Bell Laboratories

UNIX PROGRAMMER'S MANUAL

Program Generic PG-1C300 Issue 2

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This manual was set by a Graphic Systems phototypesetter driven by the *troff* formatting program operating under the UNIX system. The text of the manual was prepared using the *ed* text editor.

PREFACE

This document is published as part of the UNIX Operating System Program Generic, PG-1C300 Issue 2. The development of the Program Generic is the result of the efforts of the members of the UNIX Support Group, supervised by J. F. Maranzano and composed of: R. B. Brandt, J. Feder, C. D. Perez, T. M. Raleigh, R. E. Swift, G. C. Vogel and I. A. Winheim.

Most of the commands and system software were written by the Computing Science Research Center (127), especially K. Thompson and D. M. Ritchie. Contributions have also been made by members of the Computer Planning Department (8234), the Support Products and Systems Department (9152), and the Switching Maintenance and Administration Laboratory (522).

This manual is based on documentation by K. Thompson and D. Ritchie. These pages were phototypeset in the Murray Hill Computation Center, with the cooperation of J. Sturman, the guidance of V. B. Turner and the editing assistance of G. Pettit.

For corrections and comments please contact C. D. Perez, MH 2C-423, Extension 6041.

INTRODUCTION TO THIS MANUAL

This manual gives descriptions of the publicly available features of UNIX. It provides neither a general overview – see "The UNIX Time-sharing System" (Comm. ACM **17** 7, July 1974, pp. 365-375) for that – nor details of the implementation of the system, which remain to be disclosed.

Within the area it surveys, this manual attempts to be as complete and timely as possible. A conscious decision was made to describe each program in exactly the state it was in at the time its manual section was prepared. In particular, the desire to describe something as it should be, not as it is, was resisted. Inevitably, this means that many sections will soon be out of date.

This manual is divided into eight sections:

I. Commands
II. System Calls
III. Subroutines
IV. Drivers
V. File Formats
VI. User Programs
VII. Tables
VIII. System Programs

Commands are programs intended to be invoked directly by the user, in contradistinction to subroutines, which are intended to be called by the user's programs. Commands generally reside in directory */bin* (for *bin*ary programs). Some programs also reside in */usr/bin,* to save space in */bin*. These directories are searched automatically by the command interpreter.

System calls are entries into the UNIX supervisor. In assembly language, they are coded with the use of the opcode *sys*, a synonym for the *trap* instruction. In this edition, the C language interface routines to the system calls have been incorporated in section II.

A small assortment of subroutines is available; they are described in section III. The binary form of most of them is kept in the system library */lib/liba.a*. The subroutines available from C and from Fortran are also included; they reside in */lib/libc.a* and */lib/libf.a* respectively.

Drivers (section IV) discusses the characteristics of each system "file" which actually refers to an I/O device. The names in this section refer to the DEC device names for the hardware, instead of the names of the special files themselves.

File Formats (section V)documents the structure of particular kinds of files; for example, the form of the output of the loader and assembler is given. Excluded are files used by only one command, for example the assembler's intermediate files.

User Programs (section VI), while part of the Standard UNIX system, are not fully supported, and the principal reason for listing them is to indicate their existence without necessarily giving a complete description.

Section VII groups together the information pertaining to tabular data.

Section VIII discusses commands which are not intended for use by the ordinary user, in some cases because they disclose information in which he is presumably not interested, and in others because they perform privileged functions.

Each section consists of a number of independent entries of one or more pages. Below the program application heading is the name of the entry in bold-face type. Entries within each section are alphabetized. The page numbers of each entry start at 1.

All entries are based on a common format, not all of whose subsections will always appear.

The *name* section repeats the entry name and gives a very short description of its purpose.

The *synopsis* summarizes the use of the program being described. A few conventions are used, particularly in the Commands section:

Boldface words are considered literals, and are typed just as they appear.

Square brackets ([ ]) around an argument indicate that the argument is optional. When an argument is given as "name", 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 sign "—" is often taken to mean 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 "—".

The *description* section discusses in detail the subject at hand.

The *files* section gives the names of files which are built into the program.

A *see also* section gives pointers to related information.

A *diagnostics* section discusses the diagnostic indications which may be produced. Messages which are intended to be self-explanatory are not listed.

The *bugs* section gives known bugs and sometimes deficiencies. Occasionally also the suggested fix is described.

At the beginning of this document is a table of contents, organized by section and alphabetically within each section. There is also a permuted index derived from the table of contents. Within each index entry, the title of the writeup to which it refers is followed by the appropriate section number in parentheses. This fact is important because there is considerable name duplication among the sections, arising principally from commands which exist only to exercise a particular system call.

This manual was prepared using the UNIX text editor *ed* and the formatting program *troff*.

HOW TO GET STARTED

This section provides the basic information you need to get started on UNIX: how to log in and log out, how to communicate through your terminal, and how to run a program. See "UNIX for Beginners" by Brian W. Kernighan for a more complete introduction to the system.

Logging in. You must call UNIX from an appropriate terminal. UNIX supports ASCII terminals typified by the TTY 37, the GE Terminet 300, the Dasi 300, and various graphical terminals. You must also have a valid user name, which may be obtained, together with the telephone number, from the system administrators. The same telephone number serves terminals operating at all the standard speeds. After a data connection is established, the login procedure depends on what kind of terminal you are using.

> *300-baud terminals:* Such terminals include the GE Terminet 300, most display terminals, Execuport, TI, GSI, and certain Anderson-Jacobson terminals. These terminals generally have a speed switch which should be set at "300" (or "30" for 30 characters per second) and a half/full duplex switch which should be set at full-duplex. (This switch will often have to be changed since many other systems require half-duplex). When a connection is established, the system types "login:"; you type your user name, followed by the "return" key. If you have a password, the system asks for it and turns off the printer on the terminal so the password will not appear. After you have logged in, the "return", "new line", or "linefeed" keys will give exactly the same results.
>
> *TTY 37 terminal:* When you have established a data connection, the system types out a few garbage characters (the "login:" message at the wrong speed). Depress the "break" (or "interrupt") key; this is a speed-independent signal to UNIX that a 150-baud terminal is in use. The system then will type "login:," this time at the correct speed; you respond with your user name. From the TTY 37 terminal, and any other which has the "new-line" function (combined carriage return and linefeed), terminate each line you type with the "new-line" key (*not* the "return" key).

For all these terminals, it is important that you type your name in lower-case if possible; if you type upper-case letters, UNIX will assume that your terminal cannot generate lower-case letters and will translate all subsequent upper-case letters to lower case.

The evidence that you have successfully logged in is that the Shell program will type a "%" to you. (The Shell is described below under "How to run a program.")

For more information, consult *getty* (VIII), which discusses the login sequence in more detail, *tty* (IV), which discusses typewriter I/O, and *kl* (IV),which discusses the console typewriter.

Logging out. There are three ways to log out:

> You can simply hang up the phone.
>
> You can log out by typing an end-of-file indication (EOT character, control "d") to the Shell. The Shell will terminate and the "login: " message will appear again.
>
> You can also log in directly as another user by giving a *login* command (I).

How to communicate through your terminal. When you type to UNIX, the characters are collected and saved by the system. The characters will not be given to a program until you type a return (or new-line), as described above in *Logging in.*

UNIX typewriter I/O is full-duplex. It has full read-ahead, which means that you can type at any time, even while a program is typing at you. Of course, if you type during output, the output will have the input characters interspersed. However, whatever you type will be saved up and interpreted in correct sequence. There is a limit to the amount of read-ahead, but it is generous and not likely to be exceeded unless the system is in trouble. When the read-ahead limit is exceeded, the system throws away all the saved characters.

On a typewriter input line, the character "@" kills all the characters typed before it, so typing mistakes can be repaired on a single line. Also, the character "#" erases the last character typed. Successive uses of "#" erase characters back to, but not beyond, the beginning of the line. "@" and "#" can be transmitted to a program by preceding them with "\". (So, to erase "\", you need two "#"s).

The ASCII "delete" (a.k.a. "rubout") character is not passed to programs but instead generates an *interrupt signal.* This signal generally causes whatever program you are running to terminate. It is typically used to stop a long printout that you don't want. However, programs can arrange either to ignore this signal altogether, or to be notified when it happens (instead of being terminated). The editor, for example, catches interrupts and stops what it is doing, instead of terminating, so that an interrupt can be used to halt an editor printout without losing the file being edited.

The *quit* signal is generated by typing the ASCII FS character. It not only causes a running program to terminate but also generates a file with the core image of the terminated process. Quit is useful for debugging.

Besides adapting to the speed of the terminal, UNIX tries to be intelligent about whether you have a terminal with the new-line function or whether it must be simulated with carriage-return and line-feed. In the latter case, all input carriage returns are turned to new-line characters (the standard line delimiter) and both a carriage return and a line feed are echoed to the terminal. If you get into the wrong mode, the *stty* command (I) will rescue you.

Tab characters are used freely in UNIX source programs. If your terminal does not have the tab function, you can arrange to have them turned into spaces during output, and echoed as spaces during input. The system assumes that tabs are set every eight columns. Again, the *stty* command (I) will set or reset this mode. Also, there is a file which, if printed on TTY 37 or TerminNet 300 terminals, will set the tab stops correctly (*tabs* (VII)).

How to run a program; the Shell. When you have successfully logged into UNIX, a program called the Shell is listening to your terminal. The Shell reads typed-in lines, splits them up into a command name and arguments, and executes the command. A command is simply an executable program. The Shell looks first in your current directory (see next section) for a program with the given name, and if none is there, then in a system directory. There is nothing special about system-provided commands except that they are kept in a directory where the

Shell can find them.

The command name is always the first word on an input line; it and its arguments are separated from one another by spaces.

When a program terminates, the Shell will ordinarily regain control and type a "%" at you to indicate that it is ready for another command.

The Shell has many other capabilities, which are described in detail in section *sh* (I).

The current directory. UNIX has a file system arranged in a hierarchy of directories. When the system administrator gave you a user name, he also created a directory for you (ordinarily with the same name as your user name). When you log in, any file name you type is by default in this directory. Since you are the owner of this directory, you have full permissions to read, write, alter, or destroy its contents. Permissions to have your will with other directories and files will have been granted or denied to you by their owners. As a matter of observed fact, few UNIX users protect their files from destruction, let alone perusal, by other users.

To change the current directory (but not the set of permissions you were endowed with at login) use *chdir* (I).

Path names. To refer to files not in the current directory, you must use a path name. Full path names begin with "/", the name of the root directory of the whole file system. After the slash comes the name of each directory containing the next sub-directory (followed by a "/") until finally the file name is reached. E.g.: */usr/lem/filex* refers to the file *filex* in the directory *lem*; *lem* is itself a subdirectory of *usr*; *usr* springs directly from the root directory.

If your current directory has subdirectories, the path names of files therein begin with the name of the subdirectory (no prefixed "/").

Without important exception, a path name may be used anywhere a file name is required.

Important commands which modify the contents of files are *cp* (I), *mv* (I), and *rm* (I), which respectively copy, move (i.e. rename) and remove files. To find out the status of files or directories, use *ls* (I). See *mkdir* (I) for making directories; *rmdir* (I) for destroying them.

For a fuller discussion of the file system, see "The UNIX Time-Sharing System," by K. Thompson and D. M. Ritchie. It may also be useful to glance through section II of this manual, which discusses system calls, even if you don't intend to deal with the system at that level.

Writing a program. To enter the text of a source program into a UNIX file, use *ed* (I). The three principal languages in UNIX are assembly language (see *as* (I)), Fortran (see *fc* (I)), and C (see *cc* (I)). After the program text has been entered through the editor and written on a file, you can give the file to the appropriate language processor as an argument. The output of the language processor will be left on a file in the current directory named "a.out". (If the output is precious, use *mv* to move it to a less exposed name soon.) If you wrote in assembly language, you will probably need to load the program with library subroutines; see *ld* (I). The other two language processors call the loader automatically.

When you have finally gone through this entire process without provoking any diagnostics, the

resulting program can be run by giving its name to the Shell in response to the "%" prompt.

The next command you will need is *db* (I). As a debugger, *db* is better than average for assembly-language programs, marginally useful for C programs and virtually useless for Fortran.

Your programs can receive arguments from the command line just as system programs do. See *exec* (II).

Text processing. Almost all text is entered through the editor. The commands most often used to write text on a terminal are: *cat, pr,* and *nroff,* all in section I.

The *cat* command simply dumps ASCII text on the terminal, with no processing at all. The *pr* command paginates the text, supplies headings, and has a facility for multi-column output. *Nroff* is an elaborate text formatting program, and requires careful forethought in entering both the text and the formatting commands into the input file. *Nroff* produces output on a typewriter terminal.

Surprises. Certain commands provide inter-user communication. Even if you do not plan to use them, it would be well to learn something about them, because someone else may aim them at you.

To communicate with another user currently logged in, *write* (I) is used; *mail* (I) will leave a message whose presence will be announced to another user when he next logs in. The write-ups in the manual also suggest how to respond to the two commands if you are a target.

When you log in, a message-of-the-day may greet you before the first "%". The System Administrator, wishing to send a message-of-the-day, puts his data into /etc/motd, where it will be used as a general announcement each time someone logs on, until the message is erased from the file.

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cmp . . . . . compare two files
comm . . . . . print lines common to two files
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cref . . . . . make cross reference listing
date . . . . . print and set the date
db . . . . . debug
dc . . . . . desk calculator
dd . . . . . convert and copy a file
diff . . . . . differential file comparator
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kill . . . . . terminate a process
lc . . . . . LIL compiler
ld . . . . . link editor
ln . . . . . make a link
login . . . . . sign onto UNIX
lpr . . . . . line printer spooler
ls . . . . . list contents of directory
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chown	change owner and group of a file
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creat	create a new file
csw	read console switches
dup	duplicate an open file descriptor
exec, execl, execv	execute a file
exit	terminate process
fork	spawn new process
fstat	get status of open file
getgid	get group identifications
getpid	get process identification
getuid	get user identifications
gtty	get typewriter status
indir	indirect system call
kill	send signal to a process
link	link to a file
lock	semaphores
mdate	set modified date on file
mknod	make a directory or a special file
mount	mount file system
nice	set program priority
open	open for reading or writing
pause	suspend execution indefinitely
pipe	create an interprocess channel
profil	execution time profile
read	read from file
seek	move read/write pointer
setgid	set process group ID
setuid	set process user ID
signal	catch or ignore signals
sleep	stop execution for interval
stat	get file status
stime	set time
stty	set mode of typewriter
sync	update super-block
time	get date and time
times	get process times
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getpw . . . . . get name from UID
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hypot . . . . . calculate hypotenuse
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locv . . . . . long output conversion
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lp . . . . . line printer
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atan, atan2(III) arc tangent function

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chdir(II) change working directory
pipe(II) create an interprocess channel
gsi(VI) interpret extended character set on GSI terminal
ascii(VII) map of ASCII character set

getchar(III) read character
putchar, flush(III) write character
chdir(I) change working directory
chdir(II) change working directory
icheck(VIII) file system consistency check and interactive repair
check(VIII) file system consistency check
check(VIII) file system consistency check
chess(VI) the game of chess
chess(VI) the game of chess
chmod(I) change mode
chmod(II) change mode of file
chown(II) change owner and group of a file
chown(VIII) change owner
clri(VIII) clear i-node
alarm(II) activate alarm clock timer
close(II) close a file
close(II) close a file
clri(VIII) clear i-node
cmp(I) compare two files
getarg, iargc(III) get command arguments from Fortran
glob(VIII) generate command arguments
nice(I) run a command at low priority
exit(I) terminate command file
specify interrupt processing for a command file...onintr(I)
nohup(I) run a command immune to hangups
sh(I) shell (command interpreter)
goto(I) command transfer
if(I) conditional command
time(I) time a command
comm(I) print lines common to two files
comm(I) print lines common to two files
dc(IV) DC-11 communications interface
dh(IV) DH-11 communications multiplexer
diff(I) differential file comparator
cmp(I) compare two files
compar(III) default comparison routine for qsort
compar(III) default comparison routine for qsort
cc(I) C compiler
yacc(I) yet another compiler-compiler
fc(I) Fortran compiler
lc(I) LIL compiler
wait(I) await completion of process
cat(I) concatenate and print
if(I) conditional command

icheck(VIII) file system consistency check and interactive repair
check(VIII) file system consistency check
csw(II) read console switches
mkfs(VIII) construct a file system
ls(I) list contents of directory
init(VIII) process control initialization
floating point to double precision integer conversion...dtol(III)
ecvt, fcvt(III) output conversion
locv(III) long output conversion
double precision integer to floating point conversion...ltod(III)
dd(I) convert and copy a file
atof(III) convert ASCII to floating
atoi(III) convert ASCII to integer
ctime, localtime, gmtime(III) convert date and time to ASCII
dd(I) convert and copy a file
cp(I) copy
break, brk, sbrk(II) change core allocation
alloc(III) core allocator
core(V) format of core image file
mem, kmem, null(IV) core memory
core(V) format of core image file
sin, cos(III) trigonometric functions
nargs(III) argument count
wc(I) word count
cp(I) copy
crash(VIII) what to do when the system crashes
crash(VIII) what to do when the system crashes
creat(II) create a new file
pipe(II) create an interprocess channel
creat(II) create a new file
cref(I) make cross reference listing
cref(I) make cross reference listing
crypt(III) password encoding
csw(II) read console switches
ASCII... ctime, localtime, gmtime(III) convert date and time to
cubic(VI) three dimensional tic-tac-toe
ttyn(III) return name of current typewriter
dpd(VIII) data phone daemon
lpd(VIII) line printer daemon
dp(IV) DP-11 201 data-phone interface
prof(I) display profile data
ttys(V) typewriter initialization data
ctime, localtime, gmtime(III) convert date and time to ASCII
time(II) get date and time

mdate(II) set modified date on file
date(I) print and set the date
date(I) print and set the date
db(I) debug
dc(IV) DC-11 communications interface
dc(I) desk calculator
dc(IV) DC-11 communications interface
dd(I) convert and copy a file
db(I) debug
cdb(I) C debugger
tp(V) DEC/mag tape formats
tp(I) manipulate DECtape and magtape
tc(IV) TC-11/TU56 DECtape
compar(III) default comparison routine for qsort
dsw(I) delete interactively
mesg(I) permit or deny messages
dup(II) duplicate an open file descriptor
mail(I) send mail to designated users
dc(I) desk calculator
file(I) determine format of file
df(VIII) disk free
dh(IV) DH-11 communications multiplexer
dh(IV) DH-11 communications multiplexer
diff(I) differential file comparator
diff(I) differential file comparator
cubic(VI) three dimensional tic-tac-toe
dir(V) format of directories
unlink(II) remove directory entry
pwd(I) working directory name
mknod(II) make a directory or a special file
chdir(I) change working directory
chdir(II) change working directory
ls(I) list contents of directory
mkdir(I) make a directory
rmdir(I) remove directory
dir(V) format of directories
factor(VI) discover prime factors of a number
hs(IV) RH11/RS03-RS04 fixed-head disk file
rf(IV) RF11/RS11 fixed-head disk file
df(VIII) disk free
du(I) summarize disk usage
hp(IV) RH-11/RP04 moving-head disk
rk(IV) RK-11/RK03 (or RK05) disk
rp(IV) RP-11/RP03 moving-head disk

umount(II) dismount file system
umount(VIII) dismount file system
prof(I) display profile data
ldiv, lrem(III) long division
kl(IV) KL-11 or DL-11 asynchronous interface
dn(IV) DN-11 ACU interface
dn(IV) DN-11 ACU interface
dtol(III) floating point to double precision integer conversion
ltod(III) double precision integer to floating point conversion
dp(IV) DP-11 201 data-phone interface
dpd(VIII) data phone daemon
dp(IV) DP-11 201 data-phone interface
agen(VI) generate associative memory drivers
dsw(I) delete interactively
conversion... dtol(III) floating point to double precision integer
du(I) summarize disk usage
dump(V) incremental dump tape format
dump(VIII) incremental file system dump
od(I) octal dump
dump(V) incremental dump tape format
dump(VIII) incremental file system dump
dup(II) duplicate an open file descriptor
dup(II) duplicate an open file descriptor
echo(I) echo arguments
echo(I) echo arguments
ecvt, fcvt(III) output conversion
end, etext, edata(III) last locations in program
ed(I) text editor
fed(VI) edit form letter memory
a.out(V) assembler and link editor output
ed(I) text editor
ld(I) link editor
crypt(III) password encoding
end, etext, edata(III) last locations in program
nlist(III) get entries from name list
unlink(II) remove directory entry
perror, sys_errlist, sys_nerr, errno(III) system error messages
sys_nerr, errno(III) system error messages...perror, sys_errlist,
ierror(III) catch Fortran errors
end, etext, edata(III) last locations in program
pfe(I) print floating exception
exec, execl, execv(II) execute a file
exec, execl, execv(II) execute a file
exec, execl, execv(II) execute a file

reset, setexit(III)	execute non-local goto
sleep(I) suspend	execution for an interval
sleep(II) stop	execution for interval
pause(II) suspend	execution indefinitely
monitor(III) prepare	execution profile
profil(II)	execution time profile
exec, execl,	execv(II) execute a file
	exit(I) terminate command file
	exit(II) terminate process
	exp(III) exponential function
exp(III)	exponential function
pow(III) floating	exponentiation
gsi(VI) interpret	extended character set on GSI terminal
greek(VII) graphics for	extended TTY-37 type-box
abs,	fabs(III) absolute value
factor(VI) discover prime	factors of a number
	factor(VI) discover prime factors of a number
abort(III) generate an IOT	fault
	fc(I) Fortran compiler
putc, putw,	fcreat, fflush(III) buffered output
ecvt,	fcvt(III) output conversion
	fed(VI) edit form letter memory
putc, putw, fcreat,	fflush(III) buffered output
diff(I) differential	file comparator
dup(II) duplicate an open	file descriptor
grep(I) search a	file for a pattern
ar(V) archive (library)	file format
split(I) split a	file into pieces
setfil(III) specify Fortran	file name
read, open, onend(I) sequential	file read
stat(II) get	file status
icheck(VIII)	file system consistency check and interactive repair
check(VIII)	file system consistency check
dump(VIII) incremental	file system dump
restor(VIII) incremental	file system restore
mtab(VII) mounted	file system table
fs(V) format of	file system volume
mkfs(VIII) construct a	file system
mount(II) mount	file system
mount(VIII) mount	file system
umount(II) dismount	file system
umount(VIII) dismount	file system
chmod(II) change mode of	file
chown(II) change owner and group of a	file

close(II) close a file
core(V) format of core image file
creat(II) create a new file
dd(I) convert and copy a file
exec, execl, execv(II) execute a file
exit(I) terminate command file
file(I) determine format of file
fstat(II) get status of open file
hs(IV) RH11/RS03-RS04 fixed-head disk file
file(I) determine format of file
ino(VIII) get the i-number of a file
link(II) link to a file
mdate(II) set modified date on file
mknod(II) make a directory or a special file
mknod(VIII) build special file
mktemp(III) make a unique named temporary file
mv(I) move or rename a file
specify interrupt processing for a command file...onintr(I)
passwd(V) password file
pr(I) print file
read(II) read from file
rf(IV) RF11/RS11 fixed-head disk file
cmp(I) compare two files
comm(I) print lines common to two files
find(I) find files
size(I) size of an object file
reloc(VIII) relocate object files
rm(I) remove (unlink) files
sort(I) sort or merge files
sum(I) sum file
uniq(I) report repeated lines in a file
write(II) write on a file
find(I) find files
hyphen(VI) find hyphenated words
typo(I) find possible typos
find(I) find files
hs(IV) RH11/RS03-RS04 fixed-head disk file
rf(IV) RF11/RS11 fixed-head disk file
pfe(I) print floating exception
pow(III) floating exponentiation
fmod(III) floating modulo function
ltod(III) double precision integer to floating point conversion
fptrap(III) floating point interpreter
dtol(III) floating point to double precision integer conversion

atof(III) convert ASCII to floating
floor, ceil(III) floor and ceiling functions
floor, ceil(III) floor and ceiling functions
putchar, flush(III) write character
fmod(III) floating modulo function
getc, getw, fopen(III) buffered input
fork(II) spawn new process
form(VI) form letter generator
fed(VI) edit form letter memory
core(V) format of core image file
dir(V) format of directories
fs(V) format of file system volume
file(I) determine format of file
nroff(I) format text
ar(V) archive (library) file format
dump(V) incremental dump tape format
tp(V) DEC/mag tape formats
printf(III) formatted print
tmac(VI) macros for formatting manuscripts
form(VI) form letter generator
fc(I) Fortran compiler
ierror(III) catch Fortran errors
setfil(III) specify Fortran file name
iargc(III) get command arguments from Fortran...getarg,
fptrap(III) floating point interpreter
df(VIII) disk free
read(II) read from file
getarg, iargc(III) get command arguments from Fortran
nlist(III) get entries from name list
getpw(III) get name from UID
fstat(II) get status of open file
fs(V) format of file system volume
atan, atan2(III) arc tangent function
exp(III) exponential function
fmod(III) floating modulo function
gamma(III) log gamma function
floor, ceil(III) floor and ceiling functions
sqrt(III) square root function
sin, cos(III) trigonometric functions
bj(VI) the game of black jack
chess(VI) the game of chess
wump(VI) the game of hunt-the-wumpus
ttt(VI) the game of tic-tac-toe
moo(VI) guessing game

gamma(III) log gamma function
gamma(III) log gamma function
tty(IV) general typewriter interface
abort(III) generate an IOT fault
agen(VI) generate associative memory drivers
glob(VIII) generate command arguments
lex(VI) generate programs for simple lexical tasks
form(VI) form letter generator
rand, srand(III) random number generator
getarg, iargc(III) get command arguments from Fortran
time(II) get date and time
nlist(III) get entries from name list
stat(II) get file status
getgid(II) get group identifications
getpw(III) get name from UID
getpid(II) get process identification
times(II) get process times
fstat(II) get status of open file
ino(VIII) get the i-number of a file
tty(I) get typewriter name
gtty(II) get typewriter status
getuid(II) get user identifications
getarg, iargc(III) get command arguments from Fortran
getc, getw, fopen(III) buffered input
getchar(III) read character
getgid(II) get group identifications
getpid(II) get process identification
getpw(III) get name from UID
getty(VIII) set typewriter mode
getuid(II) get user identifications
getc, getw, fopen(III) buffered input
glob(VIII) generate command arguments
ctime, localtime, gmtime(III) convert date and time to ASCII
goto(I) command transfer
reset, setexit(III) execute non-local goto
greek(VII) graphics for extended TTY-37 type-box
greek(VII) graphics for extended TTY-37 type-box
grep(I) search a file for a pattern
getgid(II) get group identifications
setgid(II) set process group ID
chown(II) change owner and group of a file
gsi(VI) interpret extended character set on GSI terminal
gsi(VI) interpret extended character set on GSI terminal
gtty(II) get typewriter status

moo(VI) guessing game
nohup(I) run a command immune to hangups
hmul(III) high-order product
wtmp(V) user login history
hmul(III) high-order product
hp(IV) RH-11/RP04 moving-head disk
hs(IV) RH11/RS03-RS04 fixed-head disk file
ht(IV) RH-11/TU-16 magtape interface
wump(VI) the game of hunt-the-wumpus
hyphen(VI) find hyphenated words
hyphen(VI) find hyphenated words
hypot(III) calculate hypotenuse
hypot(III) calculate hypotenuse
getarg, iargc(III) get command arguments from Fortran
interactive repair... icheck(VIII) file system consistency check and
getpid(II) get process identification
getgid(II) get group identifications
getuid(II) get user identifications
setgid(II) set process group ID
setuid(II) set process user ID
ierror(III) catch Fortran errors
if(I) conditional command
signal(II) catch or ignore signals
core(V) format of core image file
nohup(I) run a command immune to hangups
dump(V) incremental dump tape format
dump(VIII) incremental file system dump
restor(VIII) incremental file system restore
pause(II) suspend execution indefinitely
ptx(VI) permuted index
indir(II) indirect system call
indir(II) indirect system call
utmp(V) user information
ttys(V) typewriter initialization data
init(VIII) process control initialization
init(VIII) process control initialization
clri(VIII) clear i-node
ino(VIII) get the i-number of a file
getc, getw, fopen(III) buffered input
floating point to double precision integer conversion...dtol(III)
ltod(III) double precision integer to floating point conversion
atoi(III) convert ASCII to integer
bc(I) arbitrary precision interactive language
file system consistency check and interactive repair...icheck(VIII)

dsw(I) delete interactively
dc(IV) DC-11 communications interface
dn(IV) DN-11 ACU interface
dp(IV) DP-11 201 data-phone interface
ht(IV) RH-11/TU-16 magtape interface
kl(IV) KL-11 or DL-11 asynchronous interface
tm(IV) TM-11/TU-10 magtape interface
tty(IV) general typewriter interface
gsi(VI) interpret extended character set on GSI terminal
fptrap(III) floating point interpreter
sh(I) shell (command interpreter)
sno(VI) Snobol interpreter
pipe(II) create an interprocess channel
onintr(I) specify interrupt processing for a command file
return(I) terminate profile or interrupt processing routine
sleep(I) suspend execution for an interval
sleep(II) stop execution for interval
intro(II) introduction to system calls
intro(II) introduction to system calls
ino(VIII) get the i-number of a file
abort(III) generate an IOT fault
bj(VI) the game of black jack
kill(I) terminate a process
kill(II) send signal to a process
kl(IV) KL-11 or DL-11 asynchronous interface
kl(IV) KL-11 or DL-11 asynchronous interface
mem, kmem, null(IV) core memory
bc(I) arbitrary precision interactive language
end, etext, edata(III) last locations in program
lc(I) LIL compiler
ld(I) link editor
ldiv, lrem(III) long division
form(VI) form letter generator
fed(VI) edit form letter memory
lex(VI) generate programs for simple lexical tasks
lex(VI) generate programs for simple lexical tasks
ar(V) archive (library) file format
ar(I) archive and library maintainer
lc(I) LIL compiler
lpd(VIII) line printer daemon
lpr(I) line printer spooler
lp(IV) line printer
comm(I) print lines common to two files
uniq(I) report repeated lines in a file

a.out(V) assembler and link editor output
ld(I) link editor
link(II) link to a file
link(II) link to a file
ln(I) make a link
ls(I) list contents of directory
cref(I) make cross reference listing
nlist(III) get entries from name list
nm(I) print name list
ln(I) make a link
ctime, localtime, gmtime(III) convert date and time to ASCII
end, etext, edata(III) last locations in program
lock(II) semaphores
locv(III) long output conversion
gamma(III) log gamma function
log(III) natural logarithm
log(III) natural logarithm
ac(VIII) login accounting
wtmp(V) user login history
passwd(I) change login password
login(I) sign onto UNIX
ldiv, lrem(III) long division
locv(III) long output conversion
nice(I) run a command at low priority
lpd(VIII) line printer daemon
lp(IV) line printer
lpr(I) line printer spooler
ldiv, lrem(III) long division
ls(I) list contents of directory
conversion... ltod(III) double precision integer to floating point
tmac(VI) macros for formatting manuscripts
mtm(I) magnetic tape manipulation
ht(IV) RH-11/TU-16 magtape interface
tm(IV) TM-11/TU-10 magtape interface
tp(I) manipulate DECtape and magtape
mail(I) send mail to designated users
mail(I) send mail to designated users
ar(I) archive and library maintainer
mknod(II) make a directory or a special file
mkdir(I) make a directory
ln(I) make a link
mktemp(III) make a unique named temporary file
cref(I) make cross reference listing
tp(I) manipulate DECtape and magtape

mtm(I) magnetic tape manipulation
tmac(VI) macros for formatting manuscripts
ascii(VII) map of ASCII character set
mdate(II) set modified date on file
mem, kmem, null(IV) core memory
agen(VI) generate associative memory drivers
fed(VI) edit form letter memory
mem, kmem, null(IV) core memory
sort(I) sort or merge files
mesg(I) permit or deny messages
mesg(III) write message on typewriter
mesg(III) write message on typewriter
mesg(I) permit or deny messages
sys_nerr, errno(III) system error messages...perror, sys_errlist,
mkdir(I) make a directory
mkfs(VIII) construct a file system
mknod(II) make a directory or a special file
mknod(VIII) build special file
mktemp(III) make a unique named temporary file
chmod(II) change mode of file
stty(II) set mode of typewriter
chmod(I) change mode
getty(VIII) set typewriter mode
mdate(II) set modified date on file
fmod(III) floating modulo function
monitor(III) prepare execution profile
moo(VI) guessing game
mount(II) mount file system
mount(VIII) mount file system
mtab(VII) mounted file system table
mount(II) mount file system
mount(VIII) mount file system
mv(I) move or rename a file
seek(II) move read/write pointer
hp(IV) RH-11/RP04 moving-head disk
rp(IV) RP-11/RP03 moving-head disk
mtab(VII) mounted file system table
mtm(I) magnetic tape manipulation
dh(IV) DH-11 communications multiplexer
mv(I) move or rename a file
getpw(III) get name from UID
nlist(III) get entries from name list
nm(I) print name list
ttyn(III) return name of current typewriter

mktemp(III) make a unique named temporary file
pwd(I) working directory name
setfil(III) specify Fortran file name
tty(I) get typewriter name
nargs(III) argument count
log(III) natural logarithm
creat(II) create a new file
fork(II) spawn new process
nice(I) run a command at low priority
nice(II) set program priority
nlist(III) get entries from name list
nm(I) print name list
nohup(I) run a command immune to hangups
reset, setexit(III) execute non-local goto
nroff(I) format text
mem, kmem, null(IV) core memory
rand, srand(III) random number generator
factor(VI) discover prime factors of a number
size(I) size of an object file
reloc(VIII) relocate object files
od(I) octal dump
od(I) octal dump
read, open, onend(I) sequential file read
file... onintr(I) specify interrupt processing for a command
login(I) sign onto UNIX
dup(II) duplicate an open file descriptor
fstat(II) get status of open file
open(II) open for reading or writing
read, open, onend(I) sequential file read
open(II) open for reading or writing
stty(I) set typewriter options
rk(IV) RK-11/RK03 (or RK05) disk
ecvt, fcvt(III) output conversion
locv(III) long output conversion
a.out(V) assembler and link editor output
putc, putw, fcreat, fflush(III) buffered output
chown(II) change owner and group of a file
chown(VIII) change owner
pc(IV) PC-11 paper tape reader/punch
passwd(I) change login password
passwd(V) password file
crypt(III) password encoding
passwd(V) password file
passwd(I) change login password

grep(I) search a file for a pattern
pause(II) suspend execution indefinitely
pc(IV) PC-11 paper tape reader/punch
pc(IV) PC-11 paper tape reader/punch
update(VIII) periodically update the super block
mesg(I) permit or deny messages
ptx(VI) permuted index
error messages... perror, sys_errlist, sys_nerr, errno(III) system
pfe(I) print floating exception
dpd(VIII) data phone daemon
split(I) split a file into pieces
pipe(II) create an interprocess channel
double precision integer to floating point conversion...ltod(III)
fptrap(III) floating point interpreter
dtol(III) floating point to double precision integer conversion
seek(II) move read/write pointer
typo(I) find possible typos
pow(III) floating exponentiation
dtol(III) floating point to double precision integer conversion
ltod(III) double precision integer to floating point conversion
bc(I) arbitrary precision interactive language
monitor(III) prepare execution profile
pr(I) print file
factor(VI) discover prime factors of a number
date(I) print and set the date
cal(VI) print calendar
pr(I) print file
pfe(I) print floating exception
comm(I) print lines common to two files
nm(I) print name list
cat(I) concatenate and print
lpd(VIII) line printer daemon
lpr(I) line printer spooler
lp(IV) line printer
printf(III) formatted print
printf(III) formatted print
nice(I) run a command at low priority
nice(II) set program priority
su(VIII) become privileged user
boot procedures(VIII) UNIX startup
init(VIII) process control initialization
setgid(II) set process group ID
getpid(II) get process identification
ps(I) process status

times(II) get process times
wait(II) wait for process to terminate
setuid(II) set process user ID
exit(II) terminate process
fork(II) spawn new process
onintr(I) specify interrupt processing for a command file
return(I) terminate profile or interrupt processing routine
kill(I) terminate a process
kill(II) send signal to a process
wait(I) await completion of process
hmul(III) high-order product
prof(I) display profile data
prof(I) display profile data
return(I) terminate profile or interrupt processing routine
monitor(III) prepare execution profile
profil(II) execution time profile
profil(II) execution time profile
nice(II) set program priority
end, etext, edata(III) last locations in program
lex(VI) generate programs for simple lexical tasks
ps(I) process status
ptx(VI) permuted index
putc, putw, fcreat, fflush(III) buffered output
putchar, flush(III) write character
putc, putw, fcreat, fflush(III) buffered output
pwd(I) working directory name
compar(III) default comparison routine for qsort
qsort(III) quicker sort
qsort(III) quicker sort
rand, srand(III) random number generator
rand, srand(III) random number generator
getchar(III) read character
csw(II) read console switches
read(II) read from file
read, open, onend(I) sequential file read
pc(IV) PC-11 paper tape reader/punch
read(II) read from file
open(II) open for reading or writing
read, open, onend(I) sequential file read
seek(II) move read/write pointer
cref(I) make cross reference listing
reloc(VIII) relocate object files
strip(I) remove symbols and relocation bits
reloc(VIII) relocate object files

unlink(II) remove directory entry
rmdir(I) remove directory
strip(I) remove symbols and relocation bits
rm(I) remove (unlink) files
mv(I) move or rename a file
system consistency check and interactive repair...icheck(VIII) file
uniq(I) report repeated lines in a file
uniq(I) report repeated lines in a file
reset, setexit(III) execute non-local goto
restor(VIII) incremental file system restore
restor(VIII) incremental file system restore
ttyn(III) return name of current typewriter
routine... return(I) terminate profile or interrupt processing
rew(I) rewind tape
rew(I) rewind tape
rf(IV) RF11/RS11 fixed-head disk file
rf(IV) RF11/RS11 fixed-head disk file
hp(IV) RH-11/RP04 moving-head disk
hs(IV) RH11/RS03-RS04 fixed-head disk file
ht(IV) RH-11/TU-16 magtape interface
rk(IV) RK-11/RK03 (or RK05) disk
rk(IV) RK-11/RK03 (or RK05) disk
rk(IV) RK-11/RK03 (or RK05) disk
rmdir(I) remove directory
rm(I) remove (unlink) files
sqrt(III) square root function
compar(III) default comparison routine for qsort
terminate profile or interrupt processing routine...return(I)
rp(IV) RP-11/RP03 moving-head disk
rp(IV) RP-11/RP03 moving-head disk
nice(I) run a command at low priority
nohup(I) run a command immune to hangups
sa(VIII) Shell accounting
break, brk, sbrk(II) change core allocation
grep(I) search a file for a pattern
seek(II) move read/write pointer
lock(II) semaphores
mail(I) send mail to designated users
kill(II) send signal to a process
read, open, onend(I) sequential file read
stty(II) set mode of typewriter
mdate(II) set modified date on file
gsi(VI) interpret extended character set on GSI terminal
setgid(II) set process group ID

setuid(II) set process user ID
nice(II) set program priority
tabs(VII) set tab stops
date(I) print and set the date
stime(II) set time
getty(VIII) set typewriter mode
stty(I) set typewriter options
ascii(VII) map of ASCII character set
reset, setexit(III) execute non-local goto
setfil(III) specify Fortran file name
setgid(II) set process group ID
setuid(II) set process user ID
sa(VIII) Shell accounting
shift(I) adjust Shell arguments
sh(I) shell (command interpreter)
sh(I) shell (command interpreter)
shift(I) adjust Shell arguments
login(I) sign onto UNIX
kill(II) send signal to a process
signal(II) catch or ignore signals
signal(II) catch or ignore signals
lex(VI) generate programs for simple lexical tasks
sin, cos(III) trigonometric functions
size(I) size of an object file
size(I) size of an object file
sleep(I) suspend execution for an interval
sleep(II) stop execution for interval
sno(VI) Snobol interpreter
sno(VI) Snobol interpreter
sort(I) sort or merge files
sort(I) sort or merge files
qsort(III) quicker sort
fork(II) spawn new process
mknod(II) make a directory or a special file
mknod(VIII) build special file
setfil(III) specify Fortran file name
onintr(I) specify interrupt processing for a command file
split(I) split a file into pieces
split(I) split a file into pieces
ipr(I) line printer spooler
sqrt(III) square root function
sqrt(III) square root function
rand, srand(III) random number generator
boot procedures(VIII) UNIX startup

stat(II) get file status
fstat(II) get status of open file
gtty(II) get typewriter status
ps(I) process status
stat(II) get file status
stime(II) set time
sleep(II) stop execution for interval
tabs(VII) set tab stops
strip(I) remove symbols and relocation bits
stty(I) set typewriter options
stty(II) set mode of typewriter
sum(I) sum file
sum(I) sum file
du(I) summarize disk usage
sync(VIII) update the super block
update(VIII) periodically update the super block
sync(II) update super-block
sleep(I) suspend execution for an interval
pause(II) suspend execution indefinitely
su(VIII) become privileged user
csw(II) read console switches
strip(I) remove symbols and relocation bits
sync(II) update super-block
sync(VIII) update the super block
messages...perror, sys_errlist, sys_nerr, errno(III) system error
perror, sys_errlist, sys_nerr, errno(III) system error messages
indir(II) indirect system call
intro(II) introduction to system calls
icheck(VIII) file system consistency check and interactive repair
check(VIII) file system consistency check
crash(VIII) what to do when the system crashes
dump(VIII) incremental file system dump
sys_errlist, sys_nerr, errno(III) system error messages.. perror,
restor(VIII) incremental file system restore
mtab(VII) mounted file system table
fs(V) format of file system volume
mkfs(VIII) construct a file system
mount(II) mount file system
mount(VIII) mount file system
umount(II) dismount file system
umount(VIII) dismount file system
who(I) who is on the system
tabs(VII) set tab stops
mtab(VII) mounted file system table

tabs(VII) set tab stops
atan, atan2(III) arc tangent function
dump(V) incremental dump tape format
tp(V) DEC/mag tape formats
mtm(I) magnetic tape manipulation
pc(IV) PC-11 paper tape reader/punch
rew(I) rewind tape
generate programs for simple lexical tasks...lex(VI)
tc(IV) TC-11/TU56 DECtape
tc(IV) TC-11/TU56 DECtape
mktemp(III) make a unique named temporary file
interpret extended character set on GSI terminal...gsi(VI)
kill(I) terminate a process
exit(I) terminate command file
exit(II) terminate process
return(I) terminate profile or interrupt processing routine
wait(II) wait for process to terminate
ed(I) text editor
nroff(I) format text
cubic(VI) three dimensional tic-tac-toe
cubic(VI) three dimensional tic-tac-toe
ttt(VI) the game of tic-tac-toe
time(I) time a command
profil(II) execution time profile
localtime, gmtime(III) convert date and time to ASCII...ctime,
time(I) time a command
time(II) get date and time
alarm(II) activate alarm clock timer
times(II) get process times
stime(II) set time
times(II) get process times
time(II) get date and time
tm(IV) TM-11/TU-10 magtape interface
tmac(VI) macros for formatting manuscripts
tm(IV) TM-11/TU-10 magtape interface
tp(I) manipulate DECtape and magtape
tp(V) DEC/mag tape formats
goto(I) command transfer
tr(I) transliterate
tr(I) transliterate
sin, cos(III) trigonometric functions
ttt(VI) the game of tic-tac-toe
greek(VII) graphics for extended TTY-37 type-box
tty(I) get typewriter name

tty(IV) general typewriter interface
ttyn(III) return name of current typewriter
ttys(V) typewriter initialization data
cmp(I) compare two files
comm(I) print lines common to two files
greek(VII) graphics for extended TTY-37 type-box
ttys(V) typewriter initialization data
tty(IV) general typewriter interface
getty(VIII) set typewriter mode
tty(I) get typewriter name
stty(I) set typewriter options
gtty(II) get typewriter status
mesg(III) write message on typewriter
stty(II) set mode of typewriter
ttyn(III) return name of current typewriter
typo(I) find possible typos
typo(I) find possible typos
getpw(III) get name from UID
umount(II) dismount file system
umount(VIII) dismount file system
uniq(I) report repeated lines in a file
mktemp(III) make a unique named temporary file
boot procedures(VIII) UNIX startup
login(I) sign onto UNIX
rm(I) remove (unlink) files
unlink(II) remove directory entry
sync(II) update super-block
sync(VIII) update the super block
update(VIII) periodically update the super block
update(VIII) periodically update the super block
du(I) summarize disk usage
getuid(II) get user identifications
setuid(II) set process user ID
utmp(V) user information
wtmp(V) user login history
mail(I) send mail to designated users
su(VIII) become privileged user
wall(VIII) write to all users
write(I) write to another user
utmp(V) user information
abs, fabs(III) absolute value
fs(V) format of file system volume
wait(II) wait for process to terminate
wait(I) await completion of process

wait(II) wait for process to terminate
wall(VIII) write to all users
wc(I) word count
crash(VIII) what to do when the system crashes
who(I) who is on the system
who(I) who is on the system
wc(I) word count
hyphen(VI) find hyphenated words
pwd(I) working directory name
chdir(I) change working directory
chdir(II) change working directory
putchar, flush(III) write character
mesg(III) write message on typewriter
write(II) write on a file
wall(VIII) write to all users
write(I) write to another user
write(I) write to another user
write(II) write on a file
open(II) open for reading or writing
wtmp(V) user login history
wump(VI) the game of hunt-the-wumpus
yacc(I) yet another compiler-compiler
yacc(I) yet another compiler-compiler

I COMMANDS

NAME

ar – archive and library maintainer

SYNOPSIS

ar key [posname] afile [name ...]

