

UNIX PROGRAMMER'S MANUAL

Second Edition

K. Thompson

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PREFACE
to the Second Edition

In the months since this manual first appeared, 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, and J. F. Ossanna for their contributions.

Finally, the number of UNIX installations has grown to 10, 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. One area to watch concerns commands which deal with special files (I/O devices). Another is places which talk about such things as absolute core locations which are likely to vary with the memory configuration and existence of protection hardware. Also, not all installations have the latest versions of all the software. In particular, the assembler and loader have just undergone major reorganizations in anticipation of a UNIX for the PDP-11/45.

INTRODUCTION

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 Inevitably, this means that many sections will soon be out of date.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 disarmingly 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 seven sections:

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

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.

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.

Each section consists of a number of independent entries of a page or so each. The name of the entry is in the upper right corner of its pages, its preparation date in the upper left. Entries within each section are alphabetized. It was thought better to avoid running page numbers, since it is hoped that the manual will be updated frequently. Therefore each entry is numbered starting at page 1.

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.

The owner section gives the name of the person or persons to be consulted in case of difficulty. The rule has been that the last one to modify something owns it, so the owner is not necessarily the author. The owner's nicknames stand for:

ken	K. Thompson
dmr	D. M. Ritchie
jfo	J. F. Ossanna
rhm	R. Morris
doug	M. D. McIlroy
lem	L. E. McMahon
llc	L. L. Cherry
csr	C. S. Roberts

These nicknames also happen to be UNIX user ID's, so messages may be transmitted by the mail command or, if the addressee is logged in, by write.

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.

TABLE OF CONTENTS

I. COMMANDS

:	place label
acct	get connect-time accounting
ar	archive (combine) files
as	assembler
bas	BASIC dialect
cat	concatenate (or print) files
cc	compile C program
chdir	change working directory
check	check consistency of file system
chmod	change access mode of files
chown	change owner of files
cmp	compare file contents
cp	copy file
date	get date and time of day
db	symbolic debugger
dc	desk calculator
df	find free disk space
dpd	spawn data-phone daemon
ds	verify directory hierarchy
dsw	delete files interactively
du	find disk usage
echo	print command arguments
ed	text editor
exit	end command sequence
fc	compile Fortran program
fed	form-letter editor
find	find file with given name
form	generate form letter
goto	command transfer
if	conditional command
istat	file status by i-number
ld	link editor (loader)
ln	link to file
login	log on to system
ls	list contents of directory
mail	send mail to another user
man	run off manual section
mesg	permit or deny messages
mkdir	create directory
mount	mount detachable file system
mt	save/restore files on magtape
mv	move or rename file
m6	macroprocessor
nm	print namelist
nroff	format text for printing
od	octal dump of file
opr	print file off-line
ov	page overlay file print
pr	print file with headings
rew	rewind DECTape
rm	remove (delete) file

rmdir	remove (delete) directory
roff	format text for printing
salv	repair damaged file system
sh	command interpreter
sort	sort ASCII file
stat	get file status
strip	remove symbols, relocation bits
stty	set typewriter modes
su	become super-user
sum	sum file
tacct	connect-time accounting
tap	manipulate DECTape
tm	get time information
tss	communicate with MH-TSS (GCOS)
tty	find name of terminal
type	print file page-by-page
umount	dismount removable file system
un	find undefined symbols
wc	get (English) word count
who	who is on the system
write	write to another user

II. SYSTEM CALLS

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
exec	execute program file
exit	terminate execution
fork	create new process
fstat	status of open file
getuid	get user ID
gtty	get typewriter mode
hog	set low-priority status
ilgins	catch illegal instruction trap
intr	catch or inhibit interrupts
link	link to file
kill	destroy process
mkdir	create directory
mdate	set date modified of file
mount	mount file system
open	open file
quit	catch or 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
tell	find read or write pointer
time	get time of year
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
const	floating-point constants
ctime	convert time to ASCII
exp	exponential function
fptrap	floating-point simulator
ftoa	convert floating to ASCII
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
ptime	print time
putc	write character or word
qsort	quicker sort
salloc	storage allocator
sin	sine, cosine
sqrt	square root
switch	transfer depending on value

IV. SPECIAL FILES

dn0	801 ACU
dp0	201 Dataphone
lpr	line printer
mem	core memory
mt0	magtape
ppt	punched paper tape
rf0	RF disk
rk0	RK disk
rp0	RP disk
tap0	DECtape
tty	console typewriter
tty0	remote typewriter

V. FILE FORMATS

a.out	assembler and loader output
archive	archive file
core	core image file

directory	directory format
file system	file system format
ident	GCOS ident cards
passwd	password file
tap	DECTape format
uids	map names to user ID's
utmp	logged-in user information
wtmp	accounting files

VI. USER MAINTAINED PROGRAMS

basic	DEC supplied BASIC
bc	compile B program
bj	the game of black jack
bj	print calendar
cal	prepare symbol table
chash	cross-reference table
cref	disassembler
das	load DEC binary paper tapes
dli	read DEC ASCII paper tapes
dpt	the game of MOO
moo	permuted index
ptx	compile tmgl program
tmg	the game of tic-tac-toe
ttt	

VII. MISCELLANEOUS

ascii	map of ASCII
bproc	boot procedure
getty	adapt to typewriter
glob	argument expander
init	initializer process
kbd	map of TTY 37 keyboard
login	how to log onto system
msh	mini Shell
tabs	set tab stops on typewriter

INDEX

:(I): place label
a.out(V): assembler and loader output
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accounting
accounting
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salloc(III): storage
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write(I): write to
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archive(V):
atan(III):
glob(VII):
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atof(III): convert
atoi(III): convert
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accounting
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another user
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dc(I):	calculator
cal(VI):	calendar
cal(VI):	print calendar
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cemt(II):	catch EMT traps
ilgins(II):	catch illegal instruction trap
intr(II):	catch or inhibit interrupts
quit(II):	catch or inhibit quits
cat(I):	concatenate (or print) files
cc(I):	compile C program
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
putc(III):	write character or word
getc(III):	get character
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	check consistency of file system
	check(I): check consistency of file system
	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
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	close(II): close open file
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	cmp(I): compare file contents
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	cc(I): compile C program
	fc(I): compile Fortran program
	tmg(VI): compile tmgl program
	hypot(III): compute hypotenuse
	cat(I): concatenate (or print) files
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	const(III): floating-point constants
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 dc(I): desk calculator
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 dsw(I): delete files interactively
 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
 mount(I): mount detachable file system
 bas(I): BASIC df(I): find free disk space
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 directory(V): directory format
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	creat(II): create	file
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	link(II): link to	file
	ln(I): link to	file
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	open(II): open	file
	passwd(V): password	file
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	roff(I):	form-letter editor
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	df(I): find	Fortran program
		fptrap(III): floating-point simulator
		free disk space
		fstat(II): status of open file
		ftoa(III): convert floating to ASCII

