with that terminal. To test a new terminal description, set the environment variable **TERMINFO** to a pathname of a directory containing the compiled description you are working on and programs will look there rather than in */usr/lib/terminfo*. To get the padding for insert-line correct (if the terminal manufacturer did not document it) a severe test is to comment out **xon**, edit a large file at 9600 baud with **vi**(1), delete 16 or so lines from the middle of the screen, then hit the **u** key several times quickly. If the display is corrupted, more padding is usually needed. A similar test can be used for insert-character.

## Basic Capabilities

The number of columns on each line for the terminal is given by the **cols** numeric capability. If the terminal has a screen, then the number of lines on the screen is given by the **lines** capability. If the terminal wraps around to the beginning of the next line when it reaches the right margin, then it should have the **am** capability. If the terminal can clear its screen, leaving the cursor in the home position, then this is given by the **clear** string capability. If the terminal overstrikes (rather than clearing a position when a character is struck over) then it should have the **os** capability. If the terminal is a printing terminal, with no soft copy unit, give it both **hc** and **os**. (**os** applies to storage scope terminals, such as Tektronix 4010 series, as well as hard-copy and APL terminals.) If there is a code to move the cursor to the left edge of the current row, give this as **cr**. (Normally this will be carriage return, control M.) If there is a code to produce an audible signal (bell, beep, etc) give this as **bel**. If the terminal uses the xon-xoff flow-control protocol, like most terminals, specify **xon**.

If there is a code to move the cursor one position to the left (such as backspace) that capability should be given as **cub1**. Similarly, codes to move to the right, up, and down should be given as **cuf1**, **cuu1**, and **cud1**. These local cursor motions should not alter the text they pass over; for example, you would not normally use "**cuf1**=\s" because the space would erase the character moved over.

A very important point here is that the local cursor motions encoded in *terminfo* are undefined at the left and top edges of a screen terminal. Programs should never attempt to backspace around the left edge, unless **bw** is given, and should never attempt to go up locally off the top. In order to scroll text up, a program will go to the bottom left corner of the screen and send the **ind** (index) string.

To scroll text down, a program goes to the top left corner of the screen and sends the **ri** (reverse index) string. The strings **ind** and **ri** are undefined when not on their respective corners of the screen.

Parameterized versions of the scrolling sequences are **indn** and **rin** which have the same semantics as **ind** and **ri** except that they take one parameter, and scroll that many lines. They are also undefined except at the appropriate edge of the screen.

The **am** capability tells whether the cursor sticks at the right edge of the screen when text is output, but this does not necessarily apply to a **cuf1** from the last column. The only local motion which is defined from the left edge is if **bw** is given, then a **cub1** from the left edge will move to the right edge of the previous row. If **bw** is not given, the effect is undefined. This is useful for drawing a box around the edge of the screen, for example. If the terminal has switch selectable automatic margins, the *terminfo* file usually assumes that this is on; i.e., **am**. If the terminal has a command which moves to the first column of the next line, that command can be given as **nel** (newline). It does not matter if the command clears the remainder of the current line, so if the terminal has no **cr** and **lf** it may still be possible to craft a working **nel** out of one or both of them.

These capabilities suffice to describe hardcopy and screen terminals. Thus the model 33 teletype is described as

33|tty33|tty|model 33 teletype, bel=^G, cols#72, cr=^M, cud1=^J, hc, ind=^J, os,

while the Lear Siegler ADM−3 is described as

adm3|lsi adm3, am, bel=^G, clear=^Z, cols#80, cr=^M, cub1=^H, cud1=^J, ind=^J, lines#24,

## Parameterized Strings

Cursor addressing and other strings requiring parameters in the terminal are described by a parameterized string capability, with **printf**(3S)-like escapes (**%x**) in it. For example, to address the cursor, the **cup** capability is given, using two parameters: the row and column to address to. (Rows and columns are numbered from zero and refer to the physical screen visible to the user, not to any unseen memory.) If the terminal has memory relative cursor addressing, that can be indicated by **mrcup**.

The parameter mechanism uses a stack and special % codes to manipulate it in the manner of a Reverse Polish Notation (postfix) calculator. Typically a sequence will push one of the parameters onto the stack and then print it in some format. Often more complex operations are necessary. Binary operations are in postfix form with the operands in the usual order. That is, to get x−5 one would use **%gx%{5}%−**.

The % encodings have the following meanings:

```
%%              outputs '%'
%[[:]flags][width[.precision]][doxXs]
                as in printf, flags are [-+#] and space
%c              print pop() gives %c

%p[1-9]         push i^th parm
%P[a-z]         set variable [a-z] to pop()
%g[a-z]         get variable [a-z] and push it
%'c'            push char constant c
%{nn}           push decimal constant nn
%l              push strlen(pop())

%+ %- %* %/ %m
                arithmetic (%m is mod):  push(pop() op pop())
%& %| %^        bit operations:  push(pop() op pop())
%= %> %<        logical operations:  push(pop() op pop())
%A %O           logical operations:  and, or
%! %~           unary operations:  push(op pop())
%i              (for ANSI terminals)
                  add 1 to first parm, if one parm present,
                  or first two parms, if more than one parm present

%? expr %t thenpart %e elsepart %;
                if-then-else, %e elsepart is optional;
                else-if's are possible ala Algol 68:
                %? c1 %t b1 %e c2 %t b2 %e c3 %t b3 %e c4 %t b4 %e b5%;
                ci are conditions, bi are bodies.
```

If the "−" flag is used with "%[doxXs]", then a colon (:) must be placed between the "%" and the "−" to differentiate the flag from the binary "%−" operator, .e.g "%:−16.16s".

Consider the Hewlett-Packard 2645, which, to get to row 3 and column 12, needs to be sent **\E&a12c03Y** padded for 6 milliseconds. Note that the order of the rows and columns is inverted here, and that the row and column are zero-padded as two digits. Thus its **cup** capability is "**cup**=\E&a%p2%2.2dc%p1%2.2dY$<6>".

The Micro-Term ACT-IV needs the current row and column sent preceded by a **^T**, with the row and column simply encoded in binary, "**cup**=^T%p1%c%p2%c". Terminals which use "%c" need to be able to backspace the cursor (**cub1**), and to move the cursor up one line on the screen (**cuu1**). This is necessary because it is not always safe to transmit **\n**, **^D**, and **\r**, as the system may change or discard them. (The library routines dealing with *terminfo* set tty modes so that tabs are never expanded, so **\t** is safe to send. This turns out to be essential for the Ann Arbor 4080.)

A final example is the LSI ADM-3a, which uses row and column offset by a blank character, thus "**cup**=\E=%p1%'\s'%+%c%p2%'\s'%+%c". After sending "\E=", this pushes the first parameter, pushes the ASCII value for a space (32), adds them (pushing the sum on the stack in place of the two previous values), and outputs that value as a character. Then the same is done for the second parameter. More complex arithmetic is possible using the stack.

