

UNIX PROGRAMMER'S MANUAL

Third Edition

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PREFACE  
to the Third Edition

In the months since the last appearance of this manual, many changes have occurred both in the system itself and in the way it is used.

Perhaps most obviously, there have been additions, deletions, and modifications to the system and its software. It is these changes, of course, that caused the appearance of this revised manual.

Second, the number of people spending an appreciable amount of time writing UNIX software has increased. Credit is due to L. L. Cherry, M. D. McIlroy, L. E. McMahon, R. Morris, J. F. Ossanna, and E. N. Pinson for their contributions.

Finally, the number of UNIX installations has grown to 16, with more expected. None of these has exactly the same complement of hardware or software. Therefore, at any particular installation, it is quite possible that this manual will give inappropriate information.

In particular, any system which uses a PDP-11/20 processor will not include all the software described herein, nor will the software behave the same way. The second, or even the first, edition of this manual is likely to be more appropriate.

Besides additions, deletions, and modifications to the writeups in each section, this manual differs from its predecessors in two ways: all the commands used for system maintenance and not intended for normal users have been moved to a new section VIII; and there is a new "How to Get Started" chapter that gives some elementary facts and many pointers to other sections.

## 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" 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 Inevitably, this means that many sections will soon be out of date. (The rate of change of the system is so great that a dismayingly large number of early sections had to be modified while the rest were being written. The unbounded effort required to stay up-to-date is best indicated by the fact that several of the programs described were written specifically to aid in preparation of this manual!)

This manual is divided into eight sections:

- I. Commands
- II. System calls
- III. Subroutines
- IV. Special files
- V. File formats
- VI. User-maintained programs
- VII. Miscellaneous
- VIII. Maintenance

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 binary programs). This directory is searched automatically by the command line interpreter. Some programs classified as commands are located elsewhere; this fact is indicated in the appropriate sections.

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.

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 /usr/lib/liba.a.

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

The 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-maintained programs (section VI) are not considered part of the UNIX system, and the principal reason for listing them is to indicate their existence without necessarily giving a complete description. The author should be consulted for information.

The miscellaneous section (VII) gathers odds and ends.

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 a page or so each. The name of the entry is in the upper corners of its pages, its preparation date in the upper middle. Entries within each section are alphabetized. The page numbers of each entry start at 1. (The earlier hope for frequent, partial updates of the manual is clearly in vain, but in any event it is not feasible to maintain consecutive page numbering in a document like this.)

All entries have a common format.

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:

Underlined 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 diagnostics that may be produced. This section tends to be as terse as the diagnostics themselves.

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

Previous edition of this manual had an owner section, which has been dropped from this edition because the "owners" of many routines became fairly hard to pin down. The major contributors to UNIX, (cast in order of appearance) together with their login names and most notable contributions, are

ken	K. Thompson	(UNIX, many commands)
dmr	D. M. Ritchie	(many commands, as, ld, C)
jfo	J. F. Ossanna	(roff, nroff)
doug	M. D. McIlroy	(tmg, m6)
rhk	R. Morris	(dc, much of library)
lem	L. E. McMahon	(cref)
llc	L. L. Cherry	(form, fed, salloc)
csr	C. S. Roberts	(tss)
enp	E. N. Pinson	(proof)

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 roff.

The assistance of R. Morris is gratefully acknowledged.

## 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.

### Logging in

You must call UNIX from an appropriate terminal. UNIX supports ASCII terminals typified by the TTY 37, the GE Terminet 300, the Memorex 1240, and various graphical terminals on the one hand, and IBM 2741-type terminals on the other.

To use UNIX, you must have a valid UNIX 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.

#### TTY 37 terminal

UNIX will type out "login: "; 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).

#### 300-baud terminals

Such terminals include the GE Terminet 300, most display terminals, Execuport, TI, 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. (Note that this switch will often have to be changed since MH-TSS requires half-duplex). When a connection with UNIX is established, a few garbage characters are typed (the login message at the wrong speed). Depress the "break" key; this is a speed-independent signal to UNIX that a 300-baud terminal is in use. UNIX will type "login: " at the correct speed; you type your user name, followed by the "return" key. Henceforth, the "return", "new line", or "linefeed" keys will give exactly the same results. Each line must be terminated with one of these keys; no one is listening to you until the return is received.

### Selectric terminals

From an IBM 2741 or the Anderson-Jacobson Selectric terminal, no message will appear. After the data connection is established, press the "return" key. UNIX should type "login: " as described above. If the greeting does not appear after a few seconds, unlock the keyboard by switching the terminal to local and back to remote, and type "return". If necessary, hang up and try again; something has gone wrong.

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 a UNIX program, the Shell, will type a "%" to you. (The Shell is described below under "How to run a program".

For more information, consult `getty(VII)`, which discusses the login sequence in more detail, and `dc(IV)`, which discusses typewriter I/O.

### Logging out

There are three ways to log out:

You can simply hang up the phone. Hanging up is safe if you are at command level, that is, if the Shell has just typed its prompt signal "%". It is also safe if you are in interactive system programs, for example the editor. It is unsafe if you are executing a non-interactive program, or one of your own programs, which either does not read the typewriter or ignores the end-of-file indications which will result from hanging up. The reason is that UNIX, unlike most systems, does not terminate a program simply because it has been hung-up upon.

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 (`login (I)`).

### How to communicate through your terminal

When you type to UNIX, a gnome deep in the system is gathering your characters and saving them in a secret place. The



characters will not be given to a program until you type a return, as described above in Logging in.

UNIX typewriter I/O is full-duplex (except for Selectric terminals). 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 stops echoing input characters, and starts echoing "#" no matter what you typed. The last character which was echoed correctly will be received correctly by the program to which you were talking; subsequent characters have been thrown away.

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 TermiNet 300 terminals, will set the tab stops correctly (tabs(VII)).

Section dc(IV) discusses typewriter I/O more fully. Section kl(IV) discusses the console typewriter.

#### 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 reference 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 file "filex" in directory "lem"; "lem" is itself a sub-directory 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) and stat(I). See mkdir(I) for making directories; rmdir(I) for destroying them.

For a fuller discussion of the file system, see MM-71-1273-4. 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 the assembly-language 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 (when completed, `cdb(I)` will be a boon), and virtually useless for Fortran.

Your programs can receive arguments from the command line just as system programs do. For assembly language programs, 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(I)`, `pr(I)`, `roff(I)`, or `nroff(I)`.

The `cat` command simply dumps ASCII text on the terminal, with no processing at all. The `pr` command paginates the text and supplies headings. The `nroff` command is an elaborate text formatting program, and requires careful forethought in entering both the text and the formatting commands into the input file. The `roff` command is a somewhat less elaborate formatting program, and requires somewhat less forethought.

### 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. To leave a message the presence of which will be announced to another user when he next logs in, `mail(I)` is used. 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 "%".

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### I. COMMANDS

:	place label
ar	archive (combine) files
as	assembler
bas	BASIC dialect
cat	concatenate (or print) files
cc	compile C program
cdb	C debugger
chdir	change working directory
chmod	change access mode of files
chown	change owner of files
cmp	compare file contents
cp	copy file
cref	cross reference table
crypt	encrypt, decrypt a file
date	get date and time of day
db	symbolic debugger
dc	desk calculator
df	find free disk space
dsw	delete files interactively
du	find disk usage
echo	print command arguments
ed	text editor
exit	end command sequence
factor	factor a number
fc	compile Fortran program
fed	form letter editor
form	generate form letter
forml	generate form letters
goto	command transfer
hyphen	find hyphenated words
if	conditional command
ld	link editor (loader)
ln	link to file
login	log on to system
ls	list contents of directory
m6	macroprocessor
mail	send mail to another user
man	run off manual section
mesg	permit or deny messages
mkdir	create directory
mt	save, restore files on magtape
mv	move or rename file
nm	print namelist
nroff	format text for printing
od	octal dump of file
opr	print file off-line
ov	page overlay file print
passwd	set login password

pr .....	print file with headings
proof .....	compare text files
reloc .....	relocate object files
rew .....	rewind DECTape
rm .....	remove (delete) file
rmdir .....	remove (delete) directory
roff .....	format text for printing
sh .....	command interpreter
size .....	get executable program size
sno .....	compile Snobol program
sort .....	sort ASCII file
speak .....	send words to voice synthesizer
split .....	break a file into pieces
stat .....	get file status
strip .....	remove symbols, relocation bits
stty .....	set typewriter modes
sum .....	sum file
tap .....	save, restore files on DECTape
time .....	get time information
tmg .....	compile tmgl program
tss .....	communicate with MH-TSS (GCOS)
tty .....	find name of terminal
type .....	print file page-by-page
typo .....	find typographic errors
un .....	find undefined symbols
uniq .....	find duplicate lines in a file
vs .....	generate voice synthesizer phonemes
wc .....	get (English) word count
who .....	who is on the system
write .....	write to another user

## II. SYSTEM CALLS

boot .....	reboot the system
break .....	set program break
cemt .....	catch EMT traps
chdir .....	change working directory
chmod .....	change mode of file
chown .....	change owner of file
close .....	close open file
creat .....	create file
csw .....	read the console switches
dup .....	duplicate an open file
exec .....	execute program file
exit .....	terminate execution
fork .....	create new process
fpe .....	catch floating exception errors
fstat .....	status of open file
getuid .....	get user ID
gtty .....	get typewriter mode
ilgins .....	catch illegal instruction trap
intr .....	catch or inhibit interrupts

kill .....	destroy process
link .....	link to file
mkdir .....	create directory
mdate .....	set date modified of file
mount .....	mount file system
nice .....	set low-priority status
open .....	open file
pipe .....	open inter process channel
quit .....	inhibit quits
read .....	read file
rele .....	release processor
seek .....	move read or write pointer
setuid .....	set user ID
sleep .....	delay execution
stat .....	get file status
stime .....	set system time
stty .....	set mode of typewriter
sync .....	assure synchronization
time .....	get time of year
times .....	get execution times
umount .....	dismount file system
unlink .....	remove (delete) file
wait .....	wait for process
write .....	write file

### III. SUBROUTINES

atan .....	arctangent
atof .....	convert ASCII to floating
atoi .....	convert ASCII to integer
compar .....	string compare for sort
crypt .....	encrypt according to a keyword
ctime .....	convert time to ASCII
ddspu .....	display character on Picturephone
ecvt .....	edited output conversion
exp .....	exponential function
ftoa .....	convert floating to ASCII
ftoo .....	convert floating to octal
gerts .....	communicate with GCOS
getc .....	get character
hypot .....	compute hypotenuse
itoa .....	convert integer to ASCII
log .....	logarithm base e
mesg .....	print string on typewriter
nlist .....	read name list
pow .....	take powers of numbers
ptime .....	print time
putc .....	write character or word
qsort .....	quicker sort
rand .....	pseudo random number generator
salloc .....	storage allocator
sin .....	sine, cosine

sqrt ..... square root  
 switch ..... transfer depending on value  
 ttyn ..... find teletype name

#### IV. SPECIAL FILES

dc ..... remote typewriter  
 dn ..... 801 ACU  
 dp ..... 201 Dataphone  
 kl ..... console typewriter  
 mem ..... core memory  
 pc ..... punched paper tape  
 rf ..... RF disk  
 rk ..... RK disk  
 tc ..... DEctape  
 tm..... 9-track magtape  
 vt ..... storage-tube display

#### V. FILE FORMATS

a.out ..... assembler and loader output  
 archive ..... archive file  
 core ..... core image file  
 directory ..... directory format  
 file system ..... file system format  
 passwd ..... password file  
 tap ..... DEctape and magtape format  
 utmp ..... logged-in user information  
 wtmp ..... accounting files

#### VI. USER MAINTAINED PROGRAMS

bc ..... compile B program  
 bj ..... blackjack  
 ptx ..... permuted index  
 yacc ..... yet another compiler-compiler

#### VII. MISCELLANEOUS

ascii ..... map of ASCII  
 dpd ..... spawn dataphone daemon  
 getty ..... adapt to typewriter  
 glob ..... argument expander  
 greek ..... extended TTY 37 typebox map  
 init ..... initializer process  
 msh ..... mini Shell  
 tabs ..... set tab stops on typewriter  
 vsp ..... voice synthesizer phonemes



## VIII. SYSTEM MAINTAINANCE

20boot .....	reboot 11/20 system
acct .....	get connect-time accounting
bproc .....	boot procedure
check .....	check consistency of file system
chk .....	check all file systems
clri .....	clear file's i-node
dcheck .....	verify directory hierarchy
dli .....	load DEC binary paper tapes
istat .....	file status by i-number
kill .....	terminate a process
mount .....	mount removable file system
ps .....	get process status
salv .....	repair damaged file system
su .....	become super-user
swtmp .....	truncate accounting files
tm .....	get system time information
umount .....	dismount removable file system

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dp(IV):	201 Dataphone
	20boot(VIII): reboot 11/20 system
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	accounting
	acct(VIII): get connect-time accounting
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	archive(V): archive file
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atoi(III): convert	ASCII to integer
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ascii(VII): map of	ASCII
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bas(I):	BASIC dialect
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bj(VI):	blackjack
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	boot(II): reboot the system
	bproc(VIII): boot procedure
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	break(II): set program break
break(II):	set program break
istat(VIII):	file status by i-number
cdb(I):	C debugger
cc(I):	compile C program
dc(I):	desk calculator
cemt(II):	catch EMT traps
fpe(II):	catch floating exception errors
ilgins(II):	catch illegal instruction trap
intr(II):	catch or inhibit interrupts
	cat(I): concatenate (or print) files
	cc(I): compile C program
	cdb(I): C debugger
	cemt(II): catch EMT traps
chmod(I):	change access mode of files
chmod(II):	change mode of file
chown(I):	change owner of files
chown(II):	change owner of file
chdir(I):	change working directory
chdir(II):	change working directory
pipe(II):	open inter process channel
ddspout(III):	display character on Picturephone
putc(III):	write character or word
getc(III):	get character
	chdir(I): change working directory
	chdir(II): change working directory
chk(VIII):	check all file systems
check(VIII):	check consistency of file system
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	chk(VIII): check all file systems
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	chown(I): change owner of files
	chown(II): change owner of file
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close(II):	close open file
	close(II): close open file
	clri(VIII): clear file's i-node
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ar(I):	archive (combine) files
echo(I):	print command arguments
sh(I):	command interpreter
exit(I):	end command sequence
goto(I):	command transfer
if(I):	conditional command
gerts(III):	communicate with GCOS

tss(I):	communicate with MH-TSS (GCOS)
cmp(I):	compare file contents
compar(III):	string compare for sort
proof(I):	compare text files
	compar(III): string compare for sort
bc(VI):	compile B program
cc(I):	compile C program
fc(I):	compile Fortran program
sno(I):	compile Snobol program
tmgl(I):	compile tmgl program
yacc(VI):	yet another compiler-compiler
hypot(III):	compute hypotenuse
cat(I):	concatenate (or print) files
if(I):	conditional command
acct(VIII):	get connect-time accounting
check(VIII):	check consistency of file system
csw(II):	read the console switches
kl(IV):	console typewriter
ls(I):	list contents of directory
cmp(I):	compare file contents
ecvt(III):	edited output conversion
atof(III):	convert ASCII to floating
atoi(III):	convert ASCII to integer
ftoa(III):	convert floating to ASCII
ftoo(III):	convert floating to octal
itoa(III):	convert integer to ASCII
ctime(III):	convert time to ASCII
cp(I):	copy file
core(V):	core image file
mem(IV):	core memory
	core(V): core image file
sin(III):	sine, cosine
wc(I):	get (English) word count
	cp(I): copy file
mkdir(II):	create directory
mkdir(I):	create directory
creat(II):	create file
fork(II):	create new process
	creat(II): create file
	cref(I): cross reference table
	cref(I): cross reference table
	crypt(I): encrypt, decrypt a file
	crypt(III): encrypt according to a keyword
	csw(II): read the console switches
	ctime(III): convert time to ASCII
dpd(VII):	spawn dataphone daemon
salv(VIII):	repair damaged file system
dpd(VII):	spawn dataphone daemon
dp(IV):	201 Dataphone
date(I):	get date and time of day
mdate(II):	set date modified of file
	date(I): get date and time of day
date(I):	get date and time of day

	db(I): symbolic debugger
	dcheck(VIII): verify directory hierarchy
	dc(I): desk calculator
	dc(IV): remote typewriter
Picturephone...	ddsput(III): display character on
cdb(I): C	debugger
db(I): symbolic	debugger
dli(VIII): load	DEC binary paper tapes
crypt(I): encrypt,	decrypt a file
tap(V):	DECTape and magtape format
rew(I): rewind	DECTape
save, restore files on	DECTape...tap(I):
tc(IV):	DECTape
sleep(II):	delay execution
dsw(I):	delete files interactively
rmdir(I): remove	(delete) directory
rm(I): remove	(delete) file
unlink(II): remove	(delete) file
mesg(I): permit or	deny messages
switch(III): transfer	depending on value
dc(I):	desk calculator
kill(II):	destroy process
	df(I): find free disk space
bas(I): BASIC	dialect
directory(V):	directory format
dcheck(VIII): verify	directory hierarchy
	directory(V): directory format
chdir(I): change working	directory
chdir(II): change working	directory
ls(I): list contents of	directory
mkdir(II): create	directory
mkdir(I): create	directory
rmdir(I): remove (delete)	directory
df(I): find free	disk space
du(I): find	disk usage
rf(IV): RF	disk
rk(IV): RK	disk
umount(II):	dismount file system
ddsput(III):	display character on Picturephone
vt(IV): storage-tube	display
	dli(VIII): load DEC binary paper tapes
	dn(IV): 801 ACU
	dpd(VII): spawn dataphone daemon
	dp(IV): 201 Dataphone
	dsw(I): delete files interactively
	du(I): find disk usage
od(I): octal	dump of file
	dup(II): duplicate an open file
dup(II):	duplicate an open file
uniq(I): find	duplicate lines in a file
	echo(I): print command arguments
	ecvt(III): edited output conversion
	ed(I): text editor

ecvt(III):	edited output conversion
ld(I): link	editor (loader)
ed(I): text	editor
fed(I): form letter	editor
cemt(II): catch	EMT traps
crypt(III):	encrypt according to a keyword
crypt(I):	encrypt, decrypt a file
exit(I):	end command sequence
wc(I): get	(English) word count
catch floating exception	errors...fpe(II):
typo(I): find typographic	errors
fpe(II): catch floating	exception errors
	exec(II): execute program file
size(I): get	executable program size
exec(II):	execute program file
times(II): get	execution times
exit(II): terminate	execution
sleep(II): delay	execution
	exit(I): end command sequence
	exit(II): terminate execution
glob(VII): argument	expander
	exp(III): exponential function
exp(III):	exponential function
greek(VII):	extended TTY 37 typebox map
log(III): logarithm base	e
factor(I):	factor a number
	factor(I): factor a number
	fc(I): compile Fortran program
	fed(I): form letter editor
cmp(I): compare	file contents
split(I): break a	file into pieces
opr(I): print	file off-line
type(I): print	file page-by-page
ov(I): page overlay	file print
istat(VIII):	file status by i-number
stat(I): get	file status
stat(II): get	file status
file system(V):	file system format
chk(VIII): check all	file systems
	file system(V): file system format
check consistency of	file system...check(VIII):
mount(II): mount	file system
mount(VIII): mount removable	file system
salv(VIII): repair damaged	file system
umount(II): dismount	file system
pr(I): print	file with headings
clri(VIII): clear	file's i-node
dsw(I): delete	files interactively
tap(I): save, restore	files on DECTape
mt(I): save, restore	files on magtape
ar(I): archive (combine)	files
concatenate (or print)	files...cat(I):
change access mode of	files...chmod(I):

chown(I):	change owner of	files
proof(I):	compare text	files
reloc(I):	relocate object	files
wtmp(V):	accounting	files
archive(V):	archive	file
chmod(II):	change mode of	file
chown(II):	change owner of	file
close(II):	close open	file
core(V):	core image	file
cp(I):	copy	file
creat(II):	create	file
crypt(I):	encrypt, decrypt a	file
dup(II):	duplicate an open	file
exec(II):	execute program	file
fstat(II):	status of open	file
link(II):	link to	file
ln(I):	link to	file
set date modified of	file...	mdate(II):
mv(I):	move or rename	file
od(I):	octal dump of	file
open(II):	open	file
passwd(V):	password	file
read(II):	read	file
rm(I):	remove (delete)	file
sort(I):	sort ASCII	file
sum(I):	sum	file
find duplicate lines in a	file...	uniq(I):
unlink(II):	remove (delete)	file
write(II):	write	file
du(I):	find disk usage	
uniq(I):	find duplicate lines in a file	
df(I):	find free disk space	
hyphen(I):	find hyphenated words	
tty(I):	find name of terminal	
ttyn(III):	find teletype name	
typo(I):	find typographic errors	
un(I):	find undefined symbols	
fpe(II):	catch	floating exception errors
ftoa(III):	convert	floating to ASCII
ftoo(III):	convert	floating to octal
atof(III):	convert ASCII to	floating
fork(II):	create new process	
fed(I):	form letter editor	
forml(I):	generate	form letters
form(I):	generate	form letter
nroff(I):	format text for printing	
roff(I):	format text for printing	
directory(V):	directory	format
file system(V):	file system	format
tap(V):	DECTape and magtape	format
form(I):	generate form letter	
forml(I):	generate form letters	
fc(I):	compile	Fortran program

	fpe(II): catch floating exception errors
df(I): find	free disk space
	fstat(II): status of open file
	ftoa(III): convert floating to ASCII
	ftoo(III): convert floating to octal
exp(III): exponential	function
communicate with MH-TSS	(GCOS)...tss(I):
gerts(III): communicate with	GCOS
forml(I):	generate form letters
form(I):	generate form letter
vs(I):	generate voice synthesizer phonemes
pseudo random number	generator...rand(III):
	gerts(III): communicate with GCOS
getc(III):	get character
acct(VIII):	get connect-time accounting
date(I):	get date and time of day
wc(I):	get (English) word count
size(I):	get executable program size
times(II):	get execution times
stat(I):	get file status
stat(II):	get file status
ps(VIII):	get process status
time(I):	get time information
time(II):	get time of year
gtty(II):	get typewriter mode
getuid(II):	get user ID
	getc(III): get character
	getty(VII): adapt to typewriter
	getuid(II): get user ID
	glob(VII): argument expander
	goto(I): command transfer
	greek(VII): extended TTY 37 typebox map
	gtty(II): get typewriter mode
pr(I): print file with	headings
verify directory	hierarchy...dcheck(VIII):
hyphen(I): find	hyphenated words
	hyphen(I): find hyphenated words
hypot(III): compute	hypotenuse
	hypot(III): compute hypotenuse
clri(VIII): clear file's	i-node
istat(VIII): file status by	i-number
getuid(II): get user	ID
setuid(II): set user	ID
	if(I): conditional command
	ilgins(II): catch illegal instruction trap
ilgins(II): catch	illegal instruction trap
core(V): core	image file
uniq(I): find duplicate lines	in a file
ptx(VI): permuted	index
time(I): get time	information
utmp(V): logged-in user	information
intr(II): catch or	inhibit interrupts
quit(II):	inhibit quits