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 gerts(III): communicate with GCOS
 communicate with MH-TSS
 form(I): generate form letter
 getc(III): get character
 acct(I): get connect-time accounting
 date(I): get date and time of day
 wc(I): get (English) word count
 stat(I): get file status
 stat(II): get file status
 tm(I): get time information
 time(II): get time of year
 gtty(II): get typewriter mode
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 ident(V): GCOS ident cards
 ID
 ID
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 ilgins(II): catch illegal instruction trap
 illegal instruction trap
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 information
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 inhibit quits
 initializer process
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 instruction trap
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 integer
 interactively
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 intr(II): catch or inhibit interrupts

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 a.out(V): assembler and
 ld(I): link editor
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 mt(I): save/restore files on
 mt0(IV):
 mail(I): send
 tap(I):
 man(I): run off
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 mem(IV): core
 mesg(I): permit or deny
 tss(I): communicate with
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 chmod(I): change access
 chmod(II): change
 stty(II): set
 stty(I): set typewriter
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 istat(I): file status by i-number
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 keyboard
 kill(II): destroy process
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 link editor (loader)
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 link to file
 link(II): link to file
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 ln(I): link to file
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 log onto system
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 logged-in user information
 log(III): logarithm base e
 login(I): log on to system
 login(VII): how to log onto system
 low-priority status
 lpr(IV): line printer
 ls(I): list contents of directory
 macroprocessor
 magtape
 mail to another user
 mail(I): send mail to another user
 mkdir(II): create directory
 man(I): run off manual section
 manipulate DECTape
 manual section
 map names to user ID's
 map of ASCII
 map of TTY 37 keyboard
 mdate(II): set date modified of file
 mem(IV): core memory
 memory
 mesg(I): permit or deny messages
 mesg(III): print string on typewriter
 messages
 MH-TSS (GCOS)
 mini Shell
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 mode of typewriter
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	mount file system
mv(I):	mount(I): mount detachable file system
seek(II):	mount(II): mount file system
	move or rename file
	move read or write pointer
	msh(VII): mini Shell
find(I): find file with given	mt(I): save/restore files on magtape
fork(II): create	mt0(IV): magtape
	mv(I): move or rename file
	m6(I): macroprocessor
	name list
nlist(III): read	name of terminal
tty(I): find	namelist
nm(I): print	names to user ID's
uids(V): map	name
find(I): find file with given	new process
fork(II): create	nlist(III): read name list
	nm(I): print namelist
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od(I):	octal dump of file
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opr(I): print file	off manual section
login(VII): how to log	off-line
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fstat(II): status of	open file
open(II):	open file
	open file
cat(I): concatenate	open(II): open file
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chown(II): change	ov(I): page overlay file print
ov(I):	owner of files
type(I): print file	owner of file
dli(VI): load DEC binary	page overlay file print
dpt(VI): read DEC ASCII	page-by-page
ppt(IV): punched	paper tapes
	paper tapes
	paper tape
passwd(V):	passwd(V): password file
mesg(I):	password file
ptx(VI):	permit or deny messages
:(I):	permuted index
seek(II): move read or write	place label
tell(II): find read or write	pointer
	pointer
chash(VI):	ppt(IV): punched paper tape
	prepare symbol table
cal(VI):	pr(I): print file with headings
echo(I):	print calendar
	print command arguments

opr(I):	print file off-line
type(I):	print file page-by-page
pr(I):	print file with headings
cat(I): concatenate (or	print) files
nm(I):	print namelist
mesg(III):	print string on typewriter
ptime(III):	print time
lpr(IV):	line printer
nroff(I):	format text for printing
roff(I):	format text for printing
ov(I):	page overlay file
bproc(VII):	boot procedure
rele(II):	release processor
fork(II):	create new process
init(VII):	initializer process
kill(II):	destroy process
wait(II):	wait for process
break(II):	set program break
exec(II):	execute program
bc(VI):	compile B program
cc(I):	compile C program
fc(I):	compile Fortran program
tmg(VI):	compile tmgl program
ppt(IV):	ptime(III): print time ptx(VI): permuted index punched paper tape putc(III): write character or word qsort(III): quicker sort quicker sort quit(II): catch or inhibit quits quits
quit(II):	catch or inhibit dpt(VI): read DEC ASCII paper tapes
read(II):	read file
nlist(III):	read name list
seek(II):	read or write pointer
tell(II):	read or write pointer
rele(II):	read(II): read file release processor rele(II): release processor relocation bits
strip(I):	remove symbols, remote typewriter
tty0(IV):	removable file system
umount(I):	dismount 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(I):	repair damaged file system
rew(I):	rew(I): rewind DECTape rewind DECTape
rf0(IV):	RF disk
rk0(IV):	RK disk rk0(IV): RK disk
rmdir(I):	remove (delete) directory
rm(I):	remove (delete) file

```

        sqrt(III): square
                    rp0(IV):
                    man(I):
                    mt(I):
man(I): run off manual
                    mail(I):
exit(I): end command
                    mdate(II):
                    hog(II):
                    stty(II):
                    break(II):
                    stime(II):
                    tabs(VII):
                    stty(I):
setuid(II):
                    msh(VII): mini
fptrap(III): floating-point
                    sin(III):
                    sort(I):
                    qsort(III): quicker
df(I): find free disk
                    dpd(I):
                    sqrt(III):
                    istat(I): file
                    fstat(II):
hog(II): set low-priority
                    stat(I): get file
                    stat(II): get file
tabs(VII): set tab
                    salloc(III):
mesg(III): print
                    sum(I):
su(I): become
basic(VI): DEC
chash(VI): prepare
                    db(I):
roff(I): format text for printing
root
RP disk
rp0(IV): RP disk
run off manual section
salloc(III): storage allocator
salv(I): repair damaged file system
save/restore files on magtape
section
seek(II): move read or write pointer
send mail to another user
sequence
set date modified of file
set low-priority status
set mode of typewriter
set program break
set system time
set tab stops on typewriter
set typewriter modes
set user ID
setuid(II): set user ID
Shell
sh(I): command interpreter
simulator
sine, cosine
sin(III): sine, cosine
sleep(II): delay execution
sort ASCII file
sort(I): sort ASCII file
sort
space
spawn data-phone daemon
sqrt(III): square root
square root
stat(I): get file status
stat(II): get file status
status by i-number
status of open file
status
status
status
status
stime(II): set system time
stops on typewriter
storage allocator
string on typewriter
strip(I): remove symbols, relocation bits
stty(I): set typewriter modes
stty(II): set mode of typewriter
su(I): become super-user
sum file
sum(I): sum file
super-user
supplied BASIC
switch(III): transfer depending on value
symbol table
symbolic debugger