## Cursor Motions

If the terminal has a fast way to home the cursor (to very upper left corner of screen) then this can be given as **home**; similarly a fast way of getting to the lower left-hand corner can be given as **ll**; this may involve going up with **cuu1** from the home position, but a program should never do this itself (unless **ll** does) because it can make no assumption about the effect of moving up from the home position. Note that the home position is the same as addressing to (0,0): to the top left corner of the screen, not of memory. (Thus, the **\EH** sequence on Hewlett-Packard terminals cannot be used for **home** without losing some of the other features on the terminal.)

If the terminal has row or column absolute-cursor addressing, these can be given as single parameter capabilities **hpa** (horizontal position absolute) and **vpa** (vertical position absolute). Sometimes these are shorter than the more general two-parameter sequence (as with the Hewlett-Packard 2645) and can be used in preference to **cup**. If there are parameterized local motions (e.g., move *n* spaces to the right) these can be given as **cud**, **cub**, **cuf**, and **cuu** with a single parameter indicating how many spaces to move. These are primarily useful if the terminal does not have **cup**, such as the Tektronix 4025.

## Area Clears

If the terminal can clear from the current position to the end of the line, leaving the cursor where it is, this should be given as **el**. If the terminal can clear from the beginning of the line to the current position inclusive, leaving the cursor where it is, this should be given as **el1**. If the terminal can clear from the current position to the end of the display, then this should be given as **ed**. **ed** is only defined from the first column of a line. (Thus, it can be simulated by a request to delete a large number of lines, if a true **ed** is not available.)

## Insert/delete line

If the terminal can open a new blank line before the line where the cursor is, this should be given as **il1**; this is done only from the first position of a line. The cursor must then appear on the newly blank line. If the terminal can delete the line which the cursor is on, then this should be given as **dl1**; this is done only from the first position on the line to be deleted. Versions of **il1** and **dl1** which take a single parameter and insert or delete that many lines can be given as **il** and **dl**.

If the terminal has a settable destructive scrolling region (like the VT100) the command to set this can be described with the **csr** capability, which takes two parameters: the top and bottom lines of the scrolling region. The cursor position is, alas, undefined after using this command. It is possible to get the effect of insert or delete line using this command -- the **sc** and **rc** (save and restore cursor) commands are also useful. Inserting lines at the top or bottom of the screen can also be done using **ri** or **ind** on many terminals without a true insert/delete line, and is often faster even on terminals with those features.

To determine whether a terminal has destructive scrolling regions or non-destructive scrolling regions, create a scrolling region in the middle of the screen, place data on the bottom line of the scrolling region, move the cursor to the top line of the scrolling region, and do a reverse index (**ri**) followed by a delete line (**dl1**) or index (**ind**). If the data that was originally on the bottom line of the scrolling region was restored into the scrolling region by the **dl1** or **ind**, then the terminal has non-destructive scrolling regions. Otherwise, it has destructive scrolling regions. Do not specify **csr** if the terminal has non-destructive scrolling regions, unless **ind**, **ri**, **indn**, **rin**, **dl**, and **dl1** all simulate destructive scrolling.

If the terminal has the ability to define a window as part of memory, which all commands affect, it should be given as the parameterized string **wind**. The four parameters are the starting and ending lines in memory and the starting and ending columns in memory, in that order.

If the terminal can retain display memory above, then the **da** capability should be given; if display memory can be retained below, then **db** should be given. These indicate that deleting a line or scrolling a full screen may bring non-blank lines up from below or that scrolling back with **ri** may bring down non-blank lines.

## Insert/Delete Character

There are two basic kinds of intelligent terminals with respect to insert/delete character operations which can be described using *terminfo.* The most common insert/delete character operations affect only the characters on the current line and shift characters off the end of the line rigidly. Other terminals, such as the *Concept* 100 and the Perkin Elmer Owl, make a distinction between typed and untyped blanks on the screen, shifting upon an insert or delete only to an untyped blank on the screen which is either eliminated, or expanded to two untyped blanks. You can determine the kind of terminal you have by clearing the screen and then typing text separated by cursor motions. Type "**abc    def**" using local cursor motions (not spaces) between the **abc** and the **def**. Then position the cursor before the **abc** and put the terminal in insert mode. If typing characters causes the rest of the line to shift rigidly and characters to fall off the end, then your terminal does not distinguish between blanks and untyped positions. If the **abc** shifts over to the **def** which then move together around the end of the current line and onto the next as you insert, you have the second type of terminal, and should give the capability **in**, which stands for "insert null". While these are two logically separate attributes (one line versus multiline insert mode, and special treatment of untyped spaces) we have seen no terminals whose insert mode cannot be described with the single attribute.

*terminfo* can describe both terminals which have an insert mode and terminals which send a simple sequence to open a blank position on the current line. Give as **smir** the sequence to get into insert mode. Give as **rmir** the sequence to leave insert mode. Now give as **ich1** any sequence needed to be sent just before sending the character to be inserted. Most terminals with a true insert mode will not give **ich1**; terminals which send a sequence to open a screen position should give it here. (If your terminal has both, insert mode is usually preferable to **ich1**. Do not give both unless the terminal actually requires both to be used in combination.) If post-insert padding is needed, give this as a number of milliseconds padding in **ip** (a string option). Any other sequence which may need to be sent after an insert of a single character may also be given in **ip**. If your terminal needs both to be placed into an 'insert mode' and a special code to precede each inserted character, then both **smir/rmir** and **ich1** can be given, and both will be used. The **ich** capability, with one parameter, *n*, will repeat the effects of **ich1** *n* times.

If padding is necessary between characters typed while not in insert mode, give this as a number of milliseconds padding in **rmp**.

It is occasionally necessary to move around while in insert mode to delete characters on the same line (e.g., if there is a tab after the insertion position). If your terminal allows motion while in insert mode you can give the capability **mir** to speed up inserting in this case. Omitting **mir** will affect only speed. Some terminals (notably Datamedia's) must not have **mir** because of the way their insert mode works.

Finally, you can specify **dch1** to delete a single character, **dch** with one parameter, *n*, to delete *n* characters, and delete mode by giving **smdc** and **rmdc** to enter and exit delete mode (any mode the terminal needs to be placed in for **dch1** to work).

A command to erase *n* characters (equivalent to outputting *n* blanks without moving the cursor) can be given as **ech** with one parameter.

## Highlighting, Underlining, and Visible Bells

If your terminal has one or more kinds of display attributes, these can be represented in a number of different ways. You should choose one display form as *standout mode* (see *curses*(3X)), representing a good, high contrast, easy-on-the-eyes, format for highlighting error messages and other attention getters. (If you have a choice, reverse-video plus half-bright is good, or reverse-video alone; however, different users have different preferences on different terminals.) The sequences to enter and exit standout mode are given as **smso** and **rmso**, respectively. If the code to change into or out of standout mode leaves one or even two blank spaces on the screen, as the TVI 912 and Teleray 1061 do, then **xmc** should be given to tell how many spaces are left.

Codes to begin underlining and end underlining can be given as **smul** and **rmul** respectively. If the terminal has a code to underline the current character and move the cursor one space to the right, such as the Micro-Term MIME, this can be given as **uc**.