init(VII):	initializer process
ilgins(II):	catch illegal instruction trap
itoa(III):	convert integer to ASCII
atoi(III):	convert ASCII to integer
pipe(II):	open inter process channel
dsw(I):	delete files interactively
sh(I):	command interpreter
intr(II):	catch or inhibit interrupts
split(I):	break a file into pieces
	intr(II): catch or inhibit interrupts
	istat(VIII): file status by i-number
	itoa(III): convert integer to ASCII
encrypt according to a	keyword...crypt(III):
	kill(II): destroy process
	kill(VIII): terminate a process
	kl(IV): console typewriter
: (I):	place label
	ld(I): link editor (loader)
fed(I):	form letter editor
forml(I):	generate form letters
form(I):	generate form letter
uniq(I):	find duplicate lines in a file
	ld(I): link editor (loader)
	link(II): link to file
	ln(I): link to file
	link(II): link to file
	ls(I): list contents of directory
nlist(III):	read name list
	ln(I): link to file
dli(VIII):	load DEC binary paper tapes
a.out(V):	assembler and loader output
ld(I):	link editor (loader)
	login(I): log on to system
	log(III): logarithm base e
	utmp(V): logged-in user information
	log(III): logarithm base e
passwd(I):	set login password
	login(I): log on to system
nice(II):	set low-priority status
	ls(I): list contents of directory
	m6(I): macroprocessor
	m6(I): macroprocessor
tap(V):	DECtape and magtape format
mt(I):	save, restore files on magtape
	tm 9-track magtape
mail(I):	send mail to another user
	mail(I): send mail to another user
	mkdir(II): create directory
	man(I): run off manual section
man(I):	run off manual section
	ascii(VII): map of ASCII
extended TTY 37	typebox map...greek(VII):

	mdate(II): set date modified of file
	mem(IV): core memory
mem(IV): core	memory
	mesg(I): permit or deny messages
mesg(I): permit or deny	mesg(III): print string on typewriter
tss(I): communicate with	messages
msh(VII):	MH-TSS (GCOS)
	mini Shell
chmod(I): change access	mkdir(I): create directory
chmod(II): change	mode of files
stty(II): set	mode of file
stty(I): set typewriter	mode of typewriter
gtty(II): get typewriter	modes
mdate(II): set date	mode
mount(II):	modified of file
mount(VIII):	mount file system
	mount removable file system
	mount(II): mount file system
	mount(VIII): mount removable file system
mv(I):	move or rename file
seek(II):	move read or write pointer
	msh(VII): mini Shell
	mt(I): save, restore files on magtape
	mv(I): move or rename file
nlist(III): read	name list
tty(I): find	name of terminal
nm(I): print	namelist
ttyn(III): find teletype	name
fork(II): create	new process
	nice(II): set low-priority status
	nlist(III): read name list
	nm(I): print namelist
	nroff(I): format text for printing
rand(III): pseudo random	number generator
pow(III): take powers of	numbers
factor(I): factor a	number
reloc(I): relocate	object files
od(I):	octal dump of file
convert floating to	octal...ftoo(III):
	od(I): octal dump of file
man(I): run	off manual section
opr(I): print file	off-line
close(II): close	open file
dup(II): duplicate an	open file
fstat(II): status of	open file
open(II):	open file
pipe(II):	open inter process channel
	open(II): open file
	opr(I): print file off-line
cat(I): concatenate	(or print) files
ecvt(III): edited	output conversion
assembler and loader	output...a.out (V):
ov(I): page	overlay file print

chown(I): change	ov(I): page overlay file print
chown(II): change	owner of files
ov(I):	owner of file
type(I): print file	page overlay file print
dli(VIII): load DEC binary	page-by-page
pc(IV): punched	paper tapes
	paper tape
	passwd(I): set login password
	passwd(V): password file
passwd(V):	password file
passwd(I): set login	password
	pc(IV): punched paper tape
mesg(I):	permit or deny messages
ptx(VI):	permuted index
generate voice synthesizer	phonemes...vs(I):
vsp(VII): voice synthesizer	phonemes
display character on	Picturephone...ddsput(III):
split(I): break a file into	pieces
	pipe(II): open inter process channel
	: (I):
seek(II): move read or write	place label
pow(III): take	pointer
	powers of numbers
	pow(III): take powers of numbers
	pr(I): print file with headings
echo(I):	print command arguments
opr(I):	print file off-line
type(I):	print file page-by-page
pr(I):	print file with headings
nm(I):	print namelist
mesg(III):	print string on typewriter
ptime(III):	print time
cat(I): concatenate (or	print) files
nroff(I): format text for	printing
roff(I): format text for	printing
ov(I): page overlay file	print
bproc(VIII): boot	procedure
pipe(II): open inter	process channel
ps(VIII): get	process status
rele(II): release	processor
fork(II): create new	process
init(VII): initializer	process
kill(II): destroy	process
kill(VIII): terminate a	process
wait(II): wait for	process
break(II): set	program break
exec(II): execute	program file
size(I): get executable	program size
bc(VI): compile B	program
cc(I): compile C	program
fc(I): compile Fortran	program
sno(I): compile Snobol	program
tmgl(I): compile tmgl	program
	proof(I): compare text files

rand(III):	pseudo random number generator
ps(VIII):	get process status
ptime(III):	print time
ptx(VI):	permuted index
pc(IV):	punched paper tape
	putc(III): write character or word
	qsort(III): quicker sort
qsort(III):	quicker sort
	quit(II): inhibit quits
quit(II):	inhibit quits
	rand(III): pseudo random number generator
rand(III):	pseudo random number generator
read(II):	read file
nlist(III):	read name list
seek(II):	move read or write pointer
csw(II):	read the console switches
	read(II): read file
20boot(VIII):	reboot 11/20 system
boot(II):	reboot the system
cref(I):	cross reference table
rele(II):	release processor
	rele(II): release processor
reloc(I):	relocate object files
strip(I):	remove symbols, relocation bits
	reloc(I): relocate object files
dc(IV):	remote typewriter
mount(VIII):	mount removable file system
rmdir(I):	remove (delete) directory
rm(I):	remove (delete) file
unlink(II):	remove (delete) file
strip(I):	remove symbols, relocation bits
mv(I):	move or rename file
salv(VIII):	repair damaged file system
tap(I):	save, restore files on DECTape
mt(I):	save, restore files on magtape
	rew(I): rewind DECTape
rew(I):	rewind DECTape
rf(IV):	RF disk
	rf(IV): RF disk
rk(IV):	RK disk
	rk(IV): RK disk
	rmdir(I): remove (delete) directory
	rm(I): remove (delete) file
	roff(I): format text for printing
sqrt(III):	square root
man(I):	run off manual section
	salloc(III): storage allocator
	salv(VIII): repair damaged file system
tap(I):	save, restore files on DECTape
mt(I):	save, restore files on magtape
man(I):	run off manual section
	seek(II): move read or write pointer
mail(I):	send mail to another user

speak(I):	send words to voice synthesizer
exit(I): end command	sequence
mdate(II):	set date modified of file
passwd(I):	set login password
nice(II):	set low-priority status
stty(II):	set mode of typewriter
break(II):	set program break
stime(II):	set system time
tabs(VII):	set tab stops on typewriter
stty(I):	set typewriter modes
setuid(II):	set user ID
	setuid(II): set user ID
msh(VII): mini	Shell
	sh(I): command interpreter
sin(III):	sine, cosine
	sin(III): sine, cosine
get executable program	size(I): get executable program size
	size...size(I):
sleep(II):	delay execution
sno(I): compile	Snobol program
	sno(I): compile Snobol program
sort(I):	sort ASCII file
	sort(I): sort ASCII file
string compare for	sort...compar(III):
qsort(III): quicker	sort
df(I): find free disk	space
dpd(VII):	spawn dataphone daemon
	speak(I): send words to voice synthesizer
	split(I): break a file into pieces
	sqrt(III): square root
sqrt(III):	square root
	stat(I): get file status
	stat(II): get file status
istat(VIII): file	status by i-number
fstat(II):	status of open file
nice(II): set low-priority	status
ps(VIII): get process	status
stat(I): get file	status
stat(II): get file	status
	stime(II): set system time
tabs(VII): set tab	stops on typewriter
salloc(III):	storage allocator
vt(IV):	storage-tube display
compar(III):	string compare for sort
mesg(III): print	string on typewriter
	strip(I): remove symbols, relocation bits
	stty(I): set typewriter modes
	stty(II): set mode of typewriter
sum(I):	sum file
	sum(I): sum file
csw(II): read the console	switches
	switch(III): transfer depending on value
db(I):	symbolic debugger

strip(I): remove	symbols, relocation bits
un(I): find undefined	symbols
sync(II): assure	synchronization
	sync(II): assure synchronization
vs(I): generate voice	synthesizer phonemes
vsp(VII): voice	synthesizer phonemes
speak(I): send words to voice	synthesizer
file system(V): file	system format
stime(II): set	system time
chk(VIII): check all file	systems
file	system(V): file system format
20boot(VIII): reboot 11/20	system
boot(II): reboot the	system
check consistency of file	system...check(VIII):
login(I): log on to	system
mount(II): mount file	system
mount removable file	system...mount(VIII):
repair damaged file	system...salv(VIII):
umount(II): dismount file	system
who(I): who is on the	system
tabs(VII): set	tab stops on typewriter
cref(I): cross reference	table
	tabs(VII): set tab stops on typewriter
pow(III):	take powers of numbers
load DEC binary paper	tapes...dli(VIII):
pc(IV): punched paper	tape
	tap(I): save, restore files on DECTape
	tap(V): DECTape and magtape format
	tc(IV): DECTape
	teletype name
ttyn(III): find	terminal
tty(I): find name of	
kill(VIII):	terminate a process
exit(II):	terminate execution
ed(I):	text editor
proof(I): compare	text files
nroff(I): format	text for printing
roff(I): format	text for printing
time(I): get	time information
date(I): get date and	time of day
time(II): get	time of year
ctime(III): convert	time to ASCII
	time(I): get time information
	time(II): get time of year
	times(II): get execution times
times(II): get execution	times
ptime(III): print	time
stime(II): set system	time
	tm 9-track magtape
	tmg(I): compile tmgl program
tmg(I): compile	tmgl program
switch(III):	transfer depending on value
goto(I): command	transfer
cent(II): catch EMT	traps

catch illegal instruction	trap...ilgins(II):
	tss(I): communicate with MH-TSS (GCOS)
greek(VII): extended	TTY 37 typebox map
	tty(I): find name of terminal
	ttyn(III): find teletype name
greek(VII): extended TTY 37	typebox map
	type(I): print file page-by-page
stty(I): set	typewriter modes
gtty(II): get	typewriter mode
dc(IV): remote	typewriter
getty(VII): adapt to	typewriter
kl(IV): console	typewriter
mesg(III): print string on	typewriter
stty(II): set mode of	typewriter
tabs(VII): set tab stops on	typewriter
typo(I): find	typographic errors
	typo(I): find typographic errors
	umount(II): dismount file system
	undefined symbols
un(I): find	un(I): find undefined symbols
	uniq(I): find duplicate lines in a file
	unlink(II): remove (delete) file
	usage
du(I): find disk	user ID
getuid(II): get	user ID
setuid(II): set	user ID
utmp(V): logged-in	user information
mail(I): send mail to another	user
write(I): write to another	user
	utmp(V): logged-in user information
transfer depending on	value...switch(III):
dcheck(VIII):	verify directory hierarchy
vs(I): generate	voice synthesizer phonemes
vsp(VII):	voice synthesizer phonemes
speak(I): send words to	voice synthesizer
	vs(I): generate voice synthesizer phonemes
	vsp(VII): voice synthesizer phonemes
	vt(IV): storage-tube display
	wait(II): wait for process
	wait(II): wait for process
	wc(I): get (English) word count
	who(I): who is on the system
	who(I): who is on the system
gerts(III): communicate	with GCOS
pr(I): print file	with headings
tss(I): communicate	with MH-TSS (GCOS)
wc(I): get (English)	word count
speak(I): send	words to voice synthesizer
hyphen(I): find hyphenated	words
putc(III): write character or	word
chdir(I): change	working directory
chdir(II): change	working directory
putc(III):	write character or word
write(II):	write file

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seek(II): move read or write pointer
        write(I): write to another user
                write(I): write to another user
                write(II): write file
                wtmp(V): accounting files
                yacc(VI): yet another compiler-compiler
time(II): get time of year
        yacc(VI): yet another compiler-compiler
```



: (I)

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: (I)

NAME : -- place a label

SYNOPSIS : [ label ]

DESCRIPTION : does nothing. Its only function is to place a label for the goto command. : is a command so the Shell doesn't have to be fixed to ignore lines with :'s.

FILES --

SEE ALSO goto(I)

DIAGNOSTICS --

BUGS --

NAME ar -- archive

SYNOPSIS ar key afile name918 ...

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 set drtux, optionally concatenated with v. afile is the archive file. The names are constituent files in the archive file. The meanings of the key characters are:

d means delete the named files from the archive file.

r means replace the named files in the archive file. If the archive file does not exist, r will create it. If the named files are not in the archive file, they are appended.

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

u is similar to r except that only those files that have been modified are replaced. If no names are given, all files in the archive that have been modified will be replaced by the modified version.

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

v means verbose. Under the verbose option, ar gives a file-by-file description of the making of a new archive file from the old archive and the constituent files. The following abbreviations are used:

- c copy
- a append
- d delete
- r replace
- x extract

FILES /tmp/vtm? temporary

SEE ALSO ld(I), archive(V)

DIAGNOSTICS "Bad usage", "afile -- not in archive format",  
"cannot open temp file", "name -- cannot open",  
"name -- phase error", "name -- cannot create",  
"no archive file", "cannot create archive file",  
"name -- not found".

BUGS Option vt should be implemented as a table with  
more information.

There should be a way to specify the placement of  
a new file in an archive. Currently, it is  
placed at the end.

"ar x" changes the modified-date of the current  
directory to a random number.

NAME           as -- assembler

SYNOPSIS       as [ - ] name918 ...

DESCRIPTION    as assembles the concatenation of name1, .... 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.

FILES          /etc/as2           pass 2 of the assembler  
              /tmp/atm1?       temporary  
              /tmp/atm2?       temporary  
              /tmp/atm3?       temporary  
              a.out           object

SEE ALSO       ld(I), nm(I), un(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  
              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 Odd-- word quantity assembled at odd address  
              P Phase error-- "." different in pass 1 and 2  
              R Relocation error  
              U Undefined symbol  
              X syntaX error

BUGS          Symbol table overflow is not checked.

NAME           bas -- basic

SYNOPSIS       bas [ file ]

DESCRIPTION    bas is a dialect of basic [1]. 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]]

list 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 " characters.)

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 re-set. 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 ('a' - 'z') 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 composed of digits, at most one decimal point ('.') and possibly a scale factor of the form e digits or e- digits.

## ( 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 [L 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 builtin function is called. The list of builtin functions appears below.

name [ expression [L 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 builtin functions:

arg

Arg(i) is the value of the ith actual parameter on the current level of function call.

exp

Exp(x) is the exponential function of x.

log

Log(x) is the logarithm base e of x.

sin

Sin(x) is the sine of x (radians).

cos

Cos(x) is the cosine of x (radians).

atn

Atn(x) is the arctangent of x.

rnd

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

expr

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

Int(x) returns x truncated to an integer.



BAS (I)

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BAS (I)

FILES           /tmp/btm?           temporary

SEE ALSO        [1] DEC-11-AJPB-D

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

BUGS           --

NAME            cat -- concatenate and print

SYNOPSIS        cat file918 ...

DESCRIPTION    cat reads each file in sequence and writes it on  
the standard output. Thus:

cat file

                is about the easiest way to print a file. Also:

cat file1 file2 >file3

                is about the easiest way to concatenate files.

                If no input file is given cat reads from the  
standard input file.

                If the argument "-" is encountered, cat reads  
from the standard input file.

FILES            --

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 cause strange re-  
sults.

NAME           cc -- C compiler

SYNOPSIS       cc [ -c ] sfile1.c ... ofile1 ...

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

Arguments whose names end with ".c" are assumed to be C source programs; 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 ".c").

Other arguments (except for "-c") are assumed 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.

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

FILES

file.c	input file
file.o	object file
a.out	loaded output
/tmp/ctm?	temporary
/lib/c[01]	compiler
/lib/crt0.o	runtime startoff
/lib/libc.a	builtin functions, etc.
/lib/liba.a	system library

SEE ALSO       C reference manual (in preparation), cdb(I)

DIAGNOSTICS   Diagnostics are intended to be self-explanatory.

BUGS           --

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.

Cdb resembles db in many respects, except that all integers are decimal.

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.

FILES           --

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

DIAGNOSTICS    "?"

BUGS           --

NAME           chdir -- change working directory

SYNOPSIS       chdir directory

DESCRIPTION    directory becomes the new working 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.

FILES          --

SEE ALSO       sh(I)

DIAGNOSTICS    "Bad directory" if the directory cannot be  
                changed to.

BUGS           --

NAME            chmod -- change mode

SYNOPSIS        chmod octal file918 ...

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

                01 write for non-owner  
                02 read for non-owner  
                04 write for owner  
                10 read for owner  
                20 executable  
                40 set-UID

                Only the owner of a file may change its mode.

FILES           --

SEE ALSO        stat(I), ls(I)

DIAGNOSTICS    "?"

BUGS           --

NAME            chown -- change owner

SYNOPSIS        chown owner file918 ...

DESCRIPTION     owner becomes the new owner of the files. The owner may be either a decimal UID or a login name found in the password file.

                Only the owner of a file is allowed to change the owner. It is illegal to change the owner of a file with the set-user-ID mode.

FILES           /etc/passwd

SEE ALSO        stat(I)

DIAGNOSTICS     "Who?" if owner cannot be found, "file?" if file cannot be found.

BUGS            --

NAME            `cmp -- compare two files`

SYNOPSIS        `cmp file918 file928`

DESCRIPTION     The two files are compared for identical contents. Discrepancies are noted by giving the offset and the differing words, all in octal.

FILES           `--`

SEE ALSO        `proof(I)`

DIAGNOSTICS     Messages are given for inability to open either argument, premature EOF on either argument, and incorrect usage.

BUGS            If the shorter of the two files is of odd length, `cmp` acts as if a null byte had been appended to it.



NAME           cp -- copy

SYNOPSIS       cp file918 file928

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 file928 is a directory, then the target file is a file in that directory with the file-name of file918.

FILES          --

SEE ALSO       cat(I), pr(I), mv(I)

DIAGNOSTICS    Error returns are checked at every system call, and appropriate diagnostics are produced.

BUGS           Copying a file onto itself destroys its contents.

NAME            `cref -- make cross reference listing`

SYNOPSIS        `cref [ -soi ] namel ...`

DESCRIPTION    CREF makes a cross reference listing of files in assembler format (see AS(I)). The files named as arguments in the command line are searched for symbols (defined as a succession of alphabetics, numerics, '.', or '\_', beginning with an alphabetic, '.', or '\_').

The output report is in four columns:

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

The third column contains the line number in the file by default; the `-s` option will cause the most recent name symbol to appear there instead.

CREF uses either an ignore file or an only file. If the `-i` option is given, it will take the next file name to be an ignore file; if the `-o` option is given, the next file name will be taken as an only file. Ignore and only files should be lists of symbols separated by new lines. If an ignore file is given, all the symbols in the file will be ignored in columns (1) and (3) of the output. If an only file is given, only symbols appearing in the file will appear in column (1), but column (3) will still contain the most recent name encountered. Only one of the options `-i` or `-o` may be used. The default setting is `-i`; all symbols predefined in the assembler are ignored, except system call names, which are collected.

FILES           Files t.0, t.1, t.2, t.3 are created (i.e. DESTROYED) in the working directory of anyone using cref. This nuisance will be repaired soon. The output is left in file s.out in the working directory.

/usr/lem/s.tab is the default ignore file.

SEE ALSO        as(I)

DIAGNOSTICS    "line too long" -- input line >131 characters  
                 "symbol too long" -- symbol >20 characters  
                 "too many symbols" -- >10 symbols in line  
                 "cannot open t.?" -- bug; see LEM

"cannot fork; examine t.out" -- can't start sort process; intermediate results are on files t.0, t.1,t.2,t.3. These may be sorted independently and the results concatenated by the user.

"cannot sort" -- odd response from sort; examine intermediate results, as above.

"impossible situation" -- system bug

"cannot open" file -- one of the input names cannot be opened for reading.

#### BUGS

The destruction of unsuspecting users' files should soon be fixed. A limitation that may eventually go away is the restriction to assembler language format. There should be options for FORTRAN, English, etc., lexical analysis.

File names longer than eight characters cause misalignment in the output if tabs are set at every eighth column.

It should write on the standard output, not s.out.

NAME            `crypt -- encode/decode`

SYNOPSIS       `crypt [ password ]`

DESCRIPTION    `crypt` is an exact implementation of Boris Hagelin's cryptographic machine called the M-209 by the U. S. Army [1].

`crypt` reads from the standard input file and writes on the standard output. For a given password, the encryption process is idempotent; that is,

```
crypt znorkle <clear >cypher
crypt znorkle <cypher
```

will print the clear.

`crypt` is suitable for use as a filter:

```
pr <"crypt bandersnatch"<cypher
```

FILES            --

SEE ALSO        [1] U. S. Patent 2,089,603.

DIAGNOSTICS     --

BUGS            --

DATE (I)

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DATE (I)

NAME           date -- print and set the date

SYNOPSIS       date [ mmddhhmm ]

DESCRIPTION    If no argument is given, the current date is  
                  printed to the second. If an argument is given,  
                  the current date is set. mm is the month number;  
                  dd is the day number in the month; hh is the hour  
                  number (24 hour system); mm is the minute number.  
                  For example:

                  date 10080045

                  sets the date to Oct 8, 12:45 AM.

FILES           --

SEE ALSO        --

DIAGNOSTICS     "?" if the argument is syntactically incorrect.

BUGS            --

NAME db -- debug

SYNOPSIS db [ core [ namelist ] ] [ = ]

DESCRIPTION Unlike many debugging packages (including DEC's ODT, on which db is loosely based) 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 "\*.".
6. 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 to 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 octal 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 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 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.

Db should not be used to examine special files, for example disks and tapes, since it reads one byte at a time. Use od(I) instead.

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, some systems cause a "squashed" core image to be written. In such a core image, addresses in the stack must be mapped according to the degree of squashing which has been employed. 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

last 512(10) bytes of the core file, can be addressed at apparent locations 160000-160777.

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.

FILES --

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

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

BUGS --

NAME           dc -- desk calculator

SYNOPSIS       dc [file]

DESCRIPTION   dc is an arbitrary precision integer arithmetic package. The overall structure of dc is a stacking (reverse Polish) calculator. The following constructions are recognized by the calculator:

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.

+ - \* / % ^

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.

sx

The top of the stack is popped and stored into a register named x, where x may be any character.

lx

The value in register x is pushed on the stack. The register x is not altered. All registers start with zero value.

d

The top value on the stack is pushed on the stack. Thus the top value 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 nesting level is popped by two.

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.

!

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.

z

the stack level is pushed onto the stack.

?

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

new-line

ignored except as the name of a register or to end the response to a ?.

space

ignored except as the name of a register or to terminate a number.

If a file name is given, input is taken from that file until end-of-file, then input is taken from the console.

An example to calculate the monthly, weekly and hourly rates for a \$10,000/year salary.