```

strip(I): remove	symbols, relocation bits
un(I): find undefined	symbols
sync(II): assure	synchronization
file system(V): file	system format
stime(II): set	system time
file	system(v): file system format
check consistency of file	system...check(I):
login(I): log on to	system
login(VII): how to log onto	system
mount detachable file	system...mount(I):
mount(II): mount file	system
salv(I): repair damaged file	system
dismount removable file	system...umount(I):
umount(II): dismount file	system
who(I): who is on the	system
tabs(VII): set	tab stops on typewriter
chash(VI): prepare symbol	table
cref(VI): cross-reference	table
load DEC binary paper	tabs(VII): set tab stops on typewriter
dpt(VI): read DEC ASCII paper	tacct(I): connect-time accounting
ppt(IV): punched paper	tapes...dli(VI):
tty(I): find name of	tapes
exit(II):	tape
ed(I):	tap(I): manipulate DECtape
nroff(I): format	tap(V): DECtape format
roff(I): format	tap0(IV): DECtape
ttt(VI): the game of	tell(II): find read or write pointer
tm(I): get	terminal
date(I): get date and	terminate execution
time(II): get	text editor
ctime(III): convert	text for printing
ptime(III): print	text for printing
stime(II): set system	tic-tac-toe
tmg(VI): compile	time information
 	time of day
switch(III):	time of year
goto(I): command	time to ASCII
cempt(II): catch EMT	time(II): get time of year
catch illegal instruction	time
 	time
kbd(VII): map of	tmgl program
 	tmg(VI): compile tmgl program
trap...ilgins(II):	tm(I): get time information
tss(I): communicate with MH-TSS (GCOS)	transfer depending on value
ttt(VI): the game of tic-tac-toe	transfer
TTY 37 keyboard	traps
tty(I): find name of terminal	trap...ilgins(II):
tty(IV): console typewriter	tss(I): communicate with MH-TSS (GCOS)
tty0(IV): remote typewriter	ttt(VI): the game of tic-tac-toe
type(I): print file page-by-page	TTY 37 keyboard
stty(I): set	tty(I): find name of terminal
	tty(IV): console typewriter
	tty0(IV): remote typewriter
	type(I): print file page-by-page
	stty(I): set typewriter modes

gtty(II): get	typewriter mode
getty(VII): adapt to	typewriter
mesg(III): print string on	typewriter
stty(II): set mode of	typewriter
tabs(VII): set tab stops on	typewriter
tty(IV): console	typewriter
tty0(IV): remote	typewriter
	uids(V): map names to user ID's
un(I): find	umount(I): dismount removable file system
	umount(II): dismount file system
	undefined symbols
du(I): find disk	un(I): find undefined symbols
uids(V): map names to	unlink(II): remove (delete) file
	usage
getuid(II): get	user ID's
setuid(II): set	user ID
utmp(V): logged-in	user ID
mail(I): send mail to another	user information
write(I): write to another	user
	user
transfer depending on	utmp(V): logged-in user information
	value...switch(III):
ds(I):	verify directory hierarchy
wait(II):	wait for process
	wait(II): wait for process
who(I):	wc(I): get (English) word count
	who is on the system
gerts(III): communicate	who(I): who is on the system
	with GCOS
find(I): find file	with given name
	with headings
pr(I): print file	with MH-TSS (GCOS)
	word count
tss(I): communicate	word
	working directory
wc(I): get (English)	working directory
putc(III): write character or	putc(III): write character or word
	write file
chdir(I): change	write pointer
	write pointer
chdir(II): change	write to another user
	write(I): write to another user
putc(III):	write(II): write file
	wtmp(V): accounting files
write(II):	year
seek(II): move read or	801 ACU
tell(II): find read or	201 Dataphone
	37 keyboard
time(II): get time of	
dn0(IV):	
dp0(IV):	
kbd(VII): map of TTY	

: (I)

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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 --
OWNER dmr

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NAME acct -- login accounting

SYNOPSIS acct [wtmp]

DESCRIPTION acct produces a printout giving connect time and total number of connects for each user who has logged in during the life of the current wtmp file. A total is also produced. If no wtmp file is given, /tmp/wtmp is used.

FILES /tmp/wtmp

SEE ALSO init(VII), tacct(I), login(I), wtmp(V).

DIAGNOSTICS "Cannot open 'wtmp'" if argument is unreadable.

BUGS --

OWNER dmr, ken

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NAME	ar -- archive
SYNOPSIS	<u>ar</u> key afile name, ...
DESCRIPTION	<u>ar</u> 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.
	<u>key</u> is one character from the set <u>drtux</u> , optionally concatenated with <u>v</u> . <u>afile</u> is the archive file. The <u>names</u> are constituent files in the archive file. The meanings of the <u>key</u> characters are:
	<u>d</u> means delete the named files from the archive file.
	<u>r</u> means replace the named files in the archive file. If the archive file does not exist, <u>r</u> will create it. If the named files are not in the archive file, they are appended.
	<u>t</u> prints a table of contents of the archive file. If no names are given, all files in the archive are tabbed. If names are given, only those files are tabbed.
	<u>u</u> is similar to <u>r</u> 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.
	<u>x</u> will extract the named files. If no names are given, all files in the archive are extracted. In neither case does <u>x</u> alter the archive file.
	<u>v</u> means verbose. Under the verbose option, <u>ar</u> 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:
	<u>c</u> copy <u>a</u> append <u>d</u> delete <u>r</u> replace <u>x</u> 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",

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"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.

OWNER

ken, dmr

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NAME **as** -- assembler

SYNOPSIS **as** [=] name₁ ...

DESCRIPTION **as** assembles the concatenation of name₁, **as** is based on the DEC-provided assembler PAL-11R [1], although it was coded locally. Therefore, only the differences will be recorded.

If the optional first argument = is used, all undefined symbols in the assembly are treated as global.

Character changes are:

for	use
@	*
#	\$
;	/

In **as**, the character ";" is a logical new line; several operations may appear on one line if separated by ";". Several new expression operators have been provided:

\>	right shift (logical)
\<	left shift
*	multiplication
\vee	division
%	remainder (no longer means "register")
!	one's complement
[]	parentheses for grouping result has value of left, type of right

For example location 0 (relocatable) can be written "0^"; another way to denote register 2 is "2^r0".

All of the preceding operators are binary; if a left operand is missing, it is taken to be 0. The "!" operator adds its left operand to the one's complement of its right operand.

There is a conditional assembly operation code different from that of PAL-11R (whose conditionals are not provided):

```
.if expression
...
.endif
```

If the expression evaluates to non-zero, the section of code between the ".if" and the ".endif" is assembled; otherwise it is ignored. ".if"s may be nested.

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Temporary labels like those introduced by Knuth [2] may be employed. A temporary label is defined as follows:

n:

where n is a digit 0 ... 9. Symbols of the form "nf" refer to the first label "n:" following the use of the symbol; those of the form "nb" refer to the last "n:". The same "n" may be used many times. Labels of this form are less taxing both on the imagination of the programmer and on the symbol table space of the assembler.

The PAL-11R opcodes ".word", ".eot" and ".end" are redundant and are omitted.

The symbols

```
r0 ... r5
fr0 ... fr5 (floating-point registers)
sp
pc
ac
mq
div
mul
lsh
ash
nor
csw
..
```

are predefined with appropriate values. The symbol "csw" refers to the console switches. .. is the relocation constant and is added to each relocatable reference. On a PDP-11 with relocation hardware, its value is 0; on most systems without protection, its value is 40000(8).

The new opcode "sys" is used to specify system calls. Names for system calls are predefined. See section (II).

The opcodes "bes" (branch on error set) and "bec" (branch on error clear) are defined to test the error status bit set on return from system calls.

Strings of characters may be assembled in a way more convenient than PAL-11's ".ascii" operation (which is, therefore, omitted). Strings are included between the string quotes "<" and ">":

<here is a string>

Escape sequences exist to enter non graphic and

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other difficult characters. These sequences are also effective in single and double character constants introduced by single (') and double ("') quotes respectively.