Other capabilities to enter various highlighting modes include **blink** (blinking), **bold** (bold or extra-bright), **dim** (dim or half-bright), **invis** (blanking or invisible text), **prot** (protected), **rev** (reverse-video), **sgr0** (turn off all attribute modes), **smacs** (enter alternate-character-set mode), and **rmacs** (exit alternate-character-set mode). Turning on any of these modes singly may or may not turn off other modes. If a command is necessary before alternate character set mode is entered, give the sequence in **enacs** (enable alternate-character-set mode).

If there is a sequence to set arbitrary combinations of modes, this should be given as **sgr** (set attributes), taking nine parameters. Each parameter is either **0** or non-zero, as the corresponding attribute is on or off. The nine parameters are, in order: standout, underline, reverse, blink, dim, bold, blank, protect, alternate character set. Not all modes need be supported by **sgr**, only those for which corresponding separate attribute commands exist. (See the example at the end of this section.)

Terminals with the "magic cookie" glitch (**xmc**) deposit special "cookies" when they receive mode-setting sequences, which affect the display algorithm rather than having extra bits for each character. Some terminals, such as the Hewlett-Packard 2621, automatically leave standout mode when they move to a new line or the cursor is addressed. Programs using standout mode should exit standout mode before moving the cursor or sending a newline, unless the **msgr** capability, asserting that it is safe to move in standout mode, is present.

If the terminal has a way of flashing the screen to indicate an error quietly (a bell replacement), then this can be given as **flash**; it must not move the cursor. A good flash can be done by changing the screen into reverse video, pad for 200 ms, then return the screen to normal video.

If the cursor needs to be made more visible than normal when it is not on the bottom line (to make, for example, a non-blinking underline into an easier to find block or blinking underline) give this sequence as **cvvis**. The boolean **chts** should also be given. If there is a way to make the cursor completely invisible, give that as **civis**. The capability **cnorm** should be given which undoes the effects of either of these modes.

If the terminal needs to be in a special mode when running a program that uses these capabilities, the codes to enter and exit this mode can be given as **smcup** and **rmcup**. This arises, for example, from terminals like the *Concept* with more than one page of memory. If the terminal has only memory relative cursor addressing and not screen relative cursor addressing, a one screen-sized window must be fixed into the terminal for cursor addressing to work properly. This is also used for the Tektronix 4025, where **smcup** sets the command character to be the one used by **terminfo**. If the **smcup** sequence will not restore the screen after an **rmcup** sequence is output (to the state prior to outputting **rmcup**), specify **nrrmc**.

If your terminal generates underlined characters by using the underline character (with no special codes needed) even though it does not otherwise overstrike characters, then you should give the capability **ul**. For terminals where a character overstriking another leaves both characters on the screen, give the capability **os**. If overstrikes are erasable with a blank, then this should be indicated by giving **eo**.

Example of highlighting: assume that the terminal under question needs the following escape sequences to turn on various modes.

| tparm parameter | attribute | escape sequence |
|---|---|---|
| | none | \E[0m |
| p1 | standout | \E[0;4;7m |
| p2 | underline | \E[0;3m |
| p3 | reverse | \E[0;4m |
| p4 | blink | \E[0;5m |
| p5 | dim | \E[0;7m |
| p6 | bold | \E[0;3;4m |
| p7 | invis | \E[0;8m |
| p8 | protect | not available |
| p9 | altcharset | ^O (off) ^N(on) |

Note that each escape sequence requires a **0** to turn off other modes before turning on its own mode. Also note that, as suggested above, *standout* is set up to be the combination of *reverse* and *dim*. Also, since this terminal has no *bold* mode, *bold* is set up as the combination of *reverse* and *underline*. In addition, to allow combinations, such as *underline+blink*, the sequence to use would be **\E[0;3;5m**. The terminal doesn't have *protect* mode, either, but that cannot be simulated in any way, so **p8** is ignored. The *altcharset* mode is different in that it is either **^O** or **^N** depending on whether it is off or on. If all modes were to be turned on, the sequence would be **\E[0;3;4;5;7;8m^N**.

Now look at when different sequences are output. For example, **;3** is output when either **p2** or **p6** is true, that is, if either *underline* or *bold* modes are turned on. Writing out the above sequences, along with their dependencies, gives the following:

| sequence | when to output | terminfo translation |
|---|---|---|
| \E[0 | always | \E[0 |
| ;3 | if p2 or p6 | %?%p2%p6%\|%t;3%; |
| ;4 | if p1 or p3 or p6 | %?%p1%p3%\|%p6%\|%t;4%; |
| ;5 | if p4 | %?%p4%t;5%; |
| ;7 | if p1 or p5 | %?%p1%p5%\|%t;7%; |
| ;8 | if p7 | %?%p7%t;8%; |
| m | always | m |
| ^N or ^O | if p9 ^N, else ^O | %?%p9%t^N%e^O%; |

Putting this all together into the **sgr** sequence gives:

```
sgr=\E[0%?%p2%p6%|%t;3%;%?%p1%p3%|%p6%|%t;4%;%?%p5%t;5%;%?%p1%p5%
        |%t;7%;%?%p7%t;8%;m%?%p9%t^N%e^O%;,
```

## Keypad

If the terminal has a keypad that transmits codes when the keys are pressed, this information can be given. Note that it is not possible to handle terminals where the keypad only works in local (this applies, for example, to the unshifted Hewlett-Packard 2621 keys). If the keypad can be set to transmit or not transmit, give these codes as **smkx** and **rmkx**. Otherwise the keypad is assumed to always transmit.

The codes sent by the left arrow, right arrow, up arrow, down arrow, and home keys can be given as **kcub1, kcuf1, kcuu1, kcud1,** and **khome** respectively. If there are function keys such as f0, f1, ..., f63, the codes they send can be given as **kf0, kf1, ..., kf63**. If the first 11 keys have labels other than the default f0 through f10, the labels can be given as **lf0, lf1, ..., lf10**. The codes transmitted by certain other special keys can be given: **kll** (home down), **kbs** (backspace), **ktbc** (clear all tabs), **kctab** (clear the tab stop in this column), **kclr** (clear screen or erase key), **kdch1** (delete character), **kdl1** (delete line), **krmir** (exit insert mode), **kel** (clear to end of line), **ked** (clear to end of screen), **kich1** (insert character or enter insert mode), **kil1** (insert line), **knp** (next page), **kpp** (previous page), **kind** (scroll forward/down), **kri** (scroll backward/up), **khts** (set a tab stop in this column). In addition, if the keypad has a 3 by 3 array of keys including the four arrow keys, the other five keys can be given as **ka1**, **ka3**, **kb2**, **kc1**, and **kc3**. These keys are useful when the effects of a 3 by 3 directional pad are needed. Further keys are defined above in the capabilities list.

Strings to program function keys can be given as **pfkey**, **pfloc**, and **pfx**. A string to program their soft-screen labels can be given as **pln**. Each of these strings takes two parameters: the function key number to program (from 0 to 10) and the string to program it with. Function key numbers out of this range may program undefined keys in a terminal-dependent manner. The difference between the capabilities is that **pfkey** causes pressing the given key to be the same as the user typing the given string; **pfloc** causes the string to be executed by the terminal in local mode; and **pfx** causes the string to be transmitted to the computer. The capabilities **nlab**, **lw** and **lh** define how many soft labels there are and their width and height. If there are commands to turn the labels on and off, give them in **smln** and **rmln**. **smln** is normally output after one or more **pln** sequences to make sure that the change becomes visible.