DESCRIPTION

Ar maintains groups of files combined into a single archive file. Its main use is to create and update library files as used by the loader. It can be used, though, for any similar purpose.

Key is one character from the command set **drtlpmx** optionally concatenated with characters from the option set **vunab.** *Afile* is the archive file. The *names* are constituent files in the archive file. The *posname* is the name of a file in the archive; it is required if and only if one of the options **a** or **b** is used in the *key*. The meanings of the *key* characters are:

d Delete the named files from the archive file.

r Replace or add the named files. New files are placed at the end of the archive unless the **a** or **b** option is used. Existing files are replaced in their current position and **a** or **b** have no effect.

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

l List the contents of the archive in long mode, giving mode, owner, size in bytes and time of last modification for each file. If no names are given, all files are listed.

p Print the named files in the archive.

m Move the named files to the end of the archive or as specified by the **a** or **b** option.

x Extract the named files. If no names are given, all files in the archive are extracted. If the optional character **u** is used with **x**, only those files with a modified date earlier than the dates of the respective files within the archive will be replaced by extracted files.

v Verbose; under the verbose option, *ar* gives additional information while working:

d,r,m	gives log of changes to archive.
x	logs files extracted.
t,l	changes **t** command into **l** command.
p	prints name of file before printing file.

u Update; under the update option *ar*, in replacing or extracting, will only over-write an older version of a file, if versions exist both within and without the archive (see **r** and **x** command descriptions).
If **u** is part of a *key* with no command character, **r** is included as the command.

n Interactive; under the interactive option, *ar* requests information from the standard input before modifying the archive.

r before creating the archive, *ar* prints:
? - afile?
Reply 'y' to create the archive; any other response and *ar* will abort.

m before modifying the archive, *ar* prints:
n - filename?
Reply with a new name to rename the file; an illegal filename or just a return will retain the old name.

d before deleting any file, *ar* prints:
d - filename?
Reply 'y' to delete the file; any other reply and the file will be kept.

a,b rearranges files in the archive file, placing them after or before the file designated as *posname*. These options require that *posname* follow the key.

FILES

/tmp/vtm? temporary

SEE ALSO

ld (I), archive (V)

BUGS

If the same file is mentioned twice in an argument list, it may be put in the archive twice. The options **a** and **b** should work with **r** when the file already exists in the archive.

AS (I)

AS (I)

NAME

as – assembler

SYNOPSIS

as [–] name ...

DESCRIPTION

As assembles the concatenation of the named files. If the optional first argument – is used, all undefined symbols in the assembly are treated as global.

The output of the assembly is left on the file **a.out.** It is executable if no errors occurred during the assembly, and if there were no unresolved external references.

FILES

/lib/as2	pass 2 of the assembler
/tmp/atm[1-3]?	temporary
a.out	object

SEE ALSO

ld (I), nm (I), db (I), a.out (V), 'UNIX Assembler Manual'.

DIAGNOSTICS

When an input file cannot be read, its name followed by a question mark is typed and assembly ceases. When syntactic or semantic errors occur, a single-character diagnostic is typed out together with the line number and the file name in which it occurred. Errors in pass 1 cause cancellation of pass 2. The possible errors are:

)	Parentheses error
]	Parentheses error
<	String not terminated properly
*	Indirection used illegally
.	Illegal assignment to '.'
A	Error in address
B	Branch instruction is odd or too remote
E	Error in expression
F	Error in local ('f' or 'b') type symbol
G	Garbage (unknown) character
I	End of file inside an if
M	Multiply defined symbol as label
O	Word quantity assembled at odd address
P	'.' different in pass 1 and 2
R	Relocation error
U	Undefined symbol
X	Syntax error

BUGS

Symbol table overflow is not checked. X errors can cause incorrect line numbers in following diagnostics.

BAS (I)

BAS (I)

NAME

bas – basic

SYNOPSIS

bas [file]

DESCRIPTION

Bas is a dialect of Basic. If a file argument is provided, the file is used for input before the console is read. *Bas* accepts lines of the form:

statement
integer statement

Integer numbered statements (known as internal statements) are stored for later execution. They are stored in sorted ascending order. Non-numbered statements are immediately executed. The result of an immediate expression statement (that does not have '=' as its highest operator) is printed.

Statements have the following syntax:

expression
The expression is executed for its side effects (assignment or function call) or for printing as described above.

done
Return to system level.

draw expression expression expression
A line is drawn on the Tektronix 611 display '/dev/vt0' from the current display position to the XY co-ordinates specified by the first two expressions. The scale is zero to one in both X and Y directions. If the third expression is zero, the line is invisible. The current display position is set to the end point.

display list
The list of expressions and strings is concatenated and displayed (i.e. printed) on the 611 starting at the current display position. The current display position is not changed.

erase
The 611 screen is erased.

for name = expression expression statement
for name = expression expression
...
next
The *for* statement repetitively executes a statement (first form) or a group of statements (second form) under control of a named variable. The variable takes on the value of the first expression, then is incremented by one on each loop, not to exceed the value of the second expression.

goto expression
The expression is evaluated, truncated to an integer and execution goes to the corresponding integer numbered statement. If executed from immediate mode, the internal statements are compiled first.

if expression statement
The statement is executed if the expression evaluates to non-zero.

list [expression [expression]]
is used to print out the stored internal statements. If no arguments are given, all internal statements are printed. If one argument is given, only that internal statement is listed. If two arguments are given, all internal statements inclusively between the arguments are printed.

print list
The list of expressions and strings are concatenated and printed. (A string is delimited by double quotes.)

return [expression]
The expression is evaluated and the result is passed back as the value of a function call. If no expression is given, zero is returned.

run
The internal statements are compiled. The symbol table is re-initialized. The random number generator is reset. Control is passed to the lowest numbered internal statement.

Expressions have the following syntax:

name
A name is used to specify a variable. Names are composed of a letter followed by letters and digits. The first four characters of a name are significant.

number
A number is used to represent a constant value. A number is written in Fortran style, and contains digits, an optional decimal point, and possibly a scale factor consisting of an e followed by an optionally signed exponent.

(expression)
Parentheses are used to alter normal order of evaluation.

expression operator expression
Common functions of two arguments are abbreviated by the two arguments separated by an operator denoting the function. A complete list of operators is given below.

expression ([expression [, expression] ...])
Functions of an arbitrary number of arguments can be called by an expression followed by the arguments in parentheses separated by commas. The expression evaluates to the line number of the entry of the function in the internally stored statements. This causes the internal statements to be compiled. If the expression evaluates negative, a built-in function is called. The list of built-in functions appears below.

name [expression [, expression] ...]
Each expression is truncated to an integer and used as a specifier for the name. The result is syntactically identical to a name. **a[1,2]** is the same as **a[1][2]**. The truncated expressions are restricted to values between 0 and 32767.

The following is the list of operators:

=
= is the assignment operator. The left operand must be a name or an array element. The result is the right operand. Assignment binds right to left, all other operators bind left to right.

& |
& (logical and) has result zero if either of its arguments are zero. It has result one if both its arguments are non-zero. | (logical or) has result zero if both of its arguments are zero. It has result one if either of its arguments are non-zero.

< <= > >= == <>
The relational operators (< less than, <= less than or equal, > greater than, >= greater than or equal, == equal to, <> not equal to) return one if their arguments are in the specified relation. They return zero otherwise. Relational operators at the same level extend as follows: a>b>c is the same as a>b&b>c.

+ −
Add and subtract.

* /
Multiply and divide.

Exponentiation.

The following is a list of built-in functions:

arg(i)
is the value of the *i*-th actual parameter on the current level of function call.

exp(x)
is the exponential function of *x*.

log(x)
is the natural logarithm of *x*.

sin(x)
is the sine of *x* (radians).

cos(x)
is the cosine of *x* (radians).

atn(x)
is the arctangent of *x*. Its value is between $-\pi/2$ and $\pi/2$.

rnd( )
is a uniformly distributed random number between zero and one.

expr( )
is the only form of program input. A line is read from the input and evaluated as an expression. The resultant value is returned.

int(x)
returns *x* truncated to an integer.

FILES

/tmp/btm? temporary

DIAGNOSTICS

Syntax errors cause the incorrect line to be typed with an underscore where the parse failed. All other diagnostics are self explanatory.

BUGS

Has been known to give core images. Needs a way to *list* a program onto a file.

BC (I) BC (I)

NAME

bc – arbitrary precision interactive language

SYNOPSIS

bc [**–l**] [file ...]

DESCRIPTION

Bc is an interactive processor for a language which resembles C but provides unlimited precision arithmetic. It takes input from any files given, then reads the standard input. The '–l' argument stands for the name of a library of mathematical subroutines which contains sine (named 's'), cosine ('c'), arctangent ('a'), natural logarithm ('l'), and exponential ('e'). The syntax for *bc* programs is as follows; E means expression, S means statement.

Comments
are enclosed in /* and */.

Names
letters a–z
array elements: letter[E]
the words 'ibase', 'obase', and 'scale'

Other operands
arbitrarily long numbers with optional sign and decimal point
(E)
sqrt (E)
<letter> (E , ... , E)

Operators
+ – * / % ^
++ –– (prefix and postfix; apply to names)
== <= >= != < >
= =+ =– =* =/ =% =^

Statements
E
{ S ; ... ; S }
if (E) S
while (E) S
for (E ; E ; E) S
null statement
break
quit

Function definitions are exemplified by

```
define <letter> ( <letter> ,..., <letter> ) {
        auto <letter>, ... , <letter>
        S; ... S
        return ( E )
}
```

All function arguments are passed by value.

The value of a statement that is an expression is printed unless the main operator is an assignment. Either semicolons or newlines may separate statements. Assignment to *scale* influences the number of digits to be retained on arithmetic operations. Assignments to *ibase* or *obase* set the input and output number radix respectively.

The same letter may be used as an array name, a function name, and a simple variable simultaneously. 'Auto' variables are saved and restored during function calls. All other variables are global to the program. When using arrays as function arguments or defining them as automatic variables empty square brackets must follow the array name.

For example

```
scale = 20
define e(x){
        auto a, b, c, i, s
        a = 1
        b = 1
        s = 1
        for(i=1; 1; i++){
                a = a*x
                b = b*i
                c = a/b
                if(c == 0) return(s)
                s = s+c
        }
}
```

defines a function to compute an approximate value of the exponential function and

```
for(i=1; i<=10; i++) e(i)
```

prints approximate values of the exponential function of the first ten integers.

FILES

/usr/lib/lib.b mathematical library

SEE ALSO

dc (I), C Reference Manual, "BC – An Arbitrary Precision Desk-Calculator Language."

BUGS

No &&, || yet.
for statement must have all three E's
quit is interpreted when read, not when executed.

CAT (I) CAT (I)

NAME

cat – concatenate and print

SYNOPSIS

cat file ...

DESCRIPTION

Cat reads each file in sequence and writes it on the standard output. Thus

cat file

prints the file, and

cat file1 file2 >file3

concatenates the first two files and places the result on the third.

If no input file is given, or if the argument '–' is encountered, *cat* reads from the standard input file.

SEE ALSO

pr (I), cp (I)

DIAGNOSTICS

None; if a file cannot be found, it is ignored.

BUGS

cat x y >x and **cat x y >y** should be avoided.

NAME

cc – C compiler

SYNOPSIS

cc [−c] [−p] [−f] [−O] [−S] [−P] file ...

DESCRIPTION

Cc is the UNIX C compiler. It accepts three types of arguments:

Arguments whose names end with '.c' are taken to be C source programs; they are compiled, and each object program is left on the file whose name is that of the source with '.o' substituted for '.c'. The '.o' file is normally deleted, however, if a single C program is compiled and loaded all at one go.

The following flags are interpreted by *cc*. See *ld* (I) for load-time flags.

−c Suppress the loading phase of the compilation, and force an object file to be produced even if only one program is compiled.

−p Arrange for the compiler to produce code which counts the number of times each routine is called; also, if loading takes place, replace the standard startup routine by one which automatically calls the *monitor* (III) subroutine at the start and arranges to write out a *mon.out* file at normal termination of execution of the object program. An execution profile can then be generated by use of *prof* (I).

−f In systems without hardware floating-point, use a version of the C compiler which handles floating-point constants and loads the object program with the floating-point interpreter. Do not use if the hardware is present.

−O Invoke an object-code optimizer.

−S Compile the named C programs, and leave the assembler-language output on corresponding files suffixed '.s'.

−P Run only the macro preprocessor on the named C programs, and leave the output on corresponding files suffixed '.i'.

Other arguments are taken to be either loader flag arguments, or C-compatible object programs, typically produced by an earlier *cc* run, or perhaps libraries of C-compatible routines. These programs, together with the results of any compilations specified, are loaded (in the order given) to produce an executable program with name **a.out.**

FILES

file.c	input file
file.o	object file
a.out	loaded output
/tmp/ctm?	temporary
/lib/c[01]	compiler
/lib/fc[01]	floating-point compiler
/lib/c2	optional optimizer
/lib/crt0.o	runtime startoff
/lib/mcrt0.o	runtime startoff of profiling
/lib/fcrt0.o	runtime startoff for floating-point interpretation
/lib/libc.a	C library; see section III.
/lib/liba.a	Assembler library used by some routines in libc.a

SEE ALSO

"Programming in C– a tutorial," C Reference Manual, monitor (III), prof (I), cdb (I), ld (I).

DIAGNOSTICS

The diagnostics produced by C itself are intended to be self-explanatory. Occasional messages may be produced by the assembler or loader. Of these, the most mystifying are from the assembler, in particular "m," which means a multiply-defined external symbol (function or data).

CDB (I)

CDB (I)

NAME

cdb – C debugger

SYNOPSIS

cdb [core [a.out]]

DESCRIPTION

Cdb is a debugging program for use with C programs. It is by no means completed, and this section is essentially only a placeholder for the actual description.

Even the present *cdb* has one useful feature: the command

$

will give a stack trace of the core image of a terminated C program. The calls are listed in the order made; the actual arguments to each routine are given in octal.

SEE ALSO

cc (I), db (I), C Reference Manual

BUGS

CHDIR (I)

CHDIR (I)

NAME

chdir – change working directory

SYNOPSIS

chdir directory

DESCRIPTION

Directory becomes the new working directory. The process must have execute (search) permission in *directory*.

Because a new process is created to execute each command, *chdir* would be ineffective if it were written as a normal command. It is therefore recognized and executed by the Shell.

SEE ALSO

sh (I), pwd (I)

BUGS

CHMOD (I) CHMOD (I)

NAME

chmod – change mode

SYNOPSIS

chmod octal file ...

DESCRIPTION

The octal mode replaces the mode of each of the files. The mode is constructed from the OR of the following modes:

4000	set user ID on execution
2000	set group ID on execution
0400	read by owner
0200	write by owner
0100	execute (search in directory) by owner
0070	read, write, execute (search) by group
0007	read, write, execute (search) by others

Only the owner of a file (or the super-user) may change its mode.

SEE ALSO

ls (I), chmod (II)

BUGS

CMP (I) **CMP (I)**

NAME

cmp – compare two files

SYNOPSIS

cmp [−s] [−l] file1 file2

DESCRIPTION

The two files are compared. Under default options, *cmp* makes no comment if the files are the same; if they differ, it announces the byte and line number at which the difference occurred. If one file is an initial subsequence of the other, that fact is noted. Moreover, return code 0 is yielded for identical files, 1 for different files, and 2 for an inaccessible or missing argument.

The optional argument −s is used to make a silent compare and only set the return code. The optional argument −l prints all differences in octal and can be used to compare binary files.

SEE ALSO

diff (I), comm (I)

BUGS

COMM (I) COMM (I)

NAME

comm – print lines common to two files

SYNOPSIS

comm [– [**123**]] file1 file2

DESCRIPTION

Comm reads *file1* and *file2,* which should be sorted, and produces a three column output: lines only in *file1;* lines only in *file2;* and lines in both files. The filename '–' means the standard input.

Flags 1, 2, or 3 suppress printing of the corresponding column. Thus **comm –12** prints only the lines common to the two files; **comm –23** prints only lines in the first file but not in the second; **comm –123** is a no-op.

SEE ALSO

cmp (I), diff (I)

BUGS

CP (I) CP (I)

NAME

cp – copy

SYNOPSIS

cp file1 file2

DESCRIPTION

The first file is copied onto the second. The mode and owner of the target file are preserved if it already existed; the mode of the source file is used otherwise.

If *file2* is a directory, then the target file is a file in that directory with the file-name of *file1*.

It is forbidden to copy a file onto itself.

SEE ALSO

cat (I), pr (I), mv (I)

BUGS

CREF (I) CREF (I)

NAME

cref − make cross reference listing

SYNOPSIS

cref [**−acilostux123**] name ...

DESCRIPTION

Cref makes a cross reference listing of program files in assembler or C format. The files named as arguments in the command line are searched for symbols in the appropriate syntax.

The output report is in four columns:

(1)	(2)	(3)	(4)
symbol	file	see below	text as it appears in file

Cref may use either an *ignore* file or an *only* file. If the **−i** option is given, the next argument is taken to be an *ignore* file; if the **−o** option is given, the next argument is taken to be an *only* file. *Ignore* and *only* files are lists of symbols separated by new lines. All symbols in an *ignore* file are ignored in columns (1) and (3) of the output. If an *only* file is given, only symbols in that file appear in column (1). At most one of **−i** and **−o** may be used. The default setting is **−i**. Assembler predefined symbols or C keywords are ignored.

The **−s** option causes current symbols to be put in column 3. In the assembler, the current symbol is the most recent name symbol; in C, it is the current function name. The **−l** option causes the line number within the file to be put in column 3.

The **−t** option causes the next available argument to be used as the name of the intermediate temporary file (instead of /tmp/crt??). The file is created and is not removed at the end of the process. The format of the output under this option is not as above.

Options:

- **a** assembler format (default)
- **c** C format input
- **i** use *ignore* file (see above)
- **l** put line number in col. 3 (instead of current symbol)
- **o** use *only* file (see above)
- **s** current symbol in col. 3 (default)
- **t** user supplied temporary file
- **u** print only symbols that occur exactly once
- **x** print only C external symbols
- **1** sort output on column 1 (default)
- **2** sort output on column 2
- **3** sort output on column 3

FILES

/tmp/crt??	temporaries
/usr/lib/aign	default assembler *ignore* file
/usr/lib/cign	default C *ignore* file
/usr/bin/crpost	post processor
/usr/bin/upost	post processor for **−u** option
/bin/sort	used to sort temporaries

SEE ALSO

as (I), cc (I)

BUGS

DATE (I) **DATE (I)**

NAME

date – print and set the date

SYNOPSIS

date [mmddhhmm[yy]]

DESCRIPTION

If no argument is given, the current date is printed to the second. If an argument is given, the current date is set. The first *mm* is the month number; *dd* is the day number in the month; *hh* is the hour number (24 hour system); the second *mm* is the minute number; *yy* is the last 2 digits of the year number and is optional. For example:

date 10080045

sets the date to Oct 8, 12:45 AM. The current year is the default if no year is mentioned. The system operates in GMT. *Date* takes care of the conversion to and from local standard and daylight time.

BUGS

It is difficult to remain current with the rules for DST.

NAME

db – debug

SYNOPSIS

db [core [namelist]] [–]

DESCRIPTION

Unlike many debugging packages *db* is not loaded as part of the core image which it is used to examine; instead it examines files. Typically, the file will be either a core image produced after a fault or the binary output of the assembler. *Core* is the file being debugged; if omitted **core** is assumed. *Namelist* is a file containing a symbol table. If it is omitted, the symbol table is obtained from the file being debugged, or if not there from **a.out.** If no appropriate name list file can be found, *db* can still be used but some of its symbolic facilities become unavailable.

For the meaning of the optional third argument, see the last paragraph below.

The format for most *db* requests is an address followed by a one character command. Addresses are expressions built up as follows:

1. A name has the value assigned to it when the input file was assembled. It may be relocatable or not depending on the use of the name during the assembly.
2. An octal number is an absolute quantity with the appropriate value.
3. A decimal number immediately followed by '.' is an absolute quantity with the appropriate value.
4. An octal number immediately followed by **r** is a relocatable quantity with the appropriate value.
5. The symbol . indicates the current pointer of *db*. The current pointer is set by many *db* requests.
6. A * before an expression forms an expression whose value is the number in the word addressed by the first expression. A * alone is equivalent to '*.'.
7. Expressions separated by + or blank are expressions with value equal to the sum of the components. At most one of the components may be relocatable.
8. Expressions separated by – form an expression with value equal to the difference between the components. If the right component is relocatable, the left component must be relocatable.
9. Expressions are evaluated left to right.

Names for registers are built in:

r0 ... r5
sp
pc
fr0 ... fr5

These may be examined. Their values are deduced from the contents of the stack in a core image file. They are meaningless in a file that is not a core image.

If no address is given for a command, the current address (also specified by ".") is assumed. In general, "." points to the last word or byte printed by *db*.

There are *db* commands for examining locations interpreted as numbers, machine instructions, ASCII characters, and addresses. For numbers and characters, either bytes or words may be examined. The following commands are used to examine the specified file.

/ The addressed word is printed in octal.

\ The addressed byte is printed in octal.

" The addressed word is printed as two ASCII characters.

' The addressed byte is printed as an ASCII character.

` The addressed word is printed in decimal.

? The addressed word is interpreted as a machine instruction and a symbolic form of the instruction, including symbolic addresses, is printed. Often, the result will appear exactly as it was written in the source program.

& The addressed word is interpreted as a symbolic address and is printed as the name of the symbol whose value is closest to the addressed word, possibly followed by a signed offset.

<nl> (i. e., the character "new line") This command advances the current location counter "." and prints the resulting location in the mode last specified by one of the above requests.

^ This character decrements "." and prints the resulting location in the mode last selected by one of the above requests. It is a converse to <nl>.

% Exit.

Odd addresses to word-oriented commands are rounded down. The incrementing and decrementing of "." done by the <**nl**> and ^ requests is by one or two depending on whether the last command was word or byte oriented.

The address portion of any of the above commands may be followed by a comma and then by an expression. In this case that number of sequential words or bytes specified by the expression is printed. "." is advanced so that it points at the last thing printed.

There are two commands to interpret the value of expressions.

= When preceded by an expression, the value of the expression is typed in octal. When not preceded by an expression, the value of "." is indicated. This command does not change the value of ".".

: An attempt is made to print the given expression as a symbolic address. If the expression is relocatable, that symbol is found whose value is nearest that of the expression, and the symbol is typed, followed by a sign and the appropriate offset. If the value of the expression is absolute, a symbol with exactly the indicated value is sought and printed if found; if no matching symbol is discovered, the octal value of the expression is given.

The following command may be used to patch the file being debugged.

! This command must be preceded by an expression. The value of the expression is stored at the location addressed by the current value of ".". The opcodes do not appear in the symbol table, so the user must assemble them by hand.

The following command is used after a fault has caused a core image file to be produced.

$ causes the fault type and the contents of the general registers and several other registers to be printed both in octal and symbolic format. The values are as they were at the time of the fault.

For some purposes, it is important to know how addresses typed by the user correspond with locations in the file being debugged. The mapping algorithm employed by *db* is non-trivial for two reasons: First, in an **a.out** file, there is a 20(8) byte header which will not appear when the file is loaded into core for execution. Therefore, apparent location 0 should correspond with actual file offset 20. Second, addresses in core images do not correspond with the addresses used by the program because in a core image there is a header containing the system's per-process data for the dumped process, and also because the stack is stored contiguously with the text and data part of the core image rather than at the highest possible locations. *Db* obeys the following rules:

If exactly one argument is given, and if it appears to be an **a.out** file, the 20-byte header is skipped during addressing, i.e., 20 is added to all addresses typed. As a consequence, the header can be examined beginning at location −20.

If exactly one argument is given and if the file does not appear to be an **a.out** file, no mapping is done.

If zero or two arguments are given, the mapping appropriate to a core image file is employed. This means that locations above the program break and below the stack effectively do not exist (and are not, in fact, recorded in the core file). Locations above the user's stack pointer are mapped, in looking at the core file, to the place where they are really stored. The per-process data kept by the system, which is stored in the first part of the core file, cannot currently be examined (except by **$**).

If one wants to examine a file which has an associated name list, but is not a core image file, the last argument "−" can be used (actually the only purpose of the last argument is to make the number of arguments not equal to two). This feature is used most frequently in examining the memory file /dev/mem.

SEE ALSO

as (I), core (V), a.out (V), od (I)

DIAGNOSTICS

"File not found" if the first argument cannot be read; otherwise "?".

BUGS

There should be some way to examine the registers and other per-process data in a core image; also there should be some way of specifying double-precision addresses. It does not know yet about shared text segments.

DC (I)

DC (I)

NAME

dc – desk calculator

SYNOPSIS

dc [file]

DESCRIPTION

Dc is an arbitrary precision arithmetic package. Ordinarily it operates on decimal integers, but one may specify an input base, output base, and a number of fractional digits to be maintained. The overall structure of *dc* is a stacking (reverse Polish) calculator. If an argument is given, input is taken from that file until its end, then from the standard input. The following constructions are recognized:

number
The value of the number is pushed on the stack. A number is an unbroken string of the digits 0-9. It may be preceded by an underscore _ to input a negative number. Numbers may contain decimal points.

+ – * % ^
The top two values on the stack are added (+), subtracted (–), multiplied (*), divided (/), remaindered (%), or exponentiated (^). The two entries are popped off the stack; the result is pushed on the stack in their place. Any fractional part of an exponent is ignored.

s*x* The top of the stack is popped and stored into a register named *x*, where *x* may be any character. If the **s** is capitalized, *x* is treated as a stack and the value is pushed on it.

l*x* The value in register *x* is pushed on the stack. The register *x* is not altered. All registers start with zero value. If the **l** is capitalized, register *x* is treated as a stack and its top value is popped onto the main stack.

d The top value on the stack is duplicated.

p The top value on the stack is printed. The top value remains unchanged.

f All values on the stack and in registers are printed.

q exits the program. If executing a string, the recursion level is popped by two. If **q** is capitalized, the top value on the stack is popped and the string execution level is popped by that value.

x treats the top element of the stack as a character string and executes it as a string of dc commands.

[... **]** puts the bracketed ascii string onto the top of the stack.

<*x* >*x* =*x*
The top two elements of the stack are popped and compared. Register *x* is executed if they obey the stated relation.

v replaces the top element on the stack by its square root. Any existing fractional part of the argument is taken into account, but otherwise the scale factor is ignored.

! interprets the rest of the line as a UNIX command.

c All values on the stack are popped.

i The top value on the stack is popped and used as the number radix for further input.

o The top value on the stack is popped and used as the number radix for further output.

k the top of the stack is popped, and that value is used as a non-negative scale factor: the appropriate number of places are printed on output, and maintained during multiplication, division, and exponentiation. The interaction of scale factor, input base, and output base will be reasonable if all are changed together.

z The stack level is pushed onto the stack.

? A line of input is taken from the input source (usually the console) and executed.

An example which prints the first ten values of n! is

```
[la1+dsa*pla10>y]sy
0sa1
lyx
```

SEE ALSO

bc (I), which is a preprocessor for *dc* providing infix notation and a C-like syntax which implements functions and reasonable control structures for programs.

DIAGNOSTICS

(x) ? for unrecognized character x.
(x) ? for not enough elements on the stack to do what was asked by command x.
'Out of space' when the free list is exhausted (too many digits).
'Out of headers' for too many numbers being kept around.
'Out of pushdown' for too many items on the stack.
'Nesting Depth' for too many levels of nested execution.

BUGS

DD (I) **DD (I)**

NAME

dd – convert and copy a file

SYNOPSIS

dd [option=value] ...

DESCRIPTION

Dd copies the specified input file to the specified output with possible conversions. The standard input and output are used by default. The input and output block size may be specified to take advantage of raw physical I/O.

option	*values*
if=	input file name; standard input is default
of=	output file name; standard output is default
ibs=	input block size (default 512)
obs=	output block size (default 512)
bs=	set both input and output block size, superseding *ibs* and *obs;* also, if no conversion is specified, it is particularly efficient since no copy need be done
cbs=*n*	conversion buffer size
skip=*n*	skip *n* input records before starting copy
count=*n*	copy only *n* input records
conv=ascii	convert EBCDIC to ASCII
ebcdic	convert ASCII to EBCDIC
lcase	map alphabetics to lower case
ucase	map alphabetics to upper case
swab	swap every pair of bytes
noerror	do not stop processing on an error
sync	pad every input record to *ibs*
... , ...	several comma-separated conversions

Where sizes are specified, a number of bytes is expected. A number may end with **k, b** or **w** to specify multiplication by 1024, 512, or 2 respectively. Also a pair of numbers may be separated by **x** to indicate a product.

Cbs is used only if *ascii* or *ebcdic* conversion is specified. In the former case *cbs* characters are placed into the conversion buffer, converted to ASCII, and trailing blanks trimmed and newline added before sending the line to the output. In the latter case ASCII characters are read into the conversion buffer, converted to EBCDIC, and blanks added to make up an output record of size *cbs.*

After completion, *dd* reports the number of whole and partial input and output blocks.

For example, to read an EBCDIC tape blocked ten 80-byte EBCDIC card images per record into the ASCII file *x:*

dd if=/dev/rmt0 of=x ibs=800 cbs=80 conv=ascii,lcase

Note the use of raw magtape. *Dd* is especially suited to I/O on the raw physical devices because it allows reading and writing in arbitrary record sizes.

SEE ALSO

cp (I)

BUGS

The ASCII/EBCDIC conversion tables are taken from the 256 character standard in the CACM Nov, 1968. It is not clear how this relates to real life.

Newlines are inserted only on conversion to ASCII; padding is done only on conversion to EBCDIC. There should be separate options.

DIFF (I) DIFF (I)

NAME

diff – differential file comparator

SYNOPSIS

diff [**–12**] name1 name2

DESCRIPTION

Diff tells what lines must be changed in two files to bring them into agreement. If either file is a directory, then a file in that directory whose file-name is the same as the file-name of the other file is used instead. The normal output contains lines of these forms:

n1 a *n3,n4*
n1,n2 d *n3*
n1,n2 c *n3,n4*

These lines resemble *ed* commands to convert file *name1* into file *name2*. The numbers after the letters pertain to file *name2*. In fact, by exchanging 'a' for 'd' and reading backward one may ascertain equally how to convert file *name2* into *name1*. As in *ed*, identical pairs where *n1* = *n2* or *n3* = *n4* are abbreviated as a single number.

Following each of these lines come all the lines that are affected in the first file flagged by '<', then all the lines that are affected in the second file flagged by '>'.

Under the **–1** option, the output of *diff* is a script of *a*, *c* and *d* commands for the editor *ed*, which will recreate file *name1* from file *name2*, and vice versa under the **–2** option. In this connection, the following shell program may help maintain multiple versions of a file. Only an ancestral file ($1) and a chain of version-to-version *ed* scripts ($2,$3,...) made by *diff* need be on hand. A 'latest version' appears on the standard output.

```
(cat $2 ... $9; echo "1,$p") | ed – $1
```

Except for occasional 'jackpots', *diff* finds a smallest sufficient set of file differences.

SEE ALSO

cmp (I), comm (I), ed (I)

DIAGNOSTICS

'jackpot' – To speed things up, the program uses hashing. You have stumbled on a case where there is a chance that this has resulted in a difference being called where none actually existed. Sometimes reversing the order of files will make a jackpot go away.

BUGS

Editing scripts produced under the – option are naive about creating lines consisting of a single

DSW (I) **DSW (I)**

NAME

dsw – delete interactively

SYNOPSIS

dsw [directory]

DESCRIPTION

For each file in the given directory ('.' if not specified) *dsw* types its name. If **y** is typed, the file is deleted; if **x**, *dsw* exits; if new-line, the file is not deleted; if anything else, *dsw* asks again.

SEE ALSO

rm (I)

BUGS

The name *dsw* is a carryover from the ancient past.

DU (I) DU (I)

NAME

du – summarize disk usage

SYNOPSIS

du [**–s**] [**–a**] [name ...]

DESCRIPTION

Du gives the number of blocks contained in all files and (recursively) directories within each specified directory or file *name*. If *name* is missing, '.' is used.

The optional argument **–s** causes only the grand total to be given. The optional argument **–a** causes an entry to be generated for each file. Absence of either causes an entry to be generated for each directory only.

A file which has two links to it is only counted once.

BUGS

Non-directories given as arguments (not under **–a** option) are not listed.

Removable file systems do not work correctly since i-numbers may be repeated while the corresponding files are distinct. *Du* should maintain an i-number list per root directory encountered.

NAME

echo – echo arguments

SYNOPSIS

echo [arg ...]

DESCRIPTION

Echo writes its arguments in order as a line on the standard output file. It is mainly useful for producing diagnostics in command files.

If the last character of a line to be echoed is followed by a space (which must be quoted), then the echoed line will not be followed by a newline.

BUGS

NAME

ed – text editor

SYNOPSIS

ed [–] [name]

DESCRIPTION

Ed is the standard text editor.

If a *name* argument is given, *ed* simulates an *e* command (see below) on the named file; that is to say, the file is read into *ed's* buffer so that it can be edited. The optional – suppresses the printing of character counts by *e*, *r*, and *w* commands.

Ed operates on a copy of any file it is editing; changes made in the copy have no effect on the file until a *w* (write) command is given. The copy of the text being edited resides in a temporary file called the *buffer*. There is only one buffer.

Commands to *ed* have a simple and regular structure: zero or more *addresses* followed by a single character *command*, possibly followed by parameters to the command. These addresses specify one or more lines in the buffer. Every command which requires addresses has default addresses, so that the addresses can often be omitted.

In general, only one command may appear on a line. Certain commands allow the input of text. This text is placed in the appropriate place in the buffer. While *ed* is accepting text, it is said to be in *input mode*. In this mode, no commands are recognized; all input is merely collected. Input mode is left by typing a period '.' alone at the beginning of a line.

Ed supports a limited form of *regular expression* notation. A regular expression specifies a set of strings of characters. A particular regular expression *matches* a string of characters when a line of text can be found that contains one of the desired character strings. The regular expressions allowed by *ed* are constructed as follows:

1. An ordinary character (not one of those discussed below) is a regular expression and matches that character.
2. A circumflex '^' at the beginning of a regular expression matches the empty string at the beginning of a line.
3. A currency symbol '$' at the end of a regular expression matches the null character at the end of a line.
4. A period '.' matches any character except a new-line character.
5. A regular expression followed by an asterisk '*' matches any number of adjacent occurrences (including zero) of the regular expression it follows.
6. A string of characters enclosed in square brackets '[ ]' matches any character in the string but no others. If, however, the first character of the string is a circumflex '^', the regular expression matches any character except new-line and the characters in the string.
7. The concatenation of regular expressions is a regular expression which matches the concatenation of the strings matched by the components of the regular expression.
8. A regular expression enclosed between the sequences '\(' and '\)'is identical to the unadorned expression; the construction has side effects discussed under the *s* command.
9. The null regular expression standing alone is equivalent to the last regular expression encountered.

Regular expressions are used in addresses to specify lines and in one command (see *s* below) to specify a portion of a line which is to be replaced. If it is desired to use one of the regular expression metacharacters as an ordinary character, that character may be preceded by '\'. This also applies to the character bounding the regular expression (often '/') and to '\' itself.

To understand addressing in *ed* it is necessary to know that at any time there is a *current line*. Generally speaking, the current line is the last line affected by a command; however, the exact effect on the current line is discussed under the description of the command. Addresses are constructed as follows.

1. The character '.' addresses the current line.
2. The character '$' addresses the last line of the buffer.
3. A decimal number *n* addresses the *n*-th line of the buffer.
4. ''*x*' addresses the line marked with the mark name character *x*, which must be a lower-case letter. Lines are marked with the *k* command described below.
5. A regular expression enclosed in slashes '/' addresses the first line found by searching toward the end of the buffer and stopping at the first line containing a string matching the regular expression. If necessary the search wraps around to the beginning of the buffer.
6. A regular expression enclosed in queries '?' addresses the first line found by searching toward the beginning of the buffer and stopping at the first line containing a string matching the regular expression. If necessary the search wraps around to the end of the buffer.
7. An address followed by a plus sign '+' or a minus sign '−' followed by a decimal number specifies that address plus (resp. minus) the indicated number of lines. The plus sign may be omitted.
8. If an address begins with '+' or '−' the addition or subtraction is taken with respect to the current line; e.g. '−5' is understood to mean '.−5'.
9. If an address ends with '+' or '−', then 1 is added (resp. subtracted). As a consequence of this rule and rule 8, the address '−' refers to the line before the current line. Moreover, trailing '+' and '−' characters have cumulative effect, so '−−' refers to the current line less 2.
10. To maintain compatibility with earlier versions of the editor, the character '^' in addresses is entirely equivalent to '−'.

Commands may require zero, one, or two addresses. Commands which require no addresses regard the presence of an address as an error. Commands which accept one or two addresses assume default addresses when insufficient are given. If more addresses are given than such a command requires, the last one or two (depending on what is accepted) are used.

Addresses are separated from each other typically by a comma ','. They may also be separated by a semicolon ';'. In this case the current line '.' is set to the previous address before the next address is interpreted. This feature can be used to determine the starting line for forward and backward searches ('/', '?'). The second address of any two-address sequence must correspond to a line following the line corresponding to the first address.