<u>use</u>	<u>for</u>
\n	newline (012)
\0	NULL (000)
\>	>
\t	TAB (011)
\a	ACK (006)
\r	CR (015)
\p	ESC (033)
\\"	\ (134)

as provides a primitive segmentation facility. There are three segments: text, data and bss. The text segment is ordinarily used for code. The data segment is provided for initialized but variable data. The bss segment cannot be initialized, but symbols may be defined to lie within this segment. In the future, it is expected that the text segment will be write-protected and sharable. Assembly begins in the text segment. The pseudo-operations

```
.text
.data
.bss
```

cause the assembler to switch to the text, data, or bss segment respectively. Segmentation is useful at present for two reasons: Non-initialized tables and variables, if placed in the bss segment, occupy no space in the output file. Also, alternative use of the text and data segments provides a primitive dual location-counter feature.

In the output file, all text-segment information comes first, followed by all data-segment information, and finally bss information. Within each segment, information appears in the order written.

Note: since nothing explicit can be assembled into the bss segment, the usual appearance of this segment is in the following style:

```
.bss
var1: .=.+2
tab1: .=.+100.
...
...
```

That is, space is reserved but nothing explicit is placed in it.

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As is evident from the example, it is legal to assign to the location counter ". . ." It is also permissible in segments other than ".bss". The restriction is made, however, that the value so assigned must be defined in the first pass and it must be a value associated with the same segment as " . . .

The pseudo-op

```
.comm symbol,expression
```

makes symbol an undefined global symbol, and places the value of the expression in the value field of the symbol's definition. Thus the above declaration is equivalent to

```
.globl symbol  
symbol = expression ^ symbol
```

The treatment of such a symbol by the loader ld(I) is as follows: If another routine in the same load defines the symbol to be an ordinary text, data, bss, or absolute symbol, that definition takes precedence and the symbol acts like a normal undefined external. If however no other routine defines the symbol, the loader defines it as an external bss-segment symbol and reserves n bytes after its location, where n is the value of the expression in the .comm operation. Thus ".comm x,100" effectively declares x to be a common region 100 bytes long. Note: all such declarations for the same symbol in various routines should request the same amount of space.

The binary output of the assembler is placed on the file "a.out" in the current directory. a.out also contains the symbol table from the assembly and relocation bits. The output of the assembler is executable immediately if the assembly was error-free and if there were no unresolved external references. The link editor ld may be used to combine several assembly outputs and resolve global symbols.

The assembler does not produce a listing of the source program. This is not a serious drawback; the debugger db discussed below is sufficiently powerful to render a printed octal translation of the source unnecessary.

On the last pages of this section is a list of all the assembler's built-in symbols. In the case of instructions, the addressing modes are as follows:

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src, dst	source, destination
r	general register
fsrc,fdst	floating source, destination
fr	floating register
exp	expression

The names of certain 11/45 opcodes are different from those in the 11/45 manual; some were changed to avoid conflict with EAE register names, others to draw analogies with existing 11/20 instructions.

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), sh(I), un(I), db(I), a.out(V), ftrap(III), [1] PAL-11R Assembler; DEC-11-ASDB- D, [2] Knuth, The Art of Computer Programming, Vol. I; Fundamental Algorithms.

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

-) parentheses error
-] parentheses error
- < String not terminated properly
- * Indirection ("_") used illegally
- . Illegal assignment to " ".
- A error in Address
- B Branch instruction is odd or too remote
- E error in Expression
- F error in local ("F" or "b") type symbol
- G Garbage (unknown) character
- I End of file inside an If
- M Multiply defined symbol as label
- O 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.

If " ." is moved backwards by an odd number of bytes, relocation bits are corrupted.

OWNER dmr

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Special variables:

.

..

Register:

r0
r1
r2
r3
r4
r5
sp
pc
fr0
fr1
fr2
fr3
fr4
fr5

tell
mount
umount
setuid
getuid
stime
quit
intr
fstat
cempt
mdate
stty
gtty
ilgins
hog

Eae & switches:

csw
div
ac
mq
mul
sc
sr
nor
lsh
ash

	src	dst
mov	,	,
movb	"	"
cmp	"	"
cmpb	"	"
bit	"	"
bitb	"	"
bic	"	"
bicb	"	"
bis	"	"
bisb	"	"
add	"	"
sub	"	"

System calls:

exit
fork
read
write
open
close
wait
creat
link
unlink
exec
chdir
time
makdir
chmod
chown
break
stat
seek

Double operand:

	src	dst
br	,	,
bne	"	"
beq	"	"
bge	"	"
blt	"	"
bgt	"	"
ble	"	"
bpl	"	"
bmi	"	"
bhi	"	"
blos	"	"
bvc	"	"
bvs	"	"
bhis	"	"
bec	(= bcc)	(= bcc)
bcc	"	"
blo	"	"
bcs	(= bcs)	(= bcs)
bes	(= bcs)	(= bcs)

Branch:

br	,	,
bne	"	"
beq	"	"
bge	"	"
blt	"	"
bgt	"	"
ble	"	"
bpl	"	"
bmi	"	"
bhi	"	"
blos	"	"
bvc	"	"
bvs	"	"
bhis	"	"
bec	(= bcc)	(= bcc)
bcc	"	"
blo	"	"
bcs	(= bcs)	(= bcs)
bes	(= bcs)	(= bcs)

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Single operand:

clr	dst
clrb	"
com	"
comb	"
inc	"
incb	"
dec	"
decb	"
neg	"
negb	"
adc	"
adcb	"
sbc	"
sbcb	"
ror	"
rorb	"
rol	"
rolb	"
asr	"
asrb	"
asl	"
aslb	"
jmp	"
swab	src
tst	src
tstb	src

Miscellaneous:

jsr	r,dst
rts	r
sys	exp

(= trap)

Flag-setting:

clc
clv
clz
cln
sec
sev
sez
sen

Floating point ops:

cfcc	
setf	
setd	
seti	
setl	
clrf	fdst
negf	fdst
absf	fdst

tstf	fsrc
movf	fsrc,fr (= ldf)
movf	fr,fdst (= stf)
movif	src,fr (= ldcif)
movfi	fr,dst (= stcfi)
movof	fsrc,fr (= ldcdf)
movfo	fr,fdst (= stcf)
addf	fsrc,fr
subf	fsrc,fr
mulf	fscr,fr
divf	fsrc,fr
cmpf	fsrc,fr
modf	fsrc,fr

11/45 operations

als	src,r	(= ash)
alsc	src,r	(= ashc)
mpy	src,r	(= mul)
dvd	src,r	(= div)
xor	src,r	
sxt	dst	
mark	exp	
sob	r,exp	

Specials

.byte
.even
.if
.endif
.globl
.text
.data
.bss
.comm

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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: (expr is short for expression)

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

done
Return to system level.

for name = expr expr statement
for name = expr expr

...

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 expr

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 expr statement

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

list [expr [expr]]

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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 expr
The expression is evaluated and printed.

return expr
The expression is evaluated and the result is passed back as the value of a function call.

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.

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

expr op expr
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.

expr ([expr [, expr ...]])
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

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to be compiled. If the expression evaluates negative, a builtin function is called. The list of builtin functions appears below.

name [expr [, expr ...]]
Arrays are not yet implemented.