## Tabs and Initialization

If the terminal has hardware tabs, the command to advance to the next tab stop can be given as **ht** (usually control I). A "backtab" command which moves leftward to the next tab stop can be given as **cbt**. By convention, if the teletype modes indicate that tabs are being expanded by the computer rather than being sent to the terminal, programs should not use **ht** or **cbt** even if they are present, since the user may not have the tab stops properly set. If the terminal has hardware tabs which are initially set every *n* spaces when the terminal is powered up, the numeric parameter **it** is given, showing the number of spaces the tabs are set to. This is normally used by **tput init** (see *tput*(1)) to determine whether to set the mode for hardware tab expansion and whether to set the tab stops. If the terminal has tab stops that can be saved in nonvolatile memory, the *terminfo* description can assume that they are properly set. If there are commands to set and clear tab stops, they can be given as **tbc** (clear all tab stops) and **hts** (set a tab stop in the current column of every row).

Other capabilities include: **is1**, **is2**, and **is3**, initialization strings for the terminal; **iprog**, the path name of a program to be run to initialize the terminal; and **if**, the name of a file containing long initialization strings. These strings are expected to set the terminal into modes consistent with the rest of the *terminfo* description. They must be sent to the terminal each time the user logs in and be output in the following order: run the program **iprog**; output **is1**; output **is2**; set the margins using **mgc**, **smgl** and **smgr**; set the tabs using **tbc** and **hts**; print the file **if**; and finally output **is3**. This is usually done using the **init** option of *tput*(1); see *profile*(4).

Most initialization is done with **is2**. Special terminal modes can be set up without duplicating strings by putting the common sequences in **is2** and special cases in **is1** and **is3**. Sequences that do a harder reset from a totally unknown state can be given as **rs1**, **rs2**, **rf**, and **rs3**, analogous to **is1**, **is2**, **is3**, and **if**. (The method using files, **if** and **rf**, is used for a few terminals, from */usr/lib/tabset/**; however, the recommended method is to use the initialization and reset strings.) These strings are output by **tput reset**, which is used when the terminal gets into a wedged state. Commands are normally placed in **rs1**, **rs2**, **rs3**, and **rf** only if they produce annoying effects on the screen and are not necessary when logging in. For example, the command to set a terminal into 80-column mode would normally be part of **is2**, but on some terminals it causes an annoying glitch on the screen and is not normally needed since the terminal is usually already in 80-column mode.

If a more complex sequence is needed to set the tabs than can be described by using **tbc** and **hts**, the sequence can be placed in **is2** or **if**.

If there are commands to set and clear margins, they can be given as **mgc** (clear all margins), **smgl** (set left margin), and **smgr** (set right margin).

## Delays

Certain capabilities control padding in the *tty*(7) driver. These are primarily needed by hard-copy terminals, and are used by **tput init** to set tty modes appropriately. Delays embedded in the capabilities **cr**, **ind**, **cub1**, **ff**, and **tab** can be used to set the appropriate delay bits to be set in the tty driver. If **pb** (padding baud rate) is given, these values can be ignored at baud rates below the value of **pb**.

## Status Lines

If the terminal has an extra "status line" that is not normally used by software, this fact can be indicated. If the status line is viewed as an extra line below the bottom line, into which one can cursor address normally (such as the Heathkit h19's 25th line, or the 24th line of a VT100 which is set to a 23-line scrolling region), the capability **hs** should be given. Special strings that go to a given column of the status line and return from the status line can be given as **tsl** and **fsl**. (**fsl** must leave the cursor position in the same place it was before **tsl**. If necessary, the **sc** and **rc** strings can be included in **tsl** and **fsl** to get this effect.) The capability **tsl** takes one parameter, which is the column number of the status line the cursor is to be moved to.

If escape sequences and other special commands, such as tab, work while in the status line, the flag **eslok** can be given. A string which turns off the status line (or otherwise erases its contents) should be given as **dsl**. If the terminal has commands to save and restore the position of the cursor, give them as **sc** and **rc**. The status line is normally assumed to be the same width as the rest of the screen, e.g., **cols**. If the status line is a different width (possibly because the terminal does not allow an entire line to be loaded) the width, in columns, can be indicated with the numeric parameter **wsl**.

## Line Graphics

If the terminal has a line drawing alternate character set, the mapping of glyph to character would be given in **acsc**. The definition of this string is based on the alternate character set used in the DEC VT100 terminal, extended slightly with some characters from the AT&T 4410v1 terminal.

| glyph name | vt100+ character |
|---|---|
| arrow pointing right | + |
| arrow pointing left | , |
| arrow pointing down | . |
| solid square block | 0 |
| lantern symbol | I |
| arrow pointing up | − |
| diamond | ` |
| checker board (stipple) | a |
| degree symbol | f |
| plus/minus | g |
| board of squares | h |
| lower right corner | j |
| upper right corner | k |
| upper left corner | l |
| lower left corner | m |
| plus | n |
| scan line 1 | o |
| horizontal line | q |
| scan line 9 | s |
| left tee (├) | t |
| right tee (┤) | u |
| bottom tee (⊥) | v |
| top tee (⊤) | w |
| vertical line | x |
| bullet | ~ |

The best way to describe a new terminal's line graphics set is to add a third column to the above table with the characters for the new terminal that produce the appropriate glyph when the terminal is in the alternate character set mode. For example,

| glyph name | vt100+ char | new tty char |
|---|---|---|
| upper left corner | l | R |
| lower left corner | m | F |
| upper right corner | k | T |
| lower right corner | j | G |
| horizontal line | q | , |
| vertical line | x | . |

Now write down the characters left to right, as in "**acsc**=lRmFkTjGq\,x.".

## Miscellaneous

If the terminal requires other than a null (zero) character as a pad, then this can be given as **pad**. Only the first character of the **pad** string is used. If the terminal does not have a pad character, specify **npc**.

If the terminal can move up or down half a line, this can be indicated with **hu** (half-line up) and **hd** (half-line down). This is primarily useful for superscripts and subscripts on hardcopy terminals. If a hardcopy terminal can eject to the next page (form feed), give this as **ff** (usually control L).

If there is a command to repeat a given character a given number of times (to save time transmitting a large number of identical characters) this can be indicated with the parameterized string **rep**. The first parameter is the character to be repeated and the second is the number of times to repeat it. Thus, **tparm(repeat_char, 'x', 10)** is the same as **xxxxxxxxxx.**

If the terminal has a settable command character, such as the Tektronix 4025, this can be indicated with **cmdch**. A prototype command character is chosen which is used in all capabilities. This character is given in the **cmdch** capability to identify it. The following convention is supported on some UNIX systems: If the environment variable **CC** exists, all occurrences of the prototype character are replaced with the character in **CC**.