In the following list of *ed* commands, the default addresses are shown in parentheses. The parentheses are not part of the address, but are used to show that the given addresses are the default.

As mentioned, it is generally illegal for more than one command to appear on a line. However, any command may be suffixed by 'p' or by 'l', in which case the current line is either printed or listed respectively in the way discussed below.

(.) a
<text>
.

The append command reads the given text and appends it after the addressed line. '.' is left on the last line input, if there were any, otherwise at the addressed line. Address '0' is legal for this command; text is placed at the beginning of the buffer.

(.,.)c
<text>
.

The change command deletes the addressed lines, then accepts input text which replaces these lines. '.' is left at the last line input; if there were none, it is left at the first line not deleted.

(.,.) d

The delete command deletes the addressed lines from the buffer. The line originally after the last line deleted becomes the current line; if the lines deleted were originally at the end, the new last line becomes the current line.

e filename

The edit command causes the entire contents of the buffer to be deleted, and then the named file to be read in. '.' is set to the last line of the buffer. The number of characters read is typed. 'filename' is remembered for possible use as a default file name in a subsequent *r* or *w* command.

f filename

The filename command prints the currently remembered file name. If 'filename' is given, the currently remembered file name is changed to 'filename'.

(1,$) g/regular expression/command list

In the global command, the first step is to mark every line which matches the given regular expression. Then for every such line, the given command list is executed with '.' initially set to that line. A single command or the first of multiple commands appears on the same line with the global command. All lines of a multi-line list except the last line must be ended with '\'. The *a*, *i*, and *c* commands and associated input are permitted; the '.' terminating input mode may be omitted if it would be on the last line of the command list. The (global) commands, *g* and *v*, are not permitted in the command list.

(.)i
<text>
.

This command inserts the given text before the addressed line. '.' is left at the last line input; if there were none, at the addressed line. This command differs from the *a* command only in the placement of the text.

(.)k*x*

The mark command marks the addressed line with name *x*, which must be a lower-case letter. The address form '*x*' then addresses this line.

(.,.)l

The list command prints the addressed lines in an unambiguous way: non-graphic characters are printed in octal, and long lines are folded. An *l* command may follow any other on the same line.

(.,.)m*a*

The move command repositions the addressed lines after the line addressed by *a*. The last of the moved lines becomes the current line.

(.,.)p

The print command prints the addressed lines. '.' is left at the last line printed. The *p* command may be placed on the same line after any command.

q

The quit command causes *ed* to exit. No automatic write of a file is done.

($) r filename

The read command reads in the given file after the addressed line. If no file name is given, the remembered file name, if any, is used (see *e* and *f* commands). The remembered file name is not changed unless 'filename' is the very first file name mentioned. Address '0' is legal for *r* and causes the file to be read at the beginning of the buffer. If

the read is successful, the number of characters read is typed. '.' is left at the last line read in from the file.

(. , .) s/regular expression/replacement/ or,
(. , .) s/regular expression/replacement/g
The substitute command searches each addressed line for an occurrence of the specified regular expression. On each line in which a match is found, all matched strings are replaced by the replacement specified, if the global replacement indicator 'g' appears after the command. If the global indicator does not appear, only the first occurrence of the matched string is replaced. It is an error for the substitution to fail on all addressed lines. Any character other than space or new-line may be used instead of '/' to delimit the regular expression and the replacement. '.' is left at the last line substituted.

An ampersand '&' appearing in the replacement is replaced by the string matching the regular expression. The special meaning of '&' in this context may be suppressed by preceding it by '\'. As a more general feature, the characters '*n*', where *n* is a digit, are replaced by the text matched by the *n*-th regular subexpression enclosed between '\(' and '\)'. When nested, parenthesized subexpressions are present, *n* is determined by counting occurrences of '\(' starting from the left.

Lines may be split by substituting new-line characters into them. The new-line in the replacement string must be escaped by preceding it by '\'.

(. , .) t *a*
This command acts just like the *m* command, except that a copy of the addressed lines is placed after address *a* (which may be 0). '.' is left on the last line of the copy.

(1,$) v/regular expression/command list
This command is the same as the global command except that the command list is executed with '.' initially set to every line *except* those matching the regular expression.

(1,$) w filename
The write command writes the addressed lines onto the given file. If the file does not exist, it is created mode 666 (readable and writeable by everyone). The remembered file name is *not* changed unless 'filename' is the very first file name mentioned. If no file name is given, the remembered file name, if any, is used (see *e* and *f* commands). '.' is unchanged. If the command is successful, the number of characters written is typed.

($) =
The line number of the addressed line is typed. '.' is unchanged by this command.

!UNIX command
The remainder of the line after the '!' is sent to UNIX to be interpreted as a command. '.' is unchanged.

(.+1) <newline>
An address alone on a line causes the addressed line to be printed. A blank line alone is equivalent to '.+1p'; it is useful for stepping through text.

If an interrupt signal (ASCII DEL) is sent, *ed* prints a '?' and returns to its command level.

The following size limitations apply: 512 characters per line, 256 characters per global command list, 64 characters per file name, and 128K characters in the temporary file. The limit on the number of lines depends on the amount of core: each line takes 1 word.

FILES
/tmp/#, temporary; '#' is the process number (in octal).

DIAGNOSTICS
'?' for errors in commands; 'TMP' for temporary file overflow.

SEE ALSO
A Tutorial Introduction to the ED Text Editor (B. W. Kernighan)

BUGS

The *s* command causes all marks to be lost on lines changed.

EXIT (I) EXIT (I)

NAME

exit – terminate command file

SYNOPSIS

exit [rtncode]

DESCRIPTION

Exit performs a seek to the end of its standard input file. Thus, if it is invoked inside a file of commands, upon return from *exit* the shell will discover an end-of-file and terminate. The optional numeric argument *rtncode,* if given, is used by *exit* for the return code; otherwise the return code is set to 0.

SEE ALSO

if (I), goto (I), sh (I)

BUGS

FC (I) **FC (I)**

NAME

fc – Fortran compiler

SYNOPSIS

fc [**–c**] sfile1.f ... ofile1 ...

DESCRIPTION

Fc is the UNIX Fortran compiler. It accepts three types of arguments:

Arguments whose names end with '.f' are assumed to be Fortran source program units; they are compiled, and the object program is left on the file sfile1.o (i.e. the file whose name is that of the source with '.o' substituted for '.f').

Other arguments (except for **–c**) are assumed to be either loader flags, or object programs, typically produced by an earlier *fc* run, or perhaps libraries of Fortran-compatible routines. These programs, together with the results of any compilations specified, are loaded (in the order given) to produce an executable program with name **a.out.**

The **–c** argument suppresses the loading phase, as does any syntax error in any of the routines being compiled.

The following is a list of differences between *fc* and ANSI standard Fortran (also see the BUGS section):

1. Arbitrary combination of types is allowed in expressions. Not all combinations are expected to be supported at runtime. All of the normal conversions involving integer, real, double precision and complex are allowed.
2. Two forms of "implicit" statements are recognized: **implicit integer /i–n/** or **implicit integer (i–n).**
3. The types doublecomplex, logical*1, integer*1, integer*2, integer*4 (same as integer), real*4 (real), and real*8 (double precision) are supported.
4. **&** as the first character of a line signals a continuation card.
5. **c** as the first character of a line signals a comment.
6. All keywords are recognized in lower case.
7. The notion of 'column 7' is not implemented.
8. G-format input is free form– leading blanks are ignored, the first blank after the start of the number terminates the field.
9. A comma in any numeric or logical input field terminates the field.
10. There is no carriage control on output.
11. A sequence of *n* characters in double quotes '"' is equivalent to *n* **h** followed by those characters.
12. In **data** statements, a hollerith string may initialize an array or a sequence of array elements.
13. The number of storage units requested by a binary **read** must be identical to the number contained in the record being read.
14. If the first character in an input file is "#", a preprocessor identical to the C preprocessor is called, which implements "#define" and "#include" preprocessor statements. (See the C reference manual for details.) The preprocessor does not recognize Hollerith strings written with *n*.

In I/O statements, only unit numbers 0-19 are supported. Unit number *n* refers to file fort*nn:* (e.g. unit 9 is file 'fort09'). For input, the file must exist; for output, it will be created. Unit 5 is permanently associated with the standard input file; unit 6 with the standard output file. Also see *setfil* (III) for a way to associate unit numbers with named files.

FILES

a.out	loaded output
f.tmp[123]	temporary (deleted)
/usr/fort/fc1	compiler proper
/lib/fr0.o	runtime startoff
/lib/filib.a	interpreter library
/lib/libf.a	built-in functions, etc.
/lib/liba.a	system library

SEE ALSO

ANSI standard, ld (I) for loader flags. For some subroutines, try ierror, getarg, setfil (III).

DIAGNOSTICS

Compile-time diagnostics are given in English, accompanied if possible with the offending line number and source line with an underscore where the error occurred. Runtime diagnostics are given by number as follows:

1 invalid log argument
2 bad arg count to amod
3 bad arg count to atan2
4 excessive argument to cabs
5 exp too large in cexp
6 bad arg count to cmplx
7 bad arg count to dim
8 excessive argument to exp
9 bad arg count to idim
10 bad arg count to isign
11 bad arg count to mod
12 bad arg count to sign
13 illegal argument to sqrt
14 assigned/computed goto out of range
15 subscript out of range
16 real**real overflow
17 (negative real)**real
100 illegal I/O unit number
101 inconsistent use of I/O unit
102 cannot create output file
103 cannot open input file
104 EOF on input file
105 illegal character in format
106 format does not begin with (
107 no conversion in format but non-empty list
108 excessive parenthesis depth in format
109 illegal format specification
110 illegal character in input field
111 end of format in hollerith specification
112 bad argument to setfil
120 bad argument to ierror
999 unimplemented input conversion

BUGS

The following is a list of those features not yet implemented:
arithmetic statement functions
scale factors on input
Backspace statement.

FILE (I) FILE (I)

NAME

file – determine format of file

SYNOPSIS

file files

DESCRIPTION

File will examine each of its arguments and give a guess as to the contents of the file. It is the only program that will give device numbers of special files.

BUGS

If the file is not instantly recognized, its type is given as 'unknown'. There should be some heuristic to recognize source file 'signatures' in each of the standard languages.

FIND (I)

FIND (I)

NAME

find – find files

SYNOPSIS

find pathname expression

DESCRIPTION

Find recursively descends the directory hierarchy from *pathname* seeking files that match a boolean *expression* written in the primaries given below. In the descriptions, the argument *n* is used as a decimal integer where +*n* means more than *n*, −*n* means less than *n* and *n* means exactly *n*.

−name filename	True if the *filename* argument matches the current file name. Normal *Shell* argument syntax may be used if escaped (watch out for '[', '?' and '*').
−perm onum	True if the file permission flags exactly match the octal number *onum* (see *chmod* (I)). If *onum* is prefixed by a minus sign, more flag bits (017777, see *stat* (II)) become significant and the flags are compared: *(flags&onum)==onum*.
−type *c*	True if the type of the file is *c*, where *c* is **b**, **c**, **d** or **f** for block special file, character special file, directory or plain file.
−links *n*	True if the file has *n* links.
−user uname	True if the file belongs to the user *uname*.
−size *n*	True if the file is *n* blocks long (512 bytes per block).
−atime *n*	True if the file has been accessed in *n* days.
−mtime *n*	True if the file has been modified in *n* days.
−exec command	True if the executed command returns exit status zero (most commands do). The end of the command is punctuated by an escaped semicolon. A command argument '{}' is replaced by the current pathname.
−ok command	Like **−exec** except that the generated command line is printed with a question mark first, and is executed only if the user responds **y**.
−print	Always true; causes the current pathname to be printed.

The primaries may be combined with these operators (ordered by precedence):

!	prefix *not*
−a	infix *and*, second operand evaluated only if first is true
−o	infix *or*, second operand evaluated only if first is false
(expression)	parentheses for grouping. (Must be escaped.)

To remove files named 'a.out' and '*.o' not accessed for a week:

```
find / "(" −name a.out −o −name "*.o" ")" −a −atime +7 −a −exec rm {} ";"
```

FILES

/etc/passwd

SEE ALSO

sh (I), if (I), file system (V)

BUGS

There is no way to check device type.
Syntax should be reconciled with *if*.

GOTO (I)

GOTO (I)

NAME

goto – command transfer

SYNOPSIS

goto label

DESCRIPTION

Goto is allowed only when the Shell is taking commands from a file. The file is searched from the beginning for a line beginning with ':' followed by one or more spaces followed by the *label*. If such a line is found, the *goto* command returns. Since the read pointer in the command file points to the line after the label, the effect is to cause the Shell to transfer to the labelled line.

Note that to the Shell, any line beginning with a ':' is a comment.

SEE ALSO

sh (I)

BUGS

GREP (I) GREP (I)

NAME

grep – search a file for a pattern

SYNOPSIS

grep [**–v**] [**–b**] [**–c**] [**–n**] expression [file] ...

DESCRIPTION

Grep searches the input files (standard input default) for lines matching the regular expression. Normally, each line found is copied to the standard output. If the **–v** flag is used, all lines but those matching are printed. If the **–c** flag is used, only a count of matching lines is printed. If the **–n** flag is used, each line is preceded by its relative line number in the file. If the **–b** flag is used, each line is preceded by the block number on which it was found. This is sometimes useful in locating disk block numbers by context.

In all cases the file name is shown if there is more than one input file.

For a complete description of the regular expression, see *ed* (I). Care should be taken when using the characters $ * [^ | ( ) and \ in the regular expression as they are also meaningful to the Shell. It is generally necessary to enclose the entire *expression* argument in double quotes.

SEE ALSO

ed (I), sh (I)

BUGS

Lines are limited to 256 characters; longer lines are truncated.

NAME

if – conditional command

SYNOPSIS

if expr command [arg ...]

DESCRIPTION

If evaluates the expression *expr,* and if its value is true, executes the given *command* with the given arguments.

The following primitives are used to construct the *expr:*

–r file	true if the file exists and is readable.
–w file	true if the file exists and is writable.
s1 = s2	true if the strings *s1* and *s2* are equal.
s1 != s2	true if the strings *s1* and *s2* are not equal.
{ command } [n]	The bracketed command is executed to obtain the exit status. Status zero is considered *true.* The command must not be another *if.* The optional *n* is a valid condition code (0 = success, 4 = partial failure, 8 = total failure) When used, status <= n is considered to be *true.*

These primaries may be combined with the following operators:

!	unary negation operator
–a	binary *and* operator
–o	binary *or* operator
(expr)	parentheses for grouping.

–a has higher precedence than **–o.** Notice that all the operators and flags are separate arguments to *if* and hence must be surrounded by spaces. Notice also that parentheses are meaningful to the Shell and must be escaped.

SEE ALSO

sh (I), exit (II)

BUGS

KILL (I) KILL (I)

NAME

kill – terminate a process

SYNOPSIS

kill [–sig] processid ...

DESCRIPTION

Kills the specified processes. The process number of each asynchronous process started with '&' is reported by the Shell. Process numbers can also be found by using *ps* (I).

If process number 0 is used, then all processes belonging to the current user and associated with the same control typewriter are killed.

The killed process must belong to the current user unless he is the super-user.

If a signal number preceded by "–" is given as first argument, that signal is sent instead of *kill* (see *signal (II)*).

SEE ALSO

ps (I), sh (I), signal (II)

BUGS

LC (I) LC (I)

NAME

lc — LIL compiler

SYNOPSIS

lc [**−c**] [**−p**] [**−P**] file ...

DESCRIPTION

Lc is the UNIX LIL compiler. It accepts three types of arguments:

Arguments whose names end with '.l' are taken to be LIL source programs; they are compiled, and each object program is left on the file whose name is that of the source with '.o' substituted for '.l'. The '.o' file is normally deleted, however, if a single LIL program is compiled and loaded all at one go.

The following flags are interpreted by *lc*. See *ld* (I) for load-time flags.

−c Suppress the loading phase of the compilation, and force an object file to be produced even if only one program is compiled.

−p Arrange for the compiler to produce code which counts the number of times each routine is called; also, if loading takes place, replace the standard startup routine by one which automatically calls the *monitor* (III) subroutine at the start and arranges to write out a *mon.out* file at normal termination of execution of the object program. An execution profile can then be generated by use of *prof* (I).

−P Run only the macro preprocessor on the named LIL programs, and leave the output on corresponding files suffixed '.i'.

Other arguments are taken to be either loader flag arguments, or LIL-compatible object programs, typically produced by an earlier *lc* run, or perhaps libraries of LIL-compatible routines. These programs, together with the results of any compilations specified, are loaded (in the order given) to produce an executable program with name **a.out.**

FILES

file.l	input file
file.o	object file
a.out	loaded output
/tmp/ctm0?	temporary
/usr/lib/lil[12]	compiler
/lib/liba.a	Assembler library

SEE ALSO

monitor (III), prof (I), ld (I).

DIAGNOSTICS

The diagnostics produced by LIL itself are intended to be self-explanatory.

BUGS

LD (I) LD (I)

NAME

ld – link editor

SYNOPSIS

ld [**−sulxXrdni**] name ...

DESCRIPTION

Ld combines several object programs into one; resolves external references; and searches libraries. In the simplest case the names of several object programs are given, and *ld* combines them, producing an object module which can be either executed or become the input for a further *ld* run. (In the latter case, the **−r** option must be given to preserve the relocation bits.) The output of *ld* is left on **a.out**. This file is made executable only if no errors occurred during the load.

The argument routines are concatenated in the order specified. The entry point of the output is the beginning of the first routine.

If any argument is a library, it is searched exactly once at the point it is encountered in the argument list. Only those routines defining an unresolved external reference are loaded. If a routine from a library references another routine in the library, the referenced routine must appear after the referencing routine in the library. Thus the order of programs within libraries is important.

Ld understands several flag arguments which are written preceded by a '−'. Except for **−l**, they should appear before the file names.

−s 'strip' the output; that is, remove the symbol table and relocation bits to save space (but impair the usefulness of the debugger). This information can also be removed by *strip*.

−u take the following argument as a symbol and enter it as undefined in the symbol table. This is useful for loading wholly from a library, since initially the symbol table is empty and an unresolved reference is needed to force the loading of the first routine.

−l This option is an abbreviation for a library name. **−l** alone stands for '/lib/liba.a', which is the standard system library for assembly language programs. **−l***x* stands for '/lib/lib*x*.a' where *x* is any character. A library is searched when its name is encountered, so the placement of a **−l** is significant.

−x do not preserve local (non-.globl) symbols in the output symbol table; only enter external symbols. This option saves some space in the output file.

−X Save local symbols except for those whose names begin with 'L'. This option is used by *cc* to discard internally generated labels while retaining symbols local to routines.

−r generate relocation bits in the output file so that it can be the subject of another *ld* run. This flag also prevents final definitions from being given to common symbols, and suppresses the 'undefined symbol' diagnostics.

−d force definition of common storage even if the **−r** flag is present.

−n Arrange that when the output file is executed, the text (program) portion will be read-only and shared among all users executing the file. This involves moving the data areas up to the first possible 4K word boundary following the end of the text.

−i When the output file is executed, the program text and data areas will live in separate address spaces. The only difference between this option and **−n** is that here the data starts at location 0.

FILES

/lib/lib?.a libraries
a.out output file

SEE ALSO

arcv (I), as (I), ar (I)

DIAGNOSTICS

archive-name: old archive format!

The archive "archive—name" is still in old archive format. The loader will handle this properly; however, program *arcv* should be used to convert this archive to the new archive format.

BUGS

LN (I) LN (I)

NAME

ln – make a link

SYNOPSIS

ln name1 [name2]

DESCRIPTION

A link is a directory entry referring to a file; the same file (together with its size, all its protection information, etc) may have several links to it. There is no way to distinguish a link to a file from its original directory entry; any changes in the file are effective independently of the name by which the file is known.

Ln creates a link to an existing file *name1*. If *name2* is given, the link has that name; otherwise it is placed in the current directory and its name is the last component of *name1*.

It is forbidden to link to a directory or to link across file systems.

SEE ALSO

rm (I)

BUGS

Tp doesn't understand about links and makes one copy for each name by which a file is known; thus if the tape is extracted, several copies are restored and the information that links were involved is lost.

If *name2* is a directory, *ln* should make a link to the file *name1* in that directory with the name *name1*.

LOGIN (I) LOGIN (I)

NAME

login – sign onto UNIX

SYNOPSIS

login [username]

DESCRIPTION

The *login* command is used when a user initially signs onto UNIX, or it may be used at any time to change from one user to another. The latter case is the one summarized above and described here. See 'How to Get Started' for how to dial up initially.

If *login* is invoked without an argument, it asks for a user name, and, if appropriate, a password. Echoing is turned off (if possible) during the typing of the password, so it will not appear on the written record of the session.

After a successful login, accounting files are updated and the user is informed of the existence of *.mail*. If the message-of-the-day file, */etc/motd*, exists, it is printed on the user's terminal. *Login* initializes the user and group IDs and the working directory, then executes a command interpreter (usually *sh* (I)) according to specifications found in a password file.

Login is recognized by the Shell and executed directly (without forking).

FILES

/tmp/utmp	accounting
/usr/adm/wtmp	accounting
.mail	mail
/etc/motd	message-of-the-day
/etc/passwd	password file

SEE ALSO

init (VIII), getty (VIII), mail (I), passwd (I), passwd (V)

DIAGNOSTICS

'login incorrect,' if the name or the password is bad. 'No Shell,', 'cannot open password file,' 'no directory': consult a UNIX programming counselor.

BUGS

LPR (I) LPR (I)

NAME

lpr – line printer spooler

SYNOPSIS

lpr [–] [+] [+–]file ...

DESCRIPTION

Lpr arranges to have the line printer daemon print the file arguments.

Normally, each file is printed in the state it is found when the line printer daemon reads it. Files following a + will be copied before printing. Files following a – will be unlinked (removed) by *lpr* after printing.

If there are no arguments, then the standard input is read and on-line printed. Thus *lpr* may be used as a filter.

FILES

/usr/lpd/*	spool area
/etc/passwd	personal ident cards
/etc/lpd	daemon

SEE ALSO

lpd (VII), passwd (V)

BUGS

LS (I) LS (I)

NAME

ls – list contents of directory

SYNOPSIS

ls [**–ltasdruif**] name ...

DESCRIPTION

For each directory argument, *ls* lists the contents of the directory; for each file argument, *ls* repeats its name and any other information requested. The output is sorted alphabetically by default. When no argument is given, the current directory is listed. When several arguments are given, the arguments are first sorted appropriately, but file arguments appear before directories and their contents. There are several options:

–l list in long format, giving mode, number of links, owner, size in bytes, and time of last modification for each file. (See below.) If the file is a special file, the size field will contain the major and minor device numbers instead.

–t sort by time modified (latest first) instead of by name, as is normal

–a list all entries; usually those beginning with '.' are suppressed

–s give size in blocks for each entry

–d if argument is a directory, list only its name, not its contents (mostly used with **–l** to get status on directory)

–r reverse the order of sort to get reverse alphabetic or oldest first as appropriate

–u use time of last access instead of last modification for sorting (**–t**) or printing (**–l**)

–i print i-number in first column of the report for each file listed

–f force each argument to be interpreted as a directory and list the name found in each slot. This option turns off **–l**, **–t**, **–s**, and **–r**, and turns on **–a**; the order is the order in which entries appear in the directory.

The mode printed under the **–l** option contains 11 characters which are interpreted as follows: the first character is

d if the entry is a directory;
b if the entry is a block-type special file;
c if the entry is a character-type special file;
– if the entry is a plain file.

The next 9 characters are interpreted as three sets of three bits each. The first set refers to owner permissions, the next to permissions to others in the same user-group, and the last to all others. Within each set the three characters indicate permission to read, to write, or to execute the file as a program, respectively. For a directory, 'execute' permission is interpreted to mean permission to search the directory for a specified file. The permissions are indicated as follows:

r if the file is readable;
w if the file is writable;
x if the file is executable;
– if the indicated permission is not granted.

The group-execute permission character is given as **s** if the file has set-group-ID mode; likewise, the user-execute permission character is given as **s** if the file has set-user-ID mode.

FILES

/etc/passwd to get user ID's for **ls –l**.

BUGS

MAIL (I)

MAIL (I)

NAME

mail – send mail to designated users

SYNOPSIS

mail [**–yn**] [person ...]

DESCRIPTION

Mail with no argument searches for a file called *.mail,* prints it if it is nonempty, then asks if it should be saved. If the answer is **y**, the mail is added to *mbox*. Finally *.mail* is truncated to zero length. To leave *.mail,* hit 'delete.' The question can be answered on the command line with the argument '–y' or '–n'.

When *persons* are named, *mail* takes the standard input up to an end of file and adds it to each *person's .mail* file. The message is preceded by the sender's name and a postmark.

A *person* is either a user name recognized by *login* (I), in which case the mail is sent to the initial working directory of that user; or the path name of a directory, in which case *.mail* in that directory is used.

When a user logs in he is informed of the presence of mail. No mail will be received from a sender to whom *.mail* is inaccessible or unwritable.

FILES

/tmp/passwd	to identify sender and locate persons
/tmp/utmp	to identify sender
.mail	input mail
mbox	saved mail
/tmp/m#	temp file

SEE ALSO

write (I)

BUGS

MESG (I) MESG (I)

NAME

mesg — permit or deny messages

SYNOPSIS

mesg [n] [y]

DESCRIPTION

Mesg with argument **n** forbids messages via *write* by revoking non-user write permission on the user's typewriter. *Mesg* with argument **y** reinstates permission. All by itself, *mesg* reverses the current permission. In all cases the previous state is reported.

FILES

/dev/tty?

SEE ALSO

write (I)

DIAGNOSTICS

'?' if the standard input file is not a typewriter.

BUGS

MKDIR (I)

MKDIR (I)

NAME

mkdir – make a directory

SYNOPSIS

mkdir dirname ...

DESCRIPTION

Mkdir creates specified directories in mode 777. The standard entries '.' and '..' are made automatically.

SEE ALSO

rmdir (I)

BUGS

NAME

mtm – magnetic tape manipulation

SYNOPSIS

mtm [s*n*][l*m*][b*p*][unit]

DESCRIPTION

Mtm will help in the processing of multifile magnetic tapes. The optional arguments are:

- **s***n* Forward space the magnetic tape for *n* files.
- **l***m* Produce a list of the number and sizes of the records on the magnetic tape for *m* files. If *m* is missing *mtm* will analyze records upto a double EOT.
- **b***p* Define the maximum record size as *p*K bytes. If *b* is missing, then the maximum record size is assumed to be 2K bytes.

As an example,

```
mtm s1 l1
```

gives:

```
File 2
Record 1 - 14 bytes
Record 2 - 512 bytes
23 records
```

This means that file 2 contains one 14-byte record and twenty two 512-byte records.

The two arguments can be combined to skip some files, then analyze some number of remaining files. If neither argument is given, *mtm* will analyze the entire tape.

Unit specifies the drive on which the magnetic tape is mounted. If *unit* is missing, drive 0 is assumed.

FILES

/dev/rmt?

SEE ALSO

tm (IV), ht (IV)

BUGS

Mtm cannot distinquish between tape errors and end of files.

MV (I) **MV (I)**

NAME

mv – move or rename a file

SYNOPSIS

mv [**–f**] name1 name2

DESCRIPTION

Mv changes the name of a file from *name1* to *name2*. If *name2* is a directory, *name1* is moved to that directory with its original file-name. Directories may only be moved within the same parent directory (just renamed).

If *name2* already exists, it is removed before *name1* is renamed. If *name2* has a mode which forbids writing, *mv* prints the mode and reads the standard input to obtain a line; if the line begins with **y**, the move takes place; if not, *mv* exits. The optional argument **-f** allows the move to take place without verification.

If *name2* would lie on a different file system, so that a simple rename is impossible, *mv* copies the file and deletes the original.

BUGS

NICE (I)

NICE (I)

NAME

nice – run a command at low priority

SYNOPSIS

nice command [arguments]

DESCRIPTION

Nice executes *command* at low priority.

SEE ALSO

nohup(I), nice(II)

BUGS

NM (I) NM (I)

NAME

nm – print name list

SYNOPSIS

nm [−cjnru] [name **]**

DESCRIPTION

Nm prints the symbol table from the output file of an assembler or loader run. 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), **B** (bss segment symbol), or **C** (common symbol). Global symbols have their first character underlined. Normally, the output is sorted alphabetically and symbols consisting of a letter followed by one or more digits are not printed (that is, symbols which look like C internal symbols).

If no file is given, the symbols in **a.out** are listed.

Options are:

−c List only C-style external symbols, that is those beginning with underscore '_'.

−j List symbols consisting of a letter followed by digits, which are normally suppressed.

−n Sort by value instead of by name.

−r Sort in reverse order

−u Print only undefined symbols.

FILES

a.out

BUGS

NOHUP (I)

NOHUP (I)

NAME

nohup – run a command immune to hangups

SYNOPSIS

nohup command [arguments]

DESCRIPTION

Nohup executes *command* with hangups, quits and interrupts all ignored.

SEE ALSO

nice (I), signal (II)

BUGS

Beware of *nohup* on command lines with pipes.

NAME

nroff – format text

SYNOPSIS

nroff [+*n*] [−*n*] [−**n***n*] [−**m***x*] [−**s**] [−**h**] [−**q**] [−**i**] files

DESCRIPTION

Nroff formats text according to control lines embedded in the text files. *Nroff* will read the standard input if no file arguments are given. The non-file option arguments are interpreted as follows:

+*n* Output will commence at the first page whose page number is *n* or larger.

−*n* Causes printing to stop after page *n*.

−**n***n* First generated (not necessarily printed) page is given number *n* ; simulates ".pn *n* ".

−**m***x* Prefixes a standard macro file; simulates ".so /usr/lib/tmac. *x*".

−**s** Stop prior to each page to permit paper loading. Printing is restarted by typing a 'newline' character.

−**h** Spaces are replaced where possible with tabs to speed up output (or reduce the size of the output file).

−**q** Prompt names for insertions are not printed and the bell character is sent instead; the insertion is not echoed.

−**i** Causes the standard input to be read after the files.

Nroff is more completely described in [1]. A condensed Request Summary is included here.

FILES

/usr/lib/suftab	suffix hyphenation tables
/tmp/rtm?	temporary

SEE ALSO

[1] NROFF User's Manual.

BUGS

Mis-defined macros can cause the temporary file to overflow.

REQUEST REFERENCE AND INDEX

Request Form	Initial Value	If no Argument	Cause Break	Explanation
I. Page Control				
.pl +N	N=66	N=66	no	Page Length.
.bp +N	N=1	-	yes	Begin Page.
.pn +N	N=1	ignored	no	Page Number.
.po +N	N=0	N=prev	no	Page Offset.
.ne N	-	N=1	no	NEed N lines.
II. Text Filling, Adjusting, and Centering				
.br	-	-	yes	BReak.
.fi	fill	-	yes	FIll output lines.
.nf	fill	-	yes	NoFill.
.ad c	adj,norm adjust		no	ADjust mode on.
.na	adjust	-	no	NoAdjust.
.ce N	off	N=1	yes	CEnter N input text lines.
III. Line Spacing and Blank Lines				
.ls +N	N=1	N=prev	no	Line Spacing.
.sp N	-	N=1	yes	SPace N lines
.lv N	-	N=1	no	LeaVe N lines
.sv N	-	N=1	no	SaVe N lines.
.os	-	-	no	Output Saved lines.
.ns	space	-	no	No-Space mode on.
.rs	-	-	no	Restore Spacing.
.xh	off	-	no	EXtra-Half-line mode on.
IV. Line Length and Indenting				
.ll +N	N=65	N=prev	no	Line Length.
.in +N	N=0	N=prev	yes	INdent.
.ti +N	-	N=1	yes	Temporary Indent.
V. Macros, Diversion, and Line Traps				
.de xx	-	ignored	no	DEfine or redefine a macro.
.ds xx	-	ignored	no	Define or redefine String.
.rm xx	-	-	no	ReMove macro name.
.di xx	-	end	no	DIvert output to macro "xx".
.wh -N xx	-	-	no	WHen; set a line trap.
.ch xx y	-	-	no	CHange trap line.
.ch -N -M	-	-	no	"
.ch xx -M	-	-	no	"
.ch -N y	-	-	no	"
VI. Number Registers				
.nr ab +N -M		-	no	Number Register.
.nr a +N -M		-	no	"
.nc c	\n	\n	no	Number Character.
.ar	arabic	-	no	Arabic numbers.
.ro	arabic	-	no	Roman numbers.
.RO	arabic	-	no	ROMAN numbers.
VII. Input and Output Conventions and Character Translations				
.ta N,M,...	-	none	no	PseudoTAbs setting.
.tc c	space	space	no	Tab replacement Character.
.lc c	.	.	no	Leader replacement Character.
.ul N	-	N=1	no	UNderline input text lines.

.cc c	.	.	no	Basic Control Character.
.c2 c	'	'	no	Nobreak control character.
.ec c	-	\	no	Escape Character.
.li N	-	N=1	no	Accept input lines LIterally.
.tr abcd....	-	-	no	TRanslate on output.

VIII. Hyphenation.

.nh	on	-	no	No Hyphen.
.hy	on	-	no	HYphenate.
.hc c	none	none	no	Hyphenation indicator Character.

IX. Three Part Titles.

.tl 'left'center'right'		-	no	TitLe.
.lt N	N=65	N=prev	no	Length of Title.

X. Output Line Numbering.

.nm +N M S I		off	no	Number Mode on or off, set parameters.
.np M S I	-	reset	no	Number Parameters set or reset.

XI. Conditional Input Line Acceptance

.if !N anything	-	no	IF true accept line of "anything".
.if c anything	-	no	"
.if !c anything	-	no	"
.if N anything	-	no	"

XII. Environment Switching.

.ev N	N=0	N=prev	no	EnVironment switched.

XIII. Insertions from the Standard Input Stream

.rd prompt	-	bell	no	ReaD insert.
.ex	-	-	no	EXit.

XIV. Input File Switching

.so filename	-	-	no	Switch SOurce file (push down).
.nx filename		-	no	NeXt file.

XV. Miscellaneous

.tm mesg	-	-	no	Typewriter Message
.ig	-	-	no	IGnore.
.fl	-	-	no	FLush output buffer.
.ab	-	-	no	ABort.

OD (I) **OD (I)**

NAME

od – octal dump

SYNOPSIS

od [**–abcdho**] [file] [[**+**] offset[**.**][**b**]]

DESCRIPTION

Od dumps *file* in one or more formats as selected by the first argument. If the first argument is missing **–o** is default. The meanings of the format argument characters are:

a interprets words as PDP-11 instructions and dis-assembles the operation code. Unknown operation codes print as ???.

b interprets bytes in octal.

c interprets bytes in ascii. Unknown ascii characters are printed as \?.

d interprets words in decimal.

h interprets words in hex.

o interprets words in octal.

The *file* argument specifies which file is to be dumped. If no file argument is specified, the standard input is used. Thus *od* can be used as a filter.

The offset argument specifies the offset in the file where dumping is to commence. This argument is normally interpreted as octal bytes. If '**.**' is appended, the offset is interpreted in decimal. If '**b**' is appended, the offset is interpreted in blocks. (A block is 512 bytes.) If the file argument is omitted, the offset argument must be preceded by '**+**'.

Dumping continues until end-of-file.

SEE ALSO

db (I)

BUGS

ONINTR (I)

ONINTR (I)

NAME

onintr – specify interrupt processing for a command file

SYNOPSIS

onintr [label]

DESCRIPTION

Onintr specifies that an interrupt processing routine begins at : 'label'. The interrupt processing continues until a *return*, an *exit*, or the end of the command file is encountered.
If an interrupt occurs on a command line **n**, control passes to the interrupt routine, and upon completion returns to the command line **n+1**, unless the completion was caused by an *exit* command, whereupon *sh* terminates the command file.

Onintr used without an argument specifies that upon interrupt the command file will terminate.
During the execution of an interrupt process routine, interrupts are suppressed.

SEE ALSO

sh (I), return (I), exit (I), goto (I)

FILES

DIAGNOSTICS

BUGS

PASSWD (I)

PASSWD (I)

NAME

passwd – change login password

SYNOPSIS

passwd name password

DESCRIPTION

The *password* becomes associated with the given login name. This can only be done by corresponding user or by the super-user. An explicit null argument ("") for the password argument removes any password.

FILES

/etc/passwd

SEE ALSO

login (I), passwd (V), crypt (III)

BUGS

PFE (I) **PFE (I)**

NAME

pfe – print floating exception

SYNOPSIS

pfe

DESCRIPTION

Pfe examines the floating point exception register and prints a diagnostic for the last floating point exception.

SEE ALSO

signal (II)

BUGS

Since the system does not save the exception register in a core image file, the message refers to the last error encountered by anyone. Floating exceptions are therefore volatile.

PR (I) PR (I)

NAME

pr – print file

SYNOPSIS

pr [**−h** *header*] [*−n*] [**+***n*] [**−w***n*] [**−l***n*] [**−t**] [**−s***c*] [**−m**] name . . .

DESCRIPTION

Pr produces a printed listing of one or more files. The output is separated into pages headed by a date, the name of the file or a specified header, and the page number. If there are no file arguments, *pr* prints its standard input, and is thus usable as a filter.

Options apply to all following files but may be reset between files:

−*n* produce *n*-column output

+*n* begin printing with page *n*

−h treat the next argument as a header to be used instead of the file name

−w*n* for purposes of multi-column output, take the width of the page to be *n* characters instead of the default 72

−l*n* take the length of the page to be *n* lines instead of the default 66

−t do not print the 5-line header or the 5-line trailer normally supplied for each page

−s*c* separate columns by the single character *c* instead of by the appropriate amount of white space. A missing *c* is taken to be a tab.

−m print all files simultaneously, each in one column

Interconsole messages via *write* (I) are forbidden during a *pr*.

FILES

/dev/tty? to suspend messages.

SEE ALSO

cat (I), cp (I)

DIAGNOSTICS

none; files not found are ignored

BUGS

PROF (I) **PROF (I)**

NAME

prof – display profile data

SYNOPSIS

prof [**–a**] [**–l**] [file]

DESCRIPTION

Prof interprets the file *mon.out* produced by the *monitor* subroutine. Under default modes, the symbol table in the named object file (*a.out* default) is read and correlated with the *mon.out* profile file. For each external symbol, the percentage of time spent executing between that symbol and the next is printed (in decreasing order), together with the number of times that routine was called and the number of milliseconds per call.

If the **–a** option is used, all symbols are reported rather than just external symbols. If the **–l** option is used, the output is listed by symbol value rather than decreasing percentage.

In order for the number of calls to a routine to be tallied, the **–p** option of *cc* must have been given when the file containing the routine was compiled. This option also arranges for the *mon.out* file to be produced automatically.

FILES

mon.out	for profile
a.out	for namelist

SEE ALSO

monitor (III), profil (II), cc (I)

BUGS

Beware of quantization errors.

PS (I) **PS (I)**

NAME

ps — process status

SYNOPSIS

ps [**-aklx**] [file]

DESCRIPTION

Ps prints certain data about active processes. If a file is specified, it must contain the system namelist for the running process if it is not in /unix. There are several options:

a asks for information about all processes with teletypes. Ordinarily, only one's own processes are displayed.

x reports on all processes regardless of typewriter.

k uses the special file /dev/rp0 in place of */dev/mem*.

l provides a long listing which contains the following meaningful columns:

Heading	Description
TTY	the last character of the control typewriter of the process.
F	a number encoding the flags associated with a process. It may be any combination of the following: 00 swapped-out process 01 swapped-in process 02 the scheduler 04 process locked in core 30 tracing
S	a letter encoding the state of the process: S - sleeping W - waiting R - running I - idling (unused) Z - zombie - process exited, parent not yet notified. T - traced
UID	the real user-id of the owner of the process.
PID	the unique process number; this is useful with *kill*.
PRI	the priority of the process; high numbers mean low priority
ADDR	the location of the process; in 64-byte granularity for swapped-in processes; in 512-byte granularity for swapped-out processes.
SIZE	the size in blocks of the core image of the process.
WCHAN	the core address in the system of the event for which the process is waiting. If blank, the process is running.
COMMAND	the file name of the process.

Ps attempts to learn the file name and arguments given when the process was created, by examining core memory and/or the swap area.

FILES

/unix	system namelist
/dev/mem	core memory
/dev/rp0	swap device
/dev/rk0	optional mem file

SEE ALSO

kill(I)

BUGS

PWD (I)

PWD (I)

NAME

pwd – working directory name

SYNOPSIS

pwd

DESCRIPTION

Pwd prints the pathname of the working (current) directory.

SEE ALSO

chdir (I)

BUGS

READ (I)

READ (I)

NAME

read, open, onend – sequential file read

SYNOPSIS

onend [label]
open [fname]
read

DESCRIPTION

Within a command file, read accesses data, one line at a time from another file. The *read* is done sequentially from the beginning of the file.

Open is needed to identify the file to be read. Only one file may be open at any time. Without an argument the standard input is used.

Onend provides a branch to *label* when the EOF condition is reached on *fname*. If *label* is not supplied, a diagnostic is written to the error output,and a null string is sent to the standard output.

FILES

SEE ALSO

sh (I), goto (I), read (II)

DIAGNOSTICS

BUGS

Standard Shell syntax is violated to allow pipe and redirected input to take precedence over an *open* file, which in turn takes precedence over standard Shell input.