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.

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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. (Not implemented.)

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.

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 Arrays [] are not yet implemented. In general, program sizes, recursion, etc are not checked, and cause trouble.

OWNER ken

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NAME cat -- concatenate and print

SYNOPSIS cat file₁ ...

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

FILES --

SEE ALSO pr(I), cp(I)

DIAGNOSTICS none; if a file cannot be found it is ignored.

BUGS --

OWNER ken, dmr

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NAME	cc -- C compiler														
SYNOPSIS	<u>cc</u> [<u>-c</u>] <u>sfile₁.c</u> ... <u>ofile₁</u> ...														
DESCRIPTION	<u>cc</u> 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 <u>sfile₁.o</u> (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 <u>cc</u> 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 <u>a.out</u> . The "-c" argument suppresses the loading phase, as does any syntax error in any of the routines being compiled.														
FILES	<table border="0"> <tr> <td>file.c</td> <td>input file</td> </tr> <tr> <td>a.out</td> <td>loaded output</td> </tr> <tr> <td>c.tmp</td> <td>temporary (deleted)</td> </tr> <tr> <td>/sys/c/nc</td> <td>compiler</td> </tr> <tr> <td>/usr/lib/crt0.o</td> <td>runtime startoff</td> </tr> <tr> <td>/usr/lib/libc.a</td> <td>builtin functions, etc.</td> </tr> <tr> <td>/usr/lib/liba.a</td> <td>system library</td> </tr> </table>	file.c	input file	a.out	loaded output	c.tmp	temporary (deleted)	/sys/c/nc	compiler	/usr/lib/crt0.o	runtime startoff	/usr/lib/libc.a	builtin functions, etc.	/usr/lib/liba.a	system library
file.c	input file														
a.out	loaded output														
c.tmp	temporary (deleted)														
/sys/c/nc	compiler														
/usr/lib/crt0.o	runtime startoff														
/usr/lib/libc.a	builtin functions, etc.														
/usr/lib/liba.a	system library														
SEE ALSO	C reference manual (in preparation), bc(VI)														
DIAGNOSTICS	Diagnostics are intended to be self-explanatory.														
BUGS	--														
OWNER	dmr														

3/15/72

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 --

OWNER ken, dmr

3/15/72

NAME `check -- file system consistency check`

SYNOPSIS `check [filesystem [blockno1 ...]]`

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 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 used blocks, and the number of free blocks.

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.
The swap space on the RF file system is not accounted for and will therefore show up as 'missing'.

OWNER ken, dmr

3/15/72

NAME **chmod** -- change mode

SYNOPSIS **chmod** octal file₁ ...

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 --

OWNER ken, dmr

3/15/72

NAME chown -- change owner

SYNOPSIS chown owner file, ...

DESCRIPTION owner becomes the new owner of the files. The owner may be either a decimal UID or a name found in /etc/uids.
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/uids

SEE ALSO stat(I)

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

BUGS --

OWNER ken, dmr

3/15/72

NAME cmp -- compare two files

SYNOPSIS cmp file₁ file₂

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

FILES --

SEE ALSO --

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

BUGS If the two files differ in length by one byte, the extra byte does not enter into the comparison.

OWNER dmr

3/15/72

NAME cp -- copy

SYNOPSIS cp file₁ file₂

DESCRIPTION The first file is opened for reading, the second created mode 17. Then the first is copied into the second.

FILES --

SEE ALSO cat(I), pr(I)

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

BUGS The second file should be created in the mode of the first.
A directory convention as used in mv should be adopted for cp.

OWNER ken, dmr

3/15/72

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 --

OWNER dmr

3/15/72

NAME	<code>db -- debug</code>
SYNOPSIS	<code>db [core [namelist]] [=]</code>
DESCRIPTION	<p>Unlike many debugging packages (including DEC's ODT, on which <code>db</code> is loosely based) <code>db</code> 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; <u>Core</u> is the file being debugged; if omitted, <u>core</u> is assumed. <u>namelist</u> 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 <u>a.out</u>. If no appropriate name list file can be found, <code>db</code> can still be used but some of its symbolic facilities become unavailable.</p>
	<p>For the meaning of the optional third argument, see the last paragraph below.</p>
	<p>The format for most <code>db</code> requests is an address followed by a one character command.</p>
	<p>Addresses are expressions built up as follows:</p> <p> Addresses are expressions built up as follows:</p> <ol style="list-style-type: none"> 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. An octal number immediately followed by "r" is a relocatable quantity with the appropriate value. 4. The symbol "." indicates the current pointer of <code>db</code>. The current pointer is set by many <code>db</code> requests. 5. 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. 6. 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. 7. Expressions are evaluated left to right.

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Names for registers are built in:

```
r0 ... r5
sp
pc
ac
mq
```

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 byte is printed as an ASCII character.
- * The addressed word is multiplied by 2, then printed in octal (used with B programs, whose addresses are word addresses).
- ? 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

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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.

It is illegal for the word-oriented commands to have odd addresses. 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.

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\$ 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

--

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SEE ALSO

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

DIAGNOSTICS

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

BUGS

The "~~" request always decrements " ." by 2, even
in byte mode.

OWNER

dmr

3/15/72

NAME	<code>dc -- desk calculator</code>
SYNOPSIS	<code>dc</code>
DESCRIPTION	<code>dc</code> 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. If the number starts with a zero, it is taken to be octal, otherwise it is decimal.
<u>±</u> = <u>*</u> / <u>%</u>	The top two values on the stack are added (<u>+</u>), subtracted (<u>-</u>), multiplied (<u>*</u>), divided (<u>/</u>), or remaindered (<u>%</u>). The two entries are popped off of the stack, the result is pushed on the stack in their place.
<u>s</u>x	The top of the stack is popped and stored into a register named x, where x may be any character.
<u>l</u>x	The value in register x is pushed on the stack. The register x is not altered.
<u>d</u>	The top value on the stack is pushed on the stack. Thus the top value is duplicated.
<u>p</u>	The top value on the stack is printed in decimal. The top value remains unchanged.
<u>f</u>	All values on the stack are popped off and printed in decimal.
<u>q</u>	exits the program
<u>x</u>	treats the top element of the stack as a character string and executes it as a string of dc commands
<u>!</u>	interprets the rest of the line as a UNIX command.
<u>r</u>	All values on the stack are popped.

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nk A scale factor of 10^n is set for all subsequent multiplication and division.

new-line
space
ignored.