```
10000
100*      (now in cents)
dsa       (non-destructive store)
12/       (pennies per month)
1a52/     (pennies per week)
```

```

d10*      (deci-pennies per week)
375/      (pennies per hour)
f         (print all results)
          512
          19230
          83333
"a"      1000000

```

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

```

[1a1+dsa*pla10>x]sx
0sa1
lxx

```

FILES --

SEE ALSO msh(VII), salloc(III)

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 --

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       check(VIII)

DIAGNOSTICS    --

BUGS           --

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 any-  
                 thing else, the file is not removed.

FILES           --

SEE ALSO        rm(I)

DIAGNOSTICS     "?"

BUGS            The name "dsw" is a carryover from the ancient  
                 past. Its etymology is amusing but the name is  
                 nonetheless ill-advised.

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.

FILES           .

SEE ALSO       --

DIAGNOSTICS    --

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 [ arg89918 ... ]

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

FILES           --

SEE ALSO       --

DIAGNOSTICS    --

BUGS           --

## NAME

ed -- editor

## SYNOPSIS

ed [ name ]

## DESCRIPTION

ed is the standard text editor.

If the optional argument is given, ed simulates an e command on the named file; that is to say, the file is read into ed's buffer so that it can be edited.

ed operates on a copy of any file it is editing; changes made in the copy have no effect on the file until a write (w) 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 is an expression which specifies a set of strings of characters. A member of this set of strings is said to be matched by the regular expression. 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 null character 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 but 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 but 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. 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 (s, see 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.

Addresses are constructed as follows. 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 by each command is discussed under the description of the command.

1. The character "." addresses the current line.
2. The character "^" addresses the line immediately before the current line.
3. The character "\$" addresses the last line of the buffer.
4. A decimal number n addresses the nth line of the buffer.
6. 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 ex-

pression. If necessary the search wraps around to the beginning of the buffer.

5. 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 found 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. "'x" addresses the line associated (marked) with the mark name character "x" which must be a printable character. Lines may be marked with the "k" command described below.

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" (for "print"). In that case, the current line is printed after the command is complete.

(.)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 com-

mand; 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 changed.

(.,.)d

The del~~e~~te 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 "\". 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.

(.)kx

The mark command associates or marks the addressed line with the single character mark name "x". The ten most recent mark names are remembered. The current mark names may be printed with the n command.

(.,.)mA

The move command will reposition the addressed lines after the line addressed by "A". The line originally after the last line moved becomes the current line; if the lines moved were originally at the end, the new last line becomes the current line.

n

The marknames command will print the current mark names.

(.,.)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.

The ampersand "&" appearing in the replacement is replaced by the regular expression that was matched. The special meaning of "&" in this context may be suppressed by preceding it by "\".

(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 17 (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 that 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 will print a "?" and return to its command level.

If invoked with the command name '-', (see init) ed will sign on with the message "Editing system" and print "\*" as the command level prompt character.

Ed has size limitations on the maximum number of lines that can be edited, and on the maximum number of characters in a line, in a global's command list, and in a remembered file name. These limitations vary with the physical core size of the PDP11 computer on which ed is being used. The range of limiting sizes for the above mentioned items is; 1300 - 4000 lines per file, 256 - 512 characters per line, 63 - 256 characters per global command list, and 64 characters per file name.

## FILES

/tmp/etm?           temporary  
/etc/msh           to implement the "!" command.

SEE ALSO           --

DIAGNOSTICS       "?" for any error

BUGS              --



NAME           exit -- terminate command file

SYNOPSIS       exit

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.

FILES          --

SEE ALSO       if(I), goto(I), sh(I)

DIAGNOSTICS    --

BUGS           --

NAME factor -- discover prime factors of a number

SYNOPSIS factor

DESCRIPTION When factor is invoked, it types out "Enter:" at you. If you type in a positive number less than  $2^{56}$  (about  $7.2E16$ ), it will repeat the number back at you and then its prime factors each one printed the proper number of times. Then it says "Enter:" again. To exit, feed it an EOT or a delete.

Maximum time to factor is proportional to  $\sqrt{n}$  and occurs when  $n$  is prime. It takes 1 minute to factor a prime near  $10^{13}$ .

FILES --

SEE ALSO --

DIAGNOSTICS "Ouch." for input out of range or for garbage input.

BUGS --

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. The 'standard' implicit statement is recognized.
3. The types doublecomplex, logical\*1, integer\*2 and real\*8 (doubleprecision) 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.

In I/O statements, only unit numbers 0-19 are supported. Unit number nn corresponds to file "fortnn;" (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.

FILES	file.f	input file
	a.out	loaded output
	f.tmp[123]	temporary (deleted)
	/usr/fort/fc[1234]	compilation phases
	/usr/lib/fr0.o	runtime startoff
	/usr/lib/filib.a	interpreter library
	/usr/lib/libf.a	builtin functions, etc.
	/usr/lib/liba.a	system library

SEE ALSO       ANSI standard

DIAGNOSTICS   Compile-time diagnostics are given by number. If the source code is available, it is printed with an underline at the current character pointer. Errors possible are:

- 1       statement too long
- 2       syntax error in type statement
- 3       redeclaration
- 4       missing ( in array declarator
- 5       syntax error in dimension statement
- 6       inappropriate or gratuitous array  
declarator
- 7       syntax error in subscript bound
- 8       illegal character
- 9       common variable is a parameter or already  
in common
- 10      common syntax error
- 11      subroutine/blockdata/function not first  
statement
- 12      subroutine/function syntax error
- 13      block data syntax error
- 14      redeclaration in external
- 15      external syntax error
- 16      implicit syntax error
- 17      subscript on non-array
- 18      incorrect subscript count

19 subscript out of range  
20 subscript syntax error  
22 DATA syntax error  
23 Illegal variable in DATA  
23 equivalence inconsistency  
24 equivalence syntax error  
25 separate common blocks equivalenced  
26 common block illegally extended by equivalence  
27 common inconsistency created by equivalence  
28 DATA table overflow  
29 () imbalance in expression  
30 expression syntax error  
31 illegal variable in equivalence  
32 Storage initialized twice by DATA  
33 non array/function used with subscripts/arguments  
35 goto syntax error  
37 illegal return  
38 continue, return, stop, call, end, or  
pause syntax error  
39 assign syntax error  
40 if syntax error  
41 I/O syntax error  
42 do or I/O iteration error  
43 do end missing  
50 illegal statement in block data  
51 multiply defined labels  
52 undefined label  
53 dimension mismatch  
54 expression syntax error  
55 end of statement in hollerith constant  
56 array too large  
99 B table overflow  
101 unrecognized statement

## Runtime diagnostics:

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
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
999	unimplemented input conversion

## BUGS

The following is a list of those features not yet implemented:

arithmetic statement functions

backspace, endfile, rewind runtime

binary I/O

no scale factors on input

## NAME

fed -- edit associative memory for form letter

## 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 where literal string names are expected. The commands are:

e name918 ...

edit writes the string whose name is name918 onto a temporary file and executes the system editor ed. On exit from the system editor the temporary file is copied back into the associative memory. Each argument is operated on separately. The sequence of commands to add the string from 'file' to memory with name 'newname' is as follows:

```

          e newname          0          (printed
by ed)      r file          200          w
          200          q          (get out of ed)
          q          (get out of fe)
```

To dump a string onto a file:

```

          e name          200          (printed by
ed)          w filename          200
          q          (get out of ed)
          q          (get out of fe)
```

d [ name918 ... ]

d 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 name918 name928 ...

(move) changes the name of name918 to name928 and removes previous string name928

if one exists. Several pairs of arguments may be given.

n [ name918 ... ]

(names) lists the string names in the memory. If called with the optional arguments, it just lists those requested.

p name918 ...

prints the contents of the strings with names given by the arguments.

q (quit) 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(I), ed(I), sh(I)

DIAGNOSTICS    '?' unknown command  
                 'name not in memory.' if string 'name' is not in the associative memory and is used as an argument for d or m.

BUGS           --

WARNING        It is legal but an unwise idea to have string names with blanks, ":" or "?" in them.



## NAME

form -- form letter generator

## SYNOPSIS

form proto arg918 ...

## 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 nth argument arg9n8 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 {}.

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 users 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(I), type(I), roff(I)

#### DIAGNOSTICS

"cannot open output file" "cannot open memory file" when the appropriate files cannot be located or created.

#### BUGS

An unbalanced ] or } acts as an end of file but may add a few strange entries to the associative memory.

NAME            forml -- form letter generator processor

SYNOPSIS       forml [ name ] ...

DESCRIPTION    A streamlined program for typing form letters.  
The names pick out prestored form letters prepared according to the conventions of form and roff. The program prompts to get each blank filled in. When all the forms are completed, it prompts "Set paper." It waits for a newline before printing each letter.

              If more than one name is given, the name of each letter is announced before the prompts for it begin. If no names are given, the program asks "Which letter?" before each. Respond with the name and a newline, or newline only when done.

              On a 2741 type terminal, the program assumes the letter is to be typed with a correspondence ball, and also prompts "Change ball." Replace the ball at the end.

FILES           form.m (memory),  
                 forma, formb, ... temporaries

SEE ALSO        form(I), fed(I), roff(I)

DIAGNOSTICS    "Try again"--can't get a process

BUGS           --

NAME            goto -- command transfer

SYNOPSIS       goto label

DESCRIPTION    goto is only allowed 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.

              ":" is a do-nothing command that only serves to place a label.

FILES           --

SEE ALSO       sh(I), :(I)

DIAGNOSTICS    "goto error", if the input file is a typewriter; "label not found".

BUGS           --

NAME            hyphen -- find hyphenated words

SYNOPSIS        hyphen file1 ...

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 output is  
used. Thus hyphen may be used as a filter.

FILES           --

SEE ALSO        --

DIAGNOSTICS     yes

BUGS            yes, it gets confused, but with no ill effects  
other than spurious extra output.

NAME           if -- conditional command

SYNOPSIS       if expr command [ arg918 ... ]

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.

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.

FILES           --

SEE ALSO        sh(I)

DIAGNOSTICS     "if error", if the expression has the wrong syntax; "command not found."

BUGS            --

NAME           ld -- link editor

SYNOPSIS       ld [ -sulxr ] name1 ...

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 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. 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 "-":

- s "squash" 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 "/usr/lib/liba.a", which is the standard system library for assembly language programs. "-lx" stands for "/usr/lib/libx.a" where x is any character. There are libraries for Fortran (x="f"), C (x="c"), Explorer (x="e") and B (x="b").
- x Do not preserve local (non-.globl) symbols in the output symbol table; only enter ex-

ternal symbols. This option saves some space in the output file.

-r generate relocation bits in the output file so that it can be the subject of another ld run.

The output of ld is left on a.out. This file is executable only if no errors occurred during the load.

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

SEE ALSO        as(I), ar(I)

DIAGNOSTICS     "file not found"-- bad argument  
  
                 "bad format"-- bad argument  
  
                 "relocation error"-- bad argument (relocation  
                 bits corrupted)  
  
                 "multiply defined"-- same symbol defined twice in  
                 same load  
  
                 "un"-- stands for "undefined symbol"  
  
                 "symbol not found"-- loader bug  
  
                 "can't move output file"-- can't move temporary  
                 to a.out file  
  
                 "no relocation bits"-- an input file lacks relo-  
                 cation information  
  
                 "too many symbols"-- too many references to ex-  
                 ternal symbols in a given routine  
  
                 "premature EOF"  
  
                 "can't create l.out"-- cannot make temporary file  
  
                 "multiple entry point"-- more than one entry  
                 point specified (not possible yet).

BUGS           --



NAME           ln -- make a link

SYNOPSIS       ln name1 [ name2 ]

DESCRIPTION    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.

FILES          --

SEE ALSO       rm(I)

DIAGNOSTICS    "?"

BUGS           There is nothing particularly wrong with ln, but links don't work right with respect to the backup system: one copy is backed up for each link, and (more serious) in case of a file system reload both copies are restored and the information that a link was involved is lost.

NAME            login -- sign onto UNIX

SYNOPSIS       login [ username [ password ] ]

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 login (VII) for how to dial up initially.

                If login is invoked without an argument, it will ask 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 mailbox and message-of-the-day files.

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

FILES            /tmp/utmp            accounting  
                 /tmp/wtmp            accounting  
                 mailbox            mail  
                 /etc/motd            message-of-the-day /etc/passwd  
                 wd            password file

SEE ALSO        login(VII), init(VII), getty(VII), mail(I)

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

BUGS            --

NAME           ls -- list contents of directory

SYNOPSIS       ls [ -ltasd ] name1 ...

DESCRIPTION   ls lists the contents of one or more directories under control of several options:

                -l list in long format, giving i-number, mode, owner, size in bytes, and time of last modification for each file. (see stat for format of the mode)

                -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)

                If no argument is given, "." is listed. If an argument is not a directory, its name is given.

FILES          /etc/passwd to get user ID's for ls -l

SEE ALSO       stat(I)

DIAGNOSTICS   "name nonexistent"; "name unreadable"; "name un-statable."

BUGS          --

NAME            m6 -- general purpose macro processor

SYNOPSIS        m6 [ -d arg1 ] [ arg2 [ arg3 ] ]

DESCRIPTION    m6 takes input from file arg2 (or standard input if arg2 is missing) and places output on file arg3 (or standard output). A working file of definitions, "m.def", is initialized from file arg1 if that is supplied. M6 differs from the standard [1] in these respects:

#trace:, #source: and #end: are not defined.

#meta,arg1,arg2: transfers the role of metacharacter arg1 to character arg2. If two metacharacters become identical thereby, the outcome of further processing is not guaranteed. For example, to make []{} play the roles of #:<> type

```
\.br [meta,<:>,]:
[meta,[substr,<<>>,1,1;,{}
[meta,[substr,{{>>,2,1;,}}
```

#del,arg1: deletes the definition of macro arg1.

#save: and #rest: save and restore the definition table together with the current metacharacters on file m.def.

#def,arg1,arg2,arg3: works as in the standard with the extension that an integer may be supplied to arg3 to cause the new macro to perform the action of a specified builtin before its replacement text is evaluated. Thus all builtins except #def: can be retrieved even after deletion. Codes for arg3 are:

```
0 - no function
1,2,3,4,5,6 - gt,eq,ge,lt,ne,le
7,8 - seq,sne
9,10,11,12,13 - add,sub,mpy,div,exp
20 - if
21,22 - def,copy
23 - meta
24 - size
25 - substr
26,27 - go,gobk
28 - del
29 - dnl
30,31 - save,rest
```

FILES           m.def--working file of definitions  
                 /usr/lang/mdir/m6a--m6 processor proper  
                 (/usr/bin/m6 is only an initializer)

/usr/lang/mdir/m6b--default initialization for  
m.def  
/bin/cp--used for copying initial value of m.def

SEE ALSO [1] A. D. Hall, The M6 Macroprocessor, Bell Telephone Laboratories, 1969

DIAGNOSTICS "err" -- a bug, an unknown builtin or a bad definition table  
"oprd"--can't open input or initial definitions  
"opwr"--can't open output  
"ova" -- overflow of nested arguments  
"ovc" -- overflow of calls  
"ovd" -- overflow of definitions  
"Try again" -- no process available for copying  
m.def

BUGS Characters in internal tables are stored one per word. They really should be packed to improve capacity. For want of space (and because of unpacked formats) no file arguments have been provided to #save: or #rest:, and no check is made on the actual opening of file m.def. Again to save space, garbage collection makes calls on #save: and #rest: and so overwrites m.def.

NAME            mail -- send mail to another user

SYNOPSIS       mail [ -yn ]  
              mail letter person ...  
              mail person

DESCRIPTION    mail without an argument searches for a file  
                 called mailbox, prints it if present, and asks if  
                 it should be saved. If the answer is "y", the  
                 mail is renamed mbox, otherwise it is deleted.  
                 Mail with a -yn argument works the same way, ex-  
                 cept that the answer to the question is supplied  
                 by the argument.

                 When followed by the names of a letter and one or  
                 more people, the letter is appended to each per-  
                 son's mailbox. When a person is specified with-  
                 out a letter, the letter is taken from the  
                 sender's standard input up to an EOT. Each let-  
                 ter is preceded by the sender's name and a post-  
                 mark.

                 A person is either a user name recognized by lo-  
                 gin, in which case the mail is sent to the de-  
                 fault working directory of that user, or the path  
                 name of a directory, in which case mailbox in  
                 that directory is used.

                 When a user logs in he is informed of the pres-  
                 ence of mail.

FILES           /etc/passwd        to identify sender  
                                    to locate persons  
                 mailbox        input mail  
                 mbox           saved mail

SEE ALSO        login(I)

DIAGNOSTICS    "Who are you?" if the user cannot be identified  
                 for some reason (a bug). "Cannot send to user"  
                 if mailbox cannot be opened.

BUGS           --

NAME           man -- run off section of UNIX manual

SYNOPSIS       man title [ section ]

DESCRIPTION    man is a shell command file that will locate and run off a particular section of this manual. Title is the the desired part of the manual. Section is the section number of the manual. (In Arabic, not Roman numerals.) If section is missing, 1 is assumed. For example,

man man

would reproduce this page.

FILES          /sys/man/man?/\*

SEE ALSO       sh(I), roff(I)

DIAGNOSTICS    "File not found", "Usage .."

BUGS          --

NAME           mesg -- permit or deny messages

SYNOPSIS       mesg [ n ][ y ]

DESCRIPTION    mesg n forbids messages via write by revoking non-user write permission on the user's typewriter. mesg y reinstates permission. mesg with no argument 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          --



NAME            mkdir -- make a directory

SYNOPSIS        mkdir dirname ...

DESCRIPTION    mkdir creates specified directories in mode 17.  
  
The standard entries "." and ".." are made automatically.

FILES           --

SEE ALSO        rmdir(I)

DIAGNOSTICS    "dirname ?"

BUGS           --

NAME            `mt -- manipulate magtape`

SYNOPSIS        `mt [ key ] [ name ... ]`

DESCRIPTION    `mt` saves and restores selected portions of the file system hierarchy on 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 tabled.

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

- `r` The indicated files and directories, together with all subdirectories, are dumped onto the tape. The old contents of the tape are lost.
- `x` extracts the named files from the tape to the file system. The owner, mode, and date-modified are restored to what they were when the file was dumped. If no file argument is given, the entire contents of the tape are extracted.
- `t` lists the names of all files stored on the tape which are the same as or are hierarchically below the file arguments. If no file argument is given, the entire contents of the tape are tabled.
- `l` is the same as `t` except that an expanded listing is produced giving all the available information about the listed files.

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

- `0, ..., 7` This modifier selects the drive on which the tape is mounted. "0" is the default.
- `v` Normally `mt` does its work silently. The `v` (verbose) option causes it to type the name of each file it treats preceded by a letter to indicate what is happening.

- `a` file is being added
  - `x` file is being extracted

The `v` option can be used with `r` and `x` only.

- f causes new entries copied on tape to be 'fake' in that only the entries, not the data associated with the entries are updated. Such fake entries cannot be extracted. Usable only with r.
- w causes mt to pause before treating each file, type the indicative letter and the file name (as with y) 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 mt command terminates immediately. In the x function, files previously asked about have been extracted already. With r, no change has been made to the tape.
- m make (create) directories during an x if necessary.

FILES                /dev/mt?

SEE ALSO            tap(I), tap(V)

DIAGNOSTICS        Tape open error  
                    Tape read error  
                    Tape write error  
                    Directory checksum  
                    Directory overflow  
                    Seek error  
                    Tape overflow  
                    Phase error (a file has changed after it was selected for dumping but before it was dumped)

BUGS                If, during an "x", the files are specified in a different order than they are on the tape, seek errors will result because the tape cannot be re-wound.

NAME mv -- move or rename a file

SYNOPSIS mv name1 name2

DESCRIPTION mv changes the name of 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).

FILES --

SEE ALSO --

DIAGNOSTICS yes

BUGS --

NAME nm -- print name list

SYNOPSIS nm [ 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), or "B" (bss segment symbol). Global symbols have their first character underlined. The output is sorted alphabetically.

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

FILES a.out

SEE ALSO as(I), ld(I)

DIAGNOSTICS "?"

BUGS --

NAME            nroff -- format text

SYNOPSIS        nroff [+N] [-s] [-h] [-q] [-i] files

DESCRIPTION    nroff formats text according to control lines embedded in the text files. The non-file option arguments are interpreted as follows:

- +N Output will commence at the first page whose page number is N (independent of whether or not the page number is being printed).
- s Stop between pages. Printing will halt prior to each page (including the first) to permit paper loading and changing. Printing is restarted by typing either a "newline" or "delete" character.
- h High-speed output. During output, strings of space characters are replaced where possible with tab characters to speed up output. Furthermore, if the output is directed into a file or a pipe, this mode effectively reduces the total number of characters in the file or pipe; this is especially important in multi-column output where the temporary file(s) or pipe(s) would otherwise contain a large number of space characters.
- q The prompt names for insertions are not printed and the bell character is sent instead; in addition, the insertion is not echoed. This mode permits insertions during the actual output printing
- i Index mode. NROFF creates a file called "index" containing every word output together with the line and page number. The format is word, tab, page, tab, line, newline, etc. Invoking this mode slows down the execution of NROFF considerably.

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

FILES            /etc/suftab        suffix hyphenation tables  
                 /tmp/rtm?        temporary

SEE ALSO        [1] NROFF User's Manual (available as MM-73-1271-2).

DIAGNOSTICS    none

NROFF (I)

1/15/73

NROFF (I)

BUGS

-

## 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	OR-
.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.
.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 ±N ±M	-	-	no	OR-
.ch xx ±M	-	-	no	OR-
.ch ±N y	-	-	no	OR-
.ch xx y	-	-	no	CHange trap line.

VI. Number Registers

.nr a ±N ±M	-	-	no	OR-
.nr ab ±N ±M	-	-	no	Number Register.
.tl '- % -'				



.tl 'NROFF (I)'1/15/73'NROFF (I)'

.nc c	\n	\n	no	<u>N</u> umber <u>C</u> haracter.
.ar	arabic	-	no	<u>A</u> rabic numbers.
.ro	arabic	-	no	<u>R</u> oman numbers.
.RO	arabic	-	no	<u>R</u> OMAN numbers.

#### VII. Input and Output Conventions and Character Translations

.ta N,M,...	none	no	<u>P</u> seudo <u>T</u> abs setting.
.tc c	space	space	<u>T</u> ab replacement <u>C</u> haracter.
.lc c	.	.	<u>L</u> eaders replacement <u>C</u> haracter.
.ul N	-	N=1	<u>U</u> nderline input text lines.
.cc c	.	.	<u>B</u> asic <u>C</u> ontrol <u>C</u> haracter.
.c2 c	'	'	<u>N</u> obreak control character.
.li N	-	N=1	<u>A</u> ccept input lines <u>L</u> iterally.
.tr abcd....	-	no	<u>T</u> Ranslate on output.

#### VIII. Hyphenation.

.nh	on	-	no	<u>N</u> o <u>H</u> yphen.
.hy	on	-	no	<u>H</u> Yphenate.
.hc c	none	none	no	<u>H</u> yphenation indicator <u>C</u> haracter.

#### IX. Three Part Titles.

.tl 'left'center'right'	no	<u>T</u> it <u>L</u> e.
.lt N N=65 N=prev	no	<u>L</u> ength of <u>T</u> itle.

#### X. Output Line Numbering.

.nm ±N M S I	off	no	<u>N</u> umber <u>M</u> ode on or off, set parameters.
.np M S I	reset	no	<u>N</u> umber <u>P</u> arameters set or reset.

#### XI. Conditional Input Line Acceptance

.if c anything	-	no	<u>O</u> R-
.if !c anything	-	no	<u>O</u> R-
.if N anything	-	no	<u>O</u> R-
.if !N anything	-	no	<u>I</u> F true accept line of "anything".

#### XII. Environment Switching.

.ev N	N=0	N=prev	no	<u>E</u> n <u>V</u> ironment switched.
-------	-----	--------	----	--

#### XIII. Insertions from the Standard Input Stream

.rd prompt	bell	no	<u>R</u> ea <u>D</u> insert.	
.ex	-	-	no	<u>E</u> Xit.

#### XIV. Input File Switching

.so filename	-	no	<u>S</u> witch <u>S</u> ource file (push down).	
.nx filename	-	no	<u>N</u> ex <u>T</u> file.	
.sp				

#### XV. Miscellaneous

.tl '- % -'

.tl 'NROFF (I)'1/15/73'NROFF (I)'

.ig	-	-	no	<u>I</u> Gnore.
.fl	-	-	no	<u>F</u> Lush output buffer.
.ab	-	-	no	<u>A</u> Bort.

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 an end-of-file condition or until halted by sending an interrupt signal.

FILES           --

SEE ALSO       db(I)

DIAGNOSTICS    --

BUGS           --

NAME           opr -- off line print

SYNOPSIS       opr [--] [-] [±] [±-]file918 ...

DESCRIPTION    opr will arrange to have the 201 data phone daemon submit a job to the Honeywell 6070 to print the file arguments. Normally, the output appears at the GCOS central site. If the first argument is --, the output is remoted to station R1. (Station R1 has a 1403 printer.)

Normally, each file is printed in the state it is found when the data phone daemon reads it. If a particular file argument is preceded by ±, or a preceding argument of ± has been encountered, then opr will make a copy for the daemon to print. If the file argument is preceded by -, or a preceding argument of - has been encountered, then opr will unlink (remove) the file.

If there are no arguments except for the optional --, then the standard input is read and off-line printed. Thus opr may be used as a filter.

FILES           /usr/dpd/\*            spool area  
                 /etc/passwd         personal ident cards  
                 /etc/dpd            daemon

SEE ALSO        dpd(I), passwd(V)

DIAGNOSTICS     --

BUGS            --

NAME           ov -- overlay pages

SYNOPSIS       ov [ file ]

DESCRIPTION    ov is a postprocessor for producing double column formatted text when using `nroff(I)`. ov literally overlays successive pairs of 66-line pages.

If the file argument is missing, the standard input is used. Thus ov may be used as a filter.

FILES          none

SEE ALSO       `nroff(I)`, `pr(I)`

DIAGNOSTICS    none

BUGS           Other page lengths should be permitted.

NAME            passwd -- set login password

SYNOPSIS        passwd name password

DESCRIPTION    The password is placed on the given login name. This can only be done by the user ID corresponding to the login name or by the super-user. An explicit null argument ("") for the password argument will remove any password from the login name.

FILES           /etc/passwd

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

DIAGNOSTICS    Diagnostics are given for a non-match of the login name, lack of permission and for password file format errors.

BUGS            --

NAME            `pr -- print file`

SYNOPSIS        `pr [-cm] [-h name] [-n] [+n] [file918 ...]`

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 header (if any), and the page number. If there are no file arguments, `pr` prints the standard input file, and is thus usable as a filter.

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

`-c` print current date

`-m` print date file last modified (default)

`-n` produce n-column output

`+n` begin printing with page n

`-h` treats the next argument as a header

If there is a header in force, it is printed in place of the file name.

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            In multi-column output, non-printing characters other than new-line cause misalignment.

NAME            proof -- compare two text files

SYNOPSIS       proof oldfile newfile

DESCRIPTION    proof lists those lines of newfile that differ from corresponding lines in oldfile. The line number in newfile is given. When changes, insertions or deletions have been made the program attempts to resynchronize the text in the two files by finding a sequence of lines in both files that again agree.

FILES          --

SEE ALSO       cmp(I)

DIAGNOSTICS    yes, but they are undecipherable, e.g. "?1".

BUGS           proof is still evolving. Any bugs discovered or suggestions should be brought to ENP.



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 the link-editor ld, the "-r" ld option must have been given to preserve the relocation information 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.

FILES           --

SEE ALSO       as(I), ld(I), a.out(V)

DIAGNOSTICS    As appropriate

BUGS           --

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?

SEE ALSO       --

DIAGNOSTICS    "?" if there is no tape mounted on the indicated drive or if the file cannot be opened.

BUGS           --

NAME           rm -- remove (unlink) files

SYNOPSIS       rm [ -f ] [ -r ] name1 ...

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 there is no write permission to a file designated to be removed, rm will print the file name, its mode and then read a line from the standard input. If the line begins with 'y', the file is removed, otherwise it is not. The optional argument -f prevents the above interaction.

              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 -r flag

SEE ALSO       rmdir(I)

DIAGNOSTICS   "name: non existent"  
              "name: not removed" if cannot remove  
              "name: try again" error from fork

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

NAME            rmdir -- remove directory

SYNOPSIS        rmdir dir1 ...

DESCRIPTION     rmdir removes (deletes) directories. The directory must be empty (except for the standard entries "." and "..", which rmdir itself removes). Write permission is required in the directory in which the directory appears.

FILES           none

SEE ALSO        --

DIAGNOSTICS     "dir?" is printed if directory dir cannot be found, is not a directory, or is not removable.

                "dir -- directory not empty" is printed if dir has entries other than "." or "..".

BUGS            --

NAME            roff -- format text

SYNOPSIS        roff [ +number ] [ -s ] [ -h ] file1 ...

DESCRIPTION    roff formats text according to control lines embedded in the text in file918, ... . Encountering a nonexistent file terminates printing. The optional argument "+number" causes printing to begin at the first page with that number. The optional argument "-s" causes printing to stop before each page including the first to allow paper manipulation; printing is resumed upon receipt of an interrupt signal. The optional argument "-h" causes the output to contain horizontal tabs for two or more spaces that end on a tab stop. An interrupt signal received during printing terminates all printing. Incoming interconsole messages are turned off during printing, and the original message acceptance state is restored upon termination.

At the present time, there is no document describing ROFF in full. A Request Summary is attached.

FILES           /etc/suftab        suffix hyphenation tables  
                 /tmp/rtm?        temporary

SEE ALSO        --

DIAGNOSTICS    none

BUGS           -

## REQUEST SUMMARY

<u>Request</u>	<u>Break</u>	<u>Initial</u>	<u>Meaning</u>
.ad	yes	yes	Begin adjusting right margins.
.ar	no	arabic	Arabic page numbers.
.br	yes	-	Causes a line break - the filling of the current line is stopped.
.bl n	yes	-	Insert contiguous block of n blank lines. If necessary, a new page will be started to accomodate the entire block.
.bp +n	yes	n=1	Begin new page and number it n. If n is not given, normal sequencing occurs.
.cc c	no	c=.	Control character becomes 'c'.
.ce n	yes	-	Center the next n input lines, without filling.
.de xx	no	-	Define macro named "xx" (definition ends with a line beginning with "..").
.ds	yes	no	Double space; same as ".ls 2".
.ef t	no	t=''''	Even foot title becomes t.
.eh t	no	t=''''	Even head title becomes t.
.fi	yes	yes	Begin filling output lines.
.fo	no	t=''''	All foot titles are t.
.hc c	no	none	Hyphenation character set to 'c'.
.he t	no	t=''''	All head titles are t.
.hx	no	-	Title lines are suppressed.
.hy n	no	n=1	Hyphenation is done, if n=1; and is not done, if n=0.
.ig	no	-	Ignore input lines until and including a line beginning with "..".
.in +n	yes	-	Indent n spaces from left margin.
.ix +n	no	-	Same as ".in" but without break.
.li n	no	-	Literal, treat next n lines as text.
.ll +n	no	n=65	Line length including indent is n characters.
.ls +n	yes	n=1	Line spacing set to n lines per output line.
.m1 n	no	n=2	n blank lines are put between the top of a new page and the head title.
.m2 n	no	n=2	n blanks lines put between head title and beginning of text on page.
.m3 n	no	n=1	n blank lines put between the end of text and the foot title.
.m4 n	no	n=3	n blank lines put between the foot title and the bottom of page.
.na	yes	no	Stop adjusting the right margin.
.ne n	no	-	Begin new page, if n output lines cannot fit on present page.
.nn +n	no	-	The next n output lines are not numbered.
.n1	no	no	Output lines are numbered sequentially beginning with 1 on each new page. Head and foot titles are not numbered.
.n2	no	no	Output lines are numbered sequentially

			beginning with 1 on the next output line.
.ni +n	no	n=0	Line numbers are indented n.
.nf	yes	no	Stop filling output lines.
.nx	filename	-	Change to input file "filename".
.of t	no	t=''''	Odd foot title becomes t.
.oh t	no	t=''''	Odd head title becomes t.
.pa +n	yes	n=1	Same as ".bp".
.pl +n	no	n=66	Total paper length taken to be n lines.
.po +n	no	n=0	Page offset. All lines are preceded by N spaces.
.ro	no	arabic	Roman page numbers.
.sk n	no	-	n pages with head and foot titles but otherwise blank will be output beginning with the next page containing text.
.sp n	yes	-	Insert block of n blank lines. If the bottom of a page is reached, remaining lines are <u>not</u> put on next page.
.ss	yes	yes	Single space output lines, equivalent to ".ls 1".
.ta N M ...		-	Pseudotab settings. Initial tab settings are columns 9,17,25,...
.tc c	no	c=" "	Tab replacement character becomes "c".
.ti +n	yes	-	Temporarily indent next output line n spaces.
.tr abcd..	no	-	Translate a into b, c into d, etc.
.ul n	no	-	Underline the letters and numbers on the next n input lines.

NAME                sh -- shell (command interpreter)

SYNOPSIS            sh [ name [ arg1 ... [ arg9 ] ] ]

#### DESCRIPTION

sh is the standard command interpreter. It is the program which reads and arranges the execution of the command lines typed by most users. It may itself be called as a command to interpret files of commands. Before discussing the arguments to the shell used as a command, the structure of command lines themselves will be given.

##### Command lines

Command lines are sequences of commands separated by command delimiters. Each command is a sequence of non-blank command arguments separated by blanks. 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 prepended to the argument. (In this way most standard commands, which reside in `"/bin"`, are found.) If no such command is found, the string `"/usr"` is further prepended (to give `"/usr/bin/command"`) and another attempt is made to execute the resulting file. (Certain "overflow" commands live in `"/usr/bin"`.) If the `"/usr/bin"` file exists, but is not executable, it is used by the shell as a command file. That is to say it is executed as though it were typed from the console. If all attempts fail, a diagnostic is printed.

The remaining non-special arguments are simply passed to the command without further interpretation by the shell.

##### Command delimiters

There are three command delimiters: the new-line, `";"`, and `"&"`. The semicolon `";"` specifies sequential execution of the commands so separated; that is,

`coma; comb`

causes the execution first of command coma, then of comb. The ampersand `"&"` causes simultaneous execution:

`coma & comb`

causes coma to be called, followed immediately by comb without waiting for coma to finish. Thus coma and comb execute simultaneously. As a special case,



coma &

causes coma to be executed and the shell immediately to request another command without waiting for coma.

#### Termination Reporting

If a command (not followed by "&") terminates abnormally, a message is printed. (All terminations other than exit and interrupt are considered abnormal.) The following is a list of the abnormal termination messages:

Bus error	Trace/BPT trap	Illegal instruction
EMT trap	Bad system call	Quit
PIR trap	Floating exception	Memo-
ry violation	Killed	User I/O
ror		Er-

If a core image is produced, " -- Core dumped" is appended to the appropriate message.

#### Redirection of I/O

Three character sequences cause the immediately following string to be interpreted as a special argument to the shell itself, not passed to the command.

An argument of the form "<arg" causes the file arg to be used as the standard input file of the given command.

An argument of the form ">arg" causes file "arg" to be used as the standard output file for the given command. "Arg" is created if it did not exist, and in any case is truncated at the outset.

An argument of the form ">>arg" causes file "arg" to be used as the standard output for the given command. If "arg" did not exist, it is created; if it did exist, the command output is appended to the file.

#### Pipes and Filters

A pipe is a channel such that information can be written into one end of the pipe by one program, and read at the other end by another program. (See pipe (II)). A filter is a program which reads the standard input file, performs some transformation, and writes the result on the standard output file. By extending the syntax used for redirection of I/O, a command line can specify that the output produced by a command be passed via a pipe through another command which acts as a filter. For example:

command >filter>

More generally, special arguments of the form