Don't try to read a directory file.

RETURN (I) RETURN (I)

NAME

return – terminate profile or interrupt processing routine

SYNOPSIS

return [rtncode]

DESCRIPTION

Return terminates processing of a profile file or an interrupt processing routine within a command file. In any other case, *sh* treats *return* as an exit.

The return code is set to the optional argument 'rtncode', otherwise to 0.

SEE ALSO

sh(I), exit(I)

REW (I) **REW (I)**

NAME

rew – rewind tape

SYNOPSIS

rew [[**m**]digit]

DESCRIPTION

Rew rewinds DECtape or magtape drives. The digit is the logical tape number, and should range from 0 to 7. if the digit is preceded by **m**, *rew* applies to magtape rather than DECtape. A missing digit indicates drive 0.

FILES

/dev/tap?
/dev/mt?

BUGS

Magnetic tape units 4-7 map into physical drives 0-3.

RM (I) **RM (I)**

NAME

rm – remove (unlink) files

SYNOPSIS

rm [−f] [−r] name ...

DESCRIPTION

Rm removes the entries for one or more files from a directory. If an entry was the last link to the file, the file is destroyed. Removal of a file requires write permission in its directory, but neither read nor write permission on the file itself.

If a file has no write permission, *rm* prints the file name and its mode, then reads a line from the standard input. If the line begins with **y**, the file is removed, otherwise it is not. The file is removed without the question being asked if option **−f** was given or if the standard input is not a typewriter.

If a designated file is a directory, an error comment is printed unless the optional argument **−r** has been used. In that case, *rm* recursively deletes the entire contents of the specified directory. To remove directories *per se* see rmdir(I).

FILES

/etc/glob to implement the **−r** flag

SEE ALSO

rmdir (I)

BUGS

When *rm* removes the contents of a directory under the **−r** flag, full pathnames are not printed in diagnostics.

RMDIR (I) RMDIR (I)

NAME

rmdir – remove directory

SYNOPSIS

rmdir dir ...

DESCRIPTION

Rmdir removes (deletes) directories. The directory must be empty (except for the standard entries '.' and '..', which *rmdir* itself removes).

BUGS

Needs a **–r** flag.
Write permission in the directory's parent should be required, but is *not.*
Mildly unpleasant consequences can follow removal of your own or someone else's current directory.

SH (I) SH (I)

NAME

sh – shell (command interpreter)

SYNOPSIS

sh [**–v**] [**–i**] [**–tc**] [name [arg1 ... [arg9]]]

DESCRIPTION

Sh is the standard command interpreter. It reads and arranges the execution of the command lines typed by the user. Unless an alternative is specified in the entry of a user in */etc/passwd*, a copy of *sh* is provided at login time. *Sh* may itself be called as a command to interpret command lines and/or command files. Before discussing the arguments to the Shell used as a command, the structure of command lines themselves will be given.

Commands. Each command is a sequence of arguments separated by blanks or tabs. The first argument specifies the name of a command to be executed. Except for certain types of special arguments discussed below, the arguments other than the command name are passed without interpretation to the invoked command.

If the first argument is the name of an executable file, it is invoked; otherwise the string '/bin/' is prefixed to the argument. (In this way most often-used commands, which reside in '/bin', are found.) If no such command is found, the string '/usr' is further prefixed (to give '/usr/bin/command') and another attempt is made to execute the resulting file name. (Certain lesser-used commands live in '/usr/bin'.) If '/usr/bin/command' exists with executable mode, but does not have the form of an executable program, it is used by *sh* as a file of commands, that is to say, it is executed as if it were typed from the console.

An attempt to execute either a file without execute permission or a directory results in a diagnostic message, as does the inablility to find the file.

Pipe-lines. Commands separated by '|' or '^' constitute a sequence of processes called a pipeline. The standard output of each command but the last is taken as the standard input of the next command. Each command is run as a separate process, connected to its neighbors by pipes (see pipe(II)).

Two or more commands may appear on the same line in other ways. When they are separated by ';', the commands are executed in order of appearance on the line. However, if a command is followed by '&', *sh* does not wait for the completion of that process, but reports the process-id of the executing process, and continues with the next command.

Commands on a line may be grouped by using parentheses. To illustrate:

```
(pwd;date) | lpr
```

sends the name of the current directory and the date to the line printer.

Redirection of I/O. Three files are opened by *sh*. A standard input file (file descriptor 0) from which input lines are read; a standard output file (file descriptor 1) on which printed output can be written; and a standard error output file (file descriptor 2) on which diagnostics can be written. These files normally point to the user's typewriter but can be redirected to other devices or files.

There are five redirection symbols that cause the immediately following string to be interpreted as a special argument to the Shell itself. Such an argument may appear anywhere among the arguments of a command, or before or after a parenthesized command list, and is associated with that command or command list.

- <name causes the file 'name' to be used as the standard input of the associated command.
- >name causes file 'name' to be used as the standard output for the associated command. 'Name' is created if it did not exist, and is truncated at the outset. When '%' is used as 'name', the output is directed to the standard error output file.

>>name causes file 'name' to be used as the standard output for the associated command. If 'name' did not exist, it is created; if it did exist, the command output is appended to the file.

As an example, either of the command lines

```
ls >junk; cat tail >>junk
( ls; cat tail ) >junk
```

creates, on file 'junk', a listing of the working directory, followed immediately by the contents of file 'tail'.

Either of the constructs '>name' or '>>name' associated with any but the last command of a pipe-line is ineffectual, as is '<name' in any but the first.

%name causes 'name' to be used as the error output file for the associated command. 'Name' is created if it did not exist and is truncated at the outset.

%%name causes 'name' to be used as the error output for the associated command. If 'name' did not exist, it is created; if it existed, the error output is appended to the file.

Generation of argument lists. If any argument contains any of the characters '?', '*' or '[', it is treated specially as follows. The directory is searched for files which *match* the given argument according to the following rules:

1. The character '*' in an argument matches any string of characters in a file 'name' (including the null string).
2. The character '?' matches any single character in a file name.
3. Square brackets '[...]' specify a class of characters which matches any single file-name character in the class. Within the brackets, each ordinary character is taken to be a member of the class. A pair of characters separated by '–' places in the class each character lexically greater than or equal to the first and less than or equal to the second member of the pair.
4. Other characters match only the same character in the file name.

For example, '*' matches all file names; '?' matches all one-character file names; '[ab]*.s' matches all file names beginning with 'a' or 'b' and ending with '.s'; '?[zi–m]' matches all two-character file names ending with 'z' or the letters 'i' through 'm'.

If the argument with '*' or '?' also contains a '/', a slightly different procedure is used: instead of the current directory, the directory used is the one obtained by taking the argument up to the last '/' before a '*' or '?'. The matching process matches the remainder of the argument after this '/' against the files in the derived directory. For example: '/usr/dmr/a*.s' matches all files in directory '/usr/dmr' which begin with 'a' and end with '.s'.

By this procedure a list of names is obtained which match the argument. This list is sorted into alphabetical order, and the resulting sequence of arguments replaces the single argument containing the '*', '[', or '?'. The same process is carried out for each argument (the resulting lists are *not* merged) and finally the command is called with the resulting list of arguments.

Quoting. The character '\' causes the immediately following character to lose any special meaning it may have to the Shell; in this way '<', '>', and other characters meaningful to the Shell may be passed as part of arguments. A special case of this feature allows the continuation of commands onto more than one line: a new-line preceded by '\' is translated into a blank.

Quoting may be accomplished by double (") or single (') quotes in the following way:

```
ls | pr –h "My directory"
```

causes a directory listing to be produced by *ls*, and passed on to *pr* to be printed with the heading 'My directory'. Quotes permit the inclusion of blanks in the heading, which is a single argument to *pr*. Characters enclosed in double quotes have no special significance to *sh*, which passes them along as an argument with no interpretation. Within single quotes, *sh* expands '\'

and '$', and takes all other characters literally.

Command Files. Since *sh* treats its first argument as a command, that argument may itself be *sh*; thus giving the Shell recursive power. A file of commands to the Shell may be prepared prior to execution of *sh*. Either of the commands

```
sh < file
sh file
```

will cause the execution of the file of commands.

Sh becomes a simple but powerful programming language by the inclusion of the following commands that have meaning within a command file:

goto	supplies the branch facility. (see *goto* (I))
exit	terminates a shell. (see *exit* (I))
: label	locates the destination of a branch. The line itself is meaningless to *sh* and is ignored.
return	transfers control within a command file. (see *return* (I))
shift	manipulates the arguments of a command file. (see *shift* (I))
if	a conditional statement. (see *if* (I))
onintr	identifies the routine to be used for interrupt processing. (see *onintr* (I))
read	along with onend, and open, provides a facility for accessing information sequentially from a file outside the command file. (see *read* (I))
echo	writes data to the standard output. (see *echo* (I))
= x [value]	makes an assignment of *value* to a single letter variable within a command file. If *value* is not specified, the variable takes on the value of the entire next line of the standard input. These variables once assigned, may be referenced throughout the command file as '$a','$b',...'$z'

Certain other variables may be referenced within a command file:

$0	the name of the command file. When no name exists, $0 is null.
$$	the process-id of the executing shell, expressed in five decimal digits (with leading zeroes).
$.	the pathname of the directory from which the command file was executed.
$T	the pathname of the controlling typewriter.
$E	an octal representation of the return code of the most recently completed process in the file. It is useful with the *if* statement.
$R	same value as $E in decimal representation.

Argument passing. When *sh* is invoked as a command, it has additional string processing capabilities. Recall that the form in which the Shell is invoked is

```
sh [ name [ arg1 ... [ arg9 ] ] ]
```

Name is a file which is read and interpreted. If not given, this subinstance of the Shell continues to read the standard input file.

In command lines in the file (not in command input), character sequences of the form '$n', where *n* is a digit, are replaced by the *n*th argument to the invocation of the Shell (arg*n*). '$0' is replaced by *name*. Up to nine arguments can be referenced at any one time.

Optional arguments which may be supplied to *sh*.

−t	Used alone, it causes *sh* to read a single line from the standard input, execute it as a command, and then exit. It is useful for interactive programs which allow users to execute system commands. For example, see'!' in *bc* (I) and *ed* (I).

−c Used with one following argument it causes the next argument to be taken as a command line and executed. No new-line need be present, but new-line characters are treated appropriately. It is useful as an alternative to −t where the caller has already read some of the characters of the command to be executed.

− A new shell process is invoked which reads from the standard input. No prompts are issued in this environment.

−v When the verbose option is selected, *sh* will echo all command lines as they are executed. The feature is useful in debugging command files.

−i Interrupts are ignored by *sh*. Ordinarily interrupts terminate a command file process.

If a user supplies a command file named *profile.sh* in his login directory, *sh* executes that command file at its first invocation. This is useful for setting up a specific environment in which to work.

End of file. An end-of-file in the Shell's input causes it to exit. A side effect of this fact means that the way to log out from UNIX is to type an EOT.

Special commands. The following commands are treated specially by the Shell.

chdir is done without spawning a new process by executing *sys chdir* (II).

login is done by executing /bin/login without creating a new process.

wait is done without spawning a new process by executing *sys wait* (II).

exit is done without spawning a new process by executing *sys exit* (II).

return is done without spawning a new process, either by calling *sys exit* or by returning to standard Shell input.

shift is done by manipulating the arguments to the command file.

= is done by storing the assigned value in a dynamic buffer that increases in size with each new assignment.

read
open
onend are all done without spawning a new process so the Shell can keep its place in the file being read.

onintr is done without spawning a new process for the interrupt processing routine to handle trap resets.

Command file errors; interrupts. Any Shell-detected error, or an interrupt signal, during the execution of a command file causes the Shell to cease execution of that file.

Processes that are created with '&' ignore interrupts. In addition, if such a process has not redirected its input with a '<', its input is automatically redirected to the zero length file /dev/null.

Termination Reporting. If a command (not followed by '&') terminates abnormally, a message is printed. (All terminations other than exit and interrupt are considered abnormal.) Termination reports for commands followed by '&' are given upon receipt of the first command subsequent to the termination of the command, or when a *wait* is executed. The following is a list of the abnormal termination messages:

Bus error
Trace/BPT trap
Illegal instruction
IOT trap
EMT trap
Bad system call
Quit
Floating exception
Memory violation
Killed
Broken Pipe
Alarm timeout

If a core image is produced, '– Core dumped' is appended to the appropriate message.

FILES

/etc/glob, which interprets '*', '?', and '['.
/dev/null as a source of end-of-file.
/dev/tty?, the control typewriter.
$./profile.sh, to set an individual user's environment.

SEE ALSO

'The UNIX Time-Sharing System', CACM, July, 1974, which gives the theory of operation of the Shell.
chdir (I), login (I), wait (I), shift (I), goto (I), read (I), return (I), exit (I), onintr (I), glob (VIII), echo (I), pipe (II).

DIAGNOSTICS

'Too many tokens','Command table overflow', and 'Too many characters', indicate buffer overflow. The command line is terminated.
"$' nesting error'; if more than nine levels of arguments occurs. The command line is terminated.

BUGS

Too many variable assignments in a command file may result in buffer overflow.

SHIFT (I) **SHIFT (I)**

NAME

shift – adjust Shell arguments

SYNOPSIS

shift [n]

DESCRIPTION

Shift is used in command files to shift the argument list left by 1, so that old *$2* can now be referred to by *$1* and so forth. *Shift* is useful to iterate over several arguments to a command file. For example, the command file

```
: loop
if $1x = x exit
pr -3 $1
shift
goto loop
```

prints each of its arguments in 3-column format.

The optional argument, n leaves the first n-1 arguments untouched, and replaces arg n with arg n+1, arg n+1 with arg n+2, ... through the remainder of the argument list.

Shift is executed within the Shell.

SEE ALSO

sh (I)

BUGS

SIZE (I) SIZE (I)

NAME

size – size of an object file

SYNOPSIS

size [object ...]

DESCRIPTION

Size prints the (decimal) number of bytes required by the text, data, and bss portions, and their sum in octal and decimal, of each object-file argument. If no file is specified, **a.out** is used.

BUGS

SLEEP (I) SLEEP (I)

NAME

sleep – suspend execution for an interval

SYNOPSIS

sleep time

DESCRIPTION

Sleep suspends execution for *time* seconds. It is used to execute a command in a certain amount of time as in:

```
(sleep 105; command)&
```

or to execute a command every so often as in this shell command file:

```
: loop
command
sleep 37
goto loop
```

SEE ALSO

sleep (II)

BUGS

Time must be less than 65536 seconds.

SORT (I) SORT (I)

NAME

sort – sort or merge files

SYNOPSIS

sort [**–mubdfinrt***x*] [**+***pos* [**–***pos*]] ... [**–o** name] [name] ...

DESCRIPTION

Sort sorts lines of all the named files together and writes the result on the standard output. The name '–' means the standard input. The standard input is also used if no input file names are given. Thus *sort* may be used as a filter.

The default sort key is an entire line. Default ordering is lexicographic by bytes in machine collating sequence. The ordering is affected by the following flags one or more of which may appear.

b Leading blanks (spaces and tabs) are not included in keys.

d 'Dictionary' order: only letters, digits and blanks are significant in comparisons.

f Fold lower case letters onto upper case.

i Ignore all nonprinting nonblank characters in nonnumeric comparisons.

n An initial numeric string, consisting of optional minus sign, digits and optionally included decimal point, is sorted by arithmetic value.

r Reverse the sense of comparisons.

t*x* Tab character starting fields is *x*.

Selected parts of the line, specified by **+***pos* and **–***pos*, may be used as sort keys. *Pos* has the form *m.n* optionally followed by one or more of the flags **bdfinr**, where *m* specifies a number of fields to skip, *n* a number of characters to skip further into the next field, and the flags specify a special ordering rule for the key. A missing *.n* is taken to be 0. **+***pos* denotes the beginning of the key; **–***pos* denotes the first position after the key (end of line by default). Later keys are compared only when all earlier keys compare equal.

When no tab character has been specified, a field consists of nonblanks and any preceding blanks. Under the **–b** flag, leading blanks are excluded from a field. When a tab character has been specified, fields are strings separated by tab characters.

Lines that otherwise compare equal are ordered with all bytes significant.

These flag arguments are also understood:

–m Merge only, the input files are already sorted.

–o The next argument is the name of an output file to use instead of the standard output. This file may be the same as one of the inputs, except under the merge flag **–m**.

–u Suppress all but one in each set of contiguous equal lines. Ignored bytes and bytes outside keys do not participate in this comparison.

Examples. Print a list of all the distinct *nroff* (I) commands in a given document:

```
grep "^\." document | sort –u +0 –0.3
```

Print the password file *passwd* (V) sorted by user id:

```
sort –t: +2n /etc/passwd
```

FILES

/usr/tmp/stm???

BUGS

SPLIT (I) **SPLIT (I)**

NAME

split – split a file into pieces

SYNOPSIS

split [–*n*] [file [name]]

DESCRIPTION

Split reads *file* and writes it in *n*-line pieces (default 1000), as many as necessary, onto a set of output files. The name of the first output file is *name* with **aa** appended, and so on lexicographically. If no output name is given, **x** is default.

If no input file is given, or if – is given in its stead, then the standard input file is used.

BUGS

STRIP (I) STRIP (I)

NAME

strip – remove symbols and relocation bits

SYNOPSIS

strip name ...

DESCRIPTION

Strip removes the symbol table and relocation bits ordinarily attached to the output of the assembler and loader. This is useful to save space after a program has been debugged.

The effect of *strip* is the the same as use of the **–s** option of *ld*.

FILES

/tmp/stm? temporary file

SEE ALSO

ld (I), as (I)

BUGS

STTY (I) **STTY (I)**

NAME

stty – set typewriter options

SYNOPSIS

stty [option ...]

DESCRIPTION

Stty sets certain I/O options on the current output typewriter. With no argument, it reports the current settings of the options. The option strings are selected from the following set:

even allow even parity
–even disallow even parity
odd allow odd parity
–odd disallow odd parity
raw raw mode input (no erase, kill, interrupt, quit, EOT; parity bit passed back)
–raw negate raw mode
–nl allow carriage return for new-line, and output CR-LF for carriage return or new-line
nl accept only new-line to end lines
echo echo back every character typed
–echo do not echo characters
lcase map upper case to lower case
–lcase do not map case
–tabs replace tabs by spaces when printing
tabs preserve tabs
cr0 cr1 cr2 cr3
select style of delay for carriage return (see *stty* (II))
nl0 nl1 nl2 nl3
select style of delay for linefeed (see *stty* (II))
tab0 tab1 tab2 tab3
select style of delay for tab (see *stty* (II))
ff0 ff1
select style of delay for form feed (see *stty* (II))
tty33 set all modes suitable for Teletype model 33
tty37 set all modes suitable for Teletype model 37
vt05 set all modes suitable for DEC VT05 terminal
tn300 set all modes suitable for GE Terminet 300
ti700 set all modes suitable for Texas Instruments 700 terminal
tek set all modes suitable for Tektronix 4014 terminal
50 75 110 134 150 200 300 600 1200 1800 2400 4800 9600 exta extb
Set typewriter baud rate to the number given, if possible. (These are the speeds supported by the DH-11 interface).

The various delay algorithms are tuned to various kinds of terminals. In general the specifications ending in '0' mean no delay for the corresponding character.

SEE ALSO

stty (II)

BUGS

SUM (I) SUM (I)

NAME

sum – sum file

SYNOPSIS

sum name ...

DESCRIPTION

Sum sums the contents of the bytes (mod 2^16) of one or more files and prints the answer in decimal. A separate sum is printed for each file specified, along with the number of whole or partial 512-byte blocks read.

In practice, *sum* is often used to verify that all of a special file can be read without error.

BUGS

TIME (I) **TIME (I)**

NAME

time – time a command

SYNOPSIS

time command

DESCRIPTION

The given command is executed; after it is complete, *time* prints the elapsed time during the command, the time spent in the system, and the time spent in execution of the command.

The execution time can depend on what kind of memory the program happens to land in; the user time in MOS is often half what it is in core.

The times are printed on the diagnostic output stream.

BUGS

Elapsed time is accurate to the second, while the CPU times are measured to the 60th second. Thus the sum of the CPU times can be up to a second larger than the elapsed time.

TP (I) **TP (I)**

NAME

tp – manipulate DECtape and magtape

SYNOPSIS

tp [key] [name ...]

DESCRIPTION

Tp saves and restores files on DECtape or magtape. Its actions are controlled by the *key* argument. The key is a string of characters containing at most one function letter and possibly one or more function modifiers. Other arguments to the command are file or directory names specifying which files are to be dumped, restored, or listed. In all cases, appearance of a directory name refers to the files and (recursively) subdirectories of that directory.

The function portion of the key is specified by one of the following letters:

r The named files are written on the tape. If files with the same names already exist, they are replaced. 'Same' is determined by string comparison, so './abc' can never be the same as '/usr/dmr/abc' even if '/usr/dmr' is the current directory. If no file argument is given, '.' is the default.

u Update the tape. **u** is like **r**, but a file is replaced only if its modification date is later than the date stored on the tape; that is to say, if it has changed since it was dumped. **u** is the default command if none is given.

d Delete the named files from the tape. At least one name argument must be given. This function is not permitted on magtapes.

x Extract the named files from the tape to the file system. The owner and mode are restored. If no file argument is given, the entire contents of the tape are extracted.

t List the names of the specified files. If no file argument is given, the entire contents of the tape is listed.

The following characters may be used in addition to the letter which selects the function desired.

m Specifies magtape as opposed to DECtape.

0,...,7 This modifier selects the drive on which the tape is mounted. For DECtape, 'x' is default; for magtape '0' is the default.

v Normally *tp* does its work silently. The **v** (verbose) option causes it to type the name of each file it treats preceded by the function letter. With the **t** function, **v** gives more information about the tape entries than just the name.

c A fresh dump is to be created; the tape directory is zeroed before beginning. Usable only with **r** and **u**. This option is assumed with magtape since it is impossible to selectively overwrite magtape.

f causes new entries on tape to be 'fake' in that no data is present for these entries. Such fake entries cannot be extracted. Usable only with **r** and **u**.

i Errors reading and writing the tape are noted, but no action is taken. Normally, errors cause a return to the command level.

w causes *tp* to pause before treating each file, type the indicative letter and the file name (as with v) and await the user's response. Response **y** means 'yes', so the file is treated. Null response means 'no', and the file does not take part in whatever is being done. Response **x** means 'exit'; the *tp* command terminates immediately. In the **x** function, files previously asked about have been extracted already. With **r**, **u**, and **d** no change has been made to the tape.

FILES

/dev/tap?
/dev/mt?

DIAGNOSTICS

Several; the non-obvious one is 'Phase error', which means the file changed after it was selected for dumping but before it was dumped.

BUGS

A single file with several links to it is treated like several files.

TR (I) **TR (I)**

NAME

tr – transliterate

SYNOPSIS

tr [**–cds**] [string1 [string2]]

DESCRIPTION

Tr copies the standard input to the standard output with substitution or deletion of selected characters. Input characters found in *string1* are mapped into the corresponding characters of *string2*.

Any combination of the options **–cds** may be used.

–c complements the set of characters in *string1* with respect to the universe of characters whose ascii codes are 001 through 377 octal.

–d deletes all input characters in *string1*.

–s squeezes all strings of repeated output characters that are in *string2* to single characters.

The following abbreviation conventions may be used to introduce ranges of characters or repeated characters into the strings:

[*a*–*b* stands for the string of characters whose ascii codes run from character *a* to character *b*.

[*a**n*, where *n* is an integer or empty, stands for *n*-fold repetition of character *a*. *n* is taken to be octal or decimal according as its first digit is or is not zero. A zero or missing *n* is taken to be huge; this facility is useful for padding *string2*.

The escape character '\' may be used as in *sh* to remove special meaning from any character in a string. In addition, '\' followed by 1, 2 or 3 octal digits stands for the character whose ascii code is given by those digits.

The following example creates a list of all the words in 'file1' one per line in 'file2', where a word is taken to be a maximal string of alphabetics. The strings are quoted to protect the special characters from interpretation by the Shell; 012 is the ascii code for newline.

```
tr –cs "[A–Z][a–z]" "[\012*]" <file1 >file2
```

SEE ALSO

sh (I), ed (I), ascii (V)

BUGS

Won't handle ascii NUL in *string1* or *string2*; always deletes NUL from input.

TTY (I) **TTY (I)**

NAME

tty – get typewriter name

SYNOPSIS

tty

DESCRIPTION

Tty gives the name of the user's typewriter in the form 'tty*n*' for *n* a digit or letter. The actual path name is then '/dev/tty*n*'.

DIAGNOSTICS

'not a tty' if the standard input file is not a typewriter.

BUGS

TYPO (I)

TYPO (I)

NAME

typo – find possible typos

SYNOPSIS

typo [**−1**] [**−n**] file ...

DESCRIPTION

Typo hunts through a document for unusual words, typographic errors, and *hapax legomena* and prints them on the standard output.

The words used in the document are printed out in decreasing order of peculiarity along with an index of peculiarity. An index of 10 or more is considered peculiar. Printing of certain very common English words is suppressed.

The statistics for judging words are taken from the document itself, with some help from known statistics of English. The **−n** option suppresses the help from English and should be used if the document is written in, for example, Urdu.

The **−1** option causes the final output to appear in a single column instead of three columns. The normal header and pagination is also suppressed.

Nroff (I) control lines are ignored. Upper case is mapped into lower case. Quote marks, vertical bars, hyphens, and ampersands within words are equivalent to spaces. Words hyphenated across lines are put back together.

FILES

/tmp/ttmp??
/usr/lib/salt
/usr/lib/w2006

BUGS

Because of the mapping into lower case and the stripping of special characters, words may be hard to locate in the original text.

UNIQ (I) UNIQ (I)

NAME

uniq – report repeated lines in a file

SYNOPSIS

uniq [**–udc** [**+**n] [**–**n]] [input [output]]

DESCRIPTION

Uniq reads the input file comparing adjacent lines. In the normal case, the second and succeeding copies of repeated lines are removed; the remainder is written on the output file. Note that repeated lines must be adjacent in order to be found; see sort(I). If the **–u** flag is used, just the lines that are not repeated in the original file are output. The **–d** option specifies that one copy of just the repeated lines is to be written. The normal mode output is the union of the **–u** and **–d** mode outputs.

The **–c** option supersedes **–u** and **–d** and generates an output report in default style but with each line preceded by a count of the number of times it occurred.

The *n* arguments specify skipping an initial portion of each line in the comparison:

–*n* The first *n* fields together with any blanks before each are ignored. A field is defined as a string of non-space, non-tab characters separated by tabs and spaces from its neighbors.

+*n* The first *n* characters are ignored. Fields are skipped before characters.

SEE ALSO

sort (I), comm (I)

BUGS

WAIT (I) WAIT (I)

NAME

wait – await completion of process

SYNOPSIS

wait [cpid]

DESCRIPTION

Wait waits until all processes started asynchronously (with '&') have terminated. If a child process-id (cpid) is specified as an argument, then the wait is only for termination of that asynchronous process.

SEE ALSO

sh (I)

BUGS

If *cpid* is not an asynchronous process, then *wait* waits for the termination of all asynchronous processes. It should indicate that *cpid* is invalid.

NAME

wc – word count

SYNOPSIS

wc [name ...]

DESCRIPTION

Wc counts lines and words in the named files, or in the standard input if no name appears. A word is a maximal string of printing characters delimited by spaces, tabs or newlines. All other characters are simply ignored.

BUGS

WHO (I) WHO (I)

NAME

who – who is on the system

SYNOPSIS

who [who-file]

DESCRIPTION

Who, without an argument, lists the name, typewriter channel, and login time for each current UNIX user.

Without an argument, *who* examines the /tmp/utmp file to obtain its information. If a file is given, that file is examined. Typically the given file will be /tmp/wtmp, which contains a record of all the logins since it was created. Then *who* will list logins, logouts, and crashes since the creation of the wtmp file.

Each login is listed with user name, typewriter name (with '/dev/' suppressed), and date and time. When an argument is given, logouts produce a similar line without a user name. Reboots produce a line with 'x' in the place of the device name, and a fossil time indicative of when the system went down.

FILES

/tmp/utmp

SEE ALSO

login(I), init(VII)

BUGS

WRITE (I) WRITE (I)

NAME

write – write to another user

SYNOPSIS

write user [ttyno]

DESCRIPTION

Write copies lines from your typewriter to that of another user. When first called, it sends the message

message from *yourname*...

The recipient of the message should write back at this point. Communication continues until an end of file is read from the typewriter or an interrupt is sent. At that point *write* writes 'EOT' on the other terminal and exits.

If you want to write to a user who is logged in more than once, the *ttyno* argument may be used to indicate the last character of the appropriate typewriter name.

Permission to write may be denied or granted by use of the *mesg* command. At the outset writing is allowed. Certain commands, in particular *nroff* and *pr*, disallow messages in order to prevent messy output.

If the character '!' is found at the beginning of a line, *write* calls the shell to execute the rest of the line as a command.

The following protocol is suggested for using *write:* when you first write to another user, wait for him to write back before starting to send. Each party should end each message with a distinctive signal (**(o)** for 'over' is conventional) that the other may reply. **(oo)** (for 'over and out') is suggested when conversation is about to be terminated.

FILES

/tmp/utmp to find user
/bin/sh to execute '!'

SEE ALSO

mesg (I), who (I), mail (I)

BUGS

YACC (I)

YACC (I)

NAME

yacc – yet another compiler-compiler

SYNOPSIS

yacc [–vo] [grammar **]**

DESCRIPTION

Yacc 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 is *y.tab.c*, which must be compiled by the C compiler and loaded with any other routines required (perhaps a lexical analyzer) and the Yacc library:

```
cc y.tab.c other.o –ly
```

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.

The **–o** flag calls an optimizer for the tables; the optimized tables, with parser included, appear on file *y.tab.c*

SEE ALSO

"LR Parsing", by A. V. Aho and S. C. Johnson, Computing Surveys, June, 1974. "The YACC Compiler-compiler", UNIX handbook.

AUTHOR

S. C. Johnson

FILES

y.output	
y.tab.c	
yacc.tmp	when optimizer is called
/lib/liby.a	runtime library for compiler
/usr/source/yacc/opar.c	parser for optimized tables
/usr/yacc/yopti	optimizer postpass

DIAGNOSTICS

The number of reduce-reduce and shift-reduce conflicts is reported on the standard output; a more detailed report is found in the *y.output* file.

BUGS

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

II System Calls

INTRODUCTION TO SYSTEM CALLS

Section II of this manual lists all the entries into the system. In most cases two calling sequences are specified, one of which is usable from assembly language, and the other from C. Most of these calls have an error return. From assembly language an erroneous call is always indicated by turning on the c-bit of the condition codes. The presence of an error is most easily tested by the instructions *bes* and *bec* ("branch on error set (or clear)"). These are synonyms for the *bcs* and *bcc* instructions.

From C, an error condition is indicated by an otherwise impossible returned value. Almost always this is −1; the individual sections specify the details.

In both cases an error number is also available. In assembly language, this number is returned in r0 on erroneous calls. From C, the external variable *errno* is set to the error number. *Errno* is not cleared on successful calls, so it should be tested only after an error has occurred. There is a table of messages associated with each error, and a routine for printing the message. See *perror (III)*.

The possible error numbers are not recited with each writeup in section II, since many errors are possible for most of the calls. Here is a list of the error numbers, their names inside the system (for the benefit of system-readers), and the messages available using *perror*. A short explanation is also provided.

0 — (unused)

1 EPERM Not owner and not super-user
Typically this error indicates an attempt to modify a file in some way forbidden except to its owner. 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
The process whose number was given to *signal* does not exist, or is already dead.

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 occurred during a *read* or *write*. 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 is beyond the limits of the allowed number of subdevices. It may also occur when, for example, a tape drive is not dialled in or no disk pack is loaded on a drive.

7 E2BIG Arg list too long
An argument list longer than 512 bytes (counting the null at the end of each argument) is presented to *exec*.

8 ENOEXEC Exec format error
A request is made to execute a file which, although it has the appropriate permissions, does not start with one of the magic numbers 407 or 410.

9 EBADF Bad file number
Either a file descriptor refers to no open file, or a read (resp. write) request is made to a file which is open only for writing (resp. reading).

10 ECHILD No children
Wait was requested but the process has no living or unwaited-for children.

11 EAGAIN No more processes
In a *fork*, the system's process table is full and no more processes can for the moment be created.

12 ENOMEM Not enough core
During an *exec* or *break*, a program asks for more core than the system is able to supply. This is not a temporary condition; the maximum core size is a system parameter. The error may also occur if the arrangement of text, data, and stack segments is such as to require more than the existing 8 segmentation registers.

13 EACCES Permission denied
An attempt was made to access a file in a way forbidden by the protection system.

14 (unused)

15 ENOTBLK Block device required
A plain file was mentioned where a block device was required, e.g. in *mount*.

16 EBUSY Mount device busy
An attempt to mount a device that was already mounted or an attempt was made to dismount a device on which there is an open file or some process's current directory.

17 EEXIST File exists
An existing file was mentioned in an inappropriate context, e.g. *link*.

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 name or as an argument to *chdir*.

21 EISDIR Is a directory
An attempt to write on a directory.

22 EINVAL Invalid argument
Some invalid argument: currently, dismounting a non-mounted device, mentioning an unknown signal in *signal*, and giving an unknown request in *stty* to the TIU special file, and passing an invalid argument list to *exec*.

23 ENFILE File table overflow
The system's table of open files is full, and temporarily no more *opens* can be accepted.

24 EMFILE Too many open files
Only 15 files can be open per process.

25 ENOTTY Not a typewriter
The file mentioned in *stty* or *gtty* is not a typewriter or one of the other devices to which these calls apply.

26 ETXTBSY Text file busy
An attempt to execute a pure-procedure program which is currently open for writing (or reading!). Also an attempt to open for writing a pure-procedure program that is being executed.

27 EFBIG File too large
An attempt to make a file larger than the maximum of 32768 blocks.

28 ENOSPC No space left on device
During a *write* to an ordinary file, there is no free space left on the device.

29 ESPIPE Seek on pipe
A *seek* was issued to a pipe. This error should also be issued for other non-seekable devices.

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 127 links to a file.

32 EPIPE Write on 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.

ALARM (II) ALARM (II)

NAME

alarm – activate alarm clock timer

SYNOPSIS

(alarm = 27.; not in assembler)
(seconds in r0)
sys alarm

alarm (seconds)

DESCRIPTION

Alarm returns immediately but starts a timer within the system which causes the alarm clock signal to be sent to the current process after the specified number of seconds have elapsed. The changing of the date via stime(II) does not cause the signal to be posted prematurely.

In assembly language, the old value of the timer (in seconds) is returned in r0. In C, that value is returned.

SEE ALSO

pause(II), sleep(II)

DIAGNOSTICS

—

BREAK (II)

BREAK (II)

NAME

break, brk, sbrk – change core allocation

SYNOPSIS

(break = 17.)
sys break; addr

char *brk(addr)

char *sbrk(incr)

DESCRIPTION

Break sets the system's idea of the lowest location not used by the program (called the break) to *addr* (rounded up to the next multiple of 64 bytes). Locations greater than *addr* and below the stack pointer are not in the address space and will thus cause a memory violation if accessed.

From C, *brk* will set the break to *addr*. The old break is returned.

In the alternate entry *sbrk, incr* more bytes are added to the program's data space and a pointer to the start of the new area is returned.

When a program begins execution via *exec* the break is set at the highest location defined by the program and data storage areas. Ordinarily, therefore, only programs with growing data areas need to use *break*.

SEE ALSO

exec (II), alloc (III), end (III)

DIAGNOSTICS

The c-bit is set if the program requests more memory than the system limit or if more than 8 segmentation registers would be required to implement the break. From C, −1 is returned for these errors.

BUGS

Setting the break in the range 0177700 to 0177777 is the same as setting it to zero.

CHDIR (II)

CHDIR (II)

NAME

chdir – change working directory

SYNOPSIS

(chdir = 12.)
sys chdir; dirname

chdir(dirname)
char *dirname;

DESCRIPTION

Dirname is the address of the pathname of a directory, terminated by a null byte. *Chdir* causes this directory to become the current working directory.

SEE ALSO

chdir (I)

DIAGNOSTICS

The error bit (c-bit) is set if the given name is not that of a directory or is not readable. From C, a −1 returned value indicates an error, 0 indicates success.

CHMOD (II) CHMOD (II)

NAME

chmod – change mode of file

SYNOPSIS

(chmod = 15.)
sys chmod; name; mode

chmod(name, mode)
char *name;

DESCRIPTION

The file whose name is given as the null-terminated string pointed to by *name* has its mode changed to *mode.* Modes are constructed by ORing together some combination of the following:

4000 set user ID on execution
2000 set group ID on execution
0400 read by owner
0200 write by owner
0100 execute (search on directory) by owner
0070 read, write, execute (search) by group
0007 read, write, execute (search) by others

Only the owner of a file (or the super-user) may change the mode.

SEE ALSO

chmod (I)

DIAGNOSTIC

Error bit (c-bit) set if *name* cannot be found or if current user is neither the owner of the file nor the super-user. From C, a −1 returned value indicates an error, 0 indicates success.

CHOWN (II) CHOWN (II)

NAME

chown – change owner and group of a file

SYNOPSIS

(chmod = 16.)
sys chown; name; owner

chown(name, owner)
char *name;

DESCRIPTION

The file whose name is given by the null-terminated string pointed to by *name* has its owner and group changed to the low and high bytes of *owner* respectively. Only the super-user may execute this call, because if users were able to give files away, they could defeat the (nonexistent) file-space accounting procedures.

SEE ALSO

chown (VIII), passwd (V)

DIAGNOSTICS

The error bit (c-bit) is set on illegal owner changes. From C a −1 returned value indicates error, 0 indicates success.

CLOSE (II) CLOSE (II)

NAME

close – close a file

SYNOPSIS

(close = 6.)
(file descriptor in r0)
sys close

close(fildes)

DESCRIPTION

Given a file descriptor such as returned from an *open, creat,* or *pipe* call, *close* closes the associated file. A close of all files is automatic on *exit,* but since processes are limited to 15 simultaneously open files, *close* is necessary for programs which deal with many files.

SEE ALSO

creat (II), open (II), pipe (II)

DIAGNOSTICS

The error bit (c-bit) is set for an unknown file descriptor. From C a −1 indicates an error, 0 indicates success.

CREAT (II)

CREAT (II)

NAME

creat – create a new file

SYNOPSIS

(creat = 8.)
sys creat; name; mode
(file descriptor in r0)

creat(name, mode)
char *name;

DESCRIPTION

Creat creates a new file or prepares to rewrite an existing file called *name*, given as the address of a null-terminated string. If the file did not exist, it is given mode *mode*. See *chmod* (II) for the construction of the *mode* argument.

If the file did exist, its mode and owner remain unchanged but it is truncated to 0 length.

The file is also opened for writing, and its file descriptor is returned (in r0).

The *mode* given is arbitrary; it need not allow writing. This feature is used by programs which deal with temporary files of fixed names. The creation is done with a mode that forbids writing. Then if a second instance of the program attempts a *creat*, an error is returned and the program knows that the name is unusable for the moment.

SEE ALSO

write (II), close (II), stat (II)

DIAGNOSTICS

The error bit (c-bit) may be set if: a needed directory is not searchable; the file does not exist and the directory in which it is to be created is not writable; the file does exist and is unwritable; the file is a directory; there are already too many files open.

From C, a −1 return indicates an error.

CSW (II)

CSW (II)

NAME

csw – read console switches

SYNOPSIS

(csw = 38.; not in assembler)
sys csw

getcsw( )

DESCRIPTION

The setting of the console switches is returned (in r0).

DUP (II) **DUP (II)**

NAME

dup – duplicate an open file descriptor

SYNOPSIS

(dup = 41.; not in assembler)
(file descriptor in r0)
sys dup

dup(fildes)
int fildes;

DESCRIPTION

Given a file descriptor returned from an *open*, *pipe*, or *creat* call, *dup* will allocate another file descriptor synonymous with the original. The new file descriptor is returned in r0.

Dup is used more to reassign the value of file descriptors than to genuinely duplicate a file descriptor. Since the algorithm to allocate file descriptors returns the lowest available value, combinations of *dup* and *close* can be used to manipulate file descriptors in a general way. This is handy for manipulating standard input and/or standard output.

SEE ALSO

creat (II), open (II), close (II), pipe (II)

DIAGNOSTICS

The error bit (c-bit) is set if: the given file descriptor is invalid; there are already too many open files. From C, a −1 returned value indicates an error.

EXEC (II) EXEC (II)

NAME

exec, execl, execv – execute a file

SYNOPSIS

```
(exec = 11.)
sys exec; name; args
...
name: <...\0>
...
args: arg0; arg1; ...; 0
arg0: <...\0>
arg1: <...\0>
  ...
execl(name, arg0, arg1, ..., argn, 0)
char *name, *arg0, *arg1, ..., *argn;
execv(name, argv)
char *name;
char *argv[ ];
```

DESCRIPTION

Exec overlays the calling process with the named file, then transfers to the beginning of the core image of the file. There can be no return from the file; the calling core image is lost.

Files remain open across *exec* calls. Ignored signals remain ignored across *exec*, but signals that are caught are reset to their default values.

Each user has a *real* user ID and group ID and an *effective* user ID and group ID. The real ID identifies the person using the system; the effective ID determines his access privileges. *Exec* changes the effective user and group ID to the owner of the executed file if the file has the "set-user-ID" or "set-group-ID" modes. The real user ID is not affected.