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)
la52/      (pennies per week)
d10*      (deci-pennies per week)
375/      (pennies per hour)
f         (print all results)

(3) 512
(2) 19230
(1) 83333
```

FILES --

SEE ALSO --

DIAGNOSTICS (x) ? for unrecognized character x.
(x) ? for not enough elements on the stack to do what was asked.
"Out of space" when the free list is exhausted.

BUGS f is not implemented
% is not implemented

OWNER rhm

3/15/72

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(I)

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

3/15/72

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/snumb 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 the file is prepended with a form feed.

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 --

BUGS --

DPD (I)

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OWNER

ken

3/15/72

NAME ds -- directory consistency check

SYNOPSIS ds [output]

DESCRIPTION ds will walk the directory tree from the root keeping a list of every file encountered. The second pass will read the i-list and compare the number of links there with the actual number found. All discrepancies are noted.

If an argument is given, a complete printout of file names by i-number is output on the argument.

FILES /, /dev/rk0, /tmp/dstmp

SEE ALSO check(I)

DIAGNOSTICS inconsistent i-numbers

BUGS the root is noted as inconsistent due to the fact that / exists in no directory. (Its i-number is 41.)
ds should take an alternate file system argument.

OWNER ken

3/15/72

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 anything 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.

OWNER dmr, ken

3/15/72

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.
OWNER dmr

3/15/72

NAME	echo -- echo arguments
SYNOPSIS	<u>echo</u> [arg, ...]
DESCRIPTION	<u>echo</u> 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	--
OWNER	doug

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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 an explicit 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.

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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.

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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 expression. 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 command; text is placed at the beginning of the buffer.

(.,.)c
<text>

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

(.,.)d

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

e filename

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

f filename

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

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

In the global command, the first step is to mark every line which matches the given regular expression. Then for every such line, the given command list is executed with ". " initially set to that line. A single command or the first of multiple commands appears on the same line with the global command. All lines of a multi-line list except the last line must be ended

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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 y, 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.

(.,.)l

The list command prints the addressed lines in an unambiguous way. Non-printing characters are over-struck as follows:

<u>char</u>	<u>prints</u>
bs	↑
tab	→
ret	↖
SI	☰
SO	☷

All characters preceded by a prefix (ESC) character are printed over-struck with without the prefix. Long lines are folded with the sequence \newline.

(.,.)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.

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NAME od -- octal dump

SYNOPSIS od name [origin]

DESCRIPTION od dumps a file in octal, eight words per line with the origin of the line on the left. If an octal origin is given it is truncated to $0 \bmod 16$ and dumping starts from there, otherwise from 0. Printing continues until an end-of-file condition or until halted by sending an interrupt signal.

Since od does not seek, but reads to the desired starting point, od (rather than db) should be used to dump special files.

FILES --

SEE ALSO db(I)

DIAGNOSTICS "?"

BUGS --

OWNER ken, dmr

g

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 <u>"!"</u> command.
-------	--

SEE ALSO	--
----------	----

DIAGNOSTICS	"?" for any error
-------------	-------------------

BUGS	--
------	----

OWNER	ken, dmr, jfo
-------	---------------

3/15/72

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 --

OWNER dmr

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 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 ".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.

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
- 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
29 () imbalance in expression
30 expression syntax error
31 illegal variable in equivalence
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 beta 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

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:

loading of common (a BLOCK DATA program must be written to allocate common).

arithmetic statement functions

data statements

backspace, endfile, rewind runtime

binary I/O

no scale factors on input

OWNER dmr, ken

6/15/72

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 e and m where literal string names are expected. The commands are:

e name₁ ...

edit writes the string whose name is name₁ 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
o                    (printed by ed)
r file
w
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
q                    (get out of ed)
q                    (get out of fe)

```

d [name₁ ...]

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 command level. Any other response does nothing.

m name₁ name₂ ...

(move) changes the name of name₁ to name₂ and removes previous string name₂ if one exists. Several pairs of arguments may be

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given.

n [name₁ ...]

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

p name₁ ...

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. 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
 'Cannot open temp. file'-- cannot create a temporary file for ed 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 --

OWNER rhm, l1c

3/15/72

NAME	find — find file with given name
SYNOPSIS	<u>find</u> name or number ...
DESCRIPTION	<u>find</u> searches the entire file system hierarchy and gives the path names of all files with the specified names or (decimal) i-numbers.
FILES	/
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	dmr

6/15/72

NAME	form -- form letter generator
SYNOPSIS	<u>form</u> proto arg ₁ ...
DESCRIPTION	<u>form</u> generates a form letter from a prototype letter, an associative memory, arguments and in a special case, the current date.
	If <u>form</u> is invoked with the <u>proto</u> 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, <u>form</u> 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 <u>arg_n</u> 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".

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The file "form.m" is created if none exists.
Because form.m is operated on by the disc allo-
cater, 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 locat-
 ed or created.

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

OWNER rhm, llc

3/15/72

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 --

OWNER dmr

3/15/72

NAME	<u>if</u> -- conditional command
SYNOPSIS	<u>if</u> <u>expr</u> <u>command</u> [<u>arg</u> ₁ ...]
DESCRIPTION	<u>if</u> evaluates the expression <u>expr</u> , and if its value is <u>true</u> , executes the given <u>command</u> with the given arguments.
	The following primitives are used to construct the <u>expr</u> :
	<u>-r</u> <u>file</u> true if the file exists and is readable.
	<u>-w</u> <u>file</u> true if the file exists and is writable
	<u>-c</u> <u>file</u> true if the file either exists and is writable, or does not exist and is creatable.
	<u>s</u> ₁ <u>=</u> <u>s</u> ₂ true if the strings <u>s</u> ₁ and <u>s</u> ₂ are equal.
	<u>s</u> ₁ <u>!=</u> <u>s</u> ₂ true if the strings <u>s</u> ₁ and <u>s</u> ₂ are not equal.
	These primaries may be combined with the following operators:
	<u>!</u> unary negation operator
	<u>-a</u> binary <u>and</u> operator
	<u>-o</u> binary <u>or</u> operator
	{ <u>expr</u> } parentheses for grouping.
FILES	--
SEE ALSO	sh(I)
DIAGNOSTICS	"if error", if the expression has the wrong syntax; "command not found."

IF (I)

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BUGS

"-c" always indicates the file is creatable, even
if it isn't.

OWNER

dmr

6/12/72

NAME	<u>istat</u> -- get inode status
SYNOPSIS	<u>istat</u> inumber1 ...
DESCRIPTION	<u>istat</u> gives information about one or more i-nodes on the file system <u>/dev/rk0</u> . The information is basically in the same form as that for stat(I). All information is self-explanatory except the mode. The mode is a seven-character string whose characters mean the following:
	<ul style="list-style-type: none"> 1 a: i-node is allocated u: i-node is free (no file) 2 s: file is small (smaller than 4096 bytes) l: file is large 3 d: file is a directory x: file is executable u: set user ID on execution -: none of the above 4 r: owner can read -: owner cannot read 5 w: owner can write -: owner cannot write 6 r: non-owner can read -: non-owner cannot read 7 w: non-owner can write -: non-owner cannot write
FILES	/etc/uids, /dev/rk0
SEE ALSO	stat(I) ls(I) (-l option)
DIAGNOSTICS	"name?" for any error.
BUGS	<u>istat</u> should take an optional alternate filesystem argument.
OWNER	dmr

3/15/72

NAME	<code>ld -- link editor</code>
SYNOPSIS	<code>ld [<u>-usaol</u>] name, ...</code>
DESCRIPTION	<p><code>ld</code> 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 <code>ld</code> combines them, producing an object module which can be either executed or become the input for a further <code>ld</code> run. In the latter case, the "<code>-r</code>" option must be given to preserve the relocation bits.</p> <p>The argument routines are concatenated in the order specified. The entry point of the output is the beginning of the first routine.</p> <p>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 libraries is important.</p> <p><code>ld</code> understands several flag arguments which are written preceded by a "<code>-</code>:</p> <ul style="list-style-type: none"> -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 <code>strip</code>. -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. "<code>-l</code>" alone stands for "<code>/usr/lib/liba.a</code>", which is the standard system library for assembly language programs. "<code>-lx</code>" stands for "<code>/usr/lib/libx.a</code>" where <code>x</code> is any character. There are libraries for Fortran (<code>x="f"</code>), C (<code>x="c"</code>), Explor (<code>x="e"</code>) and B (<code>x="b"</code>). -x Do not preserve local (non-.globl) symbols in the output symbol table; only enter external symbols. This option saves some space in the output file.