Terminal descriptions that do not represent a specific kind of known terminal, such as **switch**, **dialup**, **patch**, and **network**, should include the **gn** (generic) capability so that programs can complain that they do not know how to talk to the terminal. (This capability does not apply to **virtual** terminal descriptions for which the escape sequences are known.) If the terminal is one of those supported by the UNIX system virtual terminal protocol, the terminal number can be given as **vt**. A line-turn-around sequence to be transmitted before doing reads should be specified in **rfi**.

If the terminal uses xon/xoff handshaking for flow control, give **xon**. Padding information should still be included so that routines can make better decisions about costs, but actual pad characters will not be transmitted. Sequences to turn on and off xon/xoff handshaking may be given in **smxon** and **rmxon**. If the characters used for handshaking are not **^S** and **^Q**, they may be specified with **xonc** and **xoffc**.

If the terminal has a "meta key" which acts as a shift key, setting the 8th bit of any character transmitted, this fact can be indicated with **km**. Otherwise, software will assume that the 8th bit is parity and it will usually be cleared. If strings exist to turn this "meta mode" on and off, they can be given as **smm** and **rmm**.

If the terminal has more lines of memory than will fit on the screen at once, the number of lines of memory can be indicated with **lm**. A value of **lm**#0 indicates that the number of lines is not fixed, but that there is still more memory than fits on the screen.

Media copy strings which control an auxiliary printer connected to the terminal can be given as **mc0**: print the contents of the screen, **mc4**: turn off the printer, and **mc5**: turn on the printer. When the printer is on, all text sent to the terminal will be sent to the printer. A variation, **mc5p**, takes one parameter, and leaves printer on for as many characters as the value of the parameter, then turns the printer off. The parameter should not exceed 255. If the text is not displayed on the terminal screen when the printer is on, specify **mc5i** (silent printer). All text, including **mc4**, is transparently passed to the printer while an **mc5p** is in effect.

## Special Cases

The working model used by *terminfo* fits most terminals reasonably well. However, some terminals do not completely match that model, requiring special support by *terminfo*. These are not meant to be construed as deficiencies in the terminals; they are just differences between the working model and the actual hardware. They may be unusual devices or, for some reason, do not have all the features of the *terminfo* model implemented.

Terminals which can not display tilde (~) characters, such as certain Hazeltine terminals, should indicate **hz**.

Terminals which ignore a linefeed immediately after an **am** wrap, such as the *Concept* 100, should indicate **xenl**. Those terminals whose cursor remains on the right-most column until another character has been received, rather than wrapping immediately upon receiving the right-most character, such as the VT100, should also indicate **xenl**.

If **el** is required to get rid of standout (instead of writing normal text on top of it), **xhp** should be given.

Those Teleray terminals whose tabs turn all characters moved over to blanks, should indicate **xt** (destructive tabs). This capability is also taken to mean that it is not possible to position the cursor on top of a "magic cookie" therefore, to erase standout mode, it is instead necessary to use delete and insert line.

Those Beehive Superbee terminals which do not transmit the escape or control−C characters, should specify **xsb**, indicating that the f1 key is to be used for escape and the f2 key for control−C.

## Similar Terminals

If there are two very similar terminals, one can be defined as being just like the other with certain exceptions. The string capability **use** can be given with the name of the similar terminal. The capabilities given before **use** override those in the terminal type invoked by **use**. A capability can be canceled by placing *xx*@ to the left of the capability definition, where *xx* is the capability. For example, the entry

```
att4424-2¦Teletype 4424  in  display  function
group ii,
                rev@, sgr@, smul@, use=att4424,
```

defines an AT&T 4424 terminal that does not have the **rev**, **sgr**, and **smul** capabilities, and hence cannot do highlighting. This is useful for different modes for a terminal, or for different user preferences. More than one **use** capability may be given.

## FILES

| | |
|---|---|
| /usr/lib/terminfo/?/* | compiled terminal description database |
| /usr/lib/.COREterm/?/* | subset of compiled terminal description database |
| /usr/lib/tabset/* | tab settings for some terminals, in a format appropriate to be output to the terminal (escape sequences that set margins and tabs) |

## SEE ALSO

curses(3X), printf(3S), term(5).
captoinfo(1M), infocmp(1M), tic(1M), tty(7) in the *System Administrator's Reference Manual .*
tput(1) in the *User's Reference Manual.*
Chapter 10 of the *Programmer's Guide.*

## WARNING

As described in the "Tabs and Initialization" section above, a terminal's initialization strings, **is1**, **is2**, and **is3**, if defined, must be output before a *curses*(3X) program is run. An available mechanism for outputting such strings is **tput init** (see *tput*(1) and *profile*(4)).

Tampering with entries in */usr/lib/.COREterm/?/** or */usr/lib/terminfo/?/** (for example, changing or removing an entry) can affect programs such as *vi*(1) that expect the entry to be present and correct. In particular, removing the description for the "dumb" terminal will cause unexpected problems.

## NOTE

The *termcap* database (from earlier releases of UNIX System V) may not be supplied in future releases.

## 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), profile(4).
rc2(1M) in the *System Administrator's Reference Manual.*

## NAME

unistd – file header for symbolic constants

## SYNOPSIS

**#include <unistd.h>**

## DESCRIPTION

The header file *<unistd.h>* lists the symbolic constants and structures not already defined or declared in some other header file.

```
/* Symbolic constants for the "access" routine: */

#define R_OK        4       /*Test for Read permission */
#define W_OK        2       /*Test for Write permission */
#define X_OK        1       /*Test for eXecute permission */
#define F_OK        0       /*Test for existence of File */

#define F_ULOCK     0       /*Unlock a previously locked region */
#define F_LOCK      1       /*Lock a region for exclusive use */
#define F_TLOCK     2       /*Test and lock a region for exclusive use */
#define F_TEST      3       /*Test a region for other processes locks */

/*Symbolic constants for the "lseek" routine: */

#define SEEK_SET    0       /* Set file pointer to "offset" */
#define SEEK_CUR    1       /* Set file pointer to current plus "offset" */
#define SEEK_END    2       /* Set file pointer to EOF plus "offset" */

/*Pathnames:*/

#define GF_PATH     /etc/group /*Pathname of the group file */
#define PF_PATH     /etc/passwd/*Pathname of the passwd file */
```

## NAME

utmp, wtmp – utmp and wtmp entry formats

## SYNOPSIS

**#include <sys/types.h>**
**#include <utmp.h>**

## DESCRIPTION

These files, which hold user and accounting information for such commands as *who*(1), *write*(1), and *login*(1), have the following structure as defined by **<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];            /* /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 {
         short     e_termination;    /* Process termination status */
         short     e_exit;           /* Process exit status */
      } ut_exit;                     /* The 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      /* Largest 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 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

getut(3C).
login(1), who(1), write(1) in the *User's Reference Manual.*

## NAME

intro − introduction to miscellany

## DESCRIPTION

This section describes miscellaneous facilities such as macro packages, character set tables, etc.