The form of this call differs somewhat depending on whether it is called from assembly language or C; see below for the C version.

The first argument to *exec* is a pointer to the name of the file to be executed. The second is the address of a null-terminated list of pointers to arguments to be passed to the file. Conventionally, the first argument is the name of the file. Each pointer addresses a string terminated by a null byte.

Once the called file starts execution, the arguments are available as follows. The stack pointer points to a word containing the number of arguments. Just above this number is a list of pointers to the argument strings. The arguments are placed as high as possible in core.

```
 sp→ nargs
     arg0
     ...
     argn
     -1
arg0: <arg0\0>
     ...
argn: <argn\0>
```

From C, two interfaces are available. *execl* is useful when a known file with known arguments is being called; the arguments to *execl* are the character strings constituting the file and the arguments; as in the basic call, the first argument is conventionally the same as the file name (or its last component). A 0 argument must end the argument list.

The *execv* version is useful when the number of arguments is unknown in advance; the arguments to *execv* are the name of the file to be executed and a vector of strings containing the arguments. The last argument string must be followed by a 0 pointer.

When a C program is executed, it is called as follows:

```
main(argc, argv)
int argc;
char **argv;
```

where *argc* is the argument count and *argv* is an array of character pointers to the arguments themselves. 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.

Argv is not directly usable in another *execv*, since *argv[argc]* is −1 and not 0.

SEE ALSO

fork (II)

DIAGNOSTICS

If the file cannot be found, if it is not executable, if it does not have a valid header (407, 410, or 411 octal as first word), if maximum memory is exceeded, or if the arguments require more than 512 bytes a return from *exec* constitutes the diagnostic; the error bit (c-bit) is set. Even for the super-user, at least one of the execute-permission bits must be set for a file to be executed. From C the returned value is −1.

BUGS

Only 512 characters of arguments are allowed.

EXIT (II) EXIT (II)

NAME

exit – terminate process

SYNOPSIS

(exit = 1.)
(status in r0)
sys exit

exit(status)
int status;

DESCRIPTION

Exit is the normal means of terminating a process. *Exit* closes all the process's files and notifies the parent process if it is executing a *wait*. The low byte of r0 (resp. the argument to *exit*) is available as status to the parent process.

This call can never return.

SEE ALSO

wait (II)

DIAGNOSTICS

None.

NAME

fork – spawn new process

SYNOPSIS

(fork = 2.)
sys fork
(new process return)
(old process return)

fork( )

DESCRIPTION

Fork is the only way new processes are created. The new process's core image is a copy of that of the caller of *fork*. The only distinction is the return location and the fact that r0 in the old (parent) process contains the process ID of the new (child) process. This process ID is used by *wait*.

The two returning processes share all open files that existed before the call. In particular, this is the way that standard input and output files are passed and also how pipes are set up.

From C, the child process receives a 0 return, and the parent receives a non-zero number which is the process ID of the child; a return of −1 indicates inability to create a new process.

SEE ALSO

wait (II), exec (II)

DIAGNOSTICS

The error bit (c-bit) is set in the old process if a new process could not be created because of lack of process space. From C, a return of −1 (not just negative) indicates an error.

FSTAT (II) **FSTAT (II)**

NAME

fstat – get status of open file

SYNOPSIS

(fstat = 28.)
(file descriptor in r0)
sys fstat; buf

fstat(fildes, buf)
struct in.' *buf;

DESCRIPTION

This call is identical to *stat,* except that it operates on open files instead of files given by name. It is most often used to get the status of the standard input and output files, whose names are unknown.

SEE ALSO

stat (II)

DIAGNOSTICS

The error bit (c-bit) is set if the file descriptor is unknown; from C, a −1 return indicates an error, 0 indicates success.

GETGID (II) **GETGID (II)**

NAME

getgid – get group identifications

SYNOPSIS

(getgid = 47.; not in assembler)
sys getgid

getgid( )

DESCRIPTION

Getgid returns in r0 the real group ID of the current process. The real group ID identifies the group of the person who is logged in, in contradistinction to the effective group ID, which determines his access permission at the moment. It is thus useful to programs which operate using the "set group ID" mode, to find out who invoked them.

SEE ALSO

setgid (II)

DIAGNOSTICS

—

GETPID (II)

GETPID (II)

NAME

getpid – get process identification

SYNOPSIS

(getpid = 20.; not in assembler)
sys getpid
(pid in r0)

getpid( )

DESCRIPTION

Getpid returns the process ID of the current process. Most often it is used to generate uniquely-named temporary files.

SEE ALSO

—

BUGS

Process id's wrap around at 65K and therefore may not be unique. —

GETUID (II) **GETUID (II)**

NAME

getuid – get user identifications

SYNOPSIS

(getuid = 24.)
sys getuid

getuid( )

DESCRIPTION

Getuid returns in r0, the real user ID of the current process. The real user ID identifies the person who is logged in, in contradistinction to the effective user ID, which determines his access permission at the moment. It is thus useful to programs which operate using the "set user ID" mode, to find out who invoked them.

SEE ALSO

setuid (II)

DIAGNOSTICS

–

NAME

gtty – get typewriter status

SYNOPSIS

(gtty = 32.)
(file descriptor in r0)
sys gtty; arg
...
arg: .= 6

gtty(fildes, arg)
int arg[3];

DESCRIPTION

Gtty stores in the three words addressed by *arg* the status of the typewriter whose file descriptor is given in r0 (resp. given as the first argument). The format is the same as that passed by *stty*.

SEE ALSO

stty (II)

DIAGNOSTICS

Error bit (c-bit) is set if the file descriptor does not refer to a typewriter. From C, a −1 value is returned for an error, 0, for a successful call.

INDIR (II)

NAME

indir – indirect system call

SYNOPSIS

(indir = 0.; not in assembler)
sys indir; syscall

DESCRIPTION

The system call at the location *syscall* is executed. Execution resumes after the *indir* call.

The main purpose of *indir* is to allow a program to store arguments in system calls and execute them out of line in the data segment. This preserves the purity of the text segment.

If *indir* is executed indirectly, it is a no-op. If the instruction at the indirect location is not a system call, the executing process will get a fault.

SEE ALSO

—

DIAGNOSTICS

—

KILL (II) **KILL (II)**

NAME

kill – send signal to a process

SYNOPSIS

(kill = 37.; not in assembler)
(process number in r0)
sys kill; sig

kill(p.' sig);

DESCRIPTION

Kill sends the signal *sig* to the process specified by the process number in r0. See signal (II) for a list of signals.

The sending and receiving processes must have the same effective user ID, otherwise this call is restricted to the super-user.

If the process number is 0, the signal is sent to all other processes which have the same controlling typewriter and user ID.

In no case is it possible for a process to kill itself.

SEE ALSO

signal (II), kill (I)

DIAGNOSTICS

The error bit (c-bit) is set if the process does not have the same effective user ID and the user is not super-user, or if the process does not exist. From C, −1 is returned.

LINK (II)

LINK (II)

NAME

link – link to a file

SYNOPSIS

(link = 9.)
sys link; name1; name2

link(name1, name2)
char *name1, *name2;

DESCRIPTION

A link to *name1* is created; the link has the name *name2*. Either name may be an arbitrary path name.

SEE ALSO

ln (I), unlink (II)

DIAGNOSTICS

The error bit (c-bit) is set when *name1* cannot be found; when *name2* already exists; when the directory of *name2* cannot be written; when an attempt is made to link to a directory by a user other than the super-user; when an attempt is made to link to a file on another file system; when more than 127 links are made. From C, a −1 return indicates an error, a 0 return indicates success.

LOCK (II) LOCK (II)

NAME

lock – semaphores

SYNOPSIS

(lock = 62.;not in assembler)
sys lock; function; flag

function =	**0**	**lock**
	1	**unlock**
	2	**tlock**

lock (flag)

unlock (flag)

tlock (flag)

DESCRIPTION

The primitives *lock*, *unlock*, and *tlock* operate on non-negative integer semaphores called *flags*. *Lock*, *unlock*, and *tlock* are used in conjunction with the semaphores to simplify the communication and synchronization of processes.

lock(flag)	Suspends the execution of the calling process while the semaphore is locked by another process. Otherwise the semaphore is locked.
unlock(flag)	Activates a suspended process waiting on the semaphore flag.
tlock(flag)	Tests the condition of the semaphore but does not suspend execution of the calling process.

NAME

mdate – set modified date on file

SYNOPSIS

(mdate = 30.)
(time to r0-r1)
sys mdate; file

mdate(file, time)
char *file;
int time[2];

DESCRIPTION

File is the address of a null-terminated string naming a file; the modified time of the file is set to the time given in registers r0 and r1 (resp. in the vector which is the second argument). See time (II) for the unit and epoch.

This call is allowed only to the super-user or to the owner of the file.

SEE ALSO

time (II)

DIAGNOSTICS

Error bit is set if the user is neither the owner nor the super-user or if the file cannot be found. From C, a negative return indicates an error, a 0 return indicates success.

BUGS

Caution: setting back the date of a file probably will prevent it from being dumped by an incremental dump.

MKNOD (II)

MKNOD (II)

NAME

mknod – make a directory or a special file

SYNOPSIS

(mknod = 14.; not in assembler)
sys mknod; name; mode; addr

mknod(name, mode, addr)
char *name;

DESCRIPTION

Mknod creates a new file whose name is the null-terminated string pointed to by *name*. The mode of the new file (including directory and special file bits) is initialized from *mode*. The first physical address of the file is initialized from *addr*. Note that in the case of a directory, *addr* should be zero. In the case of a special file, *addr* specifies which special file.

Mknod may be invoked only by the super-user.

SEE ALSO

mkdir (I), mknod (VIII), fs (V)

DIAGNOSTICS

Error bit (c-bit) is set if the file already exists or if the user is not the super-user. From C, a −1 value indicates an error.

MOUNT (II)

MOUNT (II)

NAME

mount – mount file system

SYNOPSIS

(mount = 21.)
sys mount; special; name; rwflag

mount(special, name, rwflag)
char *special, *name;

DESCRIPTION

Mount announces to the system that a removable file system has been mounted on the block-structured special file *special;* from now on, references to file *name* will refer to the root file on the newly mounted file system. *Special* and *name* are pointers to null-terminated strings containing the appropriate path names.

Name must exist already. Its old contents are inaccessible while the file system is mounted.

The *rwflag* argument determines whether the file system can be written on; if it is 0 writing is allowed, if non-zero no writing is done. Physically write-protected and magnetic tape file systems must be mounted read-only or errors will occur when access times are updated, whether or not any explicit write is attempted. When a mount occurs, an open is issued to the pertinent device driver.

SEE ALSO

mount (VIII), umount (II)

DIAGNOSTICS

Error bit (c-bit) set if: *special* is inaccessible or not an appropriate file; *name* does not exist or is a special file; *special* is already mounted; *name* is in use; there are already too many file systems mounted.

BUGS

–

NICE (II) NICE (II)

NAME

nice – set program priority

SYNOPSIS

(nice = 34.)
(priority in r0)
sys nice

nice(prior;

DESCRIPTION

The scheduling *priority* of the process is changed to the argument. Positive priorities get less service than normal; 0 is default. Only the super-user may specify a negative priority. The valid range of *priority* is 20 to −220. The value of 4 is recommended to users who wish to execute long-running programs without flak from the administration.

The effect of this call is passed to a child process by the *fork* system call. The effect can be cancelled by another call to *nice* with a *priority* of 0.

The actual running priority of a process is the *priority* argument plus a number that ranges from 100 to 106 depending on the cpu usage of the process.

SEE ALSO

nice (I), ps(I)

DIAGNOSTICS

The error bit (c-bit) is set if the user requests a *priority* outside the range of 0 to 20 and is not the super-user.

OPEN (II)

OPEN (II)

NAME

open – open for reading or writing

SYNOPSIS

(open = 5.)
sys open; name; mode
(file descriptor in r0)

open(name, mode)
char *name;

DESCRIPTION

Open opens the file *name* for reading (if *mode* is 0), writing (if *mode* is 1) or for both reading and writing (if *mode* is 2). *Name* is the address of a string of ASCII characters representing a path name, terminated by a null character.

The returned file descriptor should be saved for subsequent calls to *read, write,* and *close.*

SEE ALSO

creat (II), read (II), write (II), close (II)

DIAGNOSTICS

The error bit (c-bit) is set if the file does not exist, if one of the necessary directories does not exist or is unreadable, if the file is not readable (resp. writable), or if too many files are open. From C, a −1 value is returned on an error.

PAUSE (II)

PAUSE (II)

NAME

pause – suspend execution indefinitely

SYNOPSIS

(pause = 29.; not in assembler)
sys pause

pause()

DESCRIPTION

The current process is suspended from execution until any signal arrives. *Pause* will return immediately if no alarm has been set.

SEE ALSO

alarm(II)

DIAGNOSTICS

Error bit (c-bit) is set upon return unless the pause failed because no alarm was set. From C, a −1 is returned normally, 0 if because no alarm was set.

PIPE (II) **PIPE (II)**

NAME

pipe – create an interprocess channel

SYNOPSIS

(pipe = 42.)
sys pipe
(read file descriptor in r0)
(write file descriptor in r1)

pipe(fildes)
int fildes[2];

DESCRIPTION

The *pipe* system call creates an I/O mechanism called a pipe. The file descriptors returned can be used in read and write operations. When the pipe is written using the descriptor returned in r1 (resp. fildes[1]), up to 4096 bytes of data are buffered before the writing process is suspended. A read using the descriptor returned in r0 (resp. fildes[0]) will pick up the data.

It is assumed that after the pipe has been set up, two (or more) cooperating processes (created by subsequent *fork* calls) will pass data through the pipe with *read* and *write* calls.

The Shell has a syntax to set up a linear array of processes connected by pipes.

Read calls on an empty pipe (no buffered data) with only one end (all write file descriptors closed) return an end-of-file. Write calls under similar conditions generate a fatal signal (signal (II)); if the signal is ignored, an error is returned on the write.

SEE ALSO

sh (I), read (II), write (II), fork (II)

DIAGNOSTICS

The error bit (c-bit) is set if too many files are already open. From C, a −1 returned value indicates an error. A signal is generated if a write on a pipe with only one end is attempted.

BUGS

PROFIL (II)

PROFIL (II)

NAME

profil – execution time profile

SYNOPSIS

(profil = 44.; not in assembler)
sys profil; buff; bufsiz; offset; scale

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 (60th second); *offset* is subtracted from it, and the result multiplied by *scale*. If the resulting number corresponds to a word inside *buff*, that word is incremented.

The scale is interpreted as an unsigned, fixed-point fraction with binary point at the left: 177777(8) gives a 1-1 mapping of pc's to words in *buff*; 77777(8) maps each pair of instruction words together. 2(8) 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 also turned off when an *exec* is executed but remains on in child and parent both after a *fork*.

SEE ALSO

monitor (III), prof (I)

DIAGNOSTICS

–

READ (II) READ (II)

NAME

read – read from file

SYNOPSIS

(read = 3.)
(file descriptor in r0)
sys read; buffer; nbytes

read(fildes, buffer, nbytes)
char *buffer;

DESCRIPTION

A file descriptor is a word returned from a successful *open, creat, dup,* or *pipe* call. *Buffer* is the location of *nbytes* contiguous bytes into which the input will be placed. It is not guaranteed that all *nbytes* bytes will be read; for example if the file refers to a typewriter at most one line will be returned. In any event the number of characters read is returned (in r0).

If the returned value is 0, then end-of-file has been reached.

SEE ALSO

open (II), creat (II), dup (II), pipe (II)

DIAGNOSTICS

As mentioned, 0 is returned when the end of the file has been reached. If the read was otherwise unsuccessful the error bit (c-bit) is set. Many conditions can generate an error: physical I/O errors, bad buffer address, preposterous *nbytes,* file descriptor not that of an input file. From C, a −1 return indicates the error.

SEEK (II) **SEEK (II)**

NAME

seek – move read/write pointer

SYNOPSIS

(seek = 19.)
(file descriptor in r0)
sys seek; offset; ptrname

seek(fi.les, offset, ptrname)

DESCRIPTION

The file descriptor refers to a file open for reading or writing. The read (resp. write) pointer for the file is set as follows:

if *ptrname* is 0, the pointer is set to *offset.*

if *ptrname* is 1, the pointer is set to its current location plus *offset.*

if *ptrname* is 2, the pointer is set to the size of the file plus *offset.*

if *ptrname* is 3, 4 or 5, the meaning is as above for 0, 1 and 2 except that the offset is multiplied by 512.

If *ptrname* is 0 or 3, *offset* is unsigned, otherwise it is signed.

SEE ALSO

open (II), creat (II)

DIAGNOSTICS

The error bit (c-bit) is set for an undefined file descriptor. From C, a −1 return indicates an error.

SETGID (II) **SETGID (II)**

NAME

setgid – set process group ID

SYNOPSIS

(setgid = 46.; not in assembler)
(group ID in r0)
sys setgid

setgid(gid)

DESCRIPTION

The group ID of the current process is set to the argument. Both the effective and the real group ID are set. This call is only permitted to the super-user or if the argument is the real group ID.

SEE ALSO

getgid (II)

DIAGNOSTICS

Error bit (c-bit) is set as indicated; from C, a −1 value is returned.

SETUID (II) SETUID (II)

NAME

setuid – set process user ID

SYNOPSIS

(setuid = 23.)
(user ID in r0)
sys setuid

setuid(uid)

DESCRIPTION

The user ID of the current process is set to the argument. Both the effective and the real user ID are set. This call is only permitted to the super-user or if the argument is the real user ID.

SEE ALSO

getuid (II)

DIAGNOSTICS

Error bit (c-bit) is set as indicated; from C, a −1 value is returned.

SIGNAL (II) SIGNAL (II)

NAME

signal – catch or ignore signals

SYNOPSIS

(signal = 48.)
sys signal; sig; label
(old value in r0)

signal(sig, func)
int (*func)( );

DESCRIPTION

A *signal* is generated by some abnormal event, initiated either by a user at a typewriter (quit, interrupt), by a program error (bus error, etc.), or by request of another program (kill). Normally all signals cause termination of the receiving process, but this call allows them either to be ignored or to cause an interrupt to a specified location. Here is the list of signals:

1	hangup
2	interrupt (reboot, or delete key)
3*	quit (ascii FS)
4*	illegal instruction (not reset when caught)
5*	trace trap (not reset when caught)
6*	IOT instruction
7*	EMT instruction
8*	floating point exception
9	kill (cannot be caught or ignored)
10*	bus error
11*	segmentation violation
12*	bad argument to system call
13	write on a pipe with no one to read it
14	alarm timeout
15	unused
16	unused
17	unused
18	unused
19	unused

In the assembler call, if *label* is 0, the process is terminated when the signal occurs; this is the default action. If *label* is odd, the signal is ignored. Any other even *label* specifies an address in the process where an interrupt is simulated. An RTI or RTT instruction will return from the interrupt. Except as indicated, a signal is reset to 0 after being caught. Thus if it is desired to catch every such signal, the catching routine must issue another *signal* call.

In C, if *func* is 0, the default action for signal *sig* (termination) is reinstated. If *func* is 1, the signal is ignored. If *func* is non-zero and even, it is assumed to be the address of a function entry point. When the signal occurs, the function will be called. A return from the function will continue the process at the point it was interrupted. As in the assembler call, *signal* must in general be called again to catch subsequent signals.

When a caught signal occurs during certain system calls, the call terminates prematurely. In particular this can occur during a *read* or *write* on a slow device (like a typewriter; but not a file); and during or *wait*. When such a signal occurs, the saved user status is arranged in such a way that when return from the signal-catching takes place, it will appear that the system call returned a characteristic error status. The user's program may then, if it wishes, re-execute the call.

The starred signals in the list above cause a core image if not caught or ignored.

The value returned by the signal call is the old action defined for the signal.

After a *fork* (II) the child inherits all signals. *Exec* (II) resets all caught signals to default action but allows inheritance of ignored signals.

SEE ALSO

kill (I), kill (II), reset (III)

DIAGNOSTICS

The error bit (c-bit) is set if the given signal is out of range. In C, a −1 indicates an error; otherwise indicates success.

BUGS

SLEEP (II) **SLEEP (II)**

NAME

sleep – stop execution for interval

SYNOPSIS

(sleep = 35.; not in assembler)
(seconds in r0)
sys sleep

sleep(seconds)

DESCRIPTION

The current process is suspended from execution for the number of seconds specified by the argument. This is implemented by adding the current date to the argument to produce a new date. The process is then suspended until the new date is reached.

From C, *sleep* is implemented by using signal(II) to catch the alarm clock signal, then using alarm(II) and pause(II) to set up and wait for the alarm to occur after the number of seconds specified by the argument. The treatment of the alarm clock signal by the calling program is preserved, but any alarm currently in progress is cleared.

SEE ALSO

sleep(I), alarm(II), pause(II)

DIAGNOSTICS

STAT (II) STAT (II)

NAME

stat – get file status

SYNOPSIS

(stat = 18.)
sys stat; name; buf

stat(name, buf)
char *name;
struct inode buf;

DESCRIPTION

Name points to a null-terminated string naming a file; *buf* is the address of a 36(10) byte buffer into which information is placed concerning the file. It is unnecessary to have any permissions at all with respect to the file, but all directories leading to the file must be readable. After *stat, buf* has the following structure (starting offset given in bytes):

```
struct inode {
        char    minor;          /* +0: minor device of i-node */
        char    major;          /* +1: major device */
        int     inumber;        /* +2 */
        int     flags;          /* +4: see below */
        char    nlinks;         /* +6: number of links to file */
        char    uid;            /* +7: user ID of owner */
        char    gid;            /* +8: group ID of owner */
        char    size0;          /* +9: high byte of 24-bit size */
        int     size1;          /* +10: low word of 24-bit size */
        int     addr[8];        /* +12: block numbers or device number */
        int     actime[2];      /* +28: time of last access */
        int     modtime[2];     /* +32: time of last modification */
};
```

The flags are as follows:

```
100000  i-node is allocated
060000  2-bit file type:
    000000  plain file
    040000  directory
    020000  character-type special file
    060000  block-type special file.
010000  large file
004000  set user-ID on execution
002000  set group-ID on execution
001000  save text image after execution
000400  read (owner)
000200  write (owner)
000100  execute (owner)
000070  read, write, execute (group)
000007  read, write, execute (others)
```

SEE ALSO

ls (I), fstat (II), fs (V)

DIAGNOSTICS

Error bit (c-bit) is set if the file cannot be found. From C, a −1 return indicates an error.

STIME (II) **STIME (II)**

NAME

stime – set time

SYNOPSIS

(stime = 25.)
(time in r0-r1)
sys stime

stime(tbuf)
int tbuf[2];

DESCRIPTION

Stime sets the system's idea of the time and date. Time is measured in seconds from 0000 GMT Jan 1 1970. Only the super-user may use this call.

SEE ALSO

date (I), time (II), ctime (III)

DIAGNOSTICS

Error bit (c-bit) set if user is not the super-user.

STTY (II) **STTY (II)**

NAME

stty – set mode of typewriter

SYNOPSIS

```
(stty = 31.)
(file descriptor in r0)
sys stty; arg
...
arg:  .byte ispeed, ospeed; 0; mode

stty(fildes, arg)
struct {
        char    ispeed, ospeed;
        int     unused;
        int     mode;
} *arg;
```

DESCRIPTION

Stty sets mode bits and character speeds for the typewriter whose file descriptor is passed in r0 (resp. is the first argument to the call). First, the system delays until the typewriter is quiescent. The input and output speeds are set from the first two bytes of the argument structure as indicated by the following table, which corresponds to the speeds supported by the DH-11 interface. If DC-11, DL-11 or KL-11 interfaces are used, impossible speed changes are ignored.

0	(hang up dataphone)
1	50 baud
2	75 baud
3	110 baud
4	134.5 baud
5	150 baud
6	200 baud
7	300 baud
8	600 baud
9	1200 baud
10	1800 baud
11	2400 baud
12	4800 baud
13	9600 baud
14	External A
15	External B

In the current configuration, only 110, 150 and 300 baud are really supported on dial-up lines, in that the code conversion and line control required for IBM 2741's (134.5 baud) must be implemented by the user's program, and the half-duplex line discipline required for the 202 dataset (1200 baud) is not supplied.

The second word of the argument structure is currently unused and reserved for future use.

The *mode* contains several bits which determine the system's treatment of the typewriter:

100000	Select one of two algorithms for backspace delays
040000	Select one of two algorithms for form-feed and vertical-tab delays
030000	Select one of four algorithms for carriage-return delays
006000	Select one of four algorithms for tab delays
001400	Select one of four algorithms for new-line delays
000200	even parity allowed on input (e. g. for M37s)
000100	odd parity allowed on input

000040 raw mode: wake up on all characters
000020 map CR into LF; echo LF or CR as CR-LF
000010 echo (full duplex)
000004 map upper case to lower on input (e. g. M33)
000002 echo and print tabs as spaces

The delay bits specify how long transmission stops to allow for mechanical or other movement when certain characters are sent to the terminal. In all cases a value of 0 indicates no delay.

Backspace delays are currently ignored but will be used for Terminet 300's.

If a form-feed/vertical tab delay is specified, it lasts for about 2 seconds.

Carriage-return delay type 1 lasts about .08 seconds and is suitable for the Terminet 300. Delay type 2 lasts about .16 seconds and is suitable for the VT05 and the TI 700. Delay type 3 is not implemented and is 0.

New-line delay type 1 is dependent on the current column and is tuned for Teletype model 37's. Type 2 is useful for the VT05 and is about .10 seconds. Type 3 is not implemented and is 0.

Tab delay type 1 is dependent on the amount of movement and is tuned to the Teletype model 37. Other types are unimplemented and are 0.

Characters with the wrong parity, as determined by bits 200 and 100, are ignored.

In raw mode, every character is passed immediately to the program without waiting until a full line has been typed. No erase or kill processing is done; the end-of-file character (EOT), the interrupt character (DEL) and the quit character (FS) are not treated specially.

Mode 020 causes input carriage returns to be turned into new-lines; input of either CR or LF causes LF-CR both to be echoed (used for GE TermiNet 300's and other terminals without the newline function).

This system call is also used with certain special files other than typewriters, but since none of them are part of the standard system the specifications will not be given.

SEE ALSO

stty (I), gtty (II)

DIAGNOSTICS

The error bit (c-bit) is set if the file descriptor does not refer to a typewriter. From C, a negative value indicates an error.

SYNC (II) SYNC (II)

NAME

sync — update super-block

SYNOPSIS

(sync = 36.; not in assembler)
sys sync

DESCRIPTION

Sync causes all information in core 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 *icheck, df,* etc. It is mandatory before a boot.

SEE ALSO

sync (VIII), update (VIII)

DIAGNOSTICS

—

TIME (II) **TIME (II)**

NAME

time – get date and time

SYNOPSIS

(time = 13.)
sys time

time(tvec)
int tvec[2];

DESCRIPTION

Time returns the time since 00:00:00 GMT, Jan. 1, 1970, measured in seconds. From *as*, the high order word is in the r0 register and the low order is in r1. From C, the user-supplied vector is filled in.

SEE ALSO

date (I), stime (II), ctime (III)

DIAGNOSTICS

–

TIMES (II) TIMES (II)

NAME

times – get process times

SYNOPSIS

(times = 43.; not in assembler)
sys times; buffer

times(buffer)
struct tbuffer *buffer;

DESCRIPTION

Times returns time-accounting information for the current process and for the terminated child processes of the current process. All times are in 1/60 seconds.

After the call, the buffer will appear as follows:

```
struct tbuffer {
        int     proc_user_time;
        int     proc_system_time;
        int     child_user_time[2];
        int     child_system_time[2];
};
```

The children times are the sum of the children's process times and their children's times.

SEE ALSO

time (I)

DIAGNOSTICS

—

BUGS

The process times should be 32 bits as well.

NAME

umount – dismount file system

SYNOPSIS

(umount = 22.)
sys umount; special

DESCRIPTION

Umount announces to the system that special file *special* is no longer to contain a removable file system. A *close* is issued to the pertinent device driver. The file associated with the special file reverts to its ordinary interpretation; see *mount* (II).

SEE ALSO

umount (VIII), mount (II)

DIAGNOSTICS

Error bit (c-bit) set if no file system was mounted on the special file or if there are still active files on the mounted file system.

NAME

unlink – remove directory entry

SYNOPSIS

```
(unlink = 10.)
sys unlink; name

unlink(name)
char *name;
```

DESCRIPTION

Name points to a null-terminated string. *Unlink* removes the entry for the file pointed to by *name* from its directory. If this entry was the last link to the file, the contents of the file are freed and the file is destroyed. If, however, the file was open in any process, the actual destruction is delayed until it is closed, even though the directory entry has disappeared.

SEE ALSO

rm (I), rmdir (I), link (II)

DIAGNOSTICS

The error bit (c-bit) is set to indicate that the file does not exist or that its directory cannot be written. Write permission is not required on the file itself. It is also illegal to unlink a directory (except for the super-user). From C, a −1 return indicates an error.

WAIT (II) WAIT (II)

NAME

wait – wait for process to terminate

SYNOPSIS

(wait = 7.)
sys wait
(process ID in r0)
(status in r1)

wait(status)
int *status;

DESCRIPTION

Wait causes its caller to delay until one of its child processes terminates. If any child has died since the last *wait,* return is immediate; if there are no children, return is immediate with the error bit set (resp. with a value of −1 returned). The normal return yields the process ID of the terminated child (in r0). In the case of several children several *wait* calls are needed to learn of all the deaths.

If no error is indicated on return, the r1 high byte (resp. the high byte stored into *status*) contains the low byte of the child process r0 (resp. the argument of *exit*) when it terminated. The r1 (resp. *status*) low byte contains the termination status of the process. See signal (II) for a list of termination statuses (signals); 0 status indicates normal termination. If the 0200 bit of the termination status is set, a core image of the process was produced by the system.

If the parent process terminates without waiting on its children, the initialization process (process ID = 1) inherits the children.

SEE ALSO

exit (II), fork (II), signal (II)

DIAGNOSTICS

The error bit (c-bit) is set if there are no children not previously waited for. From C, a returned value of −1 indicates an error.

WRITE (II)

WRITE (II)

NAME

write – write on a file

SYNOPSIS

(write = 4.)
(file descriptor in r0)
sys write; buffer; nbytes

write(fildes, buffer, nbytes)
char *bu...

DESCRIPTION

A file descriptor is a word returned from a successful *open, creat, dup,* or *pipe* call.

Buffer is the address of *nbytes* contiguous bytes which are written on the output file. The number of characters actually written is returned (in r0). It should be regarded as an error if this is not the same as requested.

Writes which are multiples of 512 characters long and begin on a 512-byte boundary in the file are more efficient than any others.

SEE ALSO

creat (II), open (II), pipe (II)

DIAGNOSTICS

The error bit (c-bit) is set on an error: bad descriptor, buffer address, or count; physical I/O errors. From C, a returned value of −1 indicates an error.

III SUBROUTINES

ABORT (III) ABORT (III)

NAME

abort — generate an IOT fault

SYNOPSIS

abort()

DESCRIPTION

Abort executes the IOT instruction. This is usually considered a program fault by the system and results in termination with a core dump. It is used to generate a core image for debugging.

SEE ALSO

db (I), cdb (I), signal (II)

DIAGNOSTICS

usually "IOT trap -- core dumped" from the Shell.

BUGS

ABS (III) ABS (III)

NAME

abs, fabs – absolute value

SYNOPSIS

```
abs(i)
int i;

double fabs(x)
double x;
```

DESCRIPTION

Abs returns the absolute value of its integer operand; *fabs* is the *double* version.

ALLOC (III) ALLOC (III)

NAME

alloc – core allocator

SYNOPSIS

char *alloc(size)

free(ptr)
char *ptr;

DESCRIPTION

Alloc and *free* provide a simple general-purpose core management package. *Alloc* is given a size in bytes; it returns a pointer to an area at least that size which is even and hence can hold an object of any type. The argument to *free* is a pointer to an area previous allocated by *alloc;* this space is made available for further allocation.

Needless to say, grave disorder will result if the space assigned by *alloc* is overrun or if some random number is handed to *free.*

The method uses a first-fit algorithm which coalesces blocks being freed with other blocks already free. It calls *sbrk* (see *break* (I)) to get more core from the system when there is no suitable space already free. If that fails, it writes "Out of space" on the standard output and exits.

The external variable *slop* (which is 2 if not set) is a number such that if n bytes are requested, and if the first free block of size at least n is no larger than $n+slop$, then the whole block will be allocated instead of being split up. Larger values of *slop* tend to reduce fragmentation at the expense of unused space in the allocated blocks.

DIAGNOSTICS

"Out of space" if it needs core and can't get it.

BUGS

ATAN (III) ATAN (III)

NAME

atan, atan2 – arc tangent function

SYNOPSIS

```
jsr   pc,atan
jsr   pc,atan2

double atan(x)
double x;

double atan2(x, y)
double x, y;
```

DESCRIPTION

The *atan* entry returns the arc tangent of fr0 in fr0; from C, the arc tangent of x is returned. The range is $-\pi/2$ to $\pi/2$. The *atan2* entry returns the arc tangent of fr0/fr1 in fr0; from C, the arc tangent of x/y is returned. The range is $-\pi$ to π.

DIAGNOSTIC

There is no error return.

BUGS

NAME

atof – convert ASCII to floating

SYNOPSIS

double atof(nptr)
char *nptr;

DESCRIPTION

Atof converts a string to a floating number. *Nptr* should point to a string containing the number, the first unrecognized character ends the number.

The only numbers recognized are: an optional minus sign followed by a string of digits optionally containing one decimal point, then followed optionally by the letter **e** followed by a signed integer.

DIAGNOSTICS

There are none; overflow results in a very large number and garbage characters terminate the scan.

BUGS

The routine should accept initial **+**, initial blanks, and **E** for **e**. Overflow should be signalled.

ATOI (III) **ATOI (III)**

NAME

atoi – convert ASCII to integer

SYNOPSIS

```
atoi(nptr)
char *nptr;
```

DESCRIPTION

Atoi converts the string pointed to by *nptr* to an integer. The string can contain leading blanks or tabs, an optional '–', and then an unbroken string of digits. Conversion stops at the first non-digit.

SEE ALSO

atof (III)

BUGS

There is no provision for overflow.

COMPAR (III) COMPAR (III)

NAME

compar – default comparison routine for qsort

SYNOPSIS

jsr pc,compar

DESCRIPTION

Compar is the default comparison routine called by *qsort* and is separated out so that the user can supply his own comparison.

The routine is called with the width (in bytes) of an element in r3 and it compares byte-by-byte the element pointed to by r0 with the element pointed to by r4.

Return is via the condition codes, which are tested by the instructions "blt" and "bgt". That is, in the absence of overflow, the condition (r0) < (r4) should leave the Z-bit off and N-bit on while (r0) > (r4) should leave Z and N off. Still another way of putting it is that for elements of length 1 the instruction

```
cmpb (r0),(r4)
```

suffices.

Only r0 is changed by the call.

SEE ALSO

qsort (III)

BUGS

It could be recoded to run faster.

CRYPT (III)

CRYPT (III)

NAME

crypt – password encoding

SYNOPSIS

```
mov   $key,r0
jsr   pc,crypt

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

DESCRIPTION

On entry, r0 points to a string of characters terminated by an ASCII NUL. The routine performs an operation on the key which is difficult to invert (i.e. encrypts it) and leaves the resulting eight bytes of ASCII alphanumerics in a global cell called "word".

From C, the *key* argument is a string and the value returned is a pointer to the eight-character result.

This routine is used to encrypt all passwords.

SEE ALSO

passwd (I), passwd (V), login (I)

BUGS

Short or otherwise simple passwords can be decrypted easily by exhaustive search. Six characters of gibberish is reasonably safe.

CTIME (III) **CTIME (III)**

NAME

ctime, localtime, gmtime – convert date and time to ASCII

SYNOPSIS

char *ctime(tvec)
int tvec[2];

[from Fortran]
double precision ctime
... = ctime(tvec)

int *localtime(tvec)
int tvec[2];

int *gmtime(tvec)
int tvec[2];

DESCRIPTION

Ctime converts a time in the vector *tvec* such as returned by time (II) into ASCII and returns a pointer to a character string in the form

Sun Sep 16 01:03:52 1973\n\0

All the fields have constant width.

The *localtime* and *gmtime* entries return pointers to integer vectors containing the broken-down time. *Localtime* corrects for the time zone and possible daylight savings time; *gmtime* converts directly to GMT, which is the time UNIX uses. The value is a pointer to an array whose components are

0 seconds
1 minutes
2 hours
3 day of the month (1-31)
4 month (0-11)
5 year – 1900
6 day of the week (Sunday = 0)
7 day of the year (0-365)
8 Daylight Saving Time flag if non-zero

The external variable *timezone* contains the difference, in seconds, between GMT and local standard time (in EST, it is 5*60*60); the external variable *daylight* is non-zero 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.

A routine named *ctime* is also available from Fortran. Actually it resembles more the *time* (II) system entry in that it returns the number of seconds since the epoch 0000 GMT Jan. 1, 1970 (as a floating-point number).

SEE ALSO

time(II)

BUGS

DTOL (III) **DTOL (III)**

NAME

dtol – floating point to double precision integer conversion

SYNOPSIS

```
dtol(d,t)
double d;
int t[2];
```

DESCRIPTION

Dtol converts the floating point number *d* to a double precision (i.e. long) integer.
The fractional part of the floating point number is lost during conversion; hence *dtol* (d,t) and *dtol* (*floor* (d),t) yield the same results.

SEE ALSO

ltod (III),floor(III)

ECVT (III) ECVT (III)

NAME

ecvt, fcvt – output conversion

SYNOPSIS

```
jsr     pc,ecvt
jsr     pc,fcvt
char *ecvt(value, ndigit, decpt, sign)
double value;
int ndigit, *decpt, *sign;
char *fcvt(value, ndigit, decpt, sign)
...
```

DESCRIPTION

Ecvt is called with a floating point number in fr0.

On exit, the number has been converted into a string of ascii digits in a buffer pointed to by r0. The number of digits produced is controlled by a global variable *_ndigits.*

Moreover, the position of the decimal point is contained in r2: r2=0 means the d.p. is at the left hand end of the string of digits; r2>0 means the d.p. is within or to the right of the string.

The sign of the number is indicated by r1 (0 for +; 1 for –).

The low order digit has suffered decimal rounding (i. e. may have been carried into).

From C, the *value* is converted and a pointer to a null-terminated string of *ndigit* digits is returned. The position of the decimal point is stored indirectly through *decpt* (negative means to the left of the returned digits). 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 been rounded for F-style output of the number of digits specified by *ndigits.*

SEE ALSO

printf (III)

BUGS

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. Instead, their addresses coincide with the first address above the program text region *(etext)*, above the initialized data region *(edata)*, or uninitialized data region *(end)*. The last is the same as the program break. Values are given to these symbols by the link editor *ld* (I) when, and only when, they are referred to but not defined in the set of programs loaded.

The usage of these symbols is rather specialized, but one plausible possibility is

```
extern end;
...
... = brk(&end+...);
```

(see *break* (II)). The problem with this is that it ignores any other subroutines which may want to extend core for their purposes; these include *sbrk* (see *break* (II)), *alloc* (III), and also secret subroutines invoked by the profile (−p) option of *cc*. Of course it was for the benefit of such systems that the symbols were invented, and user programs, unless they are in firm control of their environment, are wise not to refer to the absolute symbols directly.

One technique sometimes useful is to call *sbrk(0)*, which returns the value of the current program break, instead of referring to *&end*, which yields the program break at the instant execution started.

These symbols are accessible from assembly language if it is remembered that they should be prefixed by '_'

SEE ALSO

break (II), alloc (III)

BUGS

EXP (III) **EXP (III)**

NAME

exp – exponential function

SYNOPSIS

```
jsr     pc,exp

double exp(x)
double x;
```

DESCRIPTION

The exponential of fr0 is returned in fr0. From C, the exponential of *x* is returned.

DIAGNOSTICS

If the result is not representable, the c-bit is set and the largest positive number is returned. From C, no diagnostic is available.

Zero is returned if the result would underflow.

BUGS

NAME

floor, ceil – floor and ceiling functions

SYNOPSIS

```
double floor(x)
double x;

double ceil(x)
double x;
```

DESCRIPTION

The floor function returns the largest integer (as a double precision number) not greater than **x**.

The ceil function returns the smallest integer not less than **x**.

BUGS

FMOD (III) **FMOD (III)**

NAME

fmod – floating modulo function

SYNOPSIS

double fmod(x, y)
double x, y;

DESCRIPTION

Fmod returns the number *f* such that $x = iy + f$, i is an integer, and $0 \leqslant f < y$.

BUGS

NAME

fptrap – floating point interpreter

SYNOPSIS

sys signal; 4; fptrap

DESCRIPTION

Fptrap is a simulator of the 11/45 FP11-B floating point unit. It works by intercepting illegal instruction traps and decoding and executing the floating point operation codes.

FILES

In systems with real floating point, there is a fake routine in /lib/liba.a with this name; when simulation is desired, the real version should be put in liba.a.

DIAGNOSTICS

A break point trap is given when a real illegal instruction trap occurs.

SEE ALSO

signal (II), cc (I) ('–f' option)

BUGS

Rounding mode is not interpreted. It's slow.

GAMMA (III) GAMMA (III)

NAME

gamma – log gamma function

SYNOPSIS