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-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"-- and input file lacks relo- cation information "too many symbols"-- too many references to external 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	Instructions in the data segment are not relocat- ed properly.
OWNER	dmr

3/15/72

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.

OWNER ken, dmr

3/15/72

NAME	login -- sign onto UNIX
SYNOPSIS	<u>login</u> [username [password]]
DESCRIPTION	The <u>login</u> 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 <u>login</u> (VII) for how to dial up initially.
	If <u>login</u> 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
SEE ALSO	<u>login</u> (VII), <u>init</u> (VII), <u>getty</u> (VII), <u>mail</u> (I)
DIAGNOSTICS	"login incorrect", if the name or the password is bad. "No Shell", "cannot open password file," "no directory:" consult a UNIX programming counselor.
BUGS	--
OWNER	dmr, ken

3/15/72

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/uids to get user ID's for ls -l

SEE ALSO stat(I)

DIAGNOSTICS "name nonexistent"; "name unreadable"; "name unstatale."

BUGS --

OWNER dmr, ken

3/15/72

NAME	mail -- send mail to another user
SYNOPSIS	<u>mail</u> [letter person ...]
DESCRIPTION	<u>mail</u> without an argument searches for a file called <u>mailbox</u> , prints it if present, and asks if it should be saved. If the answer is "y", the mail is renamed <u>mbox</u> , otherwise it is deleted. The answer to the above question may be supplied in the <u>letter</u> argument.
	When followed by the names of a letter and one or more people, the letter is appended to each person's <u>mailbox</u> . Each letter is preceded by the sender's name and a postmark.
	A <u>person</u> is either the name of an entry in the directory <u>/usr</u> , in which case the mail is sent to <u>/usr/person/mailbox</u> , or the path name of a directory, in which case <u>mailbox</u> in that directory is used.
	When a user logs in he is informed of the presence of mail.
FILES	/etc/uids to map uids 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 <u>mailbox</u> cannot be opened.
BUGS	--
OWNER	ken

3/15/72

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. (In 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 --

OWNER ken

3/15/72

NAME mesg -- permit or deny messages

SYNOPSIS mesq [n][y]

DESCRIPTION mesq n forbids messages via write by revoking non-user write permission on the user's typewriter. mesq y reinstates permission. mesq 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 --

OWNER dmr, ken

3/15/72

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 --

OWNER ken, dmr

3/15/72

NAME `mount -- mount file system`

SYNOPSIS /etc/mount `special dir`

DESCRIPTION `mount` announces to the system that a removable file system has been mounted on the device corresponding to special file special. Directory dir (which must exist already) becomes the name of the root of the newly mounted file system.

FILES `--`

SEE ALSO `umount(I)`

DIAGNOSTICS `"?"`, if the special file is already in use, cannot be read, or if dir does not exist.

BUGS Should be usable only by the super-user.
It is possible to mount the same file system pack twice. This is a very efficient way to destroy a pack.

OWNER `ken, dmr`

6/12/72

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

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'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 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 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.
- i ignore tape errors. It is suggested that this option be used with caution to read damaged tapes.

FILES	/dev/mt?
SEE ALSO	tap(I), tap(V)
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	The <u>m</u> option does not work correctly. The <u>i</u> option is not yet implemented.
OWNER	ken

3/15/72

NAME mv -- move or rename a file

SYNOPSIS mv name₁ name₂

DESCRIPTION mv changes the name of name₁ by linking to it under the name name₂ and then unlinking name₁. If the new name is a directory, the file is moved to that directory under its old name. Directories may only be moved within the same parent directory (just renamed).

FILES --

SEE ALSO --

DIAGNOSTICS --

BUGS Since mv is implemented by combinations of link and unlink, it cannot be used to move between file systems.