```
>f1>f2>...>
```

specify that output is to be passed successively through the filters `f1`, `f2`, ..., and end up on the standard output stream. By saying instead

```
>f1>f2>...>file
```

the output finally ends up in file. (The last ">" could also have been a ">>" to specify concatenation onto the end of file.)

In exactly analogous manner input filtering can be specified via one of

```
<f1<f2<...<          <f1<f2<...<file
```

Both input and output filtering can be specified in the same command, though not in the same special argument.

For example:

```
ls >pr>
```

produces a listing of the current directory with page headings, while

```
ls >pr>xx
```

puts the paginated listing into the file `xx`.

If any of the filters needs arguments, quotes can be used to prevent the required blank characters from violating the blankless syntax of filters. For example:

```
ls >"pr -h 'My directory'">
```

uses quotes twice, once to protect the entire pr command, once to protect the heading argument of pr. (Quotes are discussed fully below.)

#### Generation of argument lists

If any argument contains any of the characters `"?"`, `"*"` or `'['`, it is treated specially as follows. The current directory is searched for files which match the given argument.

The character `"*"` in an argument matches any string of characters in a file name (including the null string).

The character `"?"` matches any single character in a file

name.

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.

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".

In any event, 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.

For example: directory /usr/dmr contains the files a1.s, a2.s, ..., a9.s. From any directory, the command

```
as /usr/dmr/a?.s
```

calls as with arguments /usr/dmr/a1.s, /usr/dmr/a2.s, ... /usr/dmr/a9.s in that order.

### 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.

Sequences of characters enclosed in double (") or single (') quotes are also taken literally.

#### Argument passing

When the shell 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 ] ] ]
```

The name is the name of a file which will be read and interpreted. If not given, this subinstance of the shell will continue 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 0, ..., 9, are replaced by the nth argument to the invocation of the shell (argn). "\$0" is replaced by name.

#### 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 end of file.

#### Special commands

Two commands are treated specially by the shell.

"Chdir" is done without spawning a new process by executing the sys chdir primitive.

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

These peculiarities are inexorably imposed upon the shell by the basic structure of the UNIX process control system. It is a rewarding exercise to work out why.

#### 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.

FILES                /etc/glob, which interprets "\*", "?", and "[".

SEE ALSO            "The UNIX Time-sharing System", which gives the theory of operation of the shell.

DIAGNOSTICS

"Input not found", when a command file is specified which cannot be read;  
"Arg count", if the number of arguments to the chdir pseudo-command is not exactly 1, or if "\*", "?", or "[" is used inappropriately;  
"Bad directory", if the directory given in "chdir" cannot be switched to;  
"Try again", if no new process can be created to execute the specified command;  
"'" imbalance", if single or double quotes are not matched;  
"Input file", if an argument after "<" cannot be read;  
"Output file", if an argument after ">" or ">>" cannot be written (or created);  
"Command not found", if the specified command cannot be executed.  
"No match", if no arguments are generated for a command which contains "\*", "?", or "[".  
Termination messages described above.

## BUGS

If any argument contains a quoted "\*", "?", or "[", then all instances of these characters must be quoted. This is because sh calls the glob routine whenever an unquoted "\*", "?", or "[" is noticed; the fact that other instances of these characters occurred quoted is not noticed by glob.

When output is redirected, particularly through a filter, diagnostics tend to be sent down the pipe and are sometimes lost altogether.

SIZE (I)

9/2/72

SIZE (I)

NAME           size -- size of an object file

SYNOPSIS       size [ object ... ]

DESCRIPTION    The size, in bytes, of the object files are  
                printed.  If no file is given, a.out is default.  
                The size is printed in octal for the text, data,  
                and bss portions of each file.  The sum of these  
                is also printed in octal and decimal.

FILES          a.out     default

SEE ALSO       --

DIAGNOSTICS    "object not found" if the input cannot be read.  
                "bad format: object" if the input file does not  
                have a valid object header.

BUGS           --

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'.

The following is a list of differences between sno and SNOBOL III:

There are no unanchored searches. To get the same effect:

```
a ** b           unanchored search for b
a *x* b = x c     unanchored assignment
```

No back referencing

```
x = "abc"
a *x* x           unanchored search for "abc"
```

Different function declaration. 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.

```
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 builtin functions

Variable length patterns at the end of a pattern match are not treated specially. They still match the shortest rather than longest text.

Parentheses for arithmetic are not needed. Normal (eg FORTRAN) precedence applies. Be-

cause 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 'syspnt' is not available.

FILES --

SEE ALSO SNOBOL III manual. (JACM; Vol. 11 No. 1; Jan 1964; pp 21)

DIAGNOSTICS As appropriate

BUGS Runtime diagnostics give the last program line number rather than the executing statement line number.



NAME            sort -- sort a file

SYNOPSIS        sort [ - ] [ input [ output ] ]

DESCRIPTION    sort will sort the input file and write the sorted file on the output file. If the output file is not given, the input file is rewritten. If the input file is missing, sort uses the standard input as input and the standard output for output. Thus sort may be used as a filter.

The sort is line-by-line in increasing ASCII collating sequence, except that upper-case letters are considered the same as the lower-case letters.

The optional argument - will cause a reverse sort.

sort is implemented in such a way that

sort /dev/mt0

works correctly provided the tape is not too big.

FILES            /tmp/stm?

SEE ALSO        --

DIAGNOSTICS    --

BUGS            The largest file that can be sorted is about 128K bytes.

NAME speak -- word to voice translator

SYNOPSIS speak [ - ] [ vocabulary ]

DESCRIPTION speak turns a stream of ascii words into utterances and outputs them to a voice synthesizer. It has facilities for maintaining a vocabulary. It receives, from the standard input

- working lines - text of words separated by blanks
- phonetic lines - strings of phonemes for one word preceded and separated by commas. The phonetic code is given in vsp(VII).
- empty lines
- command lines - beginning with !. The following forms are recognized:

```

!r file replace coded vocabulary from file
!w file write coded vocabulary on file
!p      print phonetics for working word
!l      list vocabulary on standard output
          with phonetics
!c word copy phonetics from working word to
          specified word
!s file (save) append working word and phonet-
          ics to file in style of !l

```

Each working line replaces its predecessor. Its first word is the "working word". Each phonetic line replaces the phonetics stored for the working word. Each working line, phonetic line or empty line causes the working line to be uttered. The process terminates at the end of input.

Unknown words are spelled as strings of one-letter words. Unknown one-letter words burp.

A phonetic line of comma only will delete the entry for the working word.

speak is initialized with a coded vocabulary stored in file /etc/speak.m. The vocabulary option substitutes a different file for speak.m.

The - option suppresses all utterances.

FILES /etc/speak.m

SEE ALSO vsp(VII), speakm(V), vt(IV)

BUGS Vocabulary overflow is unchecked. Excessively long words cause dumps. Space is not reclaimed from deleted entries.

NAME           split -- split a file into pieces

SYNOPSIS       split [ [ file1 ] file2 ]

DESCRIPTION    Split reads file1 and writes it in 1000-line  
pieces, as many as are necessary, onto a set of  
output files. The name of the first output file  
is file2 with an "a" appended, and so on through  
the alphabet and beyond. If no output name is  
given, "x" is default.

                If no input file is given, or the first argument  
is "-", then the standard input file is used.

FILES          -

SEE ALSO       --

DIAGNOSTICS    yes

BUGS           Watch out for 8-character file names.

NAME           stat -- get file status

SYNOPSIS       stat name1 ...

DESCRIPTION   stat gives several kinds of information about one or more files:

    i-number  
    access mode  
    number of links  
    owner  
    size in bytes  
    date and time of last modification  
    name (useful when several files are named)

All information is self-explanatory except the mode. The mode is a six-character string whose characters mean the following:

- 1 s: file is small (smaller than 4096 bytes)  
   l: file is large
- 2 d: file is a directory  
   x: file is executable  
   u: set user ID on execution  
   -: none of the above
- 3 r: owner can read  
   -: owner cannot read
- 4 w: owner can write  
   -: owner cannot write
- 5 r: non-owner can read  
   -: non-owner cannot read
- 6 w: non-owner can write  
   -: non-owner cannot write

The owner is almost always given in symbolic form; however if he cannot be found in "/etc/passwd" a number is given.

If the number of arguments to stat is not exactly 1 a header is generated identifying the fields of the status information.

FILES           /etc/passwd

SEE ALSO        istat(I), ls(I) (-l option)

DIAGNOSTICS     "name?" for any error.

NAME           strip -- remove symbols and relocation bits

SYNOPSIS       strip name1 ...

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 same as use of the -s option of ld.

FILES          /tmp/stm?           temporary file

SEE ALSO       ld(I), as(I)

DIAGNOSTICS    Diagnostics are given for: non-existent argument;  
                inability to create temporary file;  
                improper format (not an object file);  
                inability to re-read temporary file.

BUGS          --

NAME            stty -- set teletype options

SYNOPSIS        stty option918 ...

DESCRIPTION     Stty will set certain I/O options on the current  
output teletype. The option strings are selected  
from the following set:

<u>even</u>	allow even parity.
<u>-even</u>	disallow even parity.
<u>odd</u>	allow odd parity
<u>-odd</u>	disallow odd parity
<u>raw</u>	raw mode input (no erase/kill/interrupt/quit/EOT)
<u>-raw</u>	negate raw mode
<u>-nl</u>	allow cr for lf (and echo lf cr)
<u>nl</u>	allow nl only
<u>echo</u>	echo back every character typed.
<u>-echo</u>	do not echo characters.
<u>lcase</u>	map upper case to lower case
<u>-lcase</u>	do not map case
<u>-tabs</u>	replace tabs by spaces
<u>tabs</u>	preserve tabs
<u>delay</u>	calculate cr and tab delays.
<u>-delay</u>	no cr/tab delays
<u>ebcdic</u>	ebcdic ball conversion (2741 only)
<u>corres</u>	correspondence ball conversion (2741 only)

FILES           standard output.

SEE ALSO        stty(II)

DIAGNOSTICS     "Bad options"

BUGS            --

NAME           sum -- sum file

SYNOPSIS       sum name1 ...

DESCRIPTION    sum sums the contents of the bytes (mod  $2^{16}$ ) of one or more files and prints the answer in octal. 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.

FILES          none

SEE ALSO       --

DIAGNOSTICS    "oprd" if the file cannot be opened; "?" if an error is discovered during the read.

BUGS          none

NAME            tap -- manipulate DECTape

SYNOPSIS        tap [ key ] [ name ... ]

DESCRIPTION    tap saves and restores selected portions of the file system hierarchy on DECTape. 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 tabled.

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

- r   The indicated files and directories, together with all subdirectories, are dumped onto the tape. If files with the same names already exist, they are replaced (hence the "r"). "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   updates the tape. u is the same as 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   deletes the named files and directories from the tape. At least one file argument must be given.
- x   extracts the named files from the tape to the file system. The owner, mode, and date-modified are restored to what they were when the file was dumped. If no file argument is given, the entire contents of the tape are extracted.
- t   lists the names of all files stored on the tape which are the same as or are hierarchically below the file arguments. If no file argument is given, the entire contents of the tape are tabled.
- l   is the same as t except that an expanded listing is produced giving all the available information about the listed files.



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

0, ..., 7 This modifier selects the drive on which the tape is mounted. "0" is the default.

v Normally tap does its work silently. The v (verbose) option causes it to type the name of each file it treats preceded by a letter to indicate what is happening.

    r file is being replaced  
    a file is being added (not there before)  
    x file is being extracted  
    d file is being deleted

The v option can be used with r, u, d, and x only.

c means a fresh dump is being created; the tape directory will be zeroed before beginning. Usable only with r and u.

f causes new entries copied 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.

w causes tap 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 tap 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.

m make (create) directories during an x if necessary.

FILES           /dev/tap?

SEE ALSO        mt(I)

DIAGNOSTICS    Tape open error  
                 Tape read error  
                 Tape write error  
                 Directory checksum  
                 Directory overflow

Tape overflow

Phase error (a file has changed after it was selected for dumping but before it was dumped)

#### BUGS

Asks about "fake" entries on "xw", when it should ignore them. If a fake entry is extracted, and the file already exists on disk, the extraction does not take place (as is correct), but the mode and user ID of the file are set to 0.

TIME (I)

10/26/72

TIME (I)

NAME           time -- time a command

SYNOPSIS       time command

DESCRIPTION    The given command is timed; after it is complete,  
                 time prints the time spent in the system, waiting  
                 for disk, and in execution of the command.

                 The disk I/O time can be variable depending on  
                 other activity in the system.

FILES           --

SEE ALSO        tm (VIII)

DIAGNOSTICS    "?"  
                 "command terminated abnormally"  
                 "Command not found."

NAME            tmg -- compiler compiler

SYNOPSIS        tmg name

DESCRIPTION     tmg produces a translator for the language whose parsing and translation rules are described in file name.t. The new translator appears in a.out and may be used thus:

a.out input [ output ]

Except in rare cases input must be a randomly addressable file. If no output file is specified, the standard output file is assumed.

FILES           /sys/tmg/tmgl.o -- the compiler-compiler  
                /sys/tmg[abc] -- libraries  
                alloc.d -- table storage

SEE ALSO        A Manual for the Tmg Compiler-writing Language,  
                MM-72-1271-8.

DIAGNOSTICS     Syntactic errors result in "???" followed by the offending line.  
                Situations such as space overflow with which the Tmg processor or a Tmg-produced processor can not cope result in a descriptive comment and a dump.

BUGS            9.2 footnote 1 is not enforced, causing trouble.  
                Restrictions (7.) against mixing bundling primitives should be lifted.  
                Certain hidden reserved words exist: gpar, classtab, trans.  
                Octal digits include 8=10 and 9=11.

NAME            tss -- interface to Honeywell TSS

SYNOPSIS        tss

DESCRIPTION     tss will call the Honeywell 6070 on the 201 data phone. It will then go into direct access with TSS. Output generated by TSS is typed on the standard output and input requested by TSS is read from the standard input with UNIX typing conventions.

An interrupt signal (ASCII DEL) is transmitted as a "break" to TSS.

Input lines beginning with ! are interpreted as UNIX commands. Input lines beginning with ~ are interpreted as commands to the interface routine.

~<file   insert input from named UNIX file

~>file   deliver tss output to named UNIX file

~p       pop the output file

~q       disconnect from tss (quit)

~r file   receive from HIS routine CSR/DACCPY

~s file   send file to HIS routine CSR/DACCPY

Ascii files may be most efficiently transmitted using the HIS routine CSR/DACCPY in this fashion. Underlined text comes from TSS. AFTname is the 6070 file to be dealt with.

SYSTEM? CSR/DACCPY (s) AFTname  
              Send Encoded File ~s file

SYSTEM? CSR/DACCPY (r) AFTname  
              Receive Encoded File ~r file

FILES           /dev/dn0, /dev/dp0

SEE ALSO        --

DIAGNOSTICS     DONE when communication is broken.

BUGS            When diagnostic problems occur, tss exits rather abruptly.

NAME           tty -- get tty name

SYNOPSIS       tty

DESCRIPTION    tty gives the name of the user's typewriter in the form "ttyn" for n a digit. The actual path name is then "/dev/ttyn".

FILES          --

SEE ALSO       --

DIAGNOSTICS    "not a tty" if the standard input file is not a typewriter.

BUGS           --

TYPE (I)

6/12/72

TYPE (I)

NAME            type -- type on single sheet paper

SYNOPSIS       type file918 ...

DESCRIPTION    type copies its input files to the standard output. Before each new page (66 lines) and before each new file, type stops and reads the standard input for a new line character before continuing. This allows time for insertion of single sheet paper.

FILES           --

SEE ALSO        --

DIAGNOSTICS    --

BUGS            --

NAME                    `typo -- find possible typo's`

SYNOPSIS                `typo [ - ] file1 ...`

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

All 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 "-" option suppresses the help from English and should be used if the document is written in, for example, Urdu.

Roff and Nroff control lines are ignored. Upper case is mapped into lower case. Quote marks, vertical bars, hyphens, and ampersands are stripped from within words. Words hyphenated across lines are put back together.

FILES                   `/tmp/ttmp??, /etc/salt, /etc/w2006`

SEE ALSO                --

DIAGNOSTICS            yes, lots

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



NAME           un -- undefined symbols

SYNOPSIS       un [ name ]

DESCRIPTION    un prints a list of undefined symbols from an assembly or loader run. If the file argument is not specified, a.out is the default. Names are listed alphabetically except that non-global symbols come first. Undefined global symbols (unresolved external references) have their first character underlined.

FILES          a.out

SEE ALSO       as(I), ld(I)

DIAGNOSTICS    "?" if the file cannot be found.

BUGS          --

NAME                `uniq -- report repeated lines in a file`

SYNOPSIS            `uniq [ -ud ] [ 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. Note that the normal mode output is the union of the `-u` and `-d` mode outputs.

The following example will print one copy of all lines in the file `a` that do not occur in `b`:

```
                sort a x          uniq x a1          sort b
x              uniq x b1          cat a1 b1 >x
                sort x            uniq -u x >>a1
                sort a1          uniq -d a1
```

FILES              --

SEE ALSO           `sort(I)`

DIAGNOSTICS        "cannot open input", "cannot create output"

BUGS               --

NAME vs -- phoneme list to voice synthesizer

SYNOPSIS vs

DESCRIPTION vs accepts phoneme descriptor lists and translates them into byte strings suitable for the Federal Screw Works Voice Synthesizer. Phoneme descriptors should be separated by commas and have the general form "%NIxx" where "xx" is a one or two character phoneme name, "I" is an optional inflection parameter, and "%N" is an optional count of the number of times the phoneme is to be repeated (maximum 9). "I" can have the values 0, 1, 2, 3 representing decreasing strength (default is 2). A description of the phonemes and their names can be found in the file vsp(VII). For example,

a0,o1,t,r,lai,lai,d,j,ih,u1,%2s

will generate the word "outrageous". The output is buffered; a newline will cause the buffered output to be sent to the Voice Synthesizer.

FILES -

SEE ALSO vsp(VII), speak(I)

DIAGNOSTICS -

BUGS -

NAME           wc -- get (English) word count

SYNOPSIS       wc name918 ...

DESCRIPTION    wc provides a count of the words, text lines, and control lines for each argument file.

                A text line is a sequence of characters not beginning with ".", "!" or "'" and ended by a new-line. A control line is a line beginning with ".", "!" or "/". A word is a sequence of characters bounded by the beginning of a line, by the end of a line, or by a blank or a tab.

                When there is more than one input file, a grand total is also printed.

FILES           --

SEE ALSO       roff(I)

DIAGNOSTICS    none; arguments not found are ignored.

BUGS           --

NAME               who   --   who is on the system

SYNOPSIS           who [ who-file ]

DESCRIPTION       who, without an argument, lists the name, type-writer 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, last character of input device name (with /dev/tty suppressed), date and time. Certain 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)

DIAGNOSTICS       "?" if a named file cannot be read.

BUGS               --

NAME            write -- write to another user

SYNOPSIS        write user

DESCRIPTION    write copies lines from your typewriter to that of another user. When first called, write 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.

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

If the character "!" is found at the beginning of a line, write calls the mini-shell msh 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  
                 /etc/msh            to execute !

SEE ALSO        mesg(I), msh(VII)

DIAGNOSTICS    "user not logged in"; "permission denied".

BUGS            write should check the mode of the other user's typewriter and refuse to proceed unless non-user write permission is given. Currently it is possible to write to another person with the same user-ID even though he has forbidden messages.

write should also allow specification of the typewriter name of a user who is logged in several times instead of picking out the instance with the lowest name.

NAME	boot -- reboot UNIX
SYNOPSIS	sys boot            / boot = 39. not in assembler
DESCRIPTION	UNIX will clean up outstanding IO, and then execute the reboot read-only program. This call is restricted to the super-user. All users will be logged out.
SEE ALSO	boot procedures (VII)
DIAGNOSTICS	the c-bit is set if you are not the super-user
BUGS	It often doesn't work (for unknown reasons). It depends on switch settings.

NAME	break -- set program break
SYNOPSIS	sys break; addr / break = 17.
DESCRIPTION	<p><u>break</u> sets the system's idea of the highest location used by the program to <u>addr</u>. Locations greater than <u>addr</u> and below the stack pointer are not swapped and are thus liable to unexpected modification.</p> <p>An argument of 0 is taken to mean 16K bytes. If the argument is higher than the stack pointer the entire user core area is swapped.</p> <p>When a program begins execution via <u>exec</u> 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 <u>break</u>.</p>
SEE ALSO	exec(II)
DIAGNOSTICS	none; strange addresses cause the break to be set at 16K bytes.
BUGS	--



NAME            cent -- catch emt traps

SYNOPSIS        sys cent; arg / cent = 29.

DESCRIPTION    This call allows one to catch traps resulting from the emt instruction. Arg is a location within the program; emt traps are sent to that location. The normal effect of emt traps may be restored by giving an arg equal to 0.

To return after catching the emt trap, execute the rti instruction.

SEE ALSO        --

DIAGNOSTICS    --

BUGS            --

NAME           chdir -- change working directory

SYNOPSIS       sys chdir; dirname / chdir = 12.

DESCRIPTION    dirname is the address of the pathname of a directory, terminated by a 0 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.

BUGS           --

NAME            chmod -- change mode of file

SYNOPSIS        sys chmod; name; mode / chmod = 15.

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:

- 01 write, non-owner
- 02 read, non-owner
- 04 write, owner
- 10 read, owner
- 20 executable
- 40 set user ID on execution

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

SEE ALSO        chmod(I)

DIAGNOSTICS    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.

BUGS            --

NAME            chown -- change owner of file

SYNOPSIS        sys chown; name; owner / chown = 16.

DESCRIPTION    The file whose name is given by the null-terminated string pointed to by name has its owner changed to owner. Only the present owner of a file (or the super-user) may donate the file to another user. Also, one may not change the owner of a file with the set-user-ID bit on, otherwise one could create Trojan Horses.

SEE ALSO        chown(I), uids(V)

DIAGNOSTICS    The error bit (c-bit) is set on illegal owner changes.

BUGS            --

NAME            close -- close a file

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

DESCRIPTION     Given a file descriptor such as returned from an  
open or creat call, close closes the associated  
file. A close of all files is automatic on exit,  
but since processes are limited to 10 simultane-  
ously open files, close is necessary for programs  
which deal with many files.

SEE ALSO        creat(II), open(II)

DIAGNOSTICS     The error bit (c-bit) is set for an unknown file  
descriptor.

BUGS            --

NAME            creat -- create a new file

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

DESCRIPTION    creat creates a new file or prepares to rewrite  
                 an existing file called name; name is the address  
                 of a null-terminated string. If the file did not  
                 exist, it is given mode mode; if it 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 writ-  
                 ing. 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)

DIAGNOSTICS    The error bit (c-bit) may be set if: a needed di-  
                 rectory is not readable; the file does not exist  
                 and the directory in which it is to be created is  
                 not writable; the file does exist and is un-  
                 writable; the file is a directory; there are al-  
                 ready 10 files open.

BUGS            --

NAME            csw -- read console switches

SYNOPSIS        sys csw / csw = 38. not in assembler  
                 (value of csw in r0)  
                 (value of buttons in r1)

DESCRIPTION     The setting of the console switches is returned  
                 in r0. The setting of the external buttons is  
                 returned in r1. The return is synced to a 30 CPS  
                 clock for graphical applications.

SEE ALSO        --

DIAGNOSTICS     none

BUGS            Currently the buttons are unavailable.

NAME            dup -- duplicate an open file descriptor

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

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

Dup is used more to manipulate the value of file  
                  descriptors than to genuinely duplicate a file  
                  descriptor. Since the algorithm to allocate file  
                  descriptors is known to use the lowest available  
                  value between 0 and 9, 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)

DIAGNOSTICS     The error bit (c-bit) is set if: the given file  
                  descriptor is invalid; there are already 10 open  
                  files.

BUGS            --



NAME                `exec` -- execute a file

SYNOPSIS            `sys exec; name; args / exec = 11.`

`name: <...\0>`

`args: arg1; arg2; ...; 0`

`arg1: <...\0>`

DESCRIPTION        exec overlays the calling process with the named file, then transfers to the beginning of the core image of the file. The first argument to exec is a pointer to the name of the file to be executed. The second is the address of a 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.

There can be no return from the file; the calling core image is lost.

The program break is set from the executed file; see the format of `a.out`.

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.

```
sp->  nargs          arg1          ...
      argn
```

```
arg1:  <arg1\0>      ...
argn:  <argn\0>
```

The arguments are placed as high as possible in core: just below 57000(8).

Files remain open across exec calls. However, the illegal instruction, emt, quit, and interrupt trap specifications are reset to the standard values. (See ilgins, cemt, quit, intr.)

Each user has a real user ID and an effective user ID (The real ID identifies the person using the system; the effective ID determines his access privileges.) exec changes the effective user ID to the owner of the executed file if the file has the "set-user-ID" mode. The real user ID is not affected.

SEE ALSO            `fork(II)`

DIAGNOSTICS        If the file cannot be read or if it is not exe-

cutable, a return from exec constitutes the diagnostic. The error bit (c-bit) is set.

## BUGS

Very high core and very low core are used by exec to construct the argument list for the new core image. If the original copies of the arguments reside in these places, problems can result.

NAME           exit -- terminate process

SYNOPSIS       (status in r0)  
                sys exit / exit = 1

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

This call can never return.

SEE ALSO       wait(II)

DIAGNOSTICS    -

BUGS           --

NAME            fork -- spawn new process

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

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  
                 process contains the process ID of the new  
                 process. This process ID is used by wait.

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.

BUGS            See wait(II) for a subtle bug in process de-  
                 struction.

NAME            fpe -- set floating exception handling

SYNOPSIS        sys fpe; arg / fpe = 40. not in assembler

DESCRIPTION     This call allows one to catch traps resulting from floating point exceptions. Arg is a location within the program; floating exception traps are sent to that location. The normal effect of floating exception traps may be restored by giving an arg equal to 0.

                To return after catching the fpe trap, execute the rti instruction.

SEE ALSO        --

DIAGNOSTICS     --

BUGS            The floating point exception (FEC) register is not saved per process. Examining this register for possible remedial action after a floating point exception trap is not guaranteed to work.

NAME           fstat -- get status of open file

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

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 descrip-  
                 tor is unknown.

BUGS           --

NAME           getuid -- get user identification

SYNOPSIS       sys getuid / getuid = 24.  
                (user ID in r0)

DESCRIPTION    getuid returns 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 each 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    --

BUGS           --

NAME            gtty -- get typewriter status

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

DESCRIPTION     gtty stores in the three words addressed by arg  
                 the status of the typewriter whose file descrip-  
                 tor is given in r0. 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.

BUGS            --



NAME            `ilgins` -- catch illegal instruction trap

SYNOPSIS        `sys ilgins; arg / ilgins = 33.`

DESCRIPTION     ilgins allows a program to catch illegal instruction traps. If arg is zero, the normal instruction trap handling is done: the process is terminated and a core image is produced. If arg is a location within the program, control is passed to arg when the trap occurs.

                This call is used to implement the floating point simulator, which catches and interprets 11/45 floating point instructions.

                To return after catching the ilgins trap, execute the rti instruction.

SEE ALSO        PDP-11 manual

DIAGNOSTICS     --

BUGS            --

NAME           intr -- set interrupt handling

SYNOPSIS       sys intr; arg / intr = 27.

DESCRIPTION    When arg is 0, interrupts (ASCII DELETE) are ignored. When arg is 1, interrupts cause their normal result, that is, force an exit. When arg is a location within the program, control is transferred to that location when an interrupt occurs.

After an interrupt is caught, it is possible to resume execution by means of an rti instruction; however, great care must be exercised, since all I/O is terminated abruptly upon an interrupt. In particular, reads of the typewriter tend to return with 0 characters read, thus simulating an end of file.

SEE ALSO       quit(II)

DIAGNOSTICS    --

BUGS           --

NAME            kill -- destroy process

SYNOPSIS        (process number in r0)  
                sys kill / kill = 37.; not in assembler

DESCRIPTION     kill destroys a process, given its process number. The process leaves a core image.

                This call is restricted to the super-user, and is intended only to kill an otherwise unstoppable process.

SEE ALSO        --

DIAGNOSTICS     c-bit set if user is not the super-user, or if process does not exist.

BUGS            Under strange circumstances, kill is ineffective.

NAME            link -- link to a file

SYNOPSIS        sys link; name1; name2 / link = 9.

DESCRIPTION     A link to name1 is created; the link has name name2. Either name may be an arbitrary path name.

SEE ALSO        link(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.

BUGS            --

NAME            `mkdir -- make a directory`

SYNOPSIS        `sys mkdir; name; mode / mkdir = 14.`

DESCRIPTION    mkdir creates an empty directory whose name is the null-terminated string pointed to by name. The mode of the directory is mode. The special entries "." and ".." are not present.

mkdir may be invoked only by the super-user.

SEE ALSO        `mkdir(I)`

DIAGNOSTICS    Error bit (c-bit) is set if the directory already exists or if the user is not the super-user.

BUGS            --

NAME            mdate -- set modified date on file

SYNOPSIS        (time to r0-r1)  
                sys mdate; file / mdate = 30.

DESCRIPTION     File is the address of a null-terminated string  
                 giving the name of a file. The modified time of  
                 the file is set to the time given in the r0-r1  
                 registers.

                This call is allowed only to the super-user or to  
                the owner of the file.

SEE ALSO        --

DIAGNOSTICS     Error bit is set if the user is neither the owner  
                 nor the super-user or if the file cannot be  
                 found.

BUGS            --

NAME            mount -- mount file system

SYNOPSIS        sys mount; special; name / mount = 21.

DESCRIPTION    mount announces to the system that a removable  
file system has been mounted on special file spe-  
cial; 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. If it had contents,  
they are inaccessible while the file system is  
mounted.

SEE ALSO        mount(I), umount(II)

DIAGNOSTICS    Error bit (c-bit) set if: special is inaccessi-  
ble; name does not exist; special is already  
mounted; name is not on the RF; there are already  
four special files mounted.

BUGS           At most four removable devices can be mounted at  
a time. This call should be restricted to the  
super-user.

NAME            nice -- set program in low priority

SYNOPSIS        sys nice / nice = 34.

DESCRIPTION    The currently executing process is set into the  
                 lowest priority execution queue. Background jobs  
                 that execute a very long time should do this.  
                 Once done, there is no way to restore a process  
                 to normal priority.

SEE ALSO        formerly known as "hog"

DIAGNOSTICS    --

BUGS            --



NAME           open -- open for reading or writing

SYNOPSIS       sys open; name; mode / open = 5.  
                (descriptor in r0)

DESCRIPTION    open opens the file name for reading (if mode is 0) or writing (if mode is non-zero). name is the address of a string of ASCII characters representing a path name, terminated by a null character.

                The file descriptor should be saved for subsequent calls to read (or write) and close.

                In both the read and write case the file pointer is set to the beginning of the file.

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 10 files are open.

BUGS           --

NAME            pipe -- create a pipe

SYNOPSIS        sys pipe            / pipe = 42.; not in assembler  
                 (file descriptor in r0)

DESCRIPTION    The pipe system call creates an I/O mechanism  
                 called a pipe. The file descriptor returned can  
                 be used in both read and write operations. When  
                 the pipe is written, the data is buffered up to  
                 504 bytes at which time the writing process is  
                 suspended. A read on the pipe will pick up the  
                 buffered 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 (no synonymous file descriptors  
                 resulting from fork or dup) return an end-of-  
                 file. Write calls under similar conditions are  
                 ignored.

SEE ALSO        sh(I), read(II), write(II), fork(II)

DIAGNOSTICS    The error bit (c-bit) is set if 10 files are al-  
                 ready open.

BUGS            --

NAME               quit -- turn off quit signal

SYNOPSIS           sys quit; flag / quit = 26.

DESCRIPTION        When flag is 0, this call disables quit signals from the typewriter (ASCII FS). When flag is non-zero, quits are re-enabled, and cause execution to cease and a core image to be produced.

                    Quits should be turned off only with due consideration.

SEE ALSO           intr(II)

DIAGNOSTICS        --

BUGS               --

NAME            read -- read from file

SYNOPSIS        (file descriptor in r0)  
                 sys read; buffer; nbytes / read = 3.  
                 (nread in r0)

DESCRIPTION     A file descriptor is a word returned from a successful open or creat 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 r0 returns with value 0, then end-of-file has been reached.

SEE ALSO        open(II), creat(II)

DIAGNOSTICS     As mentioned, r0 is 0 on return 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.

BUGS            --

NAME            rele  --  release processor

SYNOPSIS        sys rele  / rele = 0;  not in assembler

DESCRIPTION     This call causes the process to be swapped out immediately if another process wants to run.  Its main reason for being is internal to the system, namely to implement timer-runout swaps.  However, it can be used beneficially by programs which wish to loop for some reason without consuming more processor time than necessary.

SEE ALSO        --

DIAGNOSTICS     --

BUGS            --

NAME            seek -- move read/write pointer

SYNOPSIS        (file descriptor in r0)  
                sys seek; offset; ptrname / seek = 19.

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.

SEE ALSO        --

DIAGNOSTICS     The error bit (c-bit) is set for an undefined  
                 file descriptor.

BUGS            A file can conceptually be as large as 2\*\*20  
                 bytes. Clearly only 2\*\*16 bytes can be addressed  
                 by seek. The problem is most acute on the large  
                 special files.

NAME           setuid -- set process ID

SYNOPSIS       (process ID in r0)  
sys setuid / setuid = 23.

DESCRIPTION    The user ID of the current process is set to the  
                argument in r0. Both the effective and the real  
                user ID are set. This call is only permitted to  
                the super-user or if r0 is the real user ID.

SEE ALSO       getuid(II)

DIAGNOSTICS    Error bit (c-bit) is set as indicated.

BUGS           --

NAME           sleep -- stop execution for interval

SYNOPSIS       (seconds in r0)  
              sys sleep / sleep = 35.; not in assembler

DESCRIPTION    The current process is suspended from execution  
                 for the number of seconds specified by the con-  
                 tents of register 0.

SEE ALSO       --

DIAGNOSTICS    --

BUGS           Due to the implementation, the sleep interval is  
                 only accurate to 256 60ths of a second (4.26  
                 sec). Even then, the process is placed on a low  
                 priority queue and must be scheduled.



NAME           stat -- get file status

SYNOPSIS       sys stat; name; buf / stat = 18.

DESCRIPTION    name points to a null-terminated string naming a file; buf is the address of a 34(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 format:

buf, +1	i-number
+2,+3	flags (see below)
+4	number of links
+5	user ID of owner
+6,+7	size in bytes
+8,+9	first indirect block or contents block
+22,+23	eighth indirect block or contents block
+24,+25,+26,+27	creation time
+28,+29,+30,+31	modification time
+32,+33	unused

The flags are as follows:

100000	used (always on)
040000	directory
020000	file has been modified (always on)
010000	large file
000040	set user ID
000020	executable
000010	read, owner
000004	write, owner
000002	read, non-owner
000001	write, non-owner

SEE ALSO       stat(I), fstat(II)

DIAGNOSTICS   Error bit (c-bit) is set if the file cannot be found.

BUGS           --

NAME           stime -- set time

SYNOPSIS       (time in r0-r1)  
                sys stime     / stime = 25.

DESCRIPTION    stime sets the system's idea of the time and  
                date. Only the super-user may use this call.

SEE ALSO       date(I), time(II)

DIAGNOSTICS    Error bit (c-bit) set if user is not the super-  
                user.

BUGS           --

NAME            stty -- set mode of typewriter

SYNOPSIS        (file descriptor in r0)  
                sys stty; arg / stty = 31.  
                arg: dcrsr; dctsr; mode

DESCRIPTION     stty sets mode bits for a typewriter whose file descriptor is passed in r0. First, the system delays until the typewriter is quiescent. Then, the argument dcrsr is placed into the typewriter's receiver control and status register, and dctsr is placed in the transmitter control and status register. The DC-11 manual must be consulted for the format of these words. For the purpose of this call, the most important rôle of these arguments is to adjust to the speed of the typewriter.

The mode argument contains several bits which determine the system's treatment of the typewriter:

- 200 even parity allowed on input (e. g. for M37s)
- 100 odd parity allowed on input
- 040 raw mode: wake up on all characters
- 020 map CR into LF; echo LF or CR as LF-CR
- 010 echo (full duplex)
- 004 map upper case to lower on input (e. g. M33)
- 002 echo and print tabs as spaces
- 001 inhibit all function delays (e. g. CRTs)

Characters with the wrong parity, as determined by bits 200 and 100, are ignored.

In raw mode, every character is passed back immediately to the program. No erase or kill processing is done; the end-of-file character (EOT), the interrupt character (DELETE) 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 TerminiNet 300's and other terminals without the new-line function).

Additional bits in the high order byte of the mode argument are used to indicate that the terminal is an IBM 2741 and to specify 2741 modes. These mode bits are:

- 400 terminal is an IBM 2741
- 1000 the 2741 has the transmit interrupt feature (currently ignored)
- 2000 use correspondence code conversion on output

4000 use correspondence code conversion on input  
(currently ignored)

Normal input and output code conversion for 2741s is EBCDIC (e. g. 963 ball and corresponding keyboard). The presence of the transmit interrupt feature permits the system to do read-ahead while no output is in progress. In 2741 mode, the low order bits 331 are ignored.

SEE ALSO stty(I), gtty(II)

DIAGNOSTICS The error bit (c-bit) is set if the file descriptor does not refer to a typewriter.

BUGS This call should be used with care.

NAME            sync -- update super-block

SYNOPSIS        sys sync / sync = 36.; not in assembler

DESCRIPTION     sync causes the super block for all file systems to be written out. It is only necessary on systems in which this writing may be delayed for a long time, i.e., those which incorporate hardware protection facilities.

                It should be used by programs which examine a file system, for example check, df, tm, etc.

SEE ALSO        --

DIAGNOSTICS    --

BUGS            --

TIME (II)

3/15/72

TIME (II)

NAME           time -- get time of year

SYNOPSIS       sys time / time = 13.  
                (time r0-r1)

DESCRIPTION    time returns the time since 00:00:00, Jan. 1,  
                1972, measured in sixtieths of a second. The  
                high order word is in the r0 register and the low  
                order is in the r1.

SEE ALSO       date(I), mdate(II)

DIAGNOSTICS    --

BUGS           The time is stored in 32 bits. This guarantees a  
                crisis every 2.26 years.

NAME           times -- get process times

SYNOPSIS       sys times; buffer / times = 43.; not in assembler  
               buffer: .+. [24.\*3]

DESCRIPTION    times returns time-accounting information for the system as a whole, for the current process, and for the terminated child processes of the current process. All the times are 2-word (32-bit) numbers, and the unit of measurement is 1/60 second.

After the call, the buffer will appear as follows:

```
buffer:
system:      .+.4          / absolute time
              .+.4          / total system time
              .+.4          / total swap time
              .+.4          / other I/O wait time
              .+.4          / idle time
              .+.4          / total user time

process:     .+.4          / (ignore)
              .+.4          / time in system
              .+.4          / (ignore)
              .+.4          / I/O wait time
              .+.4          / (ignore)
              .+.4          / processor time

child:       .+.24.
```

The format of the "child" times is the same as that for the process times; the numbers are the sum of the times for all terminated direct or indirect descendants of the current process.

The "absolute" time returned is the same as that given by time(II). The "total system times" are times since the last cold boot.

FILES           --

SEE ALSO       time(II), time(I)

DIAGNOSTICS    --

BUGS           --

NAME               umount -- dismount file system

SYNOPSIS           sys umount; special / umount = 22.

DESCRIPTION       umount announces to the system that special file special is no longer to contain a removable file system. The file associated with the special file reverts to its ordinary interpretation (see mount).

                    The user must take care that all activity on the file system has ceased.

SEE ALSO           umount(I), mount(II)

DIAGNOSTICS       Error bit (c-bit) set if no file system was mounted on the special file.

BUGS               Use of this call should be restricted to the super-user.



NAME unlink -- remove directory entry

SYNOPSIS sys unlink; name / unlink = 10.

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).

BUGS --

NAME               wait   --   wait for process to die

SYNOPSIS           sys wait   /   wait = 7.  
                    (process ID in r0)  
                    (termination status/user status in r1)

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.  In the case of several chil-  
dren several waits are needed to learn of all the  
deaths.

If the error bit is not set on return, the r1  
high byte contains the low byte of the child  
process r0 when it terminated.  The r1 low byte  
contains the termination status of the process  
from the following list:

0	exit
1	bus error
2	illegal instruction
3	trace trap
4	IOT trap
5	power fail trap
6	EMT trap
7	bad system call
8	PIR interrupt
9	floating point exception
10	memory violation
11	quit
12	interrupt
13	kill (see kill(II))
14	User I/O (not currently possible)
+16	core image produced

SEE ALSO           exit(II), fork(II)

DIAGNOSTICS       error bit (c-bit) on if no children not previous-  
                    ly waited for.

BUGS               A child which dies, but is never waited for con-  
                    sumes a slot in the process table.  When this ta-  
                    ble is full, the system is effectively hung.

NAME            write -- write on file

SYNOPSIS        (file descriptor in r0)  
                 sys write; buffer; nbytes / write = 4.  
                 (number written in r0)

DESCRIPTION     A file descriptor is a word returned from a successful open or creat 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 are more efficient than any others.

SEE ALSO        creat(II), open(II)

DIAGNOSTICS     The error bit (c-bit) is set on an error: bad descriptor, buffer address, or count; physical I/O errors.

BUGS            --

NAME            atan -- arc tangent function

SYNOPSIS        jsr        r5,atan[2]

DESCRIPTION     The atan entry returns the arc tangent of fr0 in  
                 fr0. The range is  $-J/2$  to  $J/2$ .

                 The atan2 entry returns the arc tangent of  
                 fr0/fr1 in fr0. The range is  $-J$  to  $J$ .

FILES           kept in /lib/liba.a

SEE ALSO        --

DIAGNOSTICS     there is no error return

BUGS            --

NAME            atof -- ascii to floating

SYNOPSIS        jsr        r5,atof; subr

DESCRIPTION     atof will convert an ascii stream to a floating number returned in fr0.

                The subroutine subr (supplied by the caller) is called on r5 for each character of the ascii stream. subr should return the character in r0. The first character not used in the conversion is left in r0.

                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.

                The subroutine subr must not disturb any registers.

FILES           kept in /lib/liba.a

SEE ALSO        Calls atoi (III)

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 with the carry bit.

NAME           atoi -- ascii to integer

SYNOPSIS       jsr       r5,atoi; subr

DESCRIPTION    atoi will convert an ascii stream to a binary number returned in r1.

                The subroutine subr (supplied by the caller) is called on r5 for each character of the ascii stream. subr should return the character in r0. The first character not used in the conversion is left in r0.

                The numbers recognized are: an optional minus sign followed by a string of digits.

                The subroutine subr must not disturb any registers.

FILES          kept in /lib/liba.a

SEE ALSO       --

DIAGNOSTICS    There are none; the routine charges on regardless of consequences; see BUGS.

BUGS           It pays no attention to overflow - you get whatever the machine instructions mul and div happen to leave in the low order half - in fact, the carry bit should be set and isn't.

                The routine should accept initial "+" and initial blanks.

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, then 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.

FILES              kept in `/lib/liba.a`

SEE ALSO           `qsort` (III)

DIAGNOSTICS        --

BUGS               It could be recoded to run faster.

NAME            crypt -- password encoding

SYNOPSIS        mov \$key,r0  
                 jsr pc,crypt

DESCRIPTION     On entry, r0 should point to a string of characters terminated by an ASCII NULL. 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".

                Login uses this result as a password.

FILES           kept in /lib/liba.a

SEE ALSO        passwd(I),passwd(V), login(I)

DIAGNOSTICS     there are none; garbage is accepted.

BUGS            --



CTIME (III)

1/15/73

CTIME (III)

NAME            ctime  --  convert date and time to ASCII

SYNOPSIS        sys        time  
                 mov        \$buffer,r2  
                 jsr        pc,ctime

DESCRIPTION     The output buffer is 16 characters long and the  
                 time has the format  
  
                 Oct  9 17:32:24\0

                 The input time must be in the r0 and r1 registers  
                 in the form returned by sys time.

FILES           kept in /lib/liba.a

SEE ALSO        ptime(III), time(II)

DIAGNOSTICS     --

BUGS            The routine must be reassembled for leap year.  
                 Dec 31 is followed by Dec 32 and so on.

NAME                ddsput -- put a character on display data set

SYNOPSIS            (file descriptor in r0)  
                    jsr        pc,ddsinit

                    (character in r0)  
                    jsr        pc,ddsput

DESCRIPTION        These routines provide an interface to the Display Data Set, a peculiar device which can be called by Picturephone sets and which will display some of the ASCII character set and certain other graphics on the Picturephone screen.

If the DC11 or other interface hardware is not already set up to talk to the Display Data Set, the ddsinit entry should be called with the appropriate file descriptor in r0. On the only known DDS attached to UNIX, the associated special file is called "/dev/ttyc". ddsinit also clears the display.

Thereafter, characters may be displayed by calling ddsput. To the extent possible, ddsput simulates an ordinary terminal. Characters falling to the right of the 22X22 screen area are ignored; the 23rd line on the screen causes the screen to be erased and that line to be put at the top of the new display. Certain ASCII characters are interpreted specially as follows:

FF    clear screen, go to top left  
HT    expand to right number of spaces  
DC1   treat as reverse line feed (move N)  
DC2   move cursor 1 place right (move E)  
DC3   forward line feed (move S)  
DC4   backspace 1 position (move W)  
SO    enter graph mode  
SI    leave graph mode  
CR    put cursor at start of current line

Graph mode allows display of the non-ASCII characters and will be described when hell freezes over.

Lower-case ASCII alphabets are mapped into upper case. Several ASCII non-alphabetic graphics are unavailable as well. Also the lower right circle of the "%" character is missing. Also one of the circuit cards in the DDS has a crack in it and sometimes it doesn't work. All in all, it is best to avoid this device.

FILES               kept in /lib/liba.a

DDSPUT, DDSINIT (III)

1/15/73

DDSPUT, DDSINIT (III)

SEE ALSO           AT&T writeup on DDS

DIAGNOSTICS       --

BUGS               yes

NAME           ecvt, fcvt -- output conversion

SYNOPSIS       jsr pc,ecvt

              or

              jsr pc,fcvt

DESCRIPTION    Ecv 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).

              Fcvt is identical to ecvt, except that the correct digit has had decimal rounding for F-style output of the number of digits specified by "\_ndigits".

FILES          kept in /lib/liba.a

SEE ALSO       ftoa(III)

DIAGNOSTICS    --

BUGS          --

EXP (III)

1/15/73

EXP (III)

NAME           exp -- exponential function

SYNOPSIS       jsr       r5,exp

DESCRIPTION    The exponential of fr0 is returned in fr0.

FILES          kept in /lib/liba.a

SEE ALSO       --

DIAGNOSTICS    If the result is not representable, the c-bit is  
                set and the largest positive number is returned.

Zero is returned if the result would underflow.

BUGS          ---

NAME               ftoa -- floating to ascii conversion

SYNOPSIS           jsr       r5,ftoa; subr

DESCRIPTION       ftoa will convert the floating point number in  
fr0 into ascii in the form

          [-]dddddd.dd\*

if possible, otherwise in the form

          [-]d.dddddddde[-]dd\*.

For each character generated by ftoa, the subrou-  
tine subr (supplied by the caller) is called on  
register r5 with the character in r0.

The number of digits can be changed by changing  
the value of "\_ndigits" in ecvt (default is 10.).

The subroutine subr must not disturb any regis-  
ters.

FILES              kept in /lib/liba.a

SEE ALSO           ecvt(III), itoa(III)

DIAGNOSTICS       --

BUGS               --

NAME               ftoo -- floating to octal conversion

SYNOPSIS           jsr       r5,ftoo; subr

DESCRIPTION       ftoo wil convert the floating point number in fr0  
into ascii in the conventional octal form

                  0000000;0000000;0000000;0000000

For each character generated by ftoo, the subrou-  
tine subr (supplied by the caller) is called on  
register r5 with the character in r0.

The subroutine subr must not disturb any regis-  
ters.

FILES              kept in /lib/liba.a

SEE ALSO           --

DIAGNOSTICS       --

BUGS               --

NAME connect, gerts -- Gerts communication over 201

SYNOPSIS jsr r5,connect  
(error return)

jsr r5,gerts; fc; oc; ibuf; obuf  
(error return)

other entry points: gcset, gout

DESCRIPTION The GCOS GERTS interface is so bad that a description here is inappropriate. Anyone needing to use this interface should seek divine guidance.

FILES /dev/dn0, /dev/dp0  
kept in /lib/liba.a

SEE ALSO dn(IV), dp(IV), HIS documentation

DIAGNOSTICS --

BUGS --



NAME            `getw, getc, fopen` -- buffered input

SYNOPSIS        `mov        $filename, r0`  
                 `jsr        r5, fopen; iobuf`  
  
                 `jsr        r5, getc; iobuf`  
                 (character in r0)  
  
                 `jsr        r5, getw; iobuf`  
                 (word in r0)

DESCRIPTION     These routines are used to provide a buffered input facility. iobuf is the address of a 518(10) byte buffer area whose contents are maintained by these routines. Its format is:

```
iopt:  .+.2            / file descriptor
        .+.2            / characters left in buffer
        .+.2            / ptr to next character
        .+.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.

getc returns the next byte from the file in r0. The error bit is set on end of file or a read error.

getw returns the next word in r0. getc and getw may be used alternately; there are no odd/even problems.

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.

FILES           kept in /lib/liba.a

SEE ALSO        `open(II), read(II), putc(III)`

DIAGNOSTICS     c-bit set on EOF or error

BUGS            --

NAME           hypot -- calculate hypotenuse

SYNOPSIS       movf     a,fr0  
                movf     b,fr1  
                jsr      r5,hypot  
                movf     fr0,...

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.

FILES          kept in /lib/liba.a

SEE ALSO       sqrt(III)

DIAGNOSTICS    The c-bit is set if the result cannot be repre-  
                sented.

BUGS           --

NAME            itoa -- integer to ascii conversion

SYNOPSIS        jsr        r5, itoa; subr

DESCRIPTION     itoa will convert the number in r0 into ascii decimal preceded by a - sign if appropriate. For each character generated by itoa, the subroutine subr (supplied by the caller) is called on register r5 with the character in r0.

                The subroutine subr must not disturb any registers.

FILES           kept in /lib/liba.a

SEE ALSO        --

DIAGNOSTICS     --

BUGS            --

LOG (III)

3/15/72

LOG (III)

NAME           log -- logarithm (base e)

SYNOPSIS       jsr       r5,log

DESCRIPTION    The logarithm (base e) of fr0 is returned in fr0.

FILES          kept in /lib/liba.a

SEE ALSO       --

DIAGNOSTICS    The error bit (c-bit) is set if the input argument is less than or equal to zero and the result is set to the largest negative number.

BUGS          --

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.

FILES          kept in /lib/liba.a

SEE ALSO       --

DIAGNOSTICS    --

BUGS          --

NAME            nlist -- get entries from name list

SYNOPSIS        jsr r5,nlist; file; list  
                file: <file name\0>; .even  
                list:  
                  <name1xxx>; type1; value1  
                  <name2xxx>; type2; value2  
                  0

DESCRIPTION     nlist will examine the name list in the given assembler output file and selectively extract 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 zero. 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 /sys/sys/unix. In this way programs can obtain system 'magic' numbers that are up to date.

FILES           kept in /lib/liba.a

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            --

NAME            pow -- floating exponentiation  $x^y$

SYNOPSIS        movf     x,fr0  
                 movf     y,fr1  
                 jsr      pc,pow  
                 movf     fr0,...

DESCRIPTION     The value of  $x^y$  (i.e.  $xy$ ) is returned in fr0.  
  
                  $0^x$  returns zero for all  $x$ .  
  
                  $(-x)^y$  returns a result only if  $y$  is an integer.

FILES           kept in /lib/liba.a

SEE ALSO        exp(III), log(III)

DIAGNOSTICS     The carry bit is set on return in case of over-  
                 flow or in case of  $0^0$  or  $(-x)^y$  for  $y$  non-inte-  
                 ger.

BUGS            --

NAME            ptime -- print date and time

SYNOPSIS        sys        time  
                mov        file,r2  
                jsr        pc,ptime

DESCRIPTION    ptime prints the date and time in the form

Oct 9 17:20:33.sp on the file whose file  
descriptor is in r2. The string is 15 characters  
long. The time to be printed must be placed in  
the r0 and r1 registers in the form returned by  
sys time.

FILES           kept in /lib/liba.a

SEE ALSO        time(II), ctime(III) (used to do the conversion)

DIAGNOSTICS    --

BUGS            see ctime



NAME	putc, putw, fcreat, flush -- buffered output
SYNOPSIS	<pre> mov    \$filename,r0 jsr    r5,fcreat; iobuf  (get byte in r0) jsr    r5,putc; iobuf  (get word in r0) jsr    r5,putw; iobuf  jsr    r5,flush; iobuf </pre>
DESCRIPTION	<p><u>fcreat</u> creates the given file (mode 17) and sets up the buffer <u>iobuf</u> (size 518(10) bytes); <u>putc</u> and <u>putw</u> write a byte or word respectively onto the file; <u>flush</u> forces the contents of the buffer to be written, but does not close the file. The format of the buffer is:</p> <pre> iobuf:  .+.2          / file descriptor          .+.2          / characters unused in buffer          .+.2          / ptr to next free character          .+.512.       / buffer </pre> <p><u>fcreat</u> sets the error bit (c-bit) if the file creation failed; none of the other routines return error information.</p> <p>Before terminating, a program should call <u>flush</u> to force out the last of the output.</p> <p>The user must supply <u>iobuf</u>, which should begin on a word boundary.</p> <p>To write a new file using the same buffer, it suffices to call <u>flush</u>, close the file, and call <u>fcreat</u> again.</p>
FILES	kept in /lib/liba.a
SEE ALSO	creat(II), write(II), getc(III)
DIAGNOSTICS	error bit possible on <u>fcreat</u> call
BUGS	--

NAME               qsort -- quicker sort

SYNOPSIS           (base of data in r1)  
                    (end+1 of data in r2)  
                    (element width in r3)  
                    jsr pc,qsort

DESCRIPTION        qsort is an implementation of the quicker sort  
                    algorithm. It is designed to sort equal length  
                    elements. Registers r1 and r2 delimit the region  
                    of core containing the array of byte strings to  
                    be sorted: r1 points to the start of the first  
                    string, r2 to the first location above the last  
                    string. Register r3 contains the length of each  
                    string. r2-r1 should be a multiple of r3. On  
                    return, r0, r1, r2, r3, r4 are destroyed.

                    The routine compar (q.v.) is called to compare  
                    elements and may be replaced by the user.

FILES              kept in /lib/liba.a

SEE ALSO           compar(III)

DIAGNOSTICS        --

BUGS               It scribbles on r4.

NAME            rand -- random number generator

SYNOPSIS       jsr pc,srand     /to initialize  
                jsr pc,rand     /to get a random number

DESCRIPTION    The routine uses a multiplicative congruential  
                random number generator to return successive  
                pseudo-random numbers in r0 in the range from 1  
                to  $2^{15}-1$ .

                The generator is reinitialized by calling srand  
                with 1 in r0.

                It can be set to a random starting point by call-  
                ing srand with whatever you like in r0, for exam-  
                ple the result left in r1 from sys time.

FILES          kept in /lib/liba.a

SEE ALSO       --

DIAGNOSTICS    --

BUGS           --

WARNING        The author of this routine has been writing ran-  
                dom-number generators for many years and has nev-  
                er been known to write one that worked.

NAME               salloc -- string manipulation routines

SYNOPSIS           (get size in r0)  
                  jsr       pc,allocate

                  (get source pointer in r0,  
                  destination pointer in r1)  
                  jsr       pc,copy

                  jsr       pc,wc

                  (all following instructions assume r1 contains pointer)

                  jsr       pc,release

                  (get character in r0)  
                  jsr       pc,putchar

                  jsr       pc,lookchar  
                  (character in r0)

                  jsr       pc,getchar  
                  (character in r0)

                  (get character in r0)  
                  jsr       pc,alterchar

                  (get position in r0)  
                  jsr       pc,seekchar

                  jsr       pc,backspace  
                  (character in r0)

                  (get word in r0)  
                  jsr       pc,putword

                  jsr       pc,lookword  
                  (word in r0)

                  jsr       pc,getword  
                  (word in r0)

                  (get word in r0)  
                  jsr       pc,alterword

                  jsr       pc,backward  
                  (word in r0)

                  jsr       pc,length  
                  (length in r0)

                  jsr       pc,position  
                  (position in r0)

```
jsr    pc,rewind
jsr    pc,create
jsr    pc,fsfile
jsr    pc,zero
```

## DESCRIPTION

This package is a complete set of routines for dealing with almost arbitrary length strings of words and bytes. The strings are stored on a disk file, so the sum of their lengths can be considerably larger than the available core.

For each string there is a header of four words, namely a write pointer, a read pointer and pointers to the beginning and end of the block containing the string. Initially the read and write pointers point to the beginning of the string. All routines that refer to a string require the header address in r1. Unless the string is destroyed by the call, upon return r1 will point to the same string, although the string may have grown to the extent that it had to be moved.

allocate obtains a string of the requested size and returns a pointer to its header in r1.

release releases a string back to free storage.

putchar and putword write a byte or word respectively into the string and advance the write pointer.

lookchar and lookword read a byte or word respectively from the string but do not advance the read pointer.

getchar and getword read a byte or word respectively from the string and advance the read pointer.

alterchar and alterword write a byte or word respectively into the string where the read pointer is pointing and advance the read pointer.

backspace and backword read the last byte or word written and decrement the write pointer.

All write operations will automatically get a larger block if the current block is exceeded. All read operations return with the error bit set if attempting to read beyond the write pointer.

seekchar moves the read pointer to the offset specified in r0.

length returns the current length of the string (beginning pointer to write pointer) in r0.

position returns the current offset of the read pointer in r0.

rewind moves the read pointer to the beginning of the string.

create returns the read and write pointers to the beginning of the string.

fsfile moves the read pointer to the current position of the write pointer.

zero zeros the whole string and sets the write pointer to the beginning of the string.

copy copies the string whose header pointer is in r0 to the string whose header pointer is in r1. Care should be taken in using the copy instruction since r1 will be changed if the contents of the source string is bigger than the destination string.

wc forces the contents of the internal buffers and the header blocks to be written on disc.

#### FILES

The allocator is in /lib/libs.a; the -s option to ld will link edit references to the allocator.

alloc.d is the temporary file used to contain the strings.

#### SEE ALSO

--

#### DIAGNOSTICS

"error in copy" if a disk write error occurs during the execution of the copy instruction. "error in allocator" if any routine is called with a bad header pointer. "Cannot open output file" if file alloc.d cannot be created or opened. "Out of space" if there's no available block of the requested size or no headers available for a new block.

#### BUGS

--

SIN, COS (III)

3/15/72

SIN, COS (III)

NAME            sin, cos -- sine cosine

SYNOPSIS       jsr       r5,sin (cos)

DESCRIPTION    The sine (cosine) of fr0 in radians is returned  
                 in fr0.

                 The magnitude of the argument should be checked  
                 by the caller to make sure the result is meaning-  
                 ful.

FILES           kept in /lib/liba.a

SEE ALSO       --

DIAGNOSTICS    there are none

BUGS           --

NAME           sqrt -- square root function

SYNOPSIS       jsr       r5,sqrt

DESCRIPTION    The square root of fr0 is returned in fr0.

FILES          kept in /lib/liba.a

SEE ALSO       --

DIAGNOSTICS    The c-bit is set on negative arguments and 0 is  
                returned.

BUGS          --



NAME            switch -- switch on value

SYNOPSIS        (switch value in r0)  
                jsr     r5,switch; swtab  
                (not-found return)  
                swtab: val1; lab1;  
                      valn; labn

DESCRIPTION     switch compares the value of r0 against each of  
                  the vali; if a match is found, control is trans-  
                  ferred to the corresponding labi (after popping  
                  the stack once). If no match has been found by  
                  the time a null labi occurs, switch returns.

FILES           kept in /lib/liba.a

SEE ALSO        --

DIAGNOSTICS     --

BUGS            --

NAME            ttyn -- return name of current tty

SYNOPSIS        jsr pc,ttyn

DESCRIPTION     The routine hunts up the name of the input tty  
                 attached to the process (one byte from the set  
                 {012345678abc} at present) and returns it in r0.  
  