```
jsr     pc,gamma

double gamma(x)
double x;
```

DESCRIPTION

If x is passed (in fr0) *gamma* returns $\ln|\Gamma(x)|$ (in fr0). The sign of $\Gamma(x)$ is returned in the external integer *signgam*. The following C program might be used to calculate Γ:

```
y = gamma(x);
if (y > 88.)
        error( );
y = exp(y);
if(signgam)
        y = -y;
```

DIAGNOSTICS

The c-bit is set on negative integral arguments and the maximum value is returned. There is no error return for C programs.

BUGS

No error return from C.

GETARG (III) **GETARG (III)**

NAME

getarg, iargc – get command arguments from Fortran

SYNOPSIS

call getarg (i, iarray [, isize])

... = iargc(dummy)

DESCRIPTION

The *getarg* entry fills in *iarray* (which is considered to be *integer)* with the Hollerith string representing the *i* th argument to the command in which it it is called. If no *isize* argument is specified, at least one blank is placed after the argument, and the last word affected is blank padded. The user should make sure that the array is big enough.

If the *isize* argument is given, the argument will be followed by blanks to fill up *isize* words, but even if the argument is long no more than that many words will be filled in.

The blank-padded array is suitable for use as an argument to setfil (III).

The *iargc* entry returns the number of arguments to the command, counting the first (file-name) argument.

SEE ALSO

exec (II), setfil (III)

BUGS

GETC (III) GETC (III)

NAME

getc, getw, fopen – buffered input

SYNOPSIS

```
mov     $filename,r0
jsr     r5,fopen; iobuf

fopen(filename, iobuf)
char *filename;
struct buf *iobuf;

jsr     r5,getc; iobuf
(character in r0)

getc(iobuf)
struct buf *iobuf;

jsr     r5,getw; iobuf
(word in r0)

getw(iobuf)
struct buf *iobuf;
```

DESCRIPTION

These routines provide a buffered input facility. *Iobuf* is the address of a 518(10) byte buffer area whose contents are maintained by these routines. Its structure is

```
struct buf {
        int fildes;     /* File descriptor */
        int nleft;      /* Chars left in buffer */
        char *nextp;    /* Ptr to next character */
        char buff[512];         /* The buffer */
};
```

Fopen may be called initially to open the file. On return, the error bit (c-bit) is set if the open failed. If *fopen* is never called, *get* will read from the standard input file. From C, the value is negative if the open failed.

Getc returns the next byte from the file in r0. The error bit is set on end of file or a read error. From C, the character is returned as an integer, without sign extension; it is −1 on end-of-file or error.

Getw returns the next word in r0. *Getc* and *getw* may be used alternately; there are no odd/even problems. *Getw* may be called from C; −1 is returned on end-of-file or error, but of course is also a legitimate value.

Iobuf must be provided by the user; it must be on a word boundary.

To reuse the same buffer for another file, it is sufficient to close the original file and call *fopen* again.

SEE ALSO

open (II), read (II), getchar (III), putc (III)

DIAGNOSTICS

c-bit set on EOF or error; from C, negative return indicates error or EOF. Moreover, *errno* is set by this routine just as it is for a system call (see introduction (II)).

BUGS

GETCHAR (III) GETCHAR (III)

NAME

getchar – read character

SYNOPSIS

getchar( )

DESCRIPTION

Getchar provides the simplest means of reading characters from the standard input for C programs. It returns successive characters until end-of-file, when it returns "\0".

Associated with this routine is an external variable called *fin*, which is a structure containing a buffer such as described under *getc* (III).

Generally speaking, *getchar* should be used only for the simplest applications; *getc* is better when there are multiple input files.

SEE ALSO

getc (III)

DIAGNOSTICS

Null character returned on EOF or error.

BUGS

–1 should be returned on EOF; null is a legitimate character.

GETPW (III) GETPW (III)

NAME

getpw – get name from UID

SYNOPSIS

getpw(uid, buf)
char *buf;

DESCRIPTION

Getpw searches the password file for the (numerical) *uid*, and fills in *buf* with the corresponding line; it returns non-zero if *uid* could not be found. The line is null-terminated.

FILES

/etc/passwd

SEE ALSO

passwd (V)

DIAGNOSTICS

non-zero return on error.

BUGS

HMUL (III) **HMUL (III)**

NAME

hmul – high-order product

SYNOPSIS

hmul(x, y)

DESCRIPTION

Hmul returns the high-order 16 bits of the product of **x** and **y**. (The binary multiplication operator generates the low-order 16 bits of a product.)

BUGS

HYPOT (III)

HYPOT (III)

NAME

hypot – calculate hypotenuse

SYNOPSIS

jsr r5,hypot

DESCRIPTION

The square root of fr0 × fr0 + fr1 × fr1 is returned in fr0. The calculation is done in such a way that overflow will not occur unless the answer is not representable in floating point.

DIAGNOSTICS

The c-bit is set if the result cannot be represented.

BUGS

IERROR (III)

IERROR (III)

NAME

ierror – catch Fortran errors

SYNOPSIS

if (ierror (*errno* **) .ne. 0) goto** *label*

DESCRIPTION

Ierror provides a way of detecting errors during the running of a Fortran program. Its argument is a run-time error number such as enumerated in *fc* (I).

When *ierror* is called, it returns a 0 value; thus the **goto** statement in the synopsis is not executed. However, the routine stores inside itself the call point and invocation level. If and when the indicated error occurs, a **return** is simulated from *ierror* with a non-zero value; thus the **goto** (or other statement) is executed. It is a ghastly error to call *ierror* from a subroutine which has already returned when the error occurs.

This routine is essentially tailored to catching end-of-file situations. Typically it is called just before the start of the loop which reads the input file, and the **goto** jumps to a graceful termination of the program.

There is a limit of 5 on the number of different error numbers which can be caught.

SEE ALSO

fc (I)

BUGS

There is no way to ignore errors.

NAME

ldiv, lrem – long division

SYNOPSIS

ldiv(hidividend, lodividend, divisor)

lrem(hidividend, lodividend, divisor)

DESCRIPTION

The concatenation of the signed 16-bit *hidividend* and the unsigned 16-bit *lodividend* is divided by *divisor*. The 16-bit signed quotient is returned by *ldiv* and the 16-bit signed remainder is returned by *lrem*. Divide check and erroneous results will occur unless the magnitude of the quotient is less than 32768.

An integer division of an unsigned dividend by a signed divisor may be accomplished by

```
quo = ldiv(0, dividend, divisor);
```

and similarly for the remainder operation.

Often both the quotient and the remainder are wanted. Therefore *ldiv* leaves a remainder in the external cell *ldivr*.

BUGS

No check on divide check.

LOCV (III) **LOCV (III)**

NAME

locv – long output conversion

SYNOPSIS

char *locv(hi, lo)
int hi, lo;

DESCRIPTION

Locv converts a signed double-precision integer, whose parts are passed as arguments, to the equivalent ASCII character string and returns a pointer to that string.

SEE ALSO

atof (III), atoi (III)

BUGS

Since *locv* returns a pointer to a static buffer containing the converted result, it cannot be used twice in the same expression; the second result overwrites the first.

LOG (III) LOG (III)

NAME

log – natural logarithm

SYNOPSIS

```
jsr     pc,log

double log(x)
double x;
```

DESCRIPTION

The natural logarithm of fr0 is returned in fr0. From C, the natural logarithm of **x** is returned.

DIAGNOSTICS

The error bit (c-bit) is set if the input argument is less than or equal to zero and the result is a negative number very large in magnitude. From C, there is no error indication.

BUGS

LTOD (III)

LTOD (III)

NAME

ltod – double precision integer to floating point conversion

SYNOPSIS

```
double ltod(t)
int    t[2];
```

DESCRIPTION

Ltod converts a signed double precision (i.e.long) integer to the equivalent floating point number.

SEE ALSO

dtol (III)

MESG (III) MESG (III)

NAME

mesg – write message on typewriter

SYNOPSIS

jsr r5,mesg; <Now is the time\0>; .even

DESCRIPTION

Mesg writes the string immediately following its call onto the standard output file. The string must be terminated by an ASCII NULL byte.

BUGS

MKTEMP (III) MKTEMP (III)

NAME

mktemp – make a unique named temporary file

SYNOPSIS

mktemp(as)
char *as;

DESCRIPTION

Mktemp creates a unique named temporary file. The name is made up of the string pointed to by *as* where each 'X' is replaced by a digit formed from the process identification. If the named file already exists the letters 'a', 'b', ... are added as the last letter and the name is tried again.

Mktemp returns a pointer to the unique name. If all the letters of the alphabet are exhausted without successfully creating a unique name the name '/' is returned.

BUGS

MONITOR (III) MONITOR (III)

NAME

monitor – prepare execution profile

SYNOPSIS

monitor(lowpc, highpc, buffer, bufsize)
int lowpc( ), highpc( ), buffer[ ], bufsize;

DESCRIPTION

Monitor is an interface to the system's *profile* (II) entry. *Lowpc* and *highpc* are the names of two functions; *buffer* is the address of a (user supplied) array of *bufsize* integers. *Monitor* arranges for the system to sample the user's program counter periodically and record the execution histogram in the buffer. The lowest address sampled is that of *lowpc* and the highest is just below *highpc*. 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(2, &etext, buf, bufsize);
```

Etext is a loader-defined symbol which lies just above all the program text.

To stop execution monitoring and write the results on the file *mon.out,* use

```
monitor(0);
```

Then, when the program exits, prof (I) can be used to examine the results.

It is seldom necessary to call this routine directly; the **-p** option of *cc* is simpler if one is satisfied with its default profile range and resolution.

FILES

mon.out

SEE ALSO

prof (I), profil (II), cc (I)

NAME

nargs – argument count

SYNOPSIS

nargs( )

DESCRIPTION

Nargs returns the number of actual parameters supplied by the caller of the routine which calls *nargs.*

The argument count is accurate only when none of the actual parameters is *float* or *double.* Such parameters count as four arguments instead of one.

BUGS

As indicated. This routine does not work (and cannot be made to work) in programs with separated I and D space. Altogether it is best to avoid using this routine and depend, for example, on passing an explicit argument count.

NLIST (III) NLIST (III)

NAME

nlist – get entries from name list

SYNOPSIS

```
nlist(filename, nl)
char *filename;
struct {
        char    name[8];
        int     type;
        int     value;
} nl[ ];
```

DESCRIPTION

Nlist examines the name list in the given executable output file and selectively extracts a list of values. The name list consists of a list of 8-character names (null padded) each followed by two words. The list is terminated with a null name. Each name is looked up in the name list of the file. If the name is found, the type and value of the name are placed in the two words following the name. If the name is not found, the type entry is set to −1.

This subroutine is useful for examining the system name list kept in the file **/unix**. In this way programs can obtain system addresses that are up to date.

SEE ALSO

a.out (V)

DIAGNOSTICS

All type entries are set to −1 if the file cannot be found or if it is not a valid namelist.

BUGS

PERROR (III) PERROR (III)

NAME

perror, sys_errlist, sys_nerr, errno – system error messages

SYNOPSIS

```
perror(s)
char *s;

int sys_nerr;
char *sys_errlist[];

int errno;
```

DESCRIPTION

Perror produces a short error message describing the last error encountered during a call to the system from a C program. First the argument string *s* is printed, then a colon, then the message and a new-line. Most usefully, the argument string is the name of the program which 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 vector of message strings *sys_errlist* is provided; *errno* can be used as an index in this table to get the message string without the newline. *Sys_nerr* is the largest message number provided for 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

Introduction to System Calls

BUGS

POW (III)

POW (III)

NAME

pow – floating exponentiation

SYNOPSIS

```
movf   x,fr0
movf   y,fr1
jsr    pc,pow

double pow(x,y)
double x, y;
```

DESCRIPTION

Pow returns the value of x^y (in fr0). *Pow(0.0, y)* is 0 for any *y*. *Pow(−x, y)* returns a result only if *y* is an integer.

SEE ALSO

exp (III), log (III)

DIAGNOSTICS

The carry bit is set on return in case of overflow, *pow(0.0, 0.0)*, or *pow(−x, y)* for non-integral *y*. From C there is no diagnostic.

BUGS

PRINTF (III)

PRINTF (III)

NAME

printf – formatted print

SYNOPSIS

printf(format, arg$_1$, ...);
char *format;

DESCRIPTION

Printf converts, formats, and prints its arguments after the first under control of the first argument. The first argument is a character string which contains two types of objects: plain characters, which are simply copied to the output stream, and conversion specifications, each of which causes conversion and printing of the next successive argument to *printf*.

Each conversion specification is introduced by the character %. Following the %, there may be

- an optional minus sign "–" which specifies *left adjustment* of the converted argument in the indicated field;
- an optional digit string specifying a *field width;* if the converted argument has fewer characters than the field width it will be blank-padded on the left (or right, if the left-adjustment indicator has been given) to make up the field width;
- an optional period "." which serves to separate the field width from the next digit string;
- an optional digit string *(precision)* which specifies the number of digits to appear after the decimal point, for e- and f-conversion, or the maximum number of characters to be printed from a string;
- a character which indicates the type of conversion to be applied.

The conversion characters and their meanings are

d
o
x The integer argument is converted to decimal, octal, or hexadecimal notation respectively.

f The argument is converted to decimal notation in the style "[–]ddd.ddd" where the number of d's after the decimal point is equal to the precision specification for the argument. If the precision is missing, 6 digits are given; if the precision is explicitly 0, no digits and no decimal point are printed. The argument should be *float* or *double*.

e The argument is converted in the style "[–]d.ddde±dd" where there is one digit before the decimal point and the number after is equal to the precision specification for the argument; when the precision is missing, 6 digits are produced. The argument should be a *float* or *double* quantity.

c The argument character is printed.

s The argument is taken to be a string (character pointer) and characters from the string are printed until a null character or until the number of characters indicated by the precision specification is reached; however if the precision is 0 or missing, all characters up to a null are printed.

l The argument is taken to be an unsigned integer which is converted to decimal and printed (the result will be in the range 0 to 65535).

If no recognizable character appears after the %, that character is printed; thus % may be printed by use of the string %%. In no case does a non-existent or small field width cause truncation of a field; padding takes place only if the specified field width exceeds the actual width. Characters generated by *printf* are printed by calling *putchar*.

SEE ALSO

putchar (III)

PRINTF (III)

BUGS

Very wide fields (>128 characters) fail.

PUTC (III)

PUTC (III)

NAME

putc, putw, fcreat, fflush — buffered output

SYNOPSIS

```
mov    $filename,r0
jsr    r5,fcreat; iobuf

fcreat(file, iobuf)
char *file;
struct buf *iobuf;

(put byte in r0)
jsr    r5,putc; iobuf

putc(c, iobuf)
int c;
struct buf *iobuf;

(put word in r0)
jsr    r5,putw; iobuf

putw(w, iobuf);
int w;
struct buf *iobuf;

jsr    r5,flush; iobuf

fflush(iobuf)
struct buf *iobuf;
```

DESCRIPTION

Fcreat creates the given file (mode 666) and sets up the buffer *iobuf* (size 518 bytes); *putc* and *putw* write a byte or word respectively onto the file; *flush* forces the contents of the buffer to be written, but does not close the file. The structure of the buffer is:

```
struct buf {
        int fildes;     /* File descriptor */
        int nunused;    /* Remaining slots */
        char *xfree;    /* Ptr to next free slot */
        char buff[512];         /* The buffer */
};
```

Before terminating, a program should call *flush* to force out the last of the output (*fflush* from C).

The user must supply *iobuf*, which should begin on a word boundary.

To write a new file using the same buffer, it suffices to call *[f]flush*, close the file, and call *fcreat* again.

SEE ALSO

creat (II), write (II), getc (III)

DIAGNOSTICS

Fcreat sets the error bit (c-bit) if the file creation failed (from C, returns −1). *Putc* and *putw* return their character (word) argument. In all calls *errno* is set appropriately to 0 or to a system error number. See *intro* (II).

BUGS

PUTCHAR (III) PUTCHAR (III)

NAME

putchar, flush – write character

SYNOPSIS

putchar(ch)

flush( )

DESCRIPTION

Putchar writes out its argument and returns it unchanged. Only the low-order byte is written, and only if it is non-null. Unless other arrangements have been made, *putchar* writes in unbuffered fashion on the standard output file.

Associated with this routine is an external variable *fout* which has the structure of a buffer discussed under *putc* (III). If the file descriptor part of this structure (first word) is greater than 2, output via *putchar* is buffered. To achieve buffered output one may say, for example:

```
fout = dup(1);          or
fout = creat(...);
```

In such a case *flush* must be called before the program terminates in order to flush out the buffered output. *Flush* may be called at any time.

SEE ALSO

putc (III)

BUGS

The *fout* notion is questionable.

QSORT (III) QSORT (III)

NAME

qsort — quicker sort

SYNOPSIS

```
qsort(base, nel, width, compar)
char *base;
int (*compar)( );
```

DESCRIPTION

Qsort is an implementation of the quicker-sort algorithm. The first argument is a pointer to the base of the data; the second is the number of elements; the third is the width of an element in bytes; the last is the name of the comparison routine. It is called with two arguments which are pointers to the elements being compared. The routine must return 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.

SEE ALSO

sort (I)

BUGS

RAND (III) RAND (III)

NAME

rand, srand – random number generator

SYNOPSIS

```
(seed in r0)
jsr     pc,srand        /to initialize
jsr     pc,rand         /to get a random number

srand(seed)
int seed;

rand( )
```

DESCRIPTION

Rand uses a multiplicative congruential random number generator to return successive pseudo-random numbers (in r0) in the range from 0 to $2^{15}-1$.

The generator is reinitialized by calling *srand* with 1 as argument (in r0). It can be set to a random starting point by calling *srand* with whatever you like as argument, for example the low-order word of the time.

BUGS

The low-order bits are not very random.

RESET (III) **RESET (III)**

NAME

reset, setexit – execute non-local goto

SYNOPSIS

setexit( )

reset( )

DESCRIPTION

These routines are useful for dealing with errors and interrupts encountered in a low-level subroutine of a program.

Setexit saves its stack environment in a static place for later use by *reset.*

Reset restores the environment saved by the last call of *setexit.* It then returns in such a way that execution continues as if the call of *setexit* had just returned. All accessible data have values as of the time *reset* was called.

The routine that called *setexit* must still be active when *reset* is called.

SEE ALSO

signal (II)

BUGS

SETFIL (III) SETFIL (III)

NAME

setfil – specify Fortran file name

SYNOPSIS

call setfil (unit, hollerith-string)

DESCRIPTION

Setfil provides a primitive way to associate an integer I/O *unit* number with a file named by the *hollerith-string*. The end of the file name is indicated by a blank. Subsequent I/O on this unit number will refer to the file whose name is specified by the string.

Setfil should be called only before any I/O has been done on the *unit*, or just after doing a **rewind** or **endfile.** It is ineffective for unit numbers 5 and 6.

SEE ALSO

fc (I)

BUGS

The exclusion of units 5 and 6 is unwarranted.

SIN (III) SIN (III)

NAME

sin, cos – trigonometric functions

SYNOPSIS

```
jsr     pc,sin (cos)

double sin(x)
double x;

double cos(x)
double x;
```

DESCRIPTION

The sine (cosine) of fr0 (resp. x), measured in radians, is returned (in fr0).

The magnitude of the argument should be checked by the caller to make sure the result is meaningful.

BUGS

SQRT (III) SQRT (III)

NAME

sqrt — square root function

SYNOPSIS

```
jsr     pc,sqrt

double sqrt(x)
double x;
```

DESCRIPTION

The square root of fr0 (resp. **x**) is returned (in fr0).

DIAGNOSTICS

The c-bit is set on negative arguments and 0 is returned. There is no error return for C programs.

BUGS

No error return from C.

TTYN (III)

TTYN (III)

NAME

ttyn – return name of current typewriter

SYNOPSIS

jsr pc,ttyn

ttyn(file)

DESCRIPTION

Ttyn hunts up the last character of the name of the typewriter which is the standard input (from *as*) or is specified by the argument *file* descriptor (from C). If *n* is returned, the typewriter name is then "/dev/tty*n*".

x is returned if the indicated file does not correspond to a typewriter.

BUGS

IV Drivers

NAME

dc – DC-11 communications interface

DESCRIPTION

The discussion of typewriter I/O given in *tty* (IV) applies to these devices.

The DC-11 typewriter interface operates at any of four speeds, independently settable for input and output. The speed is selected by the same encoding used by the *dh* (IV) device (enumerated in *stty* (II)); impossible speed changes are ignored.

FILES

/dev/tty?

SEE ALSO

tty (IV), stty (II), dh (IV), gtty (II)

BUGS

Although impossible speed changes are not attempted on the hardware, the software is quite willing to accept them and alter the software state of the device accordingly. Subsequent requests for the device's state (*gtty* (II)) provide an erroneous status.

DH (IV) **DH (IV)**

NAME

dh – DH-11 communications multiplexer

DESCRIPTION

Each line attached to the DH-11 communications multiplexer behaves as described in *tty* (IV). Input and output for each line may independently be set to run at any of 16 speeds; see *stty* (II) for the encoding.

FILES

/dev/tty?

SEE ALSO

tty (IV), stty (II)

BUGS

DN (IV) DN (IV)

NAME

dn – DN-11 ACU interface

DESCRIPTION

The *dn?* files are write-only. The permissible codes are:

0-9 dial 0-9
– 8 second delay for second dial tone

The entire telephone number must be presented in a single *write* system call.

FILES

/dev/dn?

SEE ALSO

dp (IV)

BUGS

DP (IV) **DP (IV)**

NAME

dp – DP-11 201 data-phone interface

DESCRIPTION

The *dp0* file is a 201 data-phone interface. *Read* and *write* calls to dp0 are limited to a maximum of 512 bytes. Each write call is sent as a single record. Seven bits from each byte are written along with an eighth odd parity bit. The sync must be user supplied. Each read call returns characters received from a single record. Seven bits are returned unaltered; the eighth bit is set if the byte was not received in odd parity. A 5-second time-out is set and a zero-byte record is returned if nothing is received in that time.

FILES

/dev/dp0

SEE ALSO

dn (IV)

BUGS

NAME

hp – RH-11/RP04 moving-head disk

DESCRIPTION

The files *hp0, ..., hp7* refer to sections of RP disk drive 0. The files *hp8, ..., hp15* refer to drive 1 etc. This is done since the size of a full RP drive is 170,544 blocks and internally the system is only capable of addressing 65536 blocks. Since the disk is so large, this allows it to be broken up into more manageable pieces.

The origin and size of the pseudo-disks on each drive are as follows:

disk	start	length	cylinder
0	0	9614	0 thru 23
			24 thru 43 free
1	18392	65535	44 thru 200
2	83600	65535	201 thru 357
3	149644	20900	358 thru 407
			408 thru 410 free
4	0	40600	0 thru 97
5	41800	40600	100 thru 197
6	83600	40600	201 thru 298
7	125400	40600	300 thru 397

It is unwise for all of these files to be present in one installation, since there is overlap in addresses and protection becomes a sticky matter.

The *hp* files access the disk via the system's normal buffering mechanism and may be read and written without regard to physical disk records. There is also a "raw" interface which provides for direct transmission between the disk and the user's read or write buffer. A single read or write call results in exactly one I/O operation and therefore raw I/O is considerably more efficient when many words are transmitted. The names of the raw RP files begin with *rhp* and end with a number which selects the same disk section as the corresponding *hp* file.

In raw I/O the buffer must begin on a word boundary, and counts should be a multiple of 512 bytes (a disk block). Likewise *seek* calls should specify a multiple of 512 bytes.

FILES

/dev/hp?, /dev/rhp?

BUGS

HS (IV) **HS (IV)**

NAME

hs – RH11/RS03-RS04 fixed-head disk file

DESCRIPTION

The files *hs0, ..., hs7* refer to RJS03 disk drives 0 through 7. The files *hs8, ..., hs15* refer to RJS04 disk drives 0 through 7. The RJS03 drives are each 1024 blocks long and the RJS04 drives are 2048 blocks long.

The *hs* files access the disk via the system's normal buffering mechanism and may be read and written without regard to physical disk records. There is also a "raw" inteface which provides for direct transmission between the disk and the user's read or write buffer. A single read or write call results in exactly one I/O operation and therefore raw I/O is considerably more efficient when many words are transmitted. The names of the raw HS files begin with *rhs*. The same minor device considerations hold for the raw interface as for the normal interface.

In raw I/O the buffer must begin on a word boundary, and counts should be a multiple of 512 bytes (a disk block). Likewise *seek* calls should specify a multiple of 512 bytes.

FILES

/dev/hs?, /dev/rhs?

BUGS

NAME

ht – RH-11/TU-16 magtape interface

DESCRIPTION

The files *mt?* refer to the DEC RH/TM/TU16 magtape and have the following meaning:

mt0, ..., mt3	800 bpi, rewind
mt4, ..., mt7	800 bpi, no rewind
mt8, ..., mt11	1600 bpi, rewind
mt12, ..., mt15	1600 bpi, no rewind

When a rewind *mt* file is closed, the tape is rewound; if it was open for writing, a double end-of-file is written first. Conversely, the tape is not rewound for a no-rewind *mt* file; a single end-of-file is written if the file was open for writing. By judiciously choosing *mt* files, it is possible to handle multi-file tapes.

A standard tape consists of a series of 512-byte records terminated by a double end-of-file. To the extent possible (even though it is inefficient), the system allows the tape to be treated like any other file. Seeks have their usual meaning and it is possible to read or write a byte at a time.

The *mt* files discussed above are useful when it is desired to access the tape in a way compatible with ordinary files. When foreign tapes are to be dealt with, and especially when long records are to be read or written, the "raw" interface is appropriate. The associated files are named *rmt0, ..., rmt7* and *rmt8, ..., rmt15.* Each *read* or *write* call reads or writes the next record on the tape. In the write case the record has the same length as the buffer given. During a read, the record size is passed back as the number of bytes read, provided it is no greater than the buffer size; if the record is long, an error is indicated. In raw tape I/O, the buffer must begin on a word boundary and the count must be even. Seeks are ignored. An error is returned when a tape mark is read, but another read will fetch the first record of the new tape file.

FILES

/dev/mt?, /dev/rmt?

SEE ALSO

tp (I), mtm (I)

BUGS

The magtape system is supposed to be able to take 64 drives. Such addressing has never been tried. In fact, with the mapping above, four drives are the most ever supported.

If any non-data error is encountered, it refuses to do anything more until closed.

NAME

kl – KL-11 or DL-11 asynchronous interface

DESCRIPTION

The discussion of typewriter I/O given in *tty* (IV) applies to these devices.

Since they run at a constant speed, attempts to change the speed via *stty* (II) are ignored.

The on-line console typewriter is interfaced using a KL-11 or DL-11. By appropriate switch settings during a reboot, UNIX will come up as a single-user system with I/O on the console typewriter.

FILES

/dev/tty8 console

SEE ALSO

tty (IV), init (VIII)

BUGS

Modem control for the DL-11E is not implemented.

There is a built-in notion of upper case on the console which causes problems with the LA36.

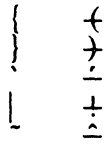
NAME

lp – line printer

DESCRIPTION

Lp provides the interface to any of the standard DEC line printers. When it is opened or closed, a suitable number of page ejects is generated. Bytes written are printed.

An internal parameter within the driver determines whether or not the device is treated as having a 96- or 64-character set. In half-ASCII (64-character) mode, lower case letters are turned into upper case and certain characters are escaped according to the following table:



The driver correctly interprets carriage returns, backspaces, tabs, and form feeds. A sequence of newlines which extends over the end of a page is turned into a form feed. Lines longer than 80 characters are truncated. This number is a parameter in the driver.

FILES

/dev/lp

SEE ALSO

lpr (I)

BUGS

Half-ASCII mode and the maximum line length should be set-able by a call analogous to *stty* (II).

If the first characters written are newlines, they are thrown away.

MEM (IV) MEM (IV)

NAME

mem, kmem, null – core memory

DESCRIPTION

Mem is a special file that is an image of the core memory of the computer. It may be used, for example, to examine, and even to patch the system using the debugger.

A memory address is an 18-bit quantity which is used directly as a UNIBUS address. References to non-existent locations cause errors to be returned.

Examining and patching device registers is likely to lead to unexpected results when read-only or write-only bits are present.

The file *kmem* is the same as *mem* except that kernel virtual memory rather than physical memory is accessed. In particular, the I/O area of *kmem* is located beginning at 160000 (octal) rather than at 760000. The 1K region beginning at 140000 (octal) is the system's data for the current process. It should be kept in mind that in systems with separate I (Instruction) and D (Data) space, the mapping for the file *kmem* is done through the kernel's D space registers.

The file *null* returns end-of-file on *read* and ignores *write*.

FILES

/dev/mem, /dev/kmem, /dev/null

PC (IV) **PC (IV)**

NAME

pc – PC-11 paper tape reader/punch

DESCRIPTION

Ppt refers to the PC-11 paper tape reader or punch, depending on whether it is read or written.

When *ppt* is opened for writing, a 100-character leader is punched. Thereafter each byte written is punched on the tape. No editing of the characters is performed. When the file is closed, a 100-character trailer is punched.

When *ppt* is opened for reading, the process waits until tape is placed in the reader and the reader is on-line. Then requests to read cause the characters read to be passed back to the program, again without any editing. This means that several null leader characters will usually appear at the beginning of the file. Likewise several nulls are likely to appear at the end. End-of-file is generated when the tape runs out.

Seek calls for this file are meaningless.

FILES

/dev/ppt

BUGS

If both the reader and the punch are open simultaneously, the trailer is sometimes not punched. Sometimes the reader goes into a dead state in which it cannot be opened.

RF (IV) **RF (IV)**

NAME

rf – RF11/RS11 fixed-head disk file

DESCRIPTION

This file refers to the concatenation of all RS-11 disks.

Each disk contains 1024 256-word blocks. The length of the combined RF file is 1024×(minor+1) blocks.

The *rf0* file accesses the disk via the system's normal buffering mechanism and may be read and written without regard to physical disk records. There is also a "raw" interface which provides for direct transmission between the disk and the user's read or write buffer. A single read or write call results in exactly one I/O operation and therefore raw I/O is considerably more efficient when many words are transmitted. The name of the raw RF file is *rrf0*. The same minor device considerations hold for the raw interface as for the normal interface.

In raw I/O the buffer must begin on a word boundary, and counts should be a multiple of 512 bytes (a disk block). Likewise *seek* calls should specify a multiple of 512 bytes.

FILES

/dev/rf0, /dev/rrf0

BUGS

The 512-byte restrictions on the raw device are not physically necessary, but are still imposed.

NAME

rk – RK-11/RK03 (or RK05) disk

DESCRIPTION

Rk? refers to an entire RK03 disk as a single sequentially-addressed file. Its 256-word blocks are numbered 0 to 4871.

Drive numbers (minor devices) of eight and larger are treated specially. Drive $8+x$ is the $x+1$ way of interleaving devices rk0 to rk*x*. Thus blocks on rk10 are distributed alternately among rk0, rk1, and rk2.

The *rk* files discussed above access the disk via the system's normal buffering mechanism and may be read and written without regard to physical disk records. There is also a "raw" interface which provides for direct transmission between the disk and the user's read or write buffer. A single read or write call results in exactly one I/O operation and therefore raw I/O is considerably more efficient when many words are transmitted. The names of the raw RK files begin with *rrk* and end with a number which selects the same disk as the corresponding *rk* file.

In raw I/O the buffer must begin on a word boundary, and counts should be a multiple of 512 bytes (a disk block). Likewise *seek* calls should specify a multiple of 512 bytes.

FILES

/dev/rk?, /dev/rrk?

BUGS

Care should be taken in using the interleaved files. First, the same drive should not be accessed simultaneously using the ordinary name and as part of an interleaved file, because the same physical blocks have in effect two different names; this fools the system's buffering strategy. Second, the combined files cannot be used for swapping or raw I/O.

NAME

rp – RP-11/RP03 moving-head disk

DESCRIPTION

The files *rp0, ..., rp7* refer to sections of RP disk drive 0; the files *rp8, ..., rp15* refer to drive 1; etc. This is done since the size of a full RP drive is 81200 blocks and internally the system is only capable of addressing 65536 blocks. Since the disk is so large, this allows it to be broken up into more manageable pieces.

The origin and size of the pseudo-disks on each drive are as follows:

disk	start	length	cylinder
0	0	40600	0 thru 202
1	40600	40600	203 thru 405
2	0	9200	0 thru 45
3	72000	9200	360 thru 405
4	0	65535	0 thru 327
5	15600	65535	78 thru 405
6-7	unassigned		

It is unwise for all of these files to be present in one installation, since there is overlap in addresses and protection becomes a sticky matter. Here is a suggestion for two useful configurations: If the root of the file system is on some other device and the RP used as a mounted device, then *rp0* and *rp1,* which divide the disk into two equal size portions, is a good idea. Other things being equal, it is advantageous to have two equal-sized portions since one can always be copied onto the other, which is occasionally useful.

If the RP is the only disk and has to contain the root and the swap area, the root can be put on *rp2* and a mountable file system on *rp5.* Then the swap space can be put in the unused blocks 9200 to 15600 of *rp0* (or, equivalently, *rp4).* This arrangement puts the root file system, the swap area, and the i-list of the mounted file system relatively near each other and thus tends to minimize head movement.

The *rp* files access the disk via the system's normal buffering mechanism and may be read and written without regard to physical disk records. There is also a "raw" interface which provides for direct transmission between the disk and the user's read or write buffer. A single read or write call results in exactly one I/O operation and therefore raw I/O is considerably more efficient when many words are transmitted. The names of the raw RP files begin with *rrp* and end with a number which selects the same disk section as the corresponding *rp* file.

In raw I/O the buffer must begin on a word boundary, and counts should be a multiple of 512 bytes (a disk block). Likewise *seek* calls should specify a multiple of 512 bytes.

FILES

/dev/rp?, /dev/rrp?

BUGS

TTY (IV) TTY (IV)

NAME

tty – general typewriter interface

DESCRIPTION

This section describes both a particular special file, and the general nature of the typewriter interface.

All typewriters on the low-speed asynchronous communications ports use the same general interface, no matter what hardware is involved. The remainder of this section discusses the common features of the interface; the *kl, dc,* and *dh* writeups (IV) describe peculiarities of the individual devices.

When a typewriter file is opened, it causes the process to wait until a connection is established. In practice user's programs seldom open these files; they are opened by *init* and become a user's input and output file. The very first typewriter file open in a process becomes the *control typewriter* for that process. The control typewriter plays a special role in handling quit or interrupt signals, as discussed below. The control typewriter is inherited by a child process during a *fork*.

A terminal associated with one of these files ordinarily operates in full-duplex mode. Characters may be typed at any time, even while output is occurring, and are only lost when the system's character input buffers become completely choked, which is rare, or when the user has accumulated the maximum allowed number of input characters which have not yet been read by some program. Currently this limit is 256 characters. When the input limit is reached all the saved characters are thrown away without notice.

When first opened, the interface mode is 300 baud, either parity accepted, 10 bits/character (one stop bit), and newline action character. The system delays transmission after sending certain function characters. Delays for horizontal tab, newline, and form feed are calculated for the Teletype Model 37; the delay for carriage return is calculated for the GE TermiNet 300. Most of these operating states can be changed by using the system call *stty* (II). In particular, provided the hardware permits, the speed of received and transmitted characters can be changed. In addition, the following software modes can be invoked: acceptance of even parity, odd parity, or both; a raw mode in which all characters may be read one at a time; a carriage return (CR) mode in which CR is mapped into newline on input and either CR or line feed (LF) cause echoing of the sequence LF-CR; mapping of upper case letters into lower case; suppression of echoing; suppression of delays after function characters; and the printing of tabs as spaces. See *getty* (VIII) for the way that terminal speed and type are detected.

Normally, typewriter input is processed in units of lines. This means that a program attempting to read will be suspended until an entire line has been typed. Also, no matter how many characters are requested in the read call, at most one line will be returned. It is not however necessary to read a whole line at once; any number of characters may be requested in a read, even one, without losing information.

During input, erase and kill processing is normally done. The character '#' erases the last character typed, except that it will not erase beyond the beginning of a line or an EOT. The character '@' kills the entire line up to the point where it was typed, but not beyond an EOT. Both these characters operate on a keystroke basis independently of any backspacing or tabbing that may have been done. Either '@' or '#' may be entered literally by preceding it by '\'; the erase or kill character remains, but the '\' disappears.

In upper-case mode, all upper-case letters are mapped into the corresponding lower-case letter. The upper-case letter may be generated by preceding it by '\'. In addition, the following escape sequences are generated on output and accepted on input:

for	use
`	\'
|	\!
~	\^
{	\(
}	\)

In raw mode, the program reading is awakened on each character. No erase or kill processing is done; and the EOT, quit and interrupt characters are not treated specially. The input parity bit is passed back to the reader, but parity is still generated for output characters.

The ASCII EOT (control-D) character may be used to generate an end of file from a typewriter. When an EOT is received, all the characters waiting to be read are immediately passed to the program, without waiting for a new-line, and the EOT is discarded. Thus if there are no characters waiting, which is to say the EOT occurred at the beginning of a line, zero characters will be passed back, and this is the standard end-of-file indication. The EOT is passed back unchanged in raw mode.

When the carrier signal from the dataset drops (usually because the user has hung up his terminal) a *hangup* signal is sent to all processes with the typewriter as control typewriter. Unless other arrangements have been made, this signal causes the processes to terminate. If the hangup signal is ignored, any read returns with an end-of-file indication. Thus programs which read a typewriter and test for end-of-file on their input can terminate appropriately when hung up on.

Two characters have a special meaning when typed. The ASCII DEL character (sometimes called 'rubout') is not passed to a program but generates an *interrupt* signal which is sent to all processes with the associated control typewriter. Normally each such process is forced to terminate, but arrangements may be made either to ignore the signal or to receive a trap to an agreed-upon location. See *signal* (II).

The ASCII character FS generates the *quit* signal. Its treatment is identical to the interrupt signal except that unless a receiving process has made other arrangements it will not only be terminated but a core image file will be generated. If you find it hard to type this character, try control-\ or control-shift-L.

When one or more characters are written, they are actually transmitted to the terminal as soon as previously-written characters have finished typing. Input characters are echoed by putting them in the output queue as they arrive. When a process produces characters more rapidly than they can be typed, it will be suspended when its output queue exceeds some limit. When the queue has drained down to some threshold the program is resumed. Even parity is always generated on output. The EOT character is not transmitted (except in raw mode) to prevent terminals which respond to it from hanging up.

FILES

/dev/tty

SEE ALSO

dc (IV), kl (IV), dh (IV), getty (VIII), stty (I, II), gtty (II), signal (II)

BUGS

Half-duplex terminals are not supported. On raw-mode output, parity should be transmitted as specified in the characters written.

TC (IV) TC (IV)

NAME

tc – TC-11/TU56 DECtape

DESCRIPTION

The files *tap0, ..., tap7* refer to the TC-11/TU56 DECtape drives 0 to 7.

The 256-word blocks on a standard DECtape are numbered 0 to 577.

FILES

/dev/tap?

SEE ALSO

tp (I)

BUGS

NAME

tm – TM-11/TU-10 magtape interface

DESCRIPTION

The files *mt0, ..., mt7* refer to the DEC TU10/TM11 magtape. When one of *mt0, ..., mt3* is closed, the tape is rewound; if it was open for writing, a double end-of-file is written first. Conversely, when one of *mt4, ..., mt7* is closed, the tape is not rewound; a single end-of-file is written if the tape was open for writing. By judiciously choosing *mt* files, it is possible to read and write multi-file tapes.

A standard tape consists of a series of 512-byte records terminated by an end-of-file. To the extent possible (even though it is inefficient), the system allows the tape to be treated like any other file. Seeks have their usual meaning and it is possible to read or write a byte at a time.

The *mt* files discussed above are useful when it is desired to access the tape in a way compatible with ordinary files. When foreign tapes are to be dealt with, and especially when long records are to be read or written, the "raw" interface is appropriate. The associated files are named *rmt0, ..., rmt7.* Each *read* or *write* call reads or writes the next record on the tape. In the write case the record has the same length as the buffer given. During a read, the record size is passed back as the number of bytes read, provided it is no greater than the buffer size; if the record is long, an error is indicated. In raw tape I/O, the buffer must begin on a word boundary and the count must be even. Seeks are ignored. An error is returned when a tape mark is read, but another read will fetch the first record of the new tape file.

FILES

/dev/mt?, /dev/rmt?

SEE ALSO

tp (I), mtm (I)

BUGS

If any non-data error is encountered, it refuses to do anything more until closed.

With the above mapping there is no way of getting to physical drives 4 to 7.

V File Formats

A.OUT (V)

A.OUT (V)

NAME

a.out – assembler and link editor output

DESCRIPTION

A.out is the output file of the assembler *as* and the link editor *ld*. Both programs make *a.out* executable if there were no errors and no unresolved external references.

This file has four sections: a header, the program and data text, relocation bits and symbol table (in that order). The last two may be empty if the program was loaded with the "–s" option of *ld* or if the symbols and relocation have been removed by *strip*.

The header always contains 8 words:

1 A magic number (407, 410, or 411(8))
2 The size of the program text segment
3 The size of the initialized portion of the data segment
4 The size of the uninitialized (bss) portion of the data segment
5 The size of the symbol table
6 The entry location (always 0 at present)
7 Unused
8 A flag indicating relocation bits have been suppressed

The sizes of each segment are in bytes but are even. The size of the header is not included in any of the other sizes.