## 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 |

## NAME

environ − user environment

## DESCRIPTION

An array of strings called the "environment" is made available by *exec*(2) when a process begins. By convention, these strings have the form "name=value". The following names are used by various commands:

| | |
|---|---|
| **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**. |
| **HOME** | Name of the user's login directory, set by *login*(1) from the password file *passwd*(4). |
| **TERM** | The kind of terminal for which output is to be prepared. This information is used by commands, such as *mm*(1) or *tplot*(1G), which may exploit special capabilities of that terminal. |
| **TZ** | Time zone information. The format is **xxx***n***zzz** where **xxx** is standard local time zone abbreviation, *n* is the difference in hours from GMT, and **zzz** is the abbreviation for the daylight-saving local time zone, if any; for example, **EST5EDT**. |

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 ALSO

exec(2).
env(1), login(1), sh(1), nice(1), nohup(1), time(1), tplot(1G) in the *User's Reference Manual.*
mm(1) in the *DOCUMENTER'S WORKBENCH Software Release 2.0 Technical Discussion and Reference Manual.*

## NAME

fcntl − file control options

## SYNOPSIS

**#include <fcntl.h>**

## DESCRIPTION

The *fcntl*(2) function provides for control over open files. This include file describes *requests* and *arguments* to *fcntl* and *open*(2).

```
/* Flag values accessible to open(2) and fcntl(2) */
/* (The first three can only be set by open) */
#define O_RDONLY 0
#define O_WRONLY 1
#define O_RDWR   2
#define O_NDELAY 04       /* Non-blocking I/O */
#define O_APPEND 010      /* append (writes guaranteed at the end) */
#define O_SYNC   020      /* synchronous write option */

/* Flag values accessible only to open(2) */
#define O_CREAT  00400    /* open with file create (uses third open arg)*/
#define O_TRUNC  01000    /* open with truncation */
#define O_EXCL   02000    /* exclusive open */

/* fcntl(2) requests */
#define F_DUPFD   0       /* Duplicate fildes */
#define F_GETFD   1       /* Get fildes flags */
#define F_SETFD   2       /* Set fildes flags */
#define F_GETFL   3       /* Get file flags */
#define F_SETFL   4       /* Set file flags */
#define F_GETLK   5       /* Get file lock */
#define F_SETLK   6       /* Set file lock */
#define F_SETLKW  7       /* Set file lock and wait */
#define F_CHKFL   8       /* Check legality of file flag changes */

/* file segment locking control structure */
struct flock {
        short l_type;
        short l_whence;
        long  l_start;
        long  l_len;      /* if 0 then until EOF */
        short l_sysid;    /* returned with F_GETLK*/
        short l_pid;      /* returned with F_GETLK*/
}

/* file segment locking types */
#define F_RDLCK 01    /* Read lock */
#define F_WRLCK 02    /* Write lock */
#define F_UNLCK 03    /* Remove locks */
```

## SEE ALSO

fcntl(2), open(2).

## NAME

jagent – host control of windowing terminal

## SYNOPSIS

**#include <sys/jioctl.h>**

**ioctl (cntlfd, JAGENT, &arg)**

**int cntlfd**
**struct bagent arg**

## DESCRIPTION

The *ioctl*(2) 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*(7) *ioctl*(2) 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 which 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*(2) is called, the *size* argument must be set to the length of the *src* string. Upon return, *size* is set by *ioctl*(2) to the length of the destination byte string, *dest*.

## RETURN VALUE

Upon successful completion, the size of the destination byte string is returned. If an error occurs, **–1** is returned.

## SEE ALSO

ioctl(2), layers(5), libwindows(3X).
xt(7) in the *System Administrator's Reference Manual.*

## NAME

layers – protocol used between host and windowing terminal under *layers*(1)

## SYNOPSIS

**#include <sys/jioctl.h>**

## DESCRIPTION

*layers* are asynchronous windows supported by the operating system in a windowing terminal. Communication between the UNIX system processes and terminal processes under *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 is 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 *timeout* and *jagent* information which take 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.

**JTIMO** Set the timeout parameters for the protocol. The data consist of two bytes: the value of the receive timeout in seconds, and the value of the transmit timeout in seconds.

**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"). |

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 is no data for this command. |
| **C_DELETE** | Delete the UNIX system process group attached to this layer. There is no data for this command. |
| **C_EXIT** | Exit. Kill all UNIX system process groups associated with this terminal and terminate the session. There is 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 is 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 takes the same form as for the **C_NEW** command. |

## SEE ALSO

libwindows(3X), jagent(5), xtproto(5).
layers(1) in the *User's Reference Manual.*
xt(7) in the *System Administrator's Reference Manual.*

## 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 an 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 | $\pi$, 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 | $2/\cdot\pi$. |
| M_SQRT2 | The positive square root of 2. |
| M_SQRT1_2 | The positive square root of $1/2$. |

For the definitions of various machine-dependent "constants," see the description of the *<values.h>* header file.

## 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* will introduce a mark called *name* that will be treated the same as a function entry point. Execution of the mark will add to a counter for that mark, and program-counter time spent will be 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 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. This may be defined by a preprocessor directive as in the synopsis, or by a command line argument, i.e:

```
cc –p –DMARK foo.c
```

If MARK is not defined, the *MARK*(name) statements may be left in the source files containing them and will be ignored.

## 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 − regular expression compile and match routines

## SYNOPSIS

**#define** INIT <declarations>
**#define** GETC() <getc code>
**#define** PEEKC() <peekc code>
**#define** UNGETC(c) <ungetc code>
**#define** RETURN(pointer) <return code>
**#define** ERROR(val) <error code>

**#include <regexp.h>**

**char *compile (instring, expbuf, endbuf, eof)**
**char *instring, *expbuf, *endbuf;**
**int eof;**

**int step (string, expbuf)**
**char *string, *expbuf;**

**extern char *loc1, *loc2, *locs;**

**extern int circf, sed, nbra;**

## DESCRIPTION

This page describes general-purpose regular expression matching routines in the form of *ed*(1), defined in **<regexp.h>** . Programs such as *ed*(1), *sed*(1), *grep*(1), *bs*(1), *expr*(1), etc., which perform regular expression matching use this source file. In this way, only this file need be changed to maintain regular expression compatibility.

The interface to this file is unpleasantly complex. Programs that include this file must have the following five macros declared before the "#include <regexp.h>" statement. These macros are used by the *compile* routine.

| | |
|---|---|
| GETC() | Return the value of the next character in the regular expression pattern. Successive calls to GETC() should return successive characters of the regular expression. |
| PEEKC() | Return the next character in the regular expression. Successive calls to PEEKC() should return the same character [which should also be the next character returned by GETC()]. |
| UNGETC(*c*) | Cause the argument *c* to be returned by the next call to GETC() [and PEEKC()]. No more that one character of pushback is ever needed and this character is guaranteed to be the last character read by GETC(). The value of the macro UNGETC(*c*) is always ignored. |
| RETURN(*pointer*) | This macro is used on normal exit of the *compile* routine. The value of the argument *pointer* 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 is the abnormal return from the *compile* routine. The argument *val* is an error number (see table below for meanings). This call should never return.

| 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 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. For example, in *ed*(1), this character is usually a /.

Each program that includes this file must have a **#define** statement for INIT. This definition will be placed right after the declaration for the function *compile* and the opening curly brace ({). It is used for dependent declarations and initializations. Most often it is used to set a register variable to point 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 the example below of the declarations taken from *grep*(1).