                 "x" is returned if no genuine input tty is at-  
                 tached to the process.

FILES           kept in /lib/liba.a

SEE ALSO        fstat(II)

DIAGNOSTICS     --

BUGS            --

NAME                   dc -- DC-11 communications interfaces

DESCRIPTION

The special files /dev/tty0, /dev/tty1, ... refer to the DC11 asynchronous communications interfaces. At the moment there are ten of them, but the number is subject to change.

When one of these files is opened, it causes the process to wait until a connection is established. (In practice, however, user's programs seldom open these files; they are opened by init and become a user's standard 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 150 characters. When this is happening the character "#" is echoed for every lost input character.

When first opened, the interface mode is ASCII characters; 150 baud; even parity only 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 TerminiNet 300. Most of these operating states can be changed by using the system call stty(II). In particular the following hardware states are program settable independently for input and output (see DC11 manual): 134.5, 150, 300, or 1200 baud; one or two stop bits on output; and 5, 6, 7, or 8 data bits/character. 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; the printing of tabs as spaces; and setting the system to handle IBM 2741s. See getty(VII) 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.

It is possible to use raw mode in which the program reading is awakened on each character. In raw mode, no erase or kill processing is done; and the EOT, quit and interrupt characters are not treated specially.

The ASCII EOT 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. 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 signal. The EOT is not passed on except in raw mode.

When the carrier signal from the dataset drops (usually because the user has hung up his terminal) 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 the interrupt signal. When this character is received from a given typewriter, a search is made for all processes which have this typewriter as their control typewriter, and which have not informed the system that they wish to ignore interrupts. If there is more than one such process, one of these is selected, for practical purposes at random. The process is either forced to exit or a trap is simulated to an agreed-upon location in the process. See intr(II).

The ASCII character FS is the quit signal. Its treatment is identical to the interrupt signal except that unless

the receiving process has made other arrangements it will not only be terminated but a core image file will be generated. See quit(II). The character is not passed on except in raw mode.

Output is prosaic compared to input. 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 to prevent terminals which respond to it from being hung up.

The system will handle IBM 2741 terminals. See getty(VII) for the way that 2741s are detected. In 2741 mode, the hardware state is: 134.5 baud; one output stop bit; and 7 bits/character. Because the 2741 is inherently half-duplex, input is not echoed. Proper function delays are provided. For 2741s without a feature known as "transmit interrupt" it is not possible to collect input ahead of the time that a program reads the typewriter, because once the keyboard has been enabled there is no way to send further output to the 2741. It is currently assumed that the feature is absent; thus the keyboard is unlocked only when some program reads. The interrupt signal (normally ASCII DEL) is simulated when the 2741 "attention" key is pushed to generate either a 2741 style EOT or a break. It is not possible to generate anything corresponding to the end-of-file EOT or the quit signal. Currently IBM EBCDIC is default for input and output; correspondence code output is settable (see stty(I)). The full ASCII character set is not available: "[", "]", "{", "}", "~", are missing on input and are printed as blank on output; "¢" is used for "\"; "\_" for "^"; " " for both "'" and "`" on output; and " " maps into "'" on input. Similar mappings occur with correspondence code output.

FILES	/dev/tty[01234567ab]	113B dataphones
	/dev/ttyc	display data set
	/dev/ttyd	113B with /dev/dn1
SEE ALSO	kl(IV), getty(VII)	
BUGS	The primarily Model 37 oriented delays may not be appropriate for all other ASCII terminals.	

NAME               dn -- dn-11 ACU interface

DESCRIPTION       dn? is a write-only file. Bytes written on dn?  
must be ASCII as follows:

```
0-9   dial 0-9
:     dial *
;     dial #
=     end-of-number
```

The entire telephone number must be presented in  
a single write system call.

It is recommended that an end-of-number code be  
given even though only one of the ACU's (113C)  
actually requires it.

FILES             /dev/dn0           connected to 801 with dp0  
                  /dev/dn1           connected to 113C with ttyd  
                  /dev/dn2           not currently connected

SEE ALSO          dp(IV), dc(IV), write(II)

BUGS             --

NAME                dp -- dp-11 201 data-phone interface

DESCRIPTION        dp? is a 201 data-phone interface file. read and write calls to dp? are limited to a maximum of 400 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 20 second time out is set and a zero byte record is returned if nothing is received in that time.

FILES              /dev/dp0                201 dataphone used to call GCOS

SEE ALSO           dn(IV), gerts(III)

BUGS               The dp file is GCOS oriented. It should be more flexible.

NAME kl -- KL-11/TTY-33 console typewriter

DESCRIPTION tty (as distinct from tty?) refers to the console typewriter hard-wired to the PDP-11 via a KL-11 interface.

Generally, the disciplines involved in dealing with tty are similar to those for tty? and section dc(IV) should be consulted. The following differences are salient:

The system calls stty and gtty do not apply to this device. It cannot be placed in raw mode; on input, upper case letters are always mapped into lower case letters; a carriage return is echoed when a line-feed is typed.

The quit character is not FS (as with tty?) but is generated by the key labelled "alt mode."

By appropriate console switch settings, it is possible to cause UNIX to come up as a single-user system with I/O on this device.

FILES /dev/tty  
/dev/tty8 synonym for /dev/tty

SEE ALSO dc(IV), init(VII)

BUGS --



NAME                    mem    --    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.

Mem is a byte-oriented file; its bytes are num-  
bered 0 to 65,535.

If a non-existent memory location is referenced,  
the user suffers the resultant bus error.

Memory referenced through the file is treated  
with movb instructions. Certain device registers  
do not implement DATOB cycles to odd addresses.  
Other registers react strangely to this address-  
ing.

FILES                    /dev/mem

SEE ALSO                --

BUGS                    --

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

SEE ALSO               --

BUGS                   --

NAME                rf -- RF11-RS11 fixed-head disk file

DESCRIPTION        This file refers to the concatenation of both RS-11 disks. It may be either read or written, although writing is inherently very dangerous, since a file system resides there.

                    The disk contains 2048 256-word blocks, numbered 0 to 2047. Like the other block-structured devices (TC, RK) this file is addressed in blocks, not bytes. This has two consequences: seek calls refer to block numbers, not byte numbers; and sequential reading or writing always advance the read or write pointer by at least one block. Thus successive reads of 10 characters from this file actually read the first 10 characters from successive blocks.

FILES              /dev/rf0

SEE ALSO           tc(IV), rk(IV)

BUGS                The fact that this device is addressed in terms of blocks, not bytes, is extremely unfortunate. It is due entirely to the fact that read and write pointers (and consequently the arguments to seek) are single-precision numbers.

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. Like the RF disk and the tape files, its addressing is block-oriented. Consult the rf(IV) section.

FILES           /dev/rk0           user available drive  
                /dev/rk1           /usr file system  
                /dev/rk2           /sys file system  
                /dev/rk3           /crp file system

SEE ALSO       rf(IV), tc(IV)

BUGS           See rf(IV)

NAME	tc -- TC-11/TU56 DEctape
DESCRIPTION	<p>The files tap0 ... tap7 refer to the TC-11/TU56 DEctape drives 0 to 7. Since the logical drive number can be manually set, all eight files exist even though at present there are fewer physical drives.</p> <p>The 256-word blocks on a standard DEctape are numbered 0 to 577. However, the system makes no assumption about this number; a block can be read or written if it exists on the tape and not otherwise. An error is returned if a transaction is attempted for a block which does not exist.</p> <p>Addressing on the tape files, like that on the RK and RF disks, is block-oriented.</p>
FILES	/dev/tap?
SEE ALSO	rf(IV), tap(I)
BUGS	see rf(IV)

NAME                   tm -- TM-11/TU-10 magtape interface

DESCRIPTION           mt? is the DEC TU10/TM11 magtape. When opened for reading or writing, the magtape is rewound. A tape consists of a series of 512 byte records terminated by an end-of-file. Reading less than 512 bytes causes the rest of a record to be ignored. Writing less than a record causes null padding to 512 bytes. When the magtape is closed after writing, an end-of-file is written.

                      Seek has no effect on the magtape. The magtape can only be opened once at any instant.

FILES                 /dev/mt0           selected drive 0

SEE ALSO              mt(I)

BUGS                 Seek should work on the magtape. Also, a provision of having the tape open for reading and writing should exist. A multi-file and multi-reel facility should be incorporated.

NAME vt -- 11/20 (vt01) interface

DESCRIPTION

The file vt0 provides the interface to a PDP 11/20 which runs both a VT01A-controlled Tektronix 611 storage display, and a Federal Screw Works (Vocal Interface Division) voice synthesizer. The inter-computer interface is a pair of DR-11C word interfaces.

Although the display has essentially only two commands, namely "erase screen" and "display point", the 11/20 program will draw points, lines, and arcs, and print text on the screen. The 11/20 can also type information on the attached 33 TTY and generate utterances via the voice synthesizer.

This special file operates in two basic modes, selected by bit 2 (octal 04) on the 11/20's console switches. If this bit is on at the opening of the file, all bytes written on the file are interpreted as ASCII characters and written on the screen. The screen has 33 lines (1/2 a standard page). The file simulates a 37 TTY: the control characters NL, CR, BS, and TAB are interpreted correctly. It also interprets the usual escape sequences for forward and reverse half-line motion and for full-line reverse. Greek is not available yet. Normally, when the screen is full (i.e. the 34th line is started) the screen is erased before starting a new page. To allow perusal of the displayed text, it is usual to assert bit 0 of the console switches (octal 01). As explained below, this causes the program to pause before erasing until one of the attached pushbuttons is depressed.

If bit 2 of the switches is down, the display is in graphic mode. In this case bytes written on the file are interpreted as display and vocal commands. Each command consists of a single byte usually followed by parameter bytes. Often the parameter bytes represent points in the plotting area. Each point coordinate consists of 2 bytes interpreted as a 2's complement 16-bit number. The plotting area itself measures  $(\pm 03777)X(\pm 03777)$  (numbers in octal); that is, 12 bits of precision. Attempts to plot points outside the screen limits are ignored.

The graphic and sonic commands are:

order (1); 1 parameter byte

The parameter indicates a subcommand, possibly followed by subparameter bytes, as follows:

erase (1)

The screen is erased. This action may be delayed, as explained below, until a pushbutton is depressed.

label (2); several subparameter bytes

The following bytes up to a null character are taken as a label and typed on the console TTY. One of the console switches gives labels a special interpretation, as explained below.

display label (3); several subparameter bytes

The following bytes up to a null byte are printed as ASCII text on the screen. The origin of the text is the last previous point plotted; or the upper left hand of the screen if there were none.

point (2); 4 parameter bytes

The 4 parameter bytes are taken as a pair of coordinates representing a point to be plotted.

line (3); 8 parameter bytes

The parameter bytes are taken as 2 pairs of coordinates representing the ends of a line segment which is plotted. Only the portion lying within the screen is displayed.

frame (4); 1 parameter byte

The parameter byte is taken as a number of sixtieths of a second; an externally-available lead is asserted for that time. Typically the lead is connected to an automatic camera which advances its film and opens the shutter for the specified time.

circle (5); 6 parameter bytes

The parameter bytes are taken as a coordinate pair representing the origin, and a word representing the radius of a circle. That portion of the circle which lies within the screen is plotted.

arc (6); 12 parameter bytes

The first 4 parameter bytes are taken to be a coordinate-pair representing the center of a circle. The next 4 represent a coordinate-pair specifying a point on this circle. The last 4 should represent another point on the circle. An arc is drawn counter-clockwise from the first circle point to the second. If the two points are the same, the whole circle is drawn. For the second point, only the smaller in magnitude of its two coordinates is significant; the other is used only to find the quadrant of the end of the arc. In any event only points within the screen limits are plotted.

dot-line (7); at least 6 parameter bytes

The first 4 parameter bytes are taken as a coordinate-pair representing the origin of a dot-line. The next byte is taken as a signed x-increment. The



next byte is an unsigned word-count, with "0" meaning "256". The indicated number of words is picked up. For each bit in each word a point is plotted which is visible if the bit is "1", invisible if not. High-order bits are plotted first. Each successive point (or non-point) is offset rightward by the given x-increment.

Speak(8); several parameter bytes

The following bytes up to a null byte are taken to represent phonemes which are fed to the voice synthesizer. vsp(VII) gives the encoding.

The 3 low-order console switches of the 11/20 modify the operation of the display as follows.

Bit 2 (octal 04) is examined at the time the display file is opened (more precisely, when the first byte is written after an open); as indicated, when on it selects character mode, otherwise graphic mode.

Bit 1 (octal 02) determines whether TTY labels are to be interpreted. Unless this bit is on, labels are ignored. (except to terminate skip mode, see below).

Bit 0 (octal 01) determines whether the display will pause before erasing the screen; if off there will be no pause. If bit 0 is on, the erase will occur and displaying will resume only when one of the 16 pushbuttons is depressed.

There is a box with 16 pushbuttons connected to the 11/20. Their state is at all times available in the 11/45 by executing the csw system call (II). They are used by the 11/20 when it is pausing before an erase. 14 of the buttons merely serve to allow the display to continue. If, however, button 7 is pushed, the display will ignore commands up to the next erase command, then ring the TTY console's bell, thereby skipping an entire picture.

If button 8 is depressed, the display will ignore commands up to the next TTY label (whether or not its typing is suppressed) before resuming the displays. Thus a sequence of frames may be skipped.

FILES                /dev/vt0

SEE ALSO            csw(II), vsp(VII)

BUGS                Two users using vt0 simultaneously can interfere with each other, e.g. plot phonemes or speak display coordinates.

NAME                    a.out    --    assembler and link editor output

DESCRIPTION

a.out is the output file of the assembler as and the link editor ld. In both cases, a.out may be executed provided there were no errors and no unresolved external references.

This file has four sections: a header, the program and data text, a symbol table, and relocation bits (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(8))
- 2 The size of the program text segment
- 3 The size of the initialized data segment
- 4 The size of the uninitialized (bss) segment
- 5 The size of the symbol table
- 6 The entry location (always 0 at present)
- 7 The stack size required (0 at present)
- 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 segments are set up: the text segment, the data segment, and the bss (uninitialized data) segment, in that order. The text segment begins at the lowest location in the core image; the header is not loaded. The data segment begins immediately after the text segment, and the bss segment immediately after the data segment. The bss segment is initialized by 0's. In the future the text segment will be write-protected and shared.

The start of the text segment in the file is 20(8); the start of the data segment is 20+S9t8 (the size of the text) the start of the relocation information is 20+S9t8+S9d8; the start of the symbol table is 20+2(S9t8+S9d8) if the relocation information is present, 20+S9t8+S9d8 if not.

The symbol table consists of 6-word entries. The first four 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
- 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 the data segment
- 06 indicates the reference is to the bss segment
- 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, 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, ld, strip, nm, un(I)

NAME 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 177555(8) (it was chosen to be unlikely to occur anywhere else). The header of each file is 16 bytes long:

0-7  
file name, null padded on the right

8-11  
Modification time of the file

12  
User ID of file owner

13  
file mode

14-15  
file size

If the file is an odd number of bytes long, it is padded with a null byte, but the size in the header is correct.

Notice there is no provision for empty areas in an archive file.

SEE ALSO ar, ld

NAME	format of core image
DESCRIPTION	<p>UNIX writes out a core image of a terminated process when any of various errors occur. See <u>wait</u>(II) for the list of reasons; the most common are memory violations, illegal instructions, bus errors, and user-generated quit signals.</p> <p>The core image is called "core" and is written in the process's working directory (provided it can be; normal access controls apply).</p> <p>The size and structure of the core image file depend to some extent on which system is involved. In general there is a 512-byte area at the end which contains the system's per-process data for that process. (64 bytes in older systems). The remainder represents the actual contents of the user's core area when the core image was written. In the current system, this area is variable in size in that only the locations from user 0 to the program break, plus the stack, are dumped.</p> <p>When any fatal trap occurs, all the useful registers are stored on the stack. In the current system, which has relocation and protection hardware, the stack used is the system stack, which is kept in the per-process area; in older systems, there is only one stack, and it is located in the user's core area.</p> <p>The actual format of the information is complicated because it depends on what hardware is present (EAE, floating-point option), whether single- or double-precision floating mode is in effect, and also involves relocating addresses in the system's address space. A guru will have to be consulted if enlightenment is required.</p> <p>In general the debugger db(I) should be used to deal with core images.</p>
SEE ALSO	db(I), wait(II)

NAME 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 10 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 2-9 represent the (8-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)

NAME                    format of file system

DESCRIPTION

Every file system storage volume (e.g. RF disk, RK 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. Blocks 0 and 1 are collectively known as the super-block for the device; they define its extent and contain an i-node map and a free-storage map. The first word contains the number of bytes in the free-storage map; it is always even. It is followed by the map. There is one bit for each block on the device; the bit is "1" if the block is free. Thus if the number of free-map bytes is  $n$ , the blocks on the device are numbered 0 through  $8n-1$ . The free-map count is followed by the free map itself. The bit for block  $k$  of the device is in byte  $k/8$  of the map; it is offset  $k(\bmod 8)$  bits from the right. Notice that bits exist for the superblock and the i-list, even though they are never allocated or freed.

After the free map is a word containing the byte count for the i-node map. It too is always even. I-numbers below 41(10) are reserved for special files, and are never allocated; the first bit in the i-node free map refers to i-number 41. Therefore the byte number in the i-node map for i-node  $i$  is  $(i-41)/8$ . It is offset  $(i-41) (\bmod 8)$  bits from the right; unlike the free map, a "0" bit indicates an available i-node.

I-numbers begin at 1, and the storage for i-nodes begins at 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  $(i+31)/16$  of the file system, and begins  $32.((i+31) (\bmod 16))$  bytes from its start.

There is always one file system which is always mounted; in standard UNIX it resides on the RF disk. This device is also used for swapping. On the primary file system device, there are several pieces of information following that previously discussed. There are two words with the calendar time (measured since 00:00 Jan 1, 1972); two words with the time spent executing in the system; two words with the time spent waiting for I/O on the RF and RK disks; two words with the time spent executing in a user's core; one byte with the count of errors on the RF disk; and one byte with the count of errors on the RK disk. All the times are measured in sixtieths of a second.

I-node 41(10) is reserved for the root directory of the file system. No i-numbers other than this one and those



from 1 to 40 (which represent special files) have a built-in meaning. Each i-node represents one file. The format of an i-node is as follows, where the left column represents the offset from the beginning of the i-node:

0-1	flags (see below)
2	number of links
3	user ID of owner
4-5	size in bytes
6-7	first indirect block or contents block
20-21	eighth indirect block or contents block
22-25	creation time
26-29	modification time
30-31	unused

The flags are as follows:

100000	i-node is allocated
040000	directory
020000	file has been modified (always on)
010000	large file
000040	set user ID on execution
000020	executable
000010	read, owner
000004	write, owner
000002	read, non-owner
000001	write, non-owner

The allocated bit (flag 100000) is believed even if the i-node map says the i-node is free; thus corruption of the map may cause i-nodes to become unallocatable, but will not cause active nodes to be reused.

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 corresponding to b is the bth entry in the address portion of the i-node.

Even if the file is large, b will be less than 128 ( $128 \times 512 = 2^{16}$ ). The first number in the i-node address portion gives the physical block number of the indirect block. b is doubled to give a byte offset in the indirect block and the word there found is the physical address of the block corresponding to b.

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.

## BUGS

Two blocks are not enough to handle the i- and free-storage maps for an RP02 disk pack, which contains around 10 million words.

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  
                  GCOS job number and box number  
                  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 job and box numbers are separated by a comma. 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.

SEE ALSO            login(I), crypt(III), passwd(I)

NAME tap -- DEC/mag tape formats

DESCRIPTION The DECTape command tap and the magtape command mt dump and extract files to and from their respective tape media. The formats of these tapes are the same except that magtapes have larger directories.

Block zero of the tape is not used. It is available to contain a boot program to be used in a stand-alone environment. This has proved valuable for DEC diagnostic programs.

Blocks 1 through 24 for DECTape (1 through 146 for magtape) contain a directory of the tape. There are 192 (resp. 1168) entries in the directory; 8 entries per block; 64 bytes per entry. Each entry has the following format:

path name	32 bytes
mode	1 byte
uid	1 byte
size	2 bytes
time modified	4 bytes
tape address	2 bytes
unused	20 bytes
check sum	2 bytes

The path name entry is the path name of the file when put on the tape. If the pathname starts with a zero word, the entry is empty. It is at most 32 bytes long and ends in a null byte. Mode, uid, size and time modified are the same as described under i-nodes (see 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  $(\text{size}+511)/512$  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. 147) on are available for file storage.

A fake entry (see `mt(I)`, `tap(I)`) has a size of zero.

SEE ALSO filesystem(V), `mt(I)`, `tap(I)`

NAME            /tmp/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.

                This file resides in directory /tmp.

SEE ALSO        /etc/init, which maintains the file;  
                who(I), which interprets it.

NAME                /tmp/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, and the typewriter name 'x' indicates that UNIX was rebooted at that point.

Wtmp is maintained by login(I) and init(VII). Neither of these programs creates the file, so if it is removed record-keeping is turned off.

This file resides in directory /tmp.

SEE ALSO            init(VII), login(I), acct(VIII), swtmp(VIII)

NAME           bc -- B interpreter

SYNOPSIS       bc [ -c ] sfile1.b ... ofile1 ...

DESCRIPTION   bc is the UNIX B interpreter. It accepts three types of arguments:

Arguments whose names end with ".b" are assumed to be B source programs; 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 ".b").

Other arguments (except for "-c") are assumed to be either loader flag arguments, or B-compatible object programs, typically produced by an earlier bc run, or perhaps libraries of B-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 language itself is described in [1].

The future of B is uncertain. The language has been totally eclipsed by the newer, more powerful, more compact, and faster language C.

FILES           file.b                   input file  
                 a.out                   loaded output  
                 b.tmp1                  temporary (deleted)  
                 b.tmp2                  temporary (deleted)  
                 /usr/lang/bdir/b[ca]    translator  
                 /usr/lang/bdir/brt[12]   runtime initialization  
                 /usr/lib/libb.a         builtin functions, etc.  
                 /usr/lang/bdir/bilib.a   interpreter library

SEE ALSO       [1] K. Thompson; MM-72-1271-1; Users' Reference to B.  
                 cc(I)

DIAGNOSTICS    see [1].

BUGS           Certain external initializations are illegal.  
                 (In particular: strings and addresses of externals.)

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



loss) is printed. To exit, hit the interrupt key (DEL)  
and the action and standing will be printed.

NAME            `ptx -- permuted index`

SYNOPSIS        `ptx 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", "and", "as", "is", "for", "of", "on", "or", "the", "to", "up".

                The index for this manual was generated using `ptx`.

FILES            --

SEE ALSO        `sort(1)`

DIAGNOSTICS     some

BUGS            --

NAME           yacc -- yet another compiler compiler

SYNOPSIS        /crp/scj/yacc [ <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 tables are provided in readable form on the standard output and in b-compiler format on file actn.b; the program /crp/scj/bpar.b will parse strings using the actn.b file.

                If your grammar is too big for yacc, you may try /crp/scj/bigyacc, some of whose size limits are larger, and others smaller.

FILES           actn.b               output tables  
                actn.tmp            temporary storage  
                Note that these files are created in the invoker's directory. The file actn.tmp is only created by /crp/scj/bigyacc (see above).

SEE ALSO        Yacc manual, by scj (available from ek); "LR Parsing", by A. V. Aho and S. C. Johnson, to be published.

DIAGNOSTICS     There are various diagnostics, but only one can be obtained in each run.

BUGS           The maximum number of terminal and non-terminal symbols is 50 each, and this is not checked. There are undoubtedly other bugs too.