When a file produced by the assembler or loader is loaded into core for execution, three logical segments are set up: the text segment, the data segment (with uninitialized data, which starts off as all 0, following initialized), and a stack. The text segment begins at 0 in the core image; the header is not loaded. If the magic number (word 0) is 407, it indicates that the text segment is not to be write-protected and shared, so the data segment is immediately contiguous with the text segment. If the magic number is 410, the data segment begins at the first 0 mod 8K byte boundary following the text segment, and the text segment is not writable by the program; if other processes are executing the same file, they will share the text segment. If the magic number is 411, the text segment is again pure, write-protected, and shared, and, moreover, instruction and data space are separated; the text and data segment both begin at location 0. See the 11/45 handbook for restrictions which apply to this situation.

The stack will occupy the highest possible locations in the core image: from 177776(8) and growing downwards. The stack is automatically extended as required. The data segment is only extended as requested by the *break* system call.

The start of the text segment in the file is 20(8); the start of the data segment is $20+S_t$ (the size of the text) the start of the relocation information is $20+S_t+S_d$; the start of the symbol table is $20+2(S_t+S_d)$ if the relocation information is present, $20+S_t+S_d$ if not.

The symbol table consists of 6-word entries. The first four words contain the ASCII name of the symbol, null-padded. The next word is a flag indicating the type of symbol. The following values are possible:

00 undefined symbol
01 absolute symbol
02 text segment symbol
03 data segment symbol
37 file name symbol (produced by ld)
04 bss segment symbol
40 undefined external (.globl) symbol
41 absolute external symbol
42 text segment external symbol
43 data segment external symbol
44 bss segment external symbol

Values other than those given above may occur if the user has defined some of his own instructions.

The last word of a symbol table entry contains the value of the symbol.

If the symbol's type is undefined external, and the value field is non-zero, the symbol is interpreted by the loader *ld* as the name of a common region whose size is indicated by the value of the symbol.

The value of a word in the text or data portions which is not a reference to an undefined external symbol is exactly that value which will appear in core when the file is executed. If a word in the text or data portion involves a reference to an undefined external symbol, as indicated by the relocation bits for that word, then the value of the word as stored in the file is an offset from the associated external symbol. When the file is processed by the link editor and the external symbol becomes defined, the value of the symbol will be added into the word in the file.

If relocation information is present, it amounts to one word per word of program text or initialized data. There is no relocation information if the "suppress relocation" flag in the header is on.

Bits 3-1 of a relocation word indicate the segment referred to by the text or data word associated with the relocation word:

00 indicates the reference is absolute
02 indicates the reference is to the text segment
04 indicates the reference is to initialized data
06 indicates the reference is to bss (uninitialized data)
10 indicates the reference is to an undefined external symbol.

Bit 0 of the relocation word indicates if *on*, that the reference is relative to the pc (e.g., "clr x"); if *off*, that the reference is to the actual symbol (e.g., "clr *$x").

The remainder of the relocation word (bits 15-4) contains a symbol number in the case of external references, and is unused otherwise. The first symbol is numbered 0, the second 1, etc.

SEE ALSO

as (I), ld (I), strip (I), nm (I)

ARCHIVE (V) ARCHIVE (V)

NAME

ar – archive (library) file format

DESCRIPTION

The archive command *ar* is used to combine several files into one. Archives are used mainly as libraries to be searched by the link-editor *ld*.

A file produced by *ar* has a magic number at the start, followed by the constituent files, each preceded by a file header. The magic number is 177545(8) (chosen because it is unlikely to occur anywhere else). The header of each file is 26 bytes long:

0-13	file name, null padded on the right
14-17	modification time of the file
18	user ID of file owner
19	group ID of file owner
20-21	file mode
22-25	file size

Each file begins on a word boundary; a null byte 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.

SEE ALSO

ar (I), ld (I)

BUGS

CORE (V) **CORE (V)**

NAME

core – format of core image file

DESCRIPTION

UNIX writes out a core image of a terminated process when any of various errors occur. See *signal (II)* 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).

The first 1024 bytes of the core image are 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 remainder represents the actual contents of the user's core area when the core image was written. If the text segment is write-protected and shared, it is not dumped; otherwise the entire address space is dumped.

The format of the information in the first 1024 bytes is described by the *user* structure of the system. The important information not detailed there is the locations of the registers. Here are their offsets. The parenthesized numbers for the floating registers are used if the floating-point hardware is in single precision mode, as indicated in the status register.

fpsr	0004	
fr0	0006	(0006)
fr1	0036	(0022)
fr2	0046	(0026)
fr3	0056	(0032)
fr4	0016	(0012)
fr5	0026	(0016)
r0	1772	
r1	1766	
r2	1750	
r3	1752	
r4	1754	
r5	1756	
sp	1764	
pc	1774	
ps	1776	

In general, the debuggers *db (I)* and *cdb (I)* are sufficient to deal with core images.

SEE ALSO

cdb (I), db (I), signal (II)

DIRECTORY (V)

DIRECTORY (V)

NAME

dir – format of directories

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. Directory entries are 16 bytes long. The first word is the i-number of the file represented by the entry, if non-zero; if zero, the entry is empty.

Bytes 2-15 represent the (14-character) file name, null padded on the right. These bytes are not cleared for empty slots.

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 and for the root directories of removable file systems. In the first case, there is no parent, and in the second, the system does not permit off-device references. Therefore in both cases ".." has the same meaning as ".".

SEE ALSO

file system (V)

DUMP (V) **DUMP (V)**

NAME

dump – incremental dump tape format

DESCRIPTION

The *dump* and *restor* commands are used to write and read incremental dump magnetic tapes.

The dump tape consists of blocks of 512-bytes each. The first block has the following structure.

```
struct {
        int     isize;
        int     fsize;
        int     date[2];
        int     ddate[2];
        int     tsize;
};
```

Isize, and *fsize* are the corresponding values from the super block of the dumped file system. (See *file system* (V).) *Date* is the date of the dump. *Ddate* is the incremental dump date. The incremental dump contains all files modified between *ddate* and *date. Tsize* is the number of blocks per reel. This block checksums to the octal value 031415.

Next there are enough whole tape blocks to contain one word per file of the dumped file system. This is *isize* divided by 16 rounded to the next higher integer. The first word corresponds to i-node 1, the second to i-node 2, and so forth. If a word is zero, then the corresponding file exists, but was not dumped (was not modified after *ddate).* If the word is −1, the file does not exist. Other values for the word indicate that the file was dumped and the value is one more than the number of blocks it contains.

The rest of the tape contains for each dumped file a header block and the data blocks from the file. The header contains an exact copy of the i-node (see *file system* (V)) and also checksums to 031415. The next-to-last word of the block contains the tape block number, to aid in (unimplemented) recovery after tape errors. The number of data blocks per file is directly specified by the control word for the file and indirectly specified by the size in the i-node. If these numbers differ, the file was dumped with a 'phase error'.

SEE ALSO

dump (VIII), restor (VIII), file system(V)

FILE SYSTEM (V)

FILE SYSTEM (V)

NAME

fs – format of file system volume

DESCRIPTION

Every file system storage volume (e.g. RF disk, RK disk, RP disk, DECtape reel) has a common format for certain vital information. Every such volume is divided into a certain number of 256-word (512 byte) blocks. Block 0 is unused and is available to contain a bootstrap program, pack label, or other information.

Block 1 is the *super block*. Starting from its first word, the format of a super-block is

```
struct {
        int     isize;
        int     fsize;
        int     nfree;
        int     free[100];
        int     ninode;
        int     inode[100];
        char    flock;
        char    ilock;
        char    fmod;
        int     time[2];
};
```

Isize is the number of blocks devoted to the i-list, which starts just after the super-block, in block 2. *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 *free* array contains, in *free*[1], ... , *free*[*nfree*−1], up to 99 numbers of free blocks. *Free*[0] is the block number of the head of a chain of blocks constituting the free list. The first word in each free-chain block is the number (up to 100) of free-block numbers listed in the next 100 words of this chain member. The first of these 100 blocks is the link to the next member of the chain. To allocate a block: decrement *nfree*, and the new block is *free*[*nfree*]. If the new block number is 0, there are no blocks left, so give an error. If *nfree* became 0, read in the block named by the new block number, replace *nfree* by its first word, and copy the block numbers in the next 100 words into the *free* array. To free a block, check if *nfree* is 100; if so, copy *nfree* and the *free* array into it, write it out, and set *nfree* to 0. In any event set *free*[*nfree*] to the freed block's number and increment *nfree*.

Ninode is the number of free i-numbers in the *inode* array. To allocate an i-node: if *ninode* is greater than 0, decrement it and return *inode*[*ninode*]. If it was 0, read the i-list and place the numbers of all free inodes (up to 100) into the *inode* array, then try again. To free an i-node, provided *ninode* is less than 100, place its number into *inode*[*ninode*] and increment *ninode*. If *ninode* is already 100, don't 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 inode is really free or not is maintained in the inode itself.

Flock and *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 *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.

Time is the last time the super-block of the file system was changed, and is a double-precision representation of the number of seconds that have elapsed since 0000 Jan. 1 1970 (GMT). During a reboot, the *time* of the super-block for the root file system is used to set the system's idea of the time.

I-numbers begin at 1, and the storage for i-nodes begins in block 2. Also, i-nodes are 32 bytes long, so 16 of them fit into a block. Therefore, i-node *i* is located in block (*i* + 31) / 16, and begins 32*((*i* + 31) (mod 16)) bytes from its start. I-node 1 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. The format of an i-node is as follows:

```
struct {
        int     flags;          /* +0: see below */
        char    nlinks;         /* +2: number of links to file */
        char    uid;            /* +3: user ID of owner */
        char    gid;            /* +4: group ID of owner */
        char    size0;          /* +5: high byte of 24-bit size */
        int     size1;          /* +6: low word of 24-bit size */
        int     addr[8];        /* +8: block numbers or device number */
        int     actime[2];      /* +24: time of last access */
        int     modtime[2];     /* +28: time of last modification */
};
```

The flags are as follows:

```
100000  i-node is allocated
060000  2-bit file type:
    000000  plain file
    040000  directory
    020000  character-type special file
    060000  block-type special file.
010000  large file
004000  set user-ID on execution
002000  set group-ID on execution
000400  read (owner)
000200  write (owner)
000100  execute (owner)
000070  read, write, execute (group)
000007  read, write, execute (others)
```

Special files are recognized by their flags and not by i-number. A block-type special file is basically one which can potentially be mounted as a file system; a character-type special file cannot, though it is not necessarily character-oriented. For special files the high byte of the first address word specifies the type of device; the low byte specifies one of several devices of that type. The device type numbers of block and character special files overlap.

The address words of ordinary files and directories contain the numbers of the blocks in the file (if it is small) or the numbers of indirect blocks (if the file is large). Byte number *n* of a file is accessed as follows: *n* is divided by 512 to find its logical block number (say *b*) in the file. If the file is small (flag 010000 is 0), then *b* must be less than 8, and the physical block number is *addr[b]*.

If the file is large, *b* is divided by 256 to yield *i*. If *i* is less than 7, then *addr[i]* is the physical block number of the indirect block. The remainder from the division yields the word in the indirect block which contains the number of the block for the sought-for byte.

For block *b* in a file to exist, it is not necessary that all blocks less than *b* exist. A zero block number either in the address words of the i-node or in an indirect block indicates that the corresponding block has never been allocated. Such a missing block reads as if it contained all zero words.

SEE ALSO

icheck (VIII), check (VIII)

PASSWD (V)

PASSWD (V)

NAME

passwd – password file

DESCRIPTION

Passwd contains for each user the following information:

name (login name, contains no upper case)
encrypted password
numerical user ID
numerical group ID (for now, always 1)
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 ID's to names.

FILES

/etc/passwd

SEE ALSO

login (I), crypt (III), passwd (I)

NAME

tp – DEC/mag tape formats

DESCRIPTION

The command *tp* dumps files to and extracts files from DECtape and magtape. The formats of these tapes are the same except that magtapes have larger directories.

Block zero contains a copy of a stand-alone bootstrap program. See *boot procedures* (VIII).

Blocks 1 through 24 for DECtape (1 through 62 for magtape) contain a directory of the tape. There are 192 (resp. 496) entries in the directory; 8 entries per block; 64 bytes per entry. Each entry has the following format:

path name	32 bytes
mode	2 bytes
uid	1 byte
gid	1 byte
unused	1 byte
size	3 bytes
time modified	4 bytes
tape address	2 bytes
unused	16 bytes
check sum	2 bytes

The path name entry is the path name of the file when put on the tape. If the path-name starts with a zero word, the entry is empty. It is at most 32 bytes long and ends in a null byte. Mode, uid, gid, size and time modified are the same as described under i-nodes (file system (V)). The tape address is the tape block number of the start of the contents of the file. Every file starts on a block boundary. The file occupies (size+511)/512 blocks of continuous tape. The checksum entry has a value such that the sum of the 32 words of the directory entry is zero.

Blocks 25 (resp. 63) on are available for file storage.

A fake entry (see *tp* (I)) has a size of zero.

SEE ALSO

file system (V), tp (I)

TTYS (V)

TTYS (V)

NAME

ttys – typewriter initialization data

DESCRIPTION

The *ttys* file is read by the *init* program and specifies which typewriter special files are to have a process created for them which will allow people to log in. It consists of lines of 3 characters each.

The first character is either '0' or '1'; the former causes the line to be ignored, the latter causes it to be effective. The second character is the last character in the name of a typewriter; e.g., *x* refers to the file '/dev/tty*x*'. The third character is used as an argument to the *getty* program, which performs such tasks as baud-rate recognition, reading the login name, and calling *login*. For normal lines, the character is '0'; other characters can be used, for example, with hard-wired terminals where speed recognition is unnecessary or which have special characteristics. (*Getty* will have to be fixed in such cases.)

FILES

/etc/ttys

SEE ALSO

init (VIII), getty (VIII), login (I)

UTMP (V)

UTMP (V)

NAME

utmp – user information

DESCRIPTION

This file allows one to discover information about who is currently using UNIX. The file is binary; each entry is 16(10) bytes long. The first eight bytes contain a user's login name or are null if the table slot is unused. The low order byte of the next word contains the last character of a typewriter name. The next two words contain the user's login time. The last word is unused.

FILES

/tmp/utmp

SEE ALSO

init (VIII) and login (I), which maintain the file; who (I), which interprets it.

WTMP (V)

WTMP (V)

NAME

wtmp – user login history

DESCRIPTION

This file records all logins and logouts. Its format is exactly like utmp (V) except that a null user name indicates a logout on the associated typewriter. Furthermore, the typewriter name '~' indicates that the system was rebooted at the indicated time; the adjacent pair of entries with typewriter names '|' and '}' indicate the system-maintained time just before and just after a *date* command has changed the system's idea of the time.

Wtmp is maintained by *login* (I) and *init* (VIII). Neither of these programs creates the file, so if it is removed, record-keeping is turned off. It is summarized by *ac* (VIII).

FILES

/usr/adm/wtmp

SEE ALSO

utmp (V), login (I), init (VIII), ac (VIII), who (I)

VI User Programs

AGEN (VI) AGEN (VI)

NAME

agen – generate associative memory drivers

SYNOPSIS

agen file

DESCRIPTION

Agen permits easy referencing of table lookups, etc.

The input consists of a series of table definitions followed by %% followed by programs. Each definition is of the form

name (accessing) object ;

where name is the name of a table to be searched; accessing is a description of the subscripts used, being a list of the choices 'string', 'int' and 'char'. Object is an example of the things in the table. It is used only to get the size in bytes; it may be replaced by the number corresponding to sizeof(object). Alternatively one of the accessing arguments may be 'size' indicating that the number of bytes required will be given as that argument. The 'exist' argument may be given; if it is, the corresponding argument of the search function is 0 for normal operation and 1 if failure to find the item should return 0 rather than a pointer to new storage for it. An 'exist' argument of -1 implies that the corresponding object should be deleted. Also, an argument of 'size' may be given; this indicates that the size of the object to be stored will be supplied in the call (in bytes).

It is also possible to specify a table size and a method.

name [length] ["hash" | "binary"] (accessing) object ;

specifies either a hash table or a binary tree search. For a hash search the length must be given.

BUGS

The lookup routines are slow.

BJ (VI) **BJ (VI)**

NAME

bj – the game of black jack

SYNOPSIS

/usr/games/bj

DESCRIPTION

Bj is a serious attempt at simulating the dealer in the game of black jack (or twenty-one) as might be found in Reno. The following rules apply:

The bet is $2 every hand.

A player 'natural' (black jack) pays $3. A dealer natural loses $2. Both dealer and player naturals is a 'push' (no money exchange).

If the dealer has an ace up, the player is allowed to make an 'insurance' bet against the chance of a dealer natural. If this bet is not taken, play resumes as normal. If the bet is taken, it is a side bet where the player wins $2 if the dealer has a natural and loses $1 if the dealer does not.

If the player is dealt two cards of the same value, he is allowed to 'double'. He is allowed to play two hands, each with one of these cards. (The bet is doubled also; $2 on each hand.)

If a dealt hand has a total of ten or eleven, the player may 'double down'. He may double the bet ($2 to $4) and receive exactly one more card on that hand.

Under normal play, the player may 'hit' (draw a card) as long as his total is not over twenty-one. If the player 'busts' (goes over twenty-one), the dealer wins the bet.

When the player 'stands' (decides not to hit), the dealer hits until he attains a total of seventeen or more. If the dealer busts, the player wins the bet.

If both player and dealer stand, the one with the largest total wins. A tie is a push.

The machine deals and keeps score. The following questions will be asked at appropriate times. Each question is answered by y followed by a new line for 'yes', or just new line for 'no'.

? (means, "do you want a hit?")
Insurance?
Double down?

Every time the deck is shuffled, the dealer so states and the 'action' (total bet) and 'standing' (total won or lost) is printed. To exit, hit the interrupt key (DEL) and the action and standing will be printed.

BUGS

CAL (VI) CAL (VI)

NAME

cal — print calendar

SYNOPSIS

cal [month] year

DESCRIPTION

Cal prints a calendar for the specified year. If a month is also specified, a calendar just for that month is printed. *Year* can be between 1 and 9999. The *month* is a number between 1 and 12. The calendar produced is that for England and her colonies.

Try September 1752.

BUGS

The year is always considered to start in January even though this is historically naive.

CHESS (VI)

CHESS (VI)

NAME

chess – the game of chess

SYNOPSIS

/usr/games/chess

DESCRIPTION

Chess is a computer program that plays class D chess. Moves may be given either in standard (descriptive) notation or in algebraic notation. The symbol '+' is used to specify check; 'o-o' and 'o-o-o' specify castling. To play black, type 'first'; to print the board, type an empty line.

Each move is echoed in the appropriate notation followed by the program's reply.

FILES

/usr/lib/book opening 'book'

DIAGNOSTICS

The most cryptic diagnostic is 'eh?' which means that the input was syntactically incorrect.

WARNING

Over-use of this program will cause it to go away.

BUGS

Pawns may be promoted only to queens.

CUBIC (VI) CUBIC (VI)

NAME

cubic – three dimensional tic-tac-toe

SYNOPSIS

/usr/games/cubic

DESCRIPTION

Cubic plays the game of three dimensional 4×4×4 tic-tac-toe. Moves are given by the three digits (each 1-4) specifying the coordinate of the square to be played.

WARNING

Too much playing of the game will cause it to disappear.

BUGS

FACTOR (VI)

FACTOR (VI)

NAME

factor – discover prime factors of a number

SYNOPSIS

factor

DESCRIPTION

When *factor* is invoked without an argument, it waits for a number to be typed in. If you type in a positive number less than 2^{56} (about 7.2×10^{16}) it will factor the number and print its prime factors; each one is printed the proper number of times. Then it waits for another number. It exits if it encounters a zero or any non-numeric character.

If *factor* is invoked with an argument, it factors the number as above and then exits.

Maximum time to factor is proportional to $\sqrt{n}$ and occurs when n is prime or the square of a prime. It takes 1 minute to factor a prime near 10^{13}.

DIAGNOSTICS

'Ouch.' for input out of range or for garbage input.

BUGS

NAME

fed – edit form letter memory

SYNOPSIS

fed

DESCRIPTION

Fed is used to edit a form letter associative memory file, **form.m**, which consists of named strings. Commands consist of single letters followed by a list of string names separated by a single space and ending with a new line. The conventions of the Shell with respect to '*' and '?' hold for all commands but **m**. The commands are:

e name ...
writes the string whose name is *name* onto a temporary file and executes *ed*. On exit from the *ed* the temporary file is copied back into the associative memory. Each argument is operated on separately. Be sure to give an editor *w* command (without a filename) to rewrite *fed's* temporary file before quitting out of *ed*.

d [name ...]
deletes a string and its name from the memory. When called with no arguments **d** operates in a verbose mode typing each string name and deleting only if a **y** is typed. A **q** response returns to *fed*'s command level. Any other response does nothing.

m name1 name2 ...
(move) changes the name of name1 to name2 and removes previous string name2 if one exists. Several pairs of arguments may be given. Literal strings are expected for the names.

n [name ...]
(names) lists the string names in the memory. If called with the optional arguments, it just lists those requested.

p name ...
prints the contents of the strings with names given by the arguments.

q
returns to the system.

c [**p**] [**f**]
checks the associative memory file for consistency and reports the number of free headers and blocks. The optional arguments do the following:

p causes any unaccounted-for string to be printed.

f fixes broken memories by adding unaccounted-for headers to free storage and removing references to released headers from associative memory.

FILES

/tmp/ftmp?	temporary
form.m	associative memory

SEE ALSO

form (VI), ed (I), sh (I)

WARNING

It is legal but unwise to have string names with blanks, '*' or '?' in them.

BUGS

FORM (VI)

FORM (VI)

NAME

form – form letter generator

SYNOPSIS

form proto **arg** ...

DESCRIPTION

Form generates a form letter from a prototype letter, an associative memory, arguments and in a special case, the current date.

If *form* is invoked with the *proto* argument *x*, the associative memory is searched for an entry with name *x* and the contents filed under that name are used as the prototype. If the search fails, the message '[*x*]:' is typed on the console and whatever text is typed in from the console, terminated by two new lines, is used as the prototype. If the prototype argument is missing, '{letter}' is assumed.

Basically, *form* is a copy process from the prototype to the output file. If an element of the form [*n*] (where *n* is a digit from 1 to 9) is encountered, the *n*-th *arg* is inserted in its place, and that argument is then rescanned. If [0] is encountered, the current date is inserted. If the desired argument has not been given, a message of the form '[*n*]:' is typed. The response typed in then is used for that argument.

If an element of the form [*name*] or {*name*} is encountered, the *name* is looked up in the associative memory. If it is found, the contents of the memory under this *name* replaces the original element (again rescanned). If the *name* is not found, a message of the form '[*name*]:' is typed. The response typed in is used for that element. The response is entered in the memory under the name if the name is enclosed in [ ]. The response is not entered in the memory but is remembered for the duration of the letter if the name is enclosed in {}. Brackets and braces may be nested.

In both of the above cases, the response is typed in by entering arbitrary text terminated by two new lines. Only the first of the two new lines is passed with the text.

If one of the special characters [{]}\ is preceded by a \, it loses its special character.

If a file named 'forma' already exists in the user's directory, 'formb' is used as the output file and so forth to 'formz'.

The file 'form.m' is created if none exists. Because form.m is operated on by the disc allocator, it should only be changed by using *fed*, the form letter editor, or *form*.

FILES

form.m	associative memory
form?	output file (read only)

SEE ALSO

fed (VI), nroff (I)

BUGS

An unbalanced] or } acts as an end of file but may add a few strange entries to the associative memory.

GSI (VI) GSI (VI)

NAME

gsi – interpret extended character set on GSI terminal

SYNOPSIS

gsi

DESCRIPTION

Gsi interprets special characters understood by the Model 37 Teletype terminal and turns them into the escape sequences understood by the GSI and other Diablo-based terminals. The things interpreted include vertical motions and extended graphic characters. It is most often used in a pipeline like

nroff file ... | gsi

SEE ALSO

BUGS

Some funny characters can't be correctly printed in column 1 because you can't move to the left from there.

HYPHEN (VI) HYPHEN (VI)

NAME

hyphen – find hyphenated words

SYNOPSIS

hyphen file ...

DESCRIPTION

It finds all of the words in a document which are hyphenated across lines and prints them back at you in a convenient format.

If no arguments are given, the standard input is used. Thus *hyphen* may be used as a filter.

BUGS

Yes, it gets confused, but with no ill effects other than spurious extra output.

LEX (VI)

LEX (VI)

NAME

lex – generate programs for simple lexical tasks

SYNOPSIS

lex [-code] file

DESCRIPTION

Lex generates programs for simple lexical analysis.

The input file contains strings and expressions to be searched for, and C text to be executed when 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 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 occurences of, the previous character or character class. The character '.' is the class of all ascii characters except newline. Parentheses for grouping and vertical bar for alternation are also supported. The character ^ at the beginning of an expression permits a successful match only immediately after a newline, and the character $ at the end of an expression requires a trailing newline. The character / in an expression indicates trailing context; only the part of the expression up to the slash is returned in yylextext, 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 \. Thus

```
[a-zA-Z]+
```

matches a string of letters. The actual string matched is left in yylextext, an external character array. Matching is done in order of the strings in the file.

Three subroutines are expected: input() to read a character; unput(c) to replace a character read; and output(c) to place an output character. The library defines these in terms of the standard streams (and the -lp portable library), but you can replace 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 yylextext; and the function yyless(p) pushes back the portion of the string matched beginning at p, which should be between yylextext and yylastch.

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 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",yylextext);
0{D}+   printf("octal number %s\n",yylextext);
{D}+    printf("decimal number %s\n",yylextext);
"++"            printf("unary op\n");
"+"             printf("binary op\n");
"/*"    {       loop:
                while (input() != '*');
                switch (input())
                        {
                        case '/': break;
```

```
                    case '*': unput('*');
                    default: go to loop;
                    }
}
```

The external names generated by *lex* all begin with the "code" string from the optional first argument; if omitted it is "yy". Furthermore,the name of the output file is "lex.code.c" in the general case. The code argument may be given on the first line of the input file as %-code.

FILES

/lib/libl.a (-ll) library

BUGS

A right context portion of an expression (past a /) may not contain the operators *, +, ? | or (.

MOO (VI)

MOO (VI)

NAME

moo – guessing game

SYNOPSIS

/usr/games/moo

DESCRIPTION

Moo is a guessing game imported from England. The computer picks a number consisting of four distinct decimal digits. The player guesses four distinct digits being scored on each guess. A 'cow' is a correct digit in an incorrect position. A 'bull' is a correct digit in a correct position. The game continues until the player guesses the number (a score of four bulls).

BUGS

NAME

ptx – permuted index

SYNOPSIS

ptx [**–t**] input [output]

DESCRIPTION

Ptx generates a permuted index from file *input* on file *output*. It has three phases: the first does the permutation, generating one line for each keyword in an input line. The keyword is rotated to the front. The permuted file is then sorted. Finally the sorted lines are rotated so the keyword comes at the middle of the page.

Input should be edited to remove useless lines. The following words are suppressed: 'a', 'an', 'and', 'as', 'is', 'for', 'of', 'on', 'or', 'the', 'to', 'up', 'all', 'at', 'data', 'do', 'in', 'into', 'when'.

The optional argument **–t** causes *ptx* to prepare its output for the phototypesetter.

The index for this manual was generated using *ptx*.

FILES

/bin/sort

SNO (VI) SNO (VI)

NAME

sno – Snobol interpreter

SYNOPSIS

sno [file]

DESCRIPTION

Sno is a Snobol III (with slight differences) compiler and interpreter. *Sno* obtains input from the concatenation of *file* and the standard input. All input through a statement containing the label 'end' is considered program and is compiled. The rest is available to 'syspit'.

Sno differs from Snobol III in the following ways.

There are no unanchored searches. To get the same effect:

```
a ** b          unanchored search for b
a *x* b = x c   unanchored assignment
```

There is no back referencing.

```
x = "abc"
a *x* x         is an unanchored search for 'abc'
```

Function declaration is different. The function declaration is done at compile time by the use of the label 'define'. Thus there is no ability to define functions at run time and the use of the name 'define' is preempted. There is also no provision for automatic variables other than the parameters. For example:

define f( )

or

define f(a,b,c)

All labels except 'define' (even 'end') must have a non-empty statement.

If 'start' is a label in the program, program execution will start there. If not, execution begins with the first executable statement. 'define' is not an executable statement.

There are no built-in functions.

Parentheses for arithmetic are not needed. Normal precedence applies. Because of this, the arithmetic operators '/' and '*' must be set off by space.

The right side of assignments must be non-empty.

Either ' or " may be used for literal quotes.

The pseudo-variable 'sysppt' is not available.

SEE ALSO

Snobol III manual. (JACM; Vol. 11 No. 1; Jan 1964; pp 21)

BUGS

NAME

tmac – macros for formatting manuscripts

SYNOPSIS

nroff –ms [options] file ...

DESCRIPTION

This package of *nroff* macro definitions provides a canned formatting facility for technical papers. When producing 2-column output on a terminal, its output should be filtered through *col* (I).

The package supports three different formats: BTL technical memorandum with cover sheet, released paper with cover sheet, and an abbreviated 'debugging' form without cover sheet.

The macro requests are defined in the attached Request Reference. Many *nroff* requests are unsafe in conjunction with this package, however the requests listed below may be used with impunity after the first .PP.

.bp begin new page
.br break output line here
.sp n insert n spacing lines
.ls n (line spacing) n=1 single, n=2 double space
.na no alignment of right margin

Output of the *tbl* (I) preprocessor for tables is acceptable as input.

FILES

/usr/lib/tmac.s

SEE ALSO

nroff (I)

BUGS

REQUEST REFERENCE

Request Form	Initial Value	Cause Break	Explanation
.1C	yes	yes	One column format on a new page.
.2C	no	yes	Two column format.
.AB	no	yes	Begin abstract.
.AE	-	yes	End abstract.
.AI	no	yes	Author's institution follows. Suppressed in TM.
.AU *x y*	no	yes	Author's name follows. *x* is location and *y* is extension, ignored except in TM.
.B	no	no	Boldface text follows.
.CS *x...*	-	yes	Cover sheet info if TM format, suppressed otherwise. Arguments are number of text pages, other pages, total pages, figures, tables, references.
.DA *x*	nroff	no	'Date line' at bottom of page is *x*. Default is today.
.DE	-	yes	End displayed text. Implies .KE.
.DS *x*	no	yes	Start of displayed text, to appear verbatim line-by-line. *x*=I for indented display (default), *x*=L for left-justified on the page, *x*=C for centered. Implies .KS.
.EN	-	yes	Space after equation produced by *eqn* or *neqn*.
.EQ *x*	-	yes	Space before equation. Equation number is *x*.
.FE	-	yes	End footnote.
.FS	no	no	Start footnote. The note will be moved to the bottom of the page.
.HO	-	no	'Bell Laboratories, Holmdel, New Jersey 07733'.
.I	no	no	Italic text follows.
.IP *x y*	no	yes	Start indented paragraph, with hanging tag *x*. Indentation is *y* ens (default 5).
.KE	-	yes	End keep. Put kept text on next page if not enough room.
.KF	no	yes	Start floating keep. If the kept text must be moved to the next page, float later text back to this page.
.KS	no	yes	Start keeping following text.
.LG	no	no	Make letters larger.
.LP	yes	yes	Start left-blocked paragraph.
.MH	-	no	'Bell Laboratories, Murray Hill, New Jersey 07974'.
.NH *n*	-	yes	Same as .SH, with section number supplied automatically. Numbers are multilevel, like 1.2.3, where *n* tells what level is wanted (default is 1).
.NL	yes	no	Make letters normal size.
.OK	-	yes	'Other keywords' for TM cover sheet follow.
.PP	no	yes	Begin paragraph. First line indented.
.R	yes	no	Roman text follows.
.RE	-	yes	End relative indent level.
.RP	no	-	Cover sheet and first page for released paper. Must precede other requests.
.RS	-	yes	Start level of relative indentation. Following .IP's measured from current indentation.
.SG *x*	no	yes	Insert signature(s) of author(s), ignored except in TM. *x* is the reference line (initials of author and typist).
.SH	-	yes	Section head follows, font automatically bold.
.SM	no	no	Make letters smaller.
.TL	no	yes	Title follows.
.TM *x y z*	no	-	BTL TM cover sheet and first page, *x*=TM number, *y*=(quoted list of) case number(s), *z*=file number. Must precede other requests.
.WH	-	no	'Bell Laboratories, Whippany, New Jersey 07981'.

TTT (VI) **TTT (VI)**

NAME

ttt – the game of tic-tac-toe

SYNOPSIS

/usr/games/ttt

DESCRIPTION

Ttt is the X and O game popular in the first grade. This is a learning program that never makes the same mistake twice.

Although it learns, it learns slowly. It must lose nearly 80 games to know the game completely.

FILES

/usr/games/ttt.k learning file

BUGS

NAME

wump – the game of hunt-the-wumpus

SYNOPSIS

/usr/games/wump

DESCRIPTION

Wump plays the game of "Hunt the Wumpus." A Wumpus is a creature that lives in a cave with several rooms connected by tunnels. You wander among the rooms, trying to shoot the Wumpus with an arrow, meanwhile avoiding being eaten by the Wumpus and falling into Bottomless Pits. There are also Super Bats which are likely to pick you up and drop you in some random room.

The program asks various questions which you answer one per line; it will give a more detailed description if you want.

This program is based on one described in *People's Computer Company, 2,* 2 (November 1973).

BUGS

It will never replace Space War.

VII Tables

ASCII (VII) ASCII (VII)

NAME

ascii – map of ASCII character set

SYNOPSIS

cat /usr/pub/ascii

DESCRIPTION

Ascii is a map of the ASCII character set, 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

FILES

found in /usr/pub

GREEK (VII) **GREEK (VII)**

NAME

greek – graphics for extended TTY-37 type-box

SYNOPSIS

cat /usr/pub/greek

DESCRIPTION

Greek gives the mapping from ascii to the "shift out" graphics in effect between SO and SI on model 37 Teletypes with a 128-character type-box. It contains:

alpha	α	A	beta	β	B	gamma	γ	\
GAMMA	Γ	G	delta	δ	D	DELTA	Δ	W
epsilon	ϵ	S	zeta	ζ	Q	eta	η	N
THETA	Θ	T	theta	θ	O	lambda	λ	L
LAMBDA	Λ	E	mu	μ	M	nu	ν	@
xi	ξ	X	pi	π	J	PI	Π	P
rho	ρ	K	sigma	σ	Y	SIGMA	Σ	R
tau	τ	I	phi	ϕ	U	PHI	Φ	F
psi	ψ	V	PSI	Ψ	H	omega	ω	C
OMEGA	Ω	Z	nabla	∇	[	not	$\neg$	_
partial	∂	]	integral	$\int$	^			

SEE ALSO

ascii (VII)

MTAB (VII) **MTAB (VII)**

NAME

mtab – mounted file system table

DESCRIPTION

Mtab resides in directory */etc* and contains a table of devices mounted by the *mount* command. *Umount* removes entries.

Each entry is 64 bytes long; the first 32 are the null-padded name of the place where the special file is mounted; the second 32 are the null-padded name of the special file. The special file has all its directories stripped away; that is, everything through the last "/" is thrown away.

This table is present only so people can look at it. It does not matter to *mount* if there are duplicated entries nor to *umount* if a name cannot be found.

FILES

/etc/mtab

SEE ALSO

mount (VIII), umount (VIII)

BUGS

TABS (VII)

TABS (VII)

NAME

tabs – set tab stops

SYNOPSIS

cat /usr/pub/tabs

DESCRIPTION

Printing this file on a suitable terminal sets tab stops every 8 columns. Suitable terminals include the Teletype model 37 and the GE TermiNet 300.

These tab stop settings are desirable because UNIX assumes them in calculating delays.

VIII System Programs

AC (VIII) AC (VIII)

NAME

ac – login accounting

SYNOPSIS

ac [**–w** wtmp] [**–p**] [**–d**] people

DESCRIPTION

Ac produces a printout giving connect time for each user who has logged in during the life of the current *wtmp* file. A total is also produced. **–w** is used to specify an alternate *wtmp* file. **–p** prints individual totals; without this option, only totals are printed. **–d** causes a printout for each midnight to midnight period. Any *people* after **–p** will limit the printout to only the specified login names. If no *wtmp* file is given, **/usr/adm/wtmp** is used.

The accounting file */usr/adm/wtmp* is maintained by *init* and *login*. Neither of these programs creates the file, so if it does not exist no connect-time accounting is done. To start accounting, it should be created with length 0. On the other hand, if the file is left undisturbed, it will grow without bound, so periodically any information desired should be collected and the file truncated.

FILES

/usr/adm/wtmp

SEE ALSO

init (VIII), login (I), wtmp (V).

BUGS

BOOT PROCEDURES (VIII) BOOT PROCEDURES (VIII)

NAME

boot procedures -- UNIX startup

DESCRIPTION

The advent of the 11/70 and its associated peripherals has changed the boot procedures. *These procedures apply only to C-language systems.*

How to start UNIX. UNIX is started by placing it in core starting at location zero and transferring to zero. There are various ways to do this.

The *tp* command places a bootstrap program on the otherwise unused block zero of the tape. The DECtape version of this boot program is called *tboot,* the magtape version *mboot.* If *tboot* or *mboot* is read into location zero and executed there, it will type '=' on the console, read in a *tp* entry name, load that entry into core, and transfer to zero. Thus one way to run UNIX is to maintain the UNIX code on a tape using *tp.* Caution: the file /usr/mdec/tboot (DECtape) or /usr/mdec/mboot (magtape) must be present when the tape is made or updated. Then when a boot is required, execute a program which reads in and jumps to the first block of the tape. The standard DEC ROM which loads DECtape is sufficient to read in *tboot,* but the magtape ROM loads block one, not zero. If no suitable ROM is available, magtape and DECtape programs are presented below which may be manually placed in core and executed. In response to the '=' prompt, type the entry name of the system on the tape (we use plain 'unix'). It is strongly recommended that a current version of the system be maintained in this way, even if another method of booting the system is usually used.

Another method of booting the system involves the otherwise unused block zero of each UNIX file system. One of four separate boot programs can be used in this method. The single-block program *uboot* reads a single character (either **p** or **k** for RP03 or RK04/05, drive 0) to specify which device is to be searched. The other boot programs are called *rkboot, rpboot,* and *hpboot.* These programs are also one block long and they also read one character from the console, but they are designed to search one device type (drive zero in all cases), not one of two. *Rkboot* accepts the character **k** and searches the RK04/05 disk. *Rpboot* accepts the character **p** and searches the RP03 disk. *Hpboot* accepts the character **4** and searches the RP04 disk. All four bootstrap programs will then read a UNIX pathname from the console, find the corresponding file on the device, load that file into core location zero, and transfer to it. *Uboot, rkboot, rpboot,* and *hpboot* operate under very severe space constraints. They supply no prompts, except a carriage return and line feed that are echoed after the **p, k,** or **4.** No diagnostic is provided if the indicated file cannot be found, nor is there any means of correcting typographical errors in the file name except to start the program over. These four bootstrap programs can reside in block zero of the device(s) they are capable of searching, or they may be loaded from a *tp* tape as described above. The correct bootstrap program can be placed on block zero at system generation by the *mkfs* (VIII) command or it can be placed there any time after that with the *cp* (I) command.

The standard DEC disk ROMs will load and execute *uboot, rkboot, rpboot,* and *hpboot* from block zero of the device.

The switches. The console switches play an important role in the use and especially the booting of UNIX. During operation, the console switches are examined 60 times per second, and the contents of the address specified by the switches are displayed in the data display register only if the data display select knob is set to display register. (This is not true on the 11/40 since there is no display register on that machine.) If the switch address is even, the address is interpreted in kernel (system) space; if odd, the rounded-down address is interpreted in the current user space.

If any diagnostics are produced by the system, they are printed on the console only if the switches are non-zero. Thus it is wise to have a non-zero value in the switches at all times.

BOOT PROCEDURES (VIII)

BOOT PROCEDURES (VIII)

During the startup of the system, the *init* program (VIII) reads the switches and will come up single-user if the switches are set to 773030 on an 11/40 or an 11/45 or if the switches are set to 1773030 on an 11/70.

It is unwise to have a non-existent address in the switches. This causes a bus error in the system (displayed as 177777) at the rate of 60 times per second. If there is a transfer of more than 16ms duration on a device with a data rate faster than the bus error timeout (approx 10μs), then a permanent disk non-existent-memory error will occur.

ROM programs. Here are some programs which are suitable for installing in read-only memories, or for manual keying into core if no ROM is present. Each program is position-independent but should be placed well above location 0 so it will not be overwritten. Each reads a block from the beginning of a physical device into core location zero. The octal words constituting the program are listed on the left.

DECtape (drive 0) from endzone:

```
012700          mov     $tcba,r0
177346
010040          mov     r0,-(r0)        / use tc addr for wc
012710          mov     $3,(r0)         / read bn forward
000003
105710  1:      tstb    (r0)            / wait for ready
002376          bge     1b
112710          movb    $5,(r0)         / read (forward)
000005
000777          br      .               / loop; now halt and start at 0
```

DECtape (drive 0) with search:

```
012700  1:      mov     $tcba,r0
177346
010040          mov     r0,-(r0)        / use tc addr for wc
012740          mov     $4003,-(r0)     / read bn reverse
004003
005710  2:      tst     (r0)
002376          bge     2b              / wait for error
005760          tst     -2(r0)          / loop if not end zone
177776
002365          bge     1b
012710          mov     $3,(r0)         / read bn forward
000003
105710  2:      tstb    (r0)            / wait for ready
002376          bge     2b
112710          movb    $5,(r0)         / read (forward)
000005
105710  2:      tstb    (r0)            / wait for ready
002376          bge     2b
005007          clr     pc              / transfer to zero
```

Caution: both of these DECtape programs will (literally) blow a fuse if 2 drives are dialed to zero.

Magtape (TU10) from load point:

```
012700          mov     $mtcma,r0
172526
010040          mov     r0,-(r0)        / usr mt addr for wc
012740          mov     $60003,-(r0)    / read 9-track
060003
000777          br      .               / loop; now halt and start at 0
```

Magtape (TU16) from load point:
The numbers in parentheses are for an 11/70
Zero the following addresses
772442 (1772442)
772444 (1772444)
772446 (1772446)
Halt and load address 772472 (1772472)
Set switches to 001300 (0001300)
Load address 772440 (1772440)
Set switches to 000071 (0000071)
Enable and deposit

RK (drive 0):

```
012700          mov     $rkmr,r0
177414
005040          clr     -(r0)
005040          clr     -(r0)
010040          mov     r0,-(r0)
012740          mov     $5,-(r0)
000005
105710  1:      tstb    (r0)
002376          bge     1b
005007          clr     pc
```

RP03 (drive 0)

```
012700          mov     $rpmr,r0
176726
005040          clr     -(r0)
005040          clr     -(r0)
005040          clr     -(r0)
010040          mov     r0,-(r0)
012740          mov     $5,-(r0)
000005
105710  1:      tstb    (r0)
002376          bge     1b
005007          clr     pc
```

RP04 (drive 0)
The parentheses are for an 11/70
Halt and load address 765000 (1765000)
Set switches to 000070 (0000070)
Enable and start

FILES

/usr/sys/unix – UNIX code
/usr/mdec/mboot – *tp* magtape bootstrap
/usr/mdec/tboot – *tp* DECtape bootstrap
/usr/mdec/uboot – file system bootstrap
/usr/mdec/tu/rkboot – RK04/05 file system bootstrap
/usr/mdec/tu/rpboot – RP03 file system bootstrap
/usr/mdec/tu/hpboot – RP04 file system bootstrap

SEE ALSO

tp (I), init (VII), mkfs (VIII)

NAME

check – file system consistency check

SYNOPSIS

check [**–lsuib** [numbers]] [filesystem]

DESCRIPTION

Check examines a file system, builds a bit map of used blocks, and compares this bit map against the free list maintained on the file system. It also compares the link-count for each allocated i-number (i.e., i-node) with the number of references (i.e., directory entries) to it. If the file system is not specified, a check of a default file system is performed. The normal output of *check* includes a report of

the number of blocks missing (i.e., not in any file nor in the free list),
the number of special files,
the total number of files,
the number of large files,
the number of directories,
the number of indirect blocks,
the number of blocks used in files,
the highest-numbered block appearing in a file,
the number of free blocks.

The **–l** flag causes *check* to produce as part of its output report a list of all the path names of files on the file system. The list is in i-number order; the first name for each file gives the i-number while subsequent names (i.e., links) have the i-number suppressed. The entries "." and ".." for directories are also suppressed. If the flag is given as **–ll**, the listing will include the accessed and modified times for each file. The **–l** option supersedes **–s**.

The **–s** flag causes *check* to ignore the actual free list and reconstruct a new one by rewriting the super-block of the file system. The file system should be dismounted while this is done; if this is not possible (for example, if the root file system has to be salvaged), care should be taken that the system is quiescent and that it is rebooted immediately afterwards so that the old, bad in-core copy of the super-block will not continue to be used. However, a *sync* (VIII) prior to the reboot will undo the salvage. Notice also that the words in the super-block which indicate the size of the free list and of the i-list are believed. If the super-block has been curdled, these words will have to be patched. The **–s** flag causes the normal output reports to be suppressed.

With the **–u** flag, *check* examines the directory structure for connectivity. A list of all i-node numbers that cannot be reached from the root is printed. This is exactly the list of i-nodes that should be cleared (see *clri* (VIII)) after a series of incremental restores. (See the bugs section of *restor* (VIII).) The **–u** option supersedes **–s**.

The occurrence of **i** *n* times in a flag argument, **–ii...i**, causes *check* to store away the next *n* arguments which are taken to be i-numbers. When any of these i-numbers is encountered in a directory, a diagnostic is produced, as described below, which indicates among other things the entry name.

Likewise, *n* appearances of **b** in a flag, like **–bb...b**, cause the next *n* arguments to be taken as block numbers which are remembered; whenever any of the named blocks turns up in a file, a diagnostic is produced.

FILES

Currently, /dev/rp0 is the default file system.

SEE ALSO

fs (V), clri (VIII), restor (VIII)

DIAGNOSTICS

If a read error is encountered, the block number of the bad block is printed and *check* exits. "Bad freeblock" means that a block number outside the available space was encountered in the free list. "*n* dups in free" means that *n* blocks were found in the free list which duplicate blocks either in some file or in the earlier part of the free list.

An important class of diagnostics is produced by a routine which is called for each block which is encountered in an i-node corresponding to an ordinary file or directory. These have the form

b# complaint ; **i**= *i#* (*class*)

Here *b#* is the block number being considered; *complaint* is the diagnostic itself. It may be

blk if the block number was mentioned as an argument after **−b**;
bad if the block number has a value not inside the allocatable space on the device, as indicated by the devices's super-block;
dup if the block number has already been seen in a file;
din if the block is a member of a directory, and if an entry is found therein whose i-number is outside the range of the i-list on the device, as indicated by the i-list size specified by the super-block. Unfortunately this diagnostic does not indicate the offending entry name, but since the i-number of the directory itself is given (see below) the problem can be tracked down.

The *i#* in the form above is the i-number in which the named block was found. The *class* is an indicator of what type of block was involved in the difficulty:

sdir indicates that the block is a data block in a small file;
ldir indicates that the block is a data block in a large file (the indirect block number is not available);
idir indicates that the block is an indirect block (pointing to data blocks) in a large file;
free indicates that the block was mentioned after **−b** and is free;
urk indicates a malfunction in *check*.

When an i-number specified after **−i** is encountered while reading a directory, a report in the form

i# **ino; i**= *d#* (*class*) *name*

where *i#* is the requested i-number, *d#* is the i-number of the directory, *class* is the class of the directory block as discussed above (virtually always "sdir") and *name* is the entry name. This diagnostic gives enough information to find a full path name for an i-number without using the **-l** option: use **−b** *n* to find an entry name and the i-number of the directory containing the reference to *n*, then recursively use **−b** on the i-number of the directory to find its name.

Another important class of file system diseases indicated by *check* is files for which the number of directory entries does not agree with the link-count field of the i-node. The diagnostic is hard to interpret. It has the form

i# delta

Here *i#* is the i-number affected. *Delta* is an octal number accumulated in a byte, and thus can have the value 0 through 377(8). The easiest way (short of rewriting the routine) of explaining the significance of *delta* is to describe how it is computed.

If the associated i-node is allocated (that is, has the *allocated* bit on), add 100 to *delta*. If its link-count is non-zero, add another 100 plus the link-count. Each time a directory entry specifying the associated i-number is encountered, subtract 1 from *delta*. At the end, the i-number and *delta* are printed if *delta* is neither 0 nor 200. The first case indicates that the i-node was unallocated and no entries for it appear; the second that it was allocated and that the link-count and the number of directory entries agree.

Therefore (to explain the symptoms of the most common difficulties) *delta* = 377 (−1 in 8-bit, 2's complement octal) means that there is a directory entry for an unallocated i-node. This is somewhat serious and the entry should be be found and removed forthwith. *Delta* = 201 usually means that a normal, allocated i-node has no directory entry. This difficulty is much less serious. Whatever blocks there are in the file are unavailable, but no further damage will occur if nothing is done. A *clri* followed by a *check* −*s* will restore the lost space at leisure.

In general, values of *delta* equal to or somewhat above 0, 100, or 200 are relatively innocuous; just below these numbers there is danger of spreading infection.

BUGS

Check −*l* or −*u* on large file systems takes a great deal of core.
Since *check* is inherently two-pass in nature, extraneous diagnostics may be produced if applied to active file systems.
It believes even preposterous super-blocks and consequently can get core images.

CHOWN (VIII) CHOWN (VIII)

NAME

chown – change owner

SYNOPSIS

chown owner file ...

DESCRIPTION

The user-ID of the files is changed to *owner*. The owner may be either a decimal UID or a login name found in the password file.

Only the owner of a file (or the super-user) is allowed to change the owner. Unless it is done by the super-user, the set-user-ID permission bit is turned off as the owner of a file is changed.

FILES

/etc/passwd

SEE ALSO

BUGS

CLRI (VIII) **CLRI (VIII)**

NAME

clri – clear i-node

SYNOPSIS

clri i-number [filesystem]

DESCRIPTION

Clri writes zeros on the 32 bytes occupied by the i-node numbered *i-number.* If the *file system* argument is given, the i-node resides on the given device, otherwise on a default file system. The file system argument must be a special file name referring to a device containing a file system. After *clri,* any blocks in the affected file will show up as "missing" in an *icheck* of the file system.

Read and write permission is required on the specified file system device. The i-node becomes allocatable.

The primary purpose of this routine is to remove a file which for some reason appears in no directory. If it is used to zap an i-node which does appear in a directory, care should be taken to track down the entry and remove it. Otherwise, when the i-node is reallocated to some new file, the old entry will still point to that file. At that point removing the old entry will destroy the new file. The new entry will again point to an unallocated i-node, so the whole cycle is likely to be repeated again and again.

BUGS

Whatever the default file system is, it is likely to be wrong. Specify the file system explicitly.

If the file is open, *clri* is likely to be ineffective.

CRASH (VIII) CRASH (VIII)

NAME

crash -- what to do when the system crashes

DESCRIPTION

This section gives at least a few clues about how to proceed if the system crashes. It can't pretend to be complete.

How to bring it back up. If the reason for the crash is not evident (see below for guidance on 'evident'), you may want to try to dump the system if you feel up to debugging. At the moment a dump can be taken only on magtape. With a tape mounted and ready on drive 0, stop the machine, load address 44, and start. This should write a copy of all of core on the tape with an EOF mark. Caution: Any error is taken to mean the end of core has been reached. This means that you must be sure the ring is in, the tape is ready, and the tape is clean and new. If the dump fails, you can try again, but some of the registers will be lost. See below for what to do with the tape.

In restarting after a crash, always bring up the system single-user. This is accomplished by following the directions in *boot procedures* (VIII) as modified for your particular installation; a single-user system is indicated by having a particular value in the switches (173030 unless you've changed *init)* as the system starts executing. When it is running, perform a *check* or *icheck* (VIII) on all file systems which could have been in use at the time of the crash. If any serious file system problems are found, they should be repaired. When you are satisfied with the health of your disks, check and set the date if necessary, then come up multi-user. This is most easily accomplished by changing the single-user value in the switches to something else, then logging out by typing an EOT.

To boot UNIX at all, three files (and the directories leading to them) must be intact. First, the initialization program */etc/init* must be present and executable. If it is not, the CPU will loop in user mode at location 6. For *init* to work correctly, */dev/tty8* and */bin/sh* must be present. If either does not exist, the symptom is best described as thrashing. *Init* will go into a *fork/exec* loop trying to create a Shell with proper standard input and output.

If you cannot get the system to boot, a runnable system must be obtained from a backup medium. The root file system may then be doctored as a mounted file system as described below. If there are any problems with the root file system, it is probably prudent to go to a backup system to avoid working on a mounted file system.

Repairing disks. The first rule to keep in mind is that an addled disk should be treated gently; it shouldn't be mounted unless necessary, and if it is very valuable yet in quite bad shape, perhaps it should be dumped before trying surgery on it. This is an area where experience and informed courage count for much.

The problems reported by *icheck* typically fall into two kinds. There can be problems with the free list: duplicates in the free list, or free blocks also in files. These can be cured easily with an *icheck* *−s*. If the same block appears in more than one file or if a file contains bad blocks, the files should be deleted, and the free list reconstructed. The best way to delete such a file is to use *clri* (VIII), then remove its directory entries. If any of the affected files is really precious, you can try to copy it to another device first.

Icheck may report files which have more directory entries than links. Such situations are potentially dangerous; *clri* discusses a special case of the problem. All the directory entries for the file should be removed. If on the other hand there are more links than directory entries, there is no danger of spreading infection, but merely some disk space that is lost for use. It is sufficient to copy the file (if it has any entries and is useful); then use *clri* on its inode and remove any directory entries that do exist.

Finally, there may be inodes reported by *check* or *icheck* that have 0 links and 0 entries. These occur on the root device when the system is stopped with pipes open, and on other file systems when the system stops with files that have been deleted while still open. A *clri* will free the inode, and an *icheck -s* will recover any missing blocks.

Why did it crash? UNIX types a message on the console typewriter when it voluntarily crashes. Here is the current list of such messages, with enough information to provide a hope at least of the remedy. The message has the form 'panic: ...', possibly accompanied by other information. Left unstated in all cases is the possibility that hardware or software error produced the message in some unexpected way.

blkdev
: The *getblk* routine was called with a nonexistent major device as argument. Definitely hardware or software error.

devtab
: Null device table entry for the major device used as argument to *getblk*. Definitely hardware or software error.

iinit
: An I/O error reading the super-block for the root file system during initialization.

out of inodes
: A mounted file system has no more i-nodes when creating a file. Sorry, the device isn't available; the *icheck* should tell you.

no fs
: A device has disappeared from the mounted-device table. Definitely hardware or software error.

no imt
: Like 'no fs', but produced elsewhere.

no inodes
: The in-core inode table is full. Try increasing NINODE in param.h. Shouldn't be a panic, just a user error.

no clock
: During initialization, neither the line nor programmable clock was found to exist.

swap error
: An unrecoverable I/O error during a swap. Really shouldn't be a panic, but it is hard to fix.

unlink – iget
: The directory containing a file being deleted can't be found. Hardware or software.

out of swap space
: A program needs to be swapped out, and there is no more swap space. It has to be increased. This really shouldn't be a panic, but there is no easy fix.

out of text
: A pure procedure program is being executed, and the table for such things is full. This shouldn't be a panic.

trap
: An unexpected trap has occurred within the system. This is accompanied by three numbers: a 'ka6', which is the contents of the segmentation register for the area in which the system's stack is kept; 'aps', which is the location where the hardware stored the program status word during the trap; and a 'trap type' which encodes which trap occurred. The trap types are:

  0 bus error
  1 illegal instruction
  2 BPT/trace

3 IOT
4 power fail
5 EMT
6 recursive system call (TRAP instruction)
7 11/70 cache parity, or programmed interrupt
10 floating point trap
11 segmentation violation

In some of these cases it is possible for octal 20 to be added into the trap type; this indicates that the processor was in user mode when the trap occurred. If you wish to examine the stack after such a trap, either dump the system, or use the console switches to examine core; the required address mapping is described below.

Interpreting dumps. All file system problems should be taken care of before attempting to look at dumps. The dump should be read into the file */usr/sys/core; cp* (I) will do. At this point, you should execute *ps −alx* and *who* to print the process table and the users who were on at the time of the crash. You should dump (*od* (I)) the first 30 bytes of */usr/sys/core*. Starting at location 4, the registers R0, R1, R2, R3, R4, R5, SP and KDSA6 (KISA6 for 11/40s) are stored. If the dump had to be restarted, R0 will not be correct. Next, take the value of KA6 (location 22(8) in the dump) multiplied by 100(8) and dump 1000(8) bytes starting from there. This is the per-process data associated with the process running at the time of the crash. Relabel the addresses 140000 to 141776. R5 is C's frame or display pointer. Stored at (R5) is the old R5 pointing to the previous stack frame. At (R5)+2 is the saved PC of the calling procedure. Trace this calling chain until you obtain an R5 value of 141756, which is where the user's R5 is stored. If the chain is broken, you have to look for a plausible R5, PC pair and continue from there. Each PC should be looked up in the system's name list, using *db* (I) and its ':' command to get a reverse calling order. In most cases this procedure will give an idea of what is wrong. A more complete discussion of system debugging is impossible here.

SEE ALSO

clri, icheck, check on boot procedures (VIII)
"Explanation of Abnormal Conditions within the UNIX Operating System",MMF,3/17/75.

BUGS

DF (VIII) **DF (VIII)**

NAME

df – disk free

SYNOPSIS

df [filesystem]

DESCRIPTION

Df prints out the number of free blocks available on a file system. If the file system is unspecified, the free space on all of the normally mounted file systems is printed.

FILES

/dev/rf?, /dev/rk?, /dev/rp?

SEE ALSO

icheck (VIII), check (VIII)

BUGS

DUMP (VIII) DUMP (VIII)

NAME

dump – incremental file system dump

SYNOPSIS

dump [key [arguments] filesystem]

DESCRIPTION

Dump makes an incremental file system dump on magtape of all files changed after a certain date. The *key* argument specifies the date and other options about the dump. *Key* consists of characters from the set **abcfiu0hds.**

- **a** Normally files larger than 1000 blocks are not incrementally dumped; this flag forces them to be dumped
- **b** The next argument is taken to be the maximum size of the dump tape in blocks (see **s**).
- **c** If the tape overflows, increment the last character of its name and continue on that drive. (Normally it asks you to change tapes.)
- **f** Place the dump on the next argument file instead of the tape.
- **i** the dump date is taken from the entry in the file /etc/dtab corresponding to the last time this file system was dumped with the **-u** option.
- **u** the date just prior to this dump is written on /etc/dtab upon successful completion of this dump This file contains a date for every file system dumped with this option.
- **0** the dump date is taken as the epoch (beginning of time). Thus this option causes an entire file system dump to be taken.
- **h** the dump date is some number of hours before the current date. The number of hours is taken from the next argument in *arguments.*
- **d** the dump date is some number of days before the current date. The number of days is taken from the next argument in *arguments.*
- **s** the size of the dump tape is specified in feet. The number of feet is taken from the next argument in *arguments.* It is assumed that there are 9 standard UNIX records per foot. When the specified size is reached, the dump will wait for reels to be changed. The default size is 2200 feet.

If no arguments are given, the *key* is assumed to be **i** and the file system is assumed to be /dev/rp0.

Full dumps should be taken on quiet file systems as follows:

```
dump 0u /dev/rp0
check -l /dev/rp0
```

The *check* will come in handy in case it is necessary to restore individual files from this dump. Incremental dumps should then be taken when desired by:

```
dump i /dev/rp0
```

When the incremental dumps get cumbersome, a new complete dump should be taken. In this way, a restore requires loading of the complete dump tape and only the latest incremental tape.

DIAGNOSTICS

If the dump requires more than one tape, it will ask you to change tapes. Reply with a new-line when this has been done. If the first block on the new tape is not writable, e.g., because you forgot the write ring, you get a chance to fix it. Generally, however, read or write failures are fatal.

DUMP (VIII)

DUMP (VIII)

FILES

/dev/mt0	magtape
/dev/rp0	default file system
/etc/dtab	

SEE ALSO

restor (VIII), check (VIII), dump (V)

BUGS

NAME

getty – set typewriter mode

SYNOPSIS

/etc/getty [char]

DESCRIPTION

Getty is invoked by *init* (VIII) immediately after a typewriter is opened following a dial-up. It reads the user's login name and invokes the *login* (I) command with the user's name as argument. While reading the name, *getty* attempts to adapt the system to the speed and type of terminal being used.

Init calls *getty* with an argument specified by the *ttys* file entry for the typewriter line. Arguments other than '0' can be used to make *getty* treat the line specially. Normally, it sets the speed of the interface to 300 baud, specifies that raw mode is to be used (break on every character), that echo is to be suppressed, and either parity allowed. It types the "login:" message, which includes the characters which put the Terminet 300 terminal into full-duplex and return the GSI terminal to non-graphic mode. Then the user's name is read, a character at a time. If a null character is received, it is assumed to be the result of the user pushing the "break" ("interrupt") key. With the normal argument of '0' for a given typewriter line, subsequent "breaks" will cause the typewriter to cycle through the three speeds from 300 to 150 t0 110 baud with the "login" typed for each occurrence. (Note that the terminal speed switch must be correspondingly set (300, 150, 110) or the typewriter output will prove incomprehensible.) If a subsequent end-of-file is received, the typewriter speed reverts to the initialized speed (300).

With arguments of '-', '1', and '2' the terminal speeds are set to 110, 150, and 1200 baud, respectively. The aforementioned arguments, however, do not have the cycling ability that '0' possesses.

The user's name is terminated by a new-line or carriage-return character. The latter results in the system being set to treat carriage returns appropriately (see *stty* (II)).

The user's name is scanned to see if it contains any lower-case alphabetic characters; if not, and if the name is non-empty, the system is told to map any future upper-case characters into the corresponding lower-case characters.

Finally, login is called with the user's name as argument.

SEE ALSO

init (VIII), login (I), stty (II), ttys (V)

BUGS

GLOB (VIII)

GLOB (VIII)

NAME

glob – generate command arguments

SYNOPSIS

/etc/glob command [arguments]

DESCRIPTION

Glob is used to expand arguments to the shell containing "*", "[", or "?". It is passed the argument list containing the metacharacters; *glob* expands the list and calls the indicated command. The actions of *glob* are detailed in the Shell writeup.

SEE ALSO

sh (I)

BUGS

NAME

icheck – file system consistency check and interactive repair

SYNOPSIS

icheck [**–syn**] [filesystem] ...

DESCRIPTION

Icheck audits UNIX file systems for consistency and corrects any discrepancies. Since these corrections will, in general, result in a loss of data, the program will request operator concurrence for each such action. All questions should be answered by typing "yes" or "no", followed by a new-line character. Typing "yes" will cause the correction to take place. However, if the program does not have write permission on the file system or the "no" option, **-n**, is on, then all questions will automatically be answered "no". Alternatively the "yes" option, **-y**, will cause all questions to be answered "yes".

The program consists of six separate phases. Some phases are skipped if they are not needed. In phase one, **icheck** examines all block pointers in all files; checking for pointers which are outside of the file system (BAD) and for blocks which appear in more than one file (DUP). A table is made of all DUP blocks and all defective files are marked for clearing. Each error is printed, but no correction takes place in this phase.

The second phase is run only if DUP blocks were found in phase one. This phase finds the rest of the DUP blocks, marking each for clearing.

The third phase checks the directory structure of the file system. This is done by descending the directory tree, examining each entry. A count is kept of the number of references to each file. If any entry refers to an unallocated file, a file marked for clearing, or a file number outside the file system, then the entry is printed, and, if the operator agrees, it is removed. Refusing to remove an entry to a marked file will clear the mark, preserving the file and its subsequent entries.

In phase four all marked or unreferenced files are listed. With concurrence from the operator, each of these files is then cleared. In addition, any file whose link count does not agree with the number of references is listed; and, if agreed, the link count is adjusted.

If the salvage option, **-s**, is on, then phase five is skipped. Otherwise, check examines the free list. If any blocks are found which are outside the file system or which have been previously encountered in a file or elsewhere in the free list, then the list is pronounced BAD and a salvage is called for. Operator agreement will set the salvage option and proceed to the next phase. If there are no defects in the free list and all blocks are accounted for, the check is finished. Otherwise, the number of missing blocks (i.e. in neither a file nor the free list) is printed and a salvage is requested.

The last phase is the salvage operation; where the free list is recreated. It is run whenever the salvage option is on or a problem has been found with the free list. Simply stated, a new free list is constructed containing all blocks not found in some file.

The system responses are in general self-explanatory and follow the sequence described above. In the specification that follows, the following notation will be used:

<b>	block number
<i>	inode number
<fname>	file pathname
<n>	positive integer

<c> option character

Icheck begins with the following output:

<filesystem>{(NO WRITE)}

Phase 1 - Check Blocks

The "(NO WRITE)" message indicates that the program does not have write permission on the file system. Therefore, subsequent corrections will be suppressed, by automatically answering "no" to all questions. Phase one then proceeds to list any BAD or DUP blocks and their inode number, as follows:

```
<b> BAD                I=<i>
<b< DUP                I=<i>
<b> EXCESSIVE DUPS     I=<i>
```

If too many DUPs are encountered, the program will list all blocks. But it will not mark the excess DUPs for later processing. When Phase 1 is finished, if any DUPs were encountered, then Phase 2 is run. Otherwise, Phase 2 is skipped. This phase will list the rest of the DUP blocks as follows:

Phase 2 - Rescan for more DUPS

```
<b> DUP                I = <i>
```

Check now descends the directory tree, asking to remove any defective entries.

Phase 3 - Check Pathnames

```
I OUT OF RANGE     I = <i>     <fname>     REMOVE?
UNALLOCATED        I = <i>     <fname>     REMOVE?
BAD/DUP            I = <i>     <fname>     REMOVE?
```

If no option has been specified, the program will wait for a response of "yes" or "no" after each question. Note, a "no" answer to the BAD/DUP entry will unmark that inode for clearing. This will suppress any subsequent correction to that file.

Now **icheck** will clear or adjust any defective files. Again, if no option has been specified, it will wait for a "yes" or "no" response to each question. The program will also indicate whether each entry is a file or a directory.

Phase 4 - Check Reference Counts

```
UNREFERENCED   {FILE/DIRECTORY}     I = <i>     CLEAR?
BAD/DUP        {FILE/DIRECTORY}     I = <i>     CLEAR?
LINK COUNT     {FILE/DIRECTORY}     I = <i>     ADJUST?
```

If the salvage option is not on, the program will now validate the free list. Otherwise, this phase is skipped. If there are any errors in the free list, it will specify them and request a salvage.

Phase 5 - Check Free List

```
BAD FREE LIST     SALVAGE?
<n> MISSING       SALVAGE?
```

Phase 6 is the salvage operation. It is only done if one has been requested.

Phase 6 - Salvage Free List

Finally, some totals are printed: the total number of allocated files (including directories and special files); the number of blocks in use; and the number of blocks in the free list.

<n> FILES <n> BLOCKS <n> FREE

If the file system has been modified, then the following message is printed and the program goes into a loop. This is only a reminder to the operator since the program can be forced to terminate with a <DEL> character.

*****BOOT UNIX(NO SYNC!)*****

A number of errors can terminate **icheck.** An illegal option or the inability to open the file system are shown as:

<c> OPTION??
CAN NOT OPEN <filesystem>

An I/O error on the filesystem will also cause an error message. In this case, the operator is given the choice of exiting ("yes") or continuing ("no"). This error is generally a hardware error, and continuing is rarely a good idea.

CAN NOT READ <filesystem> BLOCK <b>EXIT?
CAN NOT SEEK <filesystem> BLOCK <b>EXIT?
CAN NOT WRITE <filesystem> BLOCK <b>EXIT?

FILES

/dev/rootdev default file system to be checked

BUGS

Icheck has been known to produce core images on large file systems.

INIT (VIII) INIT (VIII)

NAME

init — process control initialization

SYNOPSIS

/etc/init

DESCRIPTION

Init is invoked inside UNIX as the last step in the boot procedure. Generally its role is to create a process for each typewriter on which a user may log in.

First, *init* checks to see if the console switches contain 173030. (This number is likely to vary between systems.) If so, the console typewriter **/dev/tty8** is opened for reading and writing and the Shell is invoked immediately. This feature is used to bring up a single-user system. When the system is brought up in this way, the *getty* and *login* routines mentioned below and described elsewhere are not used. If the Shell terminates, *init* starts over looking for the console switch setting.

Otherwise, *init* invokes a Shell, with input taken from the file */etc/rc*. This command file performs housekeeping, like removing temporary files, mounting file systems, and starting daemons.

Then *init* reads the file */etc/ttys* and forks several times to create a process for each typewriter specified in the file. Each of these processes opens the appropriate typewriter for reading and writing. These channels thus receive file descriptors 0 and 1, the standard input and output. Opening the typewriter will usually involve a delay, since the *open* is not completed until someone is dialed up and carrier established on the channel. Then */etc/getty* is called with argument as specified by the last character of the *ttys* file line. *Getty* reads the user's name and invokes *login* (I) to log in the user and execute the Shell.

Ultimately the Shell will terminate because of an end-of-file either typed explicitly or generated as a result of hanging up. The main path of *init*, which has been waiting for such an event, wakes up and removes the appropriate entry from the file *utmp*, which records current users, and makes an entry in */usr/adm/wtmp*, which maintains a history of logins and logouts. Then the appropriate typewriter is reopened and *getty* is reinvoked.

Init catches the *hangup* signal (signal #1) and interprets it to mean that the switches should be examined as in a reboot: if they indicate a multi-user system, the */etc/ttys* file is read again. The Shell process on each line which used to be active in *ttys* but is no longer there is terminated; a new process is created for each added line; lines unchanged in the file are undisturbed. Thus it is possible to drop or add phone lines without rebooting the system by changing the *ttys* file and sending a *hangup* signal to the *init* process: use "kill −1 1."

FILES

/dev/tty?, /tmp/utmp, /usr/adm/wtmp, /etc/ttys, /etc/rc

SEE ALSO

login (I), kill (I), sh (I), ttys (V), getty (VIII)

INO (VIII) **INO (VIII)**

NAME

ino – get the i-number of a file

SYNOPSIS

ino file ...

DESCRIPTION

The i-number of each file argument is printed. An i-number of zero is printed if a bad argument is given.

BUGS

LPD (VIII) LPD (VIII)

NAME

lpd – line printer daemon

SYNOPSIS

/etc/lpd

DESCRIPTION

Lpd is the line printer daemon (spool area handler) invoked by *lpr*. It uses the directory */usr/lpd*. The file *lock* in that directory is used to prevent two daemons from becoming active simultaneously. After the daemon has successfully set the lock, it scans the directory for files beginning with "df." Each such file is submitted as a job. Each line of a job file must begin with a key character to specify what to do with the remainder of the line.

L specifies that the remainder of the line is to be sent as a literal.

B specifies that the rest of the line is a file name. That file is to be sent as binary cards.

F is the same as **B** except a form feed is prepended to the file.

U specifies that the rest of the line is a file name. After the job has been transmitted, the file is unlinked.

FILES

/usr/lpd/*spool area
/dev/lp printer

SEE ALSO

dpd (VIII), lpr (I)

BUGS

Temporary files (of the form tf.*) never get removed and must be deleted manually.

MKFS (VIII) **MKFS (VIII)**

NAME

mkfs – construct a file system

SYNOPSIS

/etc/mkfs special proto

DESCRIPTION

Mkfs constructs a file system by writing on the special file *special* according to the directions found in the prototype file *proto*. The prototype file contains tokens separated by spaces or new lines. The first token is the name of a file to be copied onto block zero as the bootstrap program (see boot procedures (VIII)). The second token is a number specifying the size of the created file system. Typically it will be the number of blocks on the device, perhaps diminished by space for swapping. The next token is the i-list size in blocks (remember there are 16 i-nodes per block). The next set of tokens comprise the specification for the root file. File specifications consist of tokens giving the mode, the user-id, the group id, and the initial contents of the file. The syntax of the contents field depends on the mode.

The mode token for a file is a 6 character string. The first character specifies the type of the file. (The characters **–bcd** specify regular, block special, character special and directory files respectively.) The second character of the type is either **u** or **–** to specify set-user-id mode or not. The third is **g** or **–** for the set-group-id mode. The rest of the mode is a three digit octal number giving the owner, group, and other read, write, execute permissions (see *chmod* (I)).

Two decimal number tokens come after the mode; they specify the user and group ID's of the owner of the file.

If the file is a regular file, the next token is a pathname from which the contents and size are copied.

If the file is a block or character special file, two decimal number tokens follow which give the major and minor device numbers.

If the file is a directory, *mkfs* makes the entries . and .. and then reads a list of names and (recursively) file specifications for the entries in the directory. The scan is terminated with the token **$**.

If the prototype file cannot be opened and its name consists of a string of digits, *mkfs* builds a file system with a single empty directory on it. The size of the file system is the value of *proto* interpreted as a decimal number. The i-list size is the file system size divided by 43 plus the size divided by 1000. (This corresponds to an average size of three blocks per file for a 4000 block file system and six blocks per file at 40,000.) The boot program is left uninitialized.

A sample prototype specification follows:

```
/usr/mdec/uboot
4872 55
d--777 3 1
usr     d--777 3 1
        sh      ---755 3 1 /bin/sh
        ken     d--755 6 1
                $
        b0      b--644 3 1 0 0
        c0      c--644 3 1 0 0
        $
$
```

SEE ALSO

file system (V), directory (V), boot procedures (VIII)

BUGS

It is not possible to initialize a file larger than 64K bytes.
The size of the file system is restricted to 64K blocks.
There should be some way to specify links.
Unbalanced $'s cause unclear diagnostics.

MKNOD (VIII)

MKNOD (VIII)

NAME

mknod – build special file

SYNOPSIS

/etc/mknod name [**c**] [**b**] major minor

DESCRIPTION

Mknod makes a directory entry and corresponding i-node for a special file. The first argument is the *name* of the entry. The second is **b** if the special file is block-type (disks, tape) or **c** if it is character-type (other devices). The last two arguments are numbers specifying the *major* device type and the *minor* device (e.g., unit, drive, or line number).

The assignment of major device numbers is standardized; they can be found in the system source file *conf.c*.

SEE ALSO

mknod (II)

BUGS

MOUNT (VIII)

MOUNT (VIII)

NAME

mount – mount file system

SYNOPSIS

/etc/mount special file [**–r**]

DESCRIPTION

Mount announces to the system that a removable file system is present on the device corresponding to special file *special* (which must refer to a disk or possibly DECtape). The *file* must exist already; it becomes the name of the root of the newly mounted file system.

Mount maintains a table of mounted devices; if invoked without an argument it prints the table.

The optional last argument indicates that the file is to be mounted read-only. Physically write-protected and magnetic tape file systems must be mounted in this way or errors will occur when access times are updated, whether or not any explicit write is attempted.

SEE ALSO

mount (II), mtab (VII), umount (VIII)

BUGS

RELOC (VIII)

RELOC (VIII)

NAME

reloc – relocate object files

SYNOPSIS

reloc file octal [–]

DESCRIPTION

Reloc modifies the named object program file so that it will operate correctly at a different core origin than the one for which it was assembled or loaded.

The new core origin is the old origin increased by the given *octal* number (or decreased if the number has a '–' sign).

If the object file was generated by *ld*, the **–r** and **–d** options must have been given to preserve the relocation information and define any common symbols in the file.

If the optional last argument is given, then any *setd* instruction at the start of the file will be replaced by a no-op.

The purpose of this command is to simplify the preparation of object programs for systems which have no relocation hardware. It is hard to imagine a situation in which it would be useful to attempt directly to execute a program treated by *reloc*.

SEE ALSO

as (I), ld (I), a.out (V)

BUGS

RESTOR (VIII)

RESTOR (VIII)

NAME

restor – incremental file system restore

SYNOPSIS

restor key [arguments]

DESCRIPTION

Restor is used to read magtapes dumped with the *dump* command. The *key* argument specifies what is to be done. *Key* is a character from the set **trxw.**

- **t** The date that the tape was made and the date that was specified in the *dump* command are printed. A list of all of the i-numbers on the tape is also given.
- **r** The tape is read and loaded into the file system specified in *arguments.* This should not be done lightly (see below).
- **x** Each file on the tape is individually extracted into a file whose name is the file's i-number. If there are *arguments,* they are interpreted as i-numbers and only they are extracted.
- **c** If the tape overflows, increment the last character of its name and continue on that new drive. (Normally it asks you to change tapes.)
- **f** Read the dump from the next argument file instead of the tape.
- **i** All read and checksum errors are reported, but will not cause termination.
- **w** In conjunction with the **x** option, before each file is extracted, its i-number is typed out. To extract this file, you must respond with **y.**

The **x** option is used to retrieve individual files. If the i-number of the desired file is not known, it can be discovered by following the file system directory search algorithm. First retrieve the *root* directory whose i-number is 1. List this file with *ls –fi 1.* This will give names and i-numbers of sub-directories. Iterating, any file may be retrieved.

The **r** option should only be used to restore a complete dump tape onto a clear file system or to restore an incremental dump tape onto this. Thus

```
/etc/mkfs /dev/rp0 40600
restor r /dev/rp0
```

is a typical sequence to restore a complete dump. Another *restor* can be done to get an incremental dump in on top of this.

A *dump* followed by a *mkfs* and a *restor* is used to change the size of a file system.

FILES

/dev/mt0

SEE ALSO

ls (I), dump (VIII), mkfs (VIII), clri (VIII)

DIAGNOSTICS

There are various diagnostics involved with reading the tape and writing the disk. There are also diagnostics if the i-list or the free list of the file system is not large enough to hold the dump.

If the dump extends over more than one tape, it may ask you to change tapes. Reply with a new-line when the next tape has been mounted.

BUGS

There is redundant information on the tape that could be used in case of tape reading problems. Unfortunately, *restor's* approach is to exit if anything is wrong.

NAME

sa – Shell accounting

SYNOPSIS

sa [–abcjlnrstuv] [file]

DESCRIPTION

When a user logs in, if the Shell is able to open the file */usr/adm/sh_acct*, then as each command completes, the Shell writes at the end of this file the name of the command, the user, system time and real time consumed, and the user ID. *Sa* reports on, cleans up, and generally maintains this and other accounting files. To turn accounting on and off, the accounting file must be created or destroyed externally. If the user is the super-user, accounting is placed into */usr/adm/su_acct* instead. As with *sh_acct*, it must be created or destroyed externally.

Sa is able to condense the information in */usr/adm/sh_acct* into a summary file */usr/adm/sht_acct* which contains a count of the number of times each command was called and the time resources consumed. This condensation is desirable because on a large system *sh_acct* can grow by 100 blocks per day. The summary file is read before the accounting file, so the reports include all available information.

If a file name is given as the last argument, that file will be treated as the accounting file; *sh_acct* is the default. There are many options:

a Place all command names containing unprintable characters and those used only once under the name "***other."

b Sort output by sum of user and system time divided by number of calls. Default sort is by sum of user and system times.

c Besides total user time, system time, and real time for each command, print percentage of total time over all commands.

j Instead of total minutes time for each category, give seconds per call.

l Separate system and user time; normally they are combined.

n Sort by number of calls.

r Reverse order of sort.

s Merge accounting file into summary file */usr/adm/sht_acct* when done.

t For each command report ratio of real time to the sum of user and system times.

u Superseding all other flags, print for each command in the accounting file the day of the year, time, day of the week, user ID and command name.

v If the next character is a digit *n*, then type the name of each command used *n* times or fewer. Await a reply from the typewriter; if it begins with "y", add the command to the category "**junk**." This is used to strip out garbage.

FILES

/usr/adm/sh_acct
/usr/adm/sht_acct
/usr/adm/su_acct

SEE ALSO

ac (VIII)

BUGS

NAME

su – become privileged user

SYNOPSIS

su

DESCRIPTION

Su allows one to become the super-user, who has all sorts of marvelous (and correspondingly dangerous) powers. In order for *su* to do its magic, the user must supply a password. If the password is correct, *su* will execute the Shell with the UID set to that of the super-user. To restore normal UID privileges, type an end-of-file to the super-user Shell.

The password demanded is that of the entry "root" in the system's password file.

To remind the super-user of his responsibilities, the Shell substitutes '#' for its usual prompt '%'.

SEE ALSO

sh (I)

SYNC (VIII) SYNC (VIII)

NAME

sync – update the super block

SYNOPSIS

sync

DESCRIPTION

Sync executes the *sync* system primitive. If the system is to be stopped, *sync* must be called to insure file system integrity. See sync (II) for details.

SEE ALSO

sync (II)

BUGS

UMOUNT (VIII)

UMOUNT (VIII)

NAME

umount – dismount file system

SYNOPSIS

/etc/umount special

DESCRIPTION

Umount announces to the system that the removable file system previously mounted on special file *special* is to be removed.

SEE ALSO

mount (VIII), umount (II), mtab (V)

FILES

/etc/mtab mounted device table

DIAGNOSTICS

Frequently, in the case of */usr*, the file system is found to be busy because one of the Shell accounting files (*/usr/adm/sh#_acct* or */usr/adm/su_acct*) is open for some Shell.

BUGS

UPDATE (VIII) **UPDATE (VIII)**

NAME

update – periodically update the super block

SYNOPSIS

update

DESCRIPTION

Update is a program that executes the *sync* primitive every 30 seconds. This insures that the file system is fairly up to date in case of a crash. This command should not be executed directly, but should be executed out of the initialization shell command file. See sync (II) for details.

SEE ALSO

sync (II), init (VIII)

BUGS

With *update* running, if the CPU is halted just as the *sync* is executed, a file system can be damaged. This is partially due to DEC hardware that writes zeros when NPR requests fail. A fix would be to have *sync* temporarily increment the system time by at least 30 seconds to trigger the execution of *update*. This would give 30 seconds grace to halt the CPU.

WALL (VIII) WALL (VIII)

NAME

wall – write to all users

SYNOPSIS

/etc/wall

DESCRIPTION

Wall reads its standard input until an end-of-file. It then sends this message to all currently logged in users preceded by "Broadcast Message ...". It is used to warn all users, typically prior to shutting down the system.

The sender should be super-user to override any protections the users may have invoked.

FILES

/dev/tty?

SEE ALSO

mesg (I), write (I)

DIAGNOSTICS

"Cannot send to ..." when the open on a user's tty file fails.

BUGS