There are other functions in this file which perform actual regular expression matching, one of which is the function *step*. 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 second parameter *expbuf* is the compiled regular expression which was 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*. This is a pointer to the first character that matched the regular expression. The variable *loc2*, which is set by the function *advance*, points to the character after the last character that matches the regular expression. Thus if the regular expression matches the entire line, *loc1* will point to the first character of *string* and *loc2* will point to the null at the end of *string*.

*Step* uses the external variable *circf* which is set by *compile* if the regular expression begins with ^. If this is set then *step* will try to match the regular expression to the beginning of the string only. If more than one regular expression is to be compiled before the first is executed the value of *circf* should be saved for each compiled expression and *circf* should be set to that saved value before each call to *step*.

The function *advance* is called from *step* with the same arguments as *step*. The purpose of *step* is to step through the *string* argument and call *advance* until *advance* returns non-zero indicating a match or until the end of *string* is reached. If one wants to constrain *string* to the beginning of the line in all cases, *step* need not be called; simply call *advance*.

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. This is used by *ed*(1) and *sed*(1) for substitutions done globally (not just the first occurrence, but the whole line) so, for example, expressions like **s/y*//g** do not loop forever.

The additional external variables *sed* and *nbra* are used for special purposes.

## EXAMPLES

The following is an example of how the regular expression macros and calls look from *grep*(1):

```
#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();
```

SEE ALSO

ed(1), expr(1), grep(1), sed(1) in the *User's Reference Manual.*

## 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 whose structure is defined by this include file. The encoding of the field *st_mode* is defined in this file also.

Structure of the result of stat

```
struct   stat
{
         dev_t     st_dev;
         ushort    st_ino;
         ushort    st_mode;
         short     st_nlink;
         ushort    st_uid;
         ushort    st_gid;
         dev_t     st_rdev;
         off_t     st_size;
         time_t    st_atime;
         time_t    st_mtime;
         time_t    st_ctime;
};

#define S_IFMT   0170000 /* type of file */
#define S_IFDIR  0040000 /* directory */
#define S_IFCHR  0020000 /* character special */
#define S_IFBLK  0060000 /* block special */
#define S_IFREG  0100000 /* regular */
#define S_IFIFO  0010000 /* fifo */
#define S_ISUID  04000   /* set user id on execution */
#define S_ISGID  02000   /* set group id on execution */
#define S_ISVTX  01000   /* save swapped text even after use */
#define S_IREAD  00400   /* read permission, owner */
#define S_IWRITE 00200   /* write permission, owner */
#define S_IEXEC  00100   /* execute/search permission, owner */
#define S_ENFMT  S_ISGID /* record locking enforcement flag */
#define S_IRWXU  00700   /* read,write, execute: owner */
#define S_IRUSR  00400   /* read permission: owner */
#define S_IWUSR  00200   /* write permission: owner */
#define S_IXUSR  00100   /* execute permission: owner */
#define S_IRWXG  00070   /* read, write, execute: group */
#define S_IRGRP  00040   /* read permission: group */
#define S_IWGRP  00020   /* write permission: group */
#define S_IXGRP  00010   /* execute permission: group */
#define S_IRWXO  00007   /* read, write, execute: other */
#define S_IROTH  00004   /* read permission: other */
```

```
        #define S_IWOTH 00002    /* write permission: other */
        #define S_IXOTH 00001    /* execute permission: other */
```

SEE ALSO

stat(2), types(5).

## NAME

term – conventional names for terminals

## DESCRIPTION

These names are used by certain commands (e.g., *man*(1), *tabs*(1), *tput*(1), *vi*(1) and *curses*(3X)) and are maintained as part of the shell environment in the environment variable **TERM** (see *sh*(1), *profile*(4), and *environ*(5)).

Entries in *terminfo*(4) source files consist of a number of comma-separated fields. (To obtain the source description for a terminal, use the **–I** option of *infocmp*(1M).) White space after each comma is ignored. The first line of each terminal description in the *terminfo*(4) database gives the names by which *terminfo*(4) knows the terminal, separated by bar ( | ) characters. The first name given is the most common abbreviation for the terminal (this is the one to use to set the environment variable **TERMINFO** in *$HOME/.profile;* see *profile*(4)), the last name given should be a long name fully identifying the terminal, and all others are understood as synonyms for the terminal name. All names but the last should contain no blanks and must be unique in the first 14 characters; the last name may contain blanks for readability.

Terminal names (except for the last, verbose entry) should be chosen using the following conventions. The particular piece of hardware making up the terminal should have a root name chosen, for example, for the AT&T 4425 terminal, **att4425**. This name should not contain hyphens, except that synonyms may be chosen that do not conflict with other names. Up to 8 characters, chosen from [a–z0–9], make up a basic terminal name. Names should generally be based on original vendors, rather than local distributors. A terminal acquired from one vendor should not have more than one distinct basic name. Terminal submodels, operational modes that the hardware can be in, or user preferences, should be indicated by appending a hyphen and an indicator of the mode. Thus, an AT&T 4425 terminal in 132 column mode would be **att4425–w**. The following suffixes should be used where possible:

| **Suffix** | **Meaning** | **Example** |
|---|---|---|
| **–w** | Wide mode (more than 80 columns) | att4425–w |
| **–am** | With auto. margins (usually default) | vt100–am |
| **–nam** | Without automatic margins | vt100–nam |
| –n | Number of lines on the screen | aaa–60 |
| **–na** | No arrow keys (leave them in local) | c100–na |
| **–np** | Number of pages of memory | c100–4p |
| **–rv** | Reverse video | att4415–rv |

To avoid conflicts with the naming conventions used in describing the different modes of a terminal (e.g., **–w**), it is recommended that a terminal's root name not contain hyphens. Further, it is good practice to make all terminal names used in the *terminfo*(4) database unique. Terminal entries that are present only for inclusion in other entries via the **use=** facilities should have a '+' in their name, as in **4415+nl**.

Some of the known terminal names may include the following (for a complete list, type: **ls -C /usr/lib/terminfo/?**):