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`

NAME                dpd -- spawn data phone daemon

SYNOPSIS            /etc/dpd

DESCRIPTION        dpd is the 201 data phone daemon. It is designed to submit jobs to the Honeywell 6070 computer via the gerts interface.

dpd uses the directory /usr/dpd. The file lock in that directory is used to prevent two daemons from becoming active. After the daemon has successfully set the lock, it forks and the main path exits, thus spawning the daemon. /usr/dpd is scanned for any file 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

S directs dpd to generate a unique snumb card. This card is generated by incrementing the first word of the file /usr/dpd/numb and converting that to decimal concatenated with the station ID.

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.

Any error encountered will cause the daemon to drop the call, wait up to 20 minutes and start over. This means that an improperly constructed df file may cause the same job to be submitted every 20 minutes.

While waiting, the daemon checks to see that the lock file still exists. If the lock is gone, the daemon will exit.

FILES                /dev/dn0, /dev/dp0, /usr/dpd/\*

SEE ALSO            opr(I)

DIAGNOSTICS        --

DPD (VII)

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DPD (VII)

BUGS

--

NAME                `getty -- set typewriter mode and get user's name`

SYNOPSIS            `/etc/getty`

#### DESCRIPTION

`getty` is invoked by `init` (VII) immediately after a typewriter is opened following a dial-in. The user's login name is read and the `login(I)` command is called with this name as an argument. While reading this name `getty` attempts to adapt the system to the speed and type of terminal being used.

`getty` initially sets the speed of the interface to 150 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 37 Teletype terminal into full-duplex and unlock its keyboard). 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. The speed is then changed to 300 baud and the "login:" is typed again, this time with the appropriate sequence which puts a GE TermiNet 300 into full-duplex. This sequence is acceptable to other 300 baud terminals also. If a subsequent null character is received, the speed is changed again. The general approach is to cycle through a set of speeds in response to null characters caused by breaks. The sequence at this installation is 150, 300, and 134.5 baud.

Detection of IBM 2741s is accomplished while the speed is set to 150 baud. The user sends a 2741 style "eot" character by pushing the attention key or by typing return; at 150 baud, this character looks like the ascii "~" (174988). Upon receipt of the "eot", the system is set to operate 2741s and a "login: " message is typed.

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 nonempty, the system is told to map any future upper-case characters into the corresponding lower-case characters. Thus UNIX is usable from upper-case-only terminals.

Finally, `login` is called with the user's name as argument.

FILES                --

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GETTY (VII)

SEE ALSO        init(VII), login(I), stty(II)



NAME            glob -- generate command arguments

SYNOPSIS        /etc/glob

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 command itself. The actions of glob are detailed in the Shell writeup.

FILES           found in /etc/glob

SEE ALSO        sh(I)

DIAGNOSTICS    "No match", "No command", "No directory"

BUGS            If any of original command line, even the quoted metacharacters are expanded.

glob gives the "No match" diagnostic only if no arguments at all result. This is never the case if there is any argument without a metacharacter.

NAME greek -- graphics for extended ascii 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	A	A	beta	B	B	gamma	\	\
GAMMA	G	G	delta	D	D	DELTA	W	W
epsilon	S	S	zeta	Q	Q	eta	N	N
theta	T	T	THETA	O	O	lambda	L	L
LAMBDA	E	E	mu	M	M	nu	@	@
xi	X	X	pi	J	J	PI	P	P
rho	K	K	sigma	Y	Y	SIGMA	R	R
tau	I	I	phi	U	U	PHI	F	F
psi	V	V	PSI	H	H	omega	C	C
OMEGA	Z	Z	nabla	[	[	not	-	-
partial	]	]	integral	^	^			

FILES --

SEE ALSO ascii (VII)

DIAGNOSTICS --

BUGS --

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 tty is opened for reading and writing and the shell is invoked immediately. This feature is used to bring up a test system, or one which does not contain DC-11 communications interfaces. When the system is brought up in this way, the getty and login routines mentioned below and described elsewhere are not needed.

Otherwise, init does some housekeeping: the mode of each DEctape file is changed to 17 (in case the system crashed during a tap command); directory /usr is mounted on the RK0 disk; directory /sys is mounted on the RK1 disk. Also a data-phone daemon is spawned to restart any jobs being sent.

Then init forks several times to create a process for each typewriter mentioned in an internal table. 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 dialled in (and carrier established) on the channel. Then the process executes the program /etc/getty (q.v.). getty will read the user's name and invoke login (q.v.) 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 wtmp, which maintains a history of logins and logouts. Then the appropriate typewriter is reopened and getty reinvoked.

FILES               /dev/tap?, /dev/tty, /dev/tty?, /tmp/utmp,  
                      /tmp/wtmp

SEE ALSO           login(I), login(VII), getty(VII), sh(I), dpd(VII)

DIAGNOSTICS       none possible

INIT (VII)

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INIT (VII)

BUGS

none possible

NAME            msh -- mini-shell

SYNOPSIS        /etc/msh

DESCRIPTION    msh is a heavily simplified version of the Shell. It reads one line from the standard input file, interprets it as a command, and calls the command.

The mini-shell supports few of the advanced features of the Shell; none of the following characters is special:

> < \$ \ ; &

However, "\*", "[", and "?" are recognized and glob is called. The main use of msh is to provide a command-executing facility for various interactive sub-systems.

FILES           --

SEE ALSO        sh(I), glob(VII)

DIAGNOSTICS    "?"

BUGS           --

NAME            tabs -- set tab stops

SYNOPSIS        cat /usr/pub/tabs

DESCRIPTION    When printed on a suitable terminal, this file  
                 will set tab stops every 8 columns. Suitable  
                 terminals include the Teletype model 37 and the  
                 GE TerminiNet 300.

                 These tab stop settings are desirable because  
                 UNIX assumes them in calculating delays.

FILES           --

SEE ALSO        --

DIAGNOSTICS    --

BUGS            --

NAME vsp -- voice synthesizer code

SYNOPSIS cat /usr/pub/vsp

DESCRIPTION vsp contains a list of phonemes understood by the voice synthesizer on device vt. Phonemes are usually written in the form

comma inflection phoneme

The inflection and the phoneme codes are or-ed together. The phoneme codes are as follows (numbers in octal).

0 = 300	strong inflection	p = 32	<u>p</u> enny <u>p</u> ound
1 = 200		a0 = 33	con <u>t</u> act <u>c</u> ar
2 = 100		a1 = 52	co <u>n</u> nect
3 = 000	weak inflection	ai = 37	na <u>m</u> e <u>c</u> ame
		aj = 71	na <u>m</u> ely
aw = 02	<u>a</u> wful <u>l</u> aw	s = 40	<u>s</u> even <u>s</u> ix
ie = 03	<u>z</u> ero	d = 41	<u>d</u> o <u>d</u> iet
e0 = 04	<u>e</u> nter <u>m</u> et	f = 42	<u>f</u> our <u>f</u> ive
e1 = 76	<u>s</u> even	g = 43	<u>g</u> et <u>g</u> rand
e2 = 77	<u>s</u> even	h = 44	<u>h</u> ello <u>h</u> ow
er = 05	wea <u>t</u> her	j = 45	<u>j</u> udge <u>e</u> dge
th = 06	<u>t</u> hree <u>t</u> hick	k = 46	<u>c</u> ame <u>l</u> ock
dh = 07	<u>t</u> his <u>t</u> hen	l = 47	<u>h</u> ello <u>l</u> ight
yu = 27	<u>u</u> se <u>y</u> ou	oo = 50	<u>l</u> ook <u>b</u> ook
iu = 10	<u>u</u> nite	ou = 51	<u>g</u> ood <u>s</u> h <u>ou</u> d
ju = 11	<u>n</u> ew <u>y</u> ou	ng = 53	<u>r</u> ing <u>a</u> n <u>g</u> le
o0 = 31	<u>o</u> nly <u>n</u> o	z = 55	<u>z</u> ero <u>h</u> azy
o1 = 12	<u>h</u> ello	sh = 56	<u>s</u> how <u>s</u> hip
o2 = 13	<u>n</u> otice	ch = 57	<u>c</u> hair <u>c</u> hime
u0 = 14	<u>b</u> ut <u>m</u> ust	v = 60	<u>s</u> even <u>e</u> ven
u1 = 15	<u>u</u> ncle	b = 61	<u>b</u> all <u>b</u> ed
u2 = 16	stir <u>r</u> up	n = 62	<u>n</u> ine <u>s</u> even
u3 = 34	app_ <u>l</u> e ab_ <u>l</u> e	m = 63	<u>m</u> ile <u>m</u> en
ae = 21	<u>c</u> at <u>s</u> at	iy = 66	<u>l</u> ie
ea = 20	<u>a</u> ntenna	zh = 70	<u>a</u> zure <u>p</u> leas <u>u</u> re
w = 22	<u>w</u> on <u>w</u> ish	ih = 72	stat <u>i</u> on <u>c</u> ondit <u>i</u> on
ee = 23	<u>t</u> hree	ay = 36	<u>m</u> ay <u>l</u> ay
r = 24	<u>r</u> adio <u>r</u> adar		
t = 25	<u>t</u> wo <u>t</u> ime	-0 = 35	long space
ey = 26	<u>s</u> ix <u>t</u> y <u>e</u> ight <u>y</u>	-1 = 17	
i0 = 30	<u>s</u> ix <u>m</u> ix	-2 = 01	
i1 = 64	<u>i</u> nept <u>i</u> nside	-3 = 74	short delay
i2 = 65	crypt <u>i</u> c stat <u>i</u> c		

SEE ALSO speak(I), vt(IV)

NAME            20boot -- install new 11/20 system

SYNOPSIS        20boot [ x ]

DESCRIPTION     This shell command file copies the current version of the 11/20 program used to run the VT01 display onto the /dev/vt0 file.

                If no argument is given, the 11/20 program should be executing but idle; the 11/20 program is sent preceded by a "reboot" command. If an argument is given, the 11/20 should have been restarted at its ROM location 777300.

FILES           /dev/vt0;  
                /sys/mdec/20.o (11/20 program)

SEE ALSO        vt0 (IV)

DIAGNOSTICS     --



NAME               acct -- login accounting

SYNOPSIS           acct [ -w wtmp ] [ -p ] [ -d ] people

DESCRIPTION       acct 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. The people argument will limit the printout to only the specified login names. If no wtmp file is given, /usr/adm/wtmp is used.

FILES             /usr/adm/wtmp

SEE ALSO          init(VII), login(I), wtmp(V).

DIAGNOSTICS       "Cannot open 'wtmp'" if argument is unreadable.

BUGS             --

NAME                    bos, maki, vcboot, msys, et al.

DESCRIPTION

On the RF disk, the highest 16K words are reserved for stand-alone programs. These 16K words are allocated as follows:

bos	(1K)
Warm UNIX	(7K)
Cold UNIX	(8K)

The program bos (Bootstrap Operating System) examines the console switches and executes one of several internal programs depending on the setting. The following settings are currently recognized:

???	Will read Warm UNIX from the RF into core location 0 and transfer to 600.
1	Will read Cold UNIX from the RF into core location 0 and transfer to 600.
10	Will dump all of memory from core location 0 onto DECTape drive 7 and then halt.
20	Will read 256 words from RK0 into core 0 and transfer to zero. This is the procedure to boot DOS from an RK.
40	This is the same as 10 above, but instead of halting, UNIX warm is loaded.
0	Will load a standard UNIX binary paper tape into core location 0 and transfer to 0.
77500	Will load the standard DEC absolute and binary loaders and transfer to 77500.

All manual methods of booting the system involve manipulation of the console switches. In order for this to be possible, the panel must be unlocked and the machine must be halted. Also, remember that at the time UNIX comes up, the console switches must contain 773030 for a single-user system; anything else gives a multi-user system.

There are four temperatures of boots. They are:

Hot boot: restart the system without refreshing its code, that is simply by transferring to its start. The only use for this procedure is if the system has been patched and one doesn't wish to redo the patches. The procedure is:

600 in switches	Load address
-----------------	--------------

(773030 in switches for single-user system)  
start

Warm boot: refresh system code from the RF disk, but the "panic" routine must be in core. Best for general use if it works, since outstanding I/O is cleaned up. Procedure:

602 in switches                      load address  
(773030 in switches for single-user system)  
start (flushes any I/O, then executes bos)

Cool boot: RF disk is OK, but nothing in core. Procedure:

UTIL DECTape on drive 0                      773030 in  
switches                      load address                      (602 in switches  
for multi-user system)                      start                      type  
"boot" on console tty to load bos

Cold boot: nothing in core, nothing on RF. Best to have an expert around for this one. Procedure:

INIT DECTape on drive 0                      773030 in  
switches                      load address                      1 in switches  
start                      (machine halts. last chance to  
preserve RF!)                      773030 in switches  
continue                      (reads in basic files)

UNIX is then up, but for various reasons, one should do a warm boot (single user) right away. At this point also, one might consider whether the INIT tape UNIX is the latest version. If there is reason for doubt, mount the /sys disk pack, change to directory /sys/sys, do "msys u unix", and reboot. Then get the /bin-/etc-/lib tape which contains the rest of of the RF disk, and do an "mt x". Conceivably, "create errors" due to lack of some directories will occur; make the directories, then try again. Set the date correctly; the system starts off at time 0.

At this point UNIX is in full operation and can be rebooted for a multi-user system.

Here is what happens during a cold boot: the INIT tape contains a program called vcboot. The ROM program reads vcboot from the tape into core location 0 and transfers to it. vcboot then reads 16K words from the DECTape (blocks 1-32) and copies the data to the highest 16K words of the RF. Thus this initializes the read-only part of the RF. vcboot then reads in bos and executes it. bos reads in Cold UNIX and executes that. Cold UNIX halts for a last chance before it completely initializes the RF file system. When continue is pressed, Cold UNIX

initializes the RF. It then reads the DECTape for initialization files starting from block 33. Normal operation then commences with the execution of `/etc/init`.

The INIT tape is made by the program `maki` running under UNIX. `maki` writes `vcboot` on block 0 of `/dev/tap7`. It then copies the RF 16K words (using `/dev/rf0`) onto blocks 1 thru 32. It has internally a list of files to be copied from block 33 on. This list follows:

```
/etc/init
/bin/chmod
/bin/date
/bin/login
/bin/ls
/bin/mkdir
/etc/mount
/bin/sh
/bin/tap
/bin/mt
```

Thus this is the set of programs available after a cold boot. `init` and `sh` are mandatory. For multi-user UNIX, `getty` and `login` are also necessary. `mkdir` is necessary due to a bug in `tap`. `mt`, `tap` and `mount` are useful to bring in new files. As soon as possible, `date` should be done. That leaves `ls` and `chmod` as frosting.

The last link in this incestuous daisy chain is the program `msys`.

`msys` char file

will copy the file `file` onto the RF read only slot specified by the character `char`. Char is taken from the following set:

```
b bos
u Warm UNIX
l Cold UNIX
```

FILES            `/dev/rf0`, `/dev/tap?`

SEE ALSO        `init(VII)`, `tap(I)`, `sh(I)`, `mkdir(I)`

DIAGNOSTICS     --

BUGS            This section is very configuration dependent.

NAME                   check -- file system consistency check

SYNOPSIS               check [ filesystem [ blockno918 ... ] ]

DESCRIPTION           check will examine a file system, build a bit map of used blocks, and compare this bit map against the bit map maintained on the file system. If the file system is not specified, a check of all of the normally mounted file systems is performed. Output includes the number of files on the file system, the number of these that are 'large', the number of indirect blocks, the number of used blocks, and the number of free blocks.

check works by examining the i-nodes on the file system and is entirely independent of its directory hierarchy. The file system may be, but need not be, mounted.

FILES                  /dev/rf?, /dev/rk?, /dev/rp?

SEE ALSO               find(I), ds(I)

DIAGNOSTICS           Diagnostics are produced for blocks missing, duplicated, and bad block addresses. Diagnostics are also produced for block numbers passed as parameters. In each case, the block number, i-number, and block class (i = inode, x indirect, f free) is printed.

BUGS                   The checking process is two pass in nature. If checking is done on an active file system, extraneous diagnostics may occur.

NAME           chk -- check + dcheck

SYNOPSIS       chk

DESCRIPTION    This command file does a check and a dcheck of  
all of the normally mounted file systems.

FILES          /dev/[fkp]\*

SEE ALSO       check (VIII), dcheck (VIII)

DIAGNOSTICS    see "SEE ALSO"

NAME                clri -- clear i-node

SYNOPSIS            clri i-number [ file system ]

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 a check 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.

DIAGNOSTICS        "error"

NAME                dcheck -- directory consistency check

SYNOPSIS           dcheck [ -l ] [ device ]

DESCRIPTION        dcheck builds an image of the directory hierarchy of the specified device by reading all its directories (using physical I/O guided by the i-nodes on the device). A list entry is made for each file encountered. A second pass reads the i-nodes and for each file compares the number of links specified in its i-node with the number of entries actually seen. All discrepancies are noted.

                    If no device is specified, a default device is assumed.

                    The argument -l causes a complete listing of the file names on the device in i-node order.

FILES               /dev/rk?

SEE ALSO            check(VIII)

DIAGNOSTICS        inconsistent i-numbers, unnamed files, unreachable files, loops in directory "hierarchy".

BUGS                Unreachable files and loops are discovered only under the "-l" option.



NAME            dli -- load DEC binary paper tapes

SYNOPSIS        dli output [input]

DESCRIPTION     dli will load a DEC binary paper tape into the  
                 output file. The binary format paper tape is  
                 read from the input file (/dev/ppt is default.)

FILES           /dev/ppt

SEE ALSO        --

DIAGNOSTICS     "checksum"

BUGS            --

NAME            `istat -- get inode status`

SYNOPSIS        `istat [ filesystem ] inumber1 ...`

DESCRIPTION     `istat` gives information about one or more i-nodes on the given file system or on `/dev/rk0` if no file system is given.

                The information is in exactly the same form as that for `stat(I)`, except that mode letter "a" is used to indicate that the i-node is allocated, "u" that it is unallocated.

FILES           `/etc/uids, /dev/rk0`

SEE ALSO        `stat(I), ls(I) (-l option)`

DIAGNOSTICS     --

BUGS            `istat` ignores any read error and pretends to give status even if the file system is not physically present.

NAME            kill -- terminate process with extreme prejudice

SYNOPSIS        /usr/adm/kill processnumber

DESCRIPTION    After ps (q.v.) has given you the unique ID of a process, you can terminate it by this command. A core image is produced in the process's working directory.

                Only the super-user can exercise this privilege.

FILES           --

SEE ALSO        ps (VIII)

DIAGNOSTICS    yes

BUGS            If the process has executed sys nice (II) and there is another process which has not, but which loops, the first process cannot be done in properly, since it has to be swapped in so as cooperate in its own murder.

                It would also be nice if ordinary people could kill their own processes.

NAME           mount -- mount file system

SYNOPSIS        /etc/mount special file

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.

FILES           --

SEE ALSO        umount (VIII)

DIAGNOSTICS     "?", if the special file is already in use, cannot be read, or if file does not exist.

BUGS           Should be usable only by the super-user. Mounting file systems full of garbage can crash the system.

NAME                ps -- process status

SYNOPSIS            /usr/adm/ps [ -xlt ]

DESCRIPTION

ps prints certain facts about active processes. The information is columnar and consists of:

The (numerical) ID of the user associated with the process;

The last character of the control typewriter of the process or "x" if there is no control typewriter; "x" lines are suppressed unless the "x" option is given.

The number of 512-byte disk blocks holding the core image of the process;

The process's unique ID (only with "l" option)

The number of hours (mod 100) and minutes of system, disk, and user-process time accumulated by the process and all its terminated descendants (only with "t" option)

An educated guess as to the command line which caused the process to be created.

Some caveats:

The guess as to the command name and arguments is obtained by examining the process's stack. The process is entitled to destroy this information. Also, only processes whose core images are on disk have visible names. The ps command in particular does not, nor does any other process which happens to be in core at the same time. ps tries to overcome this limitation by spawning a subprocess designed to take up the other core slot, and is usually successful. Because ps examines a dynamically changing data structure, it can produce incorrect results, for example if a process's core image moves between the time ps gets its disk address and reads its stack.

Besides its utility for simple spying, ps is the only plausible way to find the process number of someone you are trying to kill (VIII).

FILES                /dev/rf0, /sys/sys/unix (to get magic numbers).

SEE ALSO            kill (VIII)

DIAGNOSTICS        "Bad RF", if a bad swap address turns up; various missing-file diagnostics.

PS (VIII)

1/20/73

PS (VIII)

BUGS

As described.

NAME               salv -- file system salvage

SYNOPSIS            /etc/salv filesystem [ -akfs ]

DESCRIPTION

salv will place a given file system in a consistent state with almost no loss of information. This is the first step in putting things together after a bad crash. Salv performs the following functions:

    A valid free list is constructed.

    The previous step is always performed; the following steps are performed only if the "a" option is given. If the file system's only defect is missing blocks, "a" should not be specified.

    All bad pointers in the file system are zeroed.

    All duplicate pointers to the same block are resolved by changing one of the pointers to point at a new block containing a copy of the data.

    Inodes (not directory entries) for special files are generated (mode 16).

    Files whose size is too large for the number of blocks they contain (after bad pointers are zeroed) have their size revised downward.

    The file system should be unmounted while it is being salvaged. In cases of extreme need the permanently mounted file system may be salvaged; in such a case the system must be rebooted before it has a chance to write out the old, bad super-block.

    The "k", "f", and "s" options tell salv what magic numbers to use to generate the size of the free list and the i-node map. "k" is default (RK disk); "f" is RF; "s" is RK with swap space on it. If salv is to be used away from the mother system its code should be checked to verify the numbers.

    After a salv, files may be safely created and removed without causing more trouble. If the "a" option had to be used, a dcheck (VIII) should be done to find the degree of the damage to the hierarchy.

FILES               /dev/rk0

SEE ALSO            check(I), ds(I)

DIAGNOSTICS        --

## BUGS

In only one (known) way does salv destroy information: if some random block appears to be an indirect block for a file, all "bad pointers" (for example, ASCII text) in it will be zeroed. If the block also appears in another file, it may be scribbled on before it is copied.



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.

                To remind the super-user of his responsibilities, the shell substitutes "#" for its usual prompt "%".

FILES           --

SEE ALSO        sh(I)

DIAGNOSTICS     "Sorry" if password is wrong

BUGS           --

NAME            swtmp -- update accounting file

SYNOPSIS        swtmp

DESCRIPTION     This shell sequence concatenates /tmp/wtmp onto  
                 /usr/adm/wtmp and truncates /tmp/wtmp. It should  
                 be used before using acct(VIII) and every so of-  
                 ten in any case if accounting is to be main-  
                 tained.

FILES           /tmp/wtmp, /usr/adm/wtmp

SEE ALSO        acct(VIII), wtmp(V)

NAME           tm   --   provide time information

SYNOPSIS       tm

DESCRIPTION    tm is used to provide timing information.  Output like the following is given:

```
tim 371:51:09      2:00.8
ovh  20:00:33      17.0
swp  13:43:20       4.6
dsk  27:14:35       4.5
idl 533:08:03      1:33.3
usr  24:53:50       1.2
der   0,  54       0,   0
```

The first column of numbers gives totals in the named categories since the last time the system was cold-booted; the second column gives the changes since the last time tm was invoked. The top left number is badly truncated and should be ignored. ovh is time spent executing in the system; swp is time waiting for swap I/O; dsk is time spent waiting for file system disk I/O; idl is idle time; usr is user execution time; der is RF disk error count (left number) and RK disk error count (right number).

FILES           /dev/rf0 (for absolute times); /tmp/ttmp for differential timing history.

SEE ALSO       time(I), file system(V)

DIAGNOSTICS    --

BUGS           --

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.

                  The user must take care not only that all I/O ac-  
tivity on the file system has ceased, but that no  
one has his current directory on it.

                  Only the super-user may issue this command.

FILES              --

SEE ALSO           mount (VIII)

DIAGNOSTICS        "?"

BUGS               This command is not, in fact, restricted to the  
super-user.