| | |
|---|---|
| 2621,hp2621 | Hewlett-Packard 2621 series |
| 2631 | Hewlett-Packard 2631 line printer |
| 2631−c | Hewlett-Packard 2631 line printer - compressed mode |
| 2631−e | Hewlett-Packard 2631 line printer - expanded mode |
| 2640,hp2640 | Hewlett-Packard 2640 series |
| 2645,hp2645 | Hewlett-Packard 2645 series |
| 3270 | IBM Model 3270 |
| 33,tty33 | AT&T Teletype Model 33 KSR |
| 35,tty35 | AT&T Teletype Model 35 KSR |
| 37,tty37 | AT&T Teletype Model 37 KSR |
| 4000a | Trendata 4000a |
| 4014,tek4014 | TEKTRONIX 4014 |
| 40,tty40 | AT&T Teletype Dataspeed 40/2 |
| 43,tty43 | AT&T Teletype Model 43 KSR |
| 4410,5410 | AT&T 4410/5410 terminal in 80-column mode - version 2 |
| 4410−nfk,5410−nfk | AT&T 4410/5410 without function keys - version 1 |
| 4410−nsl,5410−nsl | AT&T 4410/5410 without pln defined |
| 4410−w,5410−w | AT&T 4410/5410 in 132-column mode |
| 4410v1,5410v1 | AT&T 4410/5410 terminal in 80-column mode - version 1 |
| 4410v1−w,5410v1−w | AT&T 4410/5410 terminal in 132-column mode - version 1 |
| 4415,5420 | AT&T 4415/5420 in 80-column mode |
| 4415−nl,5420−nl | AT&T 4415/5420 without changing labels |
| 4415−rv,5420−rv | AT&T 4415/5420 80 columns in reverse video |
| 4415−rv−nl,5420−rv−nl | AT&T 4415/5420 reverse video without changing labels |
| 4415−w,5420−w | AT&T 4415/5420 in 132-column mode |
| 4415−w−nl,5420−w−nl | AT&T 4415/5420 in 132-column mode without changing labels |
| 4415−w−rv,5420−w−rv | AT&T 4415/5420 132 columns in reverse video |
| 4415−w−rv−nl,5420−w−rv−nl | AT&T 4415/5420 132 columns reverse video without changing labels |
| 4418,5418 | AT&T 5418 in 80-column mode |
| 4418−w,5418−w | AT&T 5418 in 132-column mode |
| 4420 | AT&T Teletype Model 4420 |
| 4424 | AT&T Teletype Model 4424 |
| 4424-2 | AT&T Teletype Model 4424 in display function group ii |
| 4425,5425 | AT&T 4425/5425 |
| 4425−fk,5425−fk | AT&T 4425/5425 without function keys |
| 4425−nl,5425−nl | AT&T 4425/5425 without changing labels in 80-column mode |
| 4425−w,5425−w | AT&T 4425/5425 in 132-column mode |
| 4425−w−fk,5425−w−fk | AT&T 4425/5425 without function keys in 132-column mode |
| 4425−nl−w,5425−nl−w | AT&T 4425/5425 without changing labels in 132-column mode |
| 4426 | AT&T Teletype Model 4426S |
| 450 | DASI 450 (same as Diablo 1620) |
| 450−12 | DASI 450 in 12-pitch mode |
| 500,att500 | AT&T-IS 500 terminal |
| 510,510a | AT&T 510/510a in 80-column mode |

| | |
|---|---|
| 513bct,att513 | AT&T 513 bct terminal |
| 5320 | AT&T 5320 hardcopy terminal |
| 5420_2 | AT&T 5420 model 2 in 80-column mode |
| 5420_2−w | AT&T 5420 model 2 in 132-column mode |
| 5620,dmd | AT&T 5620 terminal 88 columns |
| 5620−24,dmd−24 | AT&T Teletype Model DMD 5620 in a 24x80 layer |
| 5620−34,dmd−34 | AT&T Teletype Model DMD 5620 in a 34x80 layer |
| 610,610bct | AT&T 610 bct terminal in 80-column mode |
| 610−w,610bct−w | AT&T 610 bct terminal in 132-column mode |
| 7300,pc7300,unix_pc | AT&T UNIX PC Model 7300 |
| 735,ti | Texas Instruments TI735 and TI725 |
| 745 | Texas Instruments TI745 |
| dumb | generic name for terminals that lack reverse line-feed and other special escape sequences |
| hp | Hewlett-Packard (same as 2645) |
| lp | generic name for a line printer |
| pt505 | AT&T Personal Terminal 505 (22 lines) |
| pt505−24 | AT&T Personal Terminal 505 (24-line mode) |
| sync | generic name for synchronous Teletype Model 4540-compatible terminals |

Commands whose behavior depends on the type of terminal should accept arguments of the form **−T***term* where *term* is one of the names given above; if no such argument is present, such commands should obtain the terminal type from the environment variable **TERM**, which, in turn, should contain *term*.

FILES

/usr/lib/terminfo/?/* compiled terminal description database

SEE ALSO

curses(3X), profile(4), terminfo(4), environ(5).
man(1), sh(1), stty(1), tabs(1), tput(1), tplot(1G), vi(1) in the *User's Reference Manual.*
infocmp(1M) in the *System Administrator's Reference Manual.*
Chapter 10 of the *Programmer's Guide.*

NOTES

Not all programs follow the above naming conventions.

## NAME

types — primitive system data types

## SYNOPSIS

**#include <sys/types.h>**

## DESCRIPTION

The data types defined in the include file are used in UNIX system code; some data of these types are accessible to user code:

```
typedef  struct { int r[1]; } *physadr;
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  short            cnt_t;
typedef  long             time_t;
typedef  int              label_t[10];
typedef  short            dev_t;
typedef  long             off_t;
typedef  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;
```

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 GMT, 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.

## SEE ALSO

fs(4).

## 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 (in most implementations, 0x8000). |
| HIBITL | The value of a long integer with only the high-order bit set (in most implementations, 0x80000000). |
| HIBITI | The value of a regular integer with only the high-order bit set (usually the same as HIBITS or HIBITL). |
| MAXSHORT | The maximum value of a signed short integer (in most implementations, 0x7FFF ≡ 32767). |
| MAXLONG | The maximum value of a signed long integer (in most implementations, 0x7FFFFFFF ≡ 2147483647). |
| MAXINT | The maximum value of a signed regular integer (usually the same as MAXSHORT or MAXLONG). |
| 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**

**void va_start(pvar)**
**va_list pvar;**

*type* **va_arg(pvar,** *type***)**
**va_list pvar;**

**void va_end(pvar)**
**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 nonportable, 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* ... *va_end*, are possible.

## EXAMPLE

This example is a possible implementation of *execl*(2).

```
#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];
        int argno = 0;
```

```
                va_start(ap);
                file = va_arg(ap, char *);
                while ((args[argno++] = va_arg(ap, char *)) != (char *)0)
                        ;
                va_end(ap);
                return execv(file, args);
        }
```

SEE ALSO

exec(2), printf(3S), vprintf(3S).

NOTES

It is up to the calling routine to specify how many arguments there are, since it is not always possible to determine this 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.

## NAME

xtproto – multiplexed channels protocol used by **xt**(7) driver

## DESCRIPTION

The *xt*(7) driver contains routines which implement a multiplexed, multi-buffered, full-duplex protocol with guaranteed delivery of ordered data via an 8-bit byte data stream. This protocol is used for communication between multiple UNIX system host processes and an AT&T windowing terminal operating under *layers*(1).

The protocol uses packets with a 2-byte header containing a 3-bit sequence number, 3-bit channel number, control flag, and data size. The data part of a packet may not be larger than 32 bytes. The trailer contains a CRC-16 code in 2 bytes. Each channel is double-buffered.

Correctly received 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 will cause the retransmission in sequence of all unacknowledged packets.

Unacknowledged packets are retransmitted after a timeout interval which is dependent on baud rate. Another timeout parameter specifies the interval after which incomplete receive packets are discarded.

## FILES

| | |
|---|---|
| /usr/include/sys/xtproto.h | channel multiplexing protocol definitions |

## SEE ALSO

layers(5).
layers(1) in the *User's Reference Manual.*
xt(7) in the *System Administrator's Reference Manual.*

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