OWNER ken, dmr

3/15/72

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

```
\#meta,<\#>,:  
[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,movy,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
 /sys/lang/mdir/m6a--m6 processor proper (/bin/m6
 is only an initializer)
 /sys/lang/mdir/m6b--default initialization for

3/15/72

m.def

SEE ALSO

[1] M6 reference

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 "ovc" -- overflow of nested calls
"ova" -- overflow of nested arguments
"ovd" -- overflow of definitions
"rdd" -- can't read definition table
"wrd" -- can't write definition table, either on #save: or on garbage collection

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: Again to save space, garbage collection makes calls on #save: and #rest: and so overwrites m.def.

OWNER

doug

3/15/72

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 --

OWNER dmr, ken

3/15/72

NAME od -- octal dump

SYNOPSIS od name [origin]

DESCRIPTION od dumps a file in octal, eight words per line with the origin of the line on the left. If an octal origin is given it is truncated to 0 mod 16 and dumping starts from there, otherwise from 0. Printing continues until an end-of-file condition or until halted by sending an interrupt signal.
Since od does not seek, but reads to the desired starting point, od (rather than db) should be used to dump special files.

FILES --

SEE ALSO db(I)

DIAGNOSTICS "?"

BUGS --

OWNER ken, dmr

3/15/72

NAME opr -- off line print

SYNOPSIS opr file₁ ...

DESCRIPTION opr will arrange to have the 201 data phone daemon submit a job to the Honeywell 6070 to print the file arguments. 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 + then opr will make a copy for the daemon to print. If the file argument is preceded by = then opr will unlink the file.

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

SEE ALSO dpd(I), ident(V)

DIAGNOSTICS --

BUGS Since all but the + option in opr is implemented with links, one cannot use these options for files not in /usr.
opr should recognize + and = alone and apply them to all subsequent arguments.

OWNER ken

6/12/72

NAME ov -- overlay pages

SYNOPSIS ov filename

DESCRIPTION ov is a postprocessor for producing double column formatted text when using nroff(I). ov assumes that the named file contains an even number of 66 line pages and literally overlays successive pairs of pages.

FILES none

SEE ALSO nroff(I)

DIAGNOSTICS none

BUGS Other page lengths should be permitted.

OWNER jfo

3/15/72

NAME `pr -- print file`

SYNOPSIS `pr [-lcm] name1 ...`

DESCRIPTION `pr` produces a printed listing of one or more files. The output is separated into pages headed by the name of the file, a date, and the page number.

The optional flag -l causes each page to contain 78 lines instead of the standard 66 to accommodate legal size paper.

The optional flags -c (current date) and -m (modified date) specify which date will head all subsequent files. -m is default.

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

FILES /dev/tty? to suspend messages.

SEE ALSO `cat(I), cp(I), mesg(I)`

DIAGNOSTICS -- (files not found are ignored)

BUGS none

OWNER ken, dmr

3/15/72

NAME rew -- rewind tape

SYNOPSIS rew [digit]

DESCRIPTION rew rewinds DECtape drives. The digit is the logical tape number, and should range from 0 to 7. A missing digit indicates drive 0.

FILES /dev/tap?

SEE ALSO --

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

BUGS --

OWNER ken, dmr

3/15/72

NAME rm -- remove (unlink) files

SYNOPSIS rm 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.

Directories cannot be removed by rm; cf. rmdir.

FILES none

SEE ALSO rmdir(I)

DIAGNOSTICS If the file cannot be removed or does not exist, the name of the file followed by a question mark is typed.

BUGS rm probably should ask whether a read-only file is really to be removed.

OWNER ken, dmr

3/15/72

NAME rmdir -- remove directory

SYNOPSIS rmdir dir, ...

DESCRIPTION rmdir removes (deletes) directories. The directory must be empty (except for the standard entries ". " and "...", which rmdir itself removes). 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 --

OWNER ken, dmr

6/12/72

NAME roff -- format text

SYNOPSIS roff [+number1] [-number2] [-stop] name₁ ...

DESCRIPTION roff formats text according to control lines embedded in the text in files name₁, Encountering a nonexistent file terminates printing. The optional argument "+number1" causes printing to begin at the first page numbered number1; the optional argument "-number2" stops printing after the page numbered number2. The optional argument "-stop" or "-s" causes printing to stop before each page including the first to allow paper manipulation; printing is resumed upon receipt of an interrupt signal. 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.

roff is described in a separate publication [1].

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

SEE ALSO [1] (See J. F. Ossanna)

DIAGNOSTICS none

BUGS --

OWNER jfo

3/15/72

NAME	salv -- file system salvage
SYNOPSIS	<u>/etc/salv</u>
DESCRIPTION	<p><u>salv</u> will reconstruct the file system /dev/rk0 to a consistent state. This is the first step in putting things together after a bad crash. Salv performs the following functions:</p> <p>A valid free list is constructed.</p> <p>All bad pointers in the file system are zeroed.</p> <p>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.</p> <p>After a salv, a warm boot must be performed instantly to effect the change made. (Because the salv works on the disk copy of the file system super-block, and the core copy is unaffected.)</p> <p>After a salv, files may be safely created and removed without causing more trouble. However, it is more likely than not that directories are corrupted as well, so a <u>ds</u> should be performed.</p>
FILES	/dev/rk0
SEE ALSO	check(I), ds(I)
DIAGNOSTICS	--
BUGS	The file system to be salvaged should be an argument.
OWNER	ken

3/15/72

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 simply passed 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 the standard commands, which reside in "/bin", are found.) If the "/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 input 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 newline, ";", 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,

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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 trap
Illegal instruction
IOT trap
Power fail trap
EMT trap
Bad system call
Quit
Error

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.

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.

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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.

Each "[" must be paired with a matching "]". The characters between "[" and "]" specify a class of characters. It matches any single character in a file name which is in the class. An ordinary character in the brackets specifies that character to be in the class. A pair of characters separated by "-" specifies each character lexically greater than or equal to the first and less than or equal to the second member of the pair is to be included in the class. If the first member of the pair lexically exceeds the second, the second member is the sole character specified.

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"; "?[z-i-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

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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 [ arg, ... [ 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 the file, 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 (arg_n). "\$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

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to work out why.

Command file errors

Any shell-detected error in a file of commands causes that shell to cease executing 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);
"No command", 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.

OWNER

dmr, ken

3/15/72

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. The sort is line-by-line in increasing ASCII collating sequence. Space required is 6*number-of-lines in bytes.

FILES /tmp/stm?

SEE ALSO --

DIAGNOSTICS --

BUGS Sort does not put a maximum on the size of file that it sorts. Thus a bus error will occur if too large an input file is supplied.

The input is copied to a temporary file. Thus the maximum file that can be sorted is the maximum non-special file (currently 64K bytes.)

OWNER dmr, ken

3/15/72

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/uids" 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/uids

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

DIAGNOSTICS "name?" for any error.

OWNER dmr

3/15/72

NAME strip -- remove symbols and relocation bits

SYNOPSIS strip name, ...

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

The effect of strip is the 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 --

OWNER dmr

6/12/72

NAME	<u>stty</u> -- set teletype options																																																																
SYNOPSIS	<u>stty</u> option ₁ ...																																																																
DESCRIPTION	<u>Stty</u> will set certain I/O options on the current output teletype. The option strings are selected from the following set:																																																																
	<table border="0"> <tr><td><u>even</u></td><td>allow even parity.</td></tr> <tr><td><u>-even</u></td><td>disallow even parity.</td></tr> <tr><td><u>odd</u></td><td>allow odd parity</td></tr> <tr><td><u>-odd</u></td><td>disallow odd parity</td></tr> <tr><td><u>raw</u></td><td>raw input (no erase/kill)</td></tr> <tr><td><u>-canon</u></td><td>negate raw mode (erase/kill)</td></tr> <tr><td><u>-raw</u></td><td></td></tr> <tr><td><u>canon</u></td><td>allow (and echo) cr for lf.</td></tr> <tr><td><u>cr</u></td><td></td></tr> <tr><td><u>-nl</u></td><td>negate cr mode.</td></tr> <tr><td><u>nl</u></td><td></td></tr> <tr><td><u>-cr</u></td><td>echo back every character typed.</td></tr> <tr><td><u>echo</u></td><td></td></tr> <tr><td><u>full</u></td><td>"</td></tr> <tr><td><u>-half</u></td><td>do not echo characters as typed.</td></tr> <tr><td><u>half</u></td><td>"</td></tr> <tr><td><u>-echo</u></td><td>"</td></tr> <tr><td><u>-full</u></td><td>map upper case to lower case</td></tr> <tr><td><u>lcase</u></td><td></td></tr> <tr><td><u>-ucase</u></td><td>do not map case</td></tr> <tr><td><u>ucase</u></td><td></td></tr> <tr><td><u>-lcase</u></td><td>map tabs into spaces</td></tr> <tr><td><u>space</u></td><td></td></tr> <tr><td><u>-tab</u></td><td>do not map tabs</td></tr> <tr><td><u>tab</u></td><td></td></tr> <tr><td><u>-space</u></td><td>calculate cr and tab delays.</td></tr> <tr><td><u>delay</u></td><td></td></tr> <tr><td><u>-delay</u></td><td>no cr/tab delays</td></tr> <tr><td><u>ebcdic</u></td><td>ebcdic ball conversion (2741 only)</td></tr> <tr><td><u>-corres</u></td><td></td></tr> <tr><td><u>corres</u></td><td>correspondence ball conversion (2741 only)</td></tr> <tr><td><u>-ebcdic</u></td><td></td></tr> </table>	<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 input (no erase/kill)	<u>-canon</u>	negate raw mode (erase/kill)	<u>-raw</u>		<u>canon</u>	allow (and echo) cr for lf.	<u>cr</u>		<u>-nl</u>	negate cr mode.	<u>nl</u>		<u>-cr</u>	echo back every character typed.	<u>echo</u>		<u>full</u>	"	<u>-half</u>	do not echo characters as typed.	<u>half</u>	"	<u>-echo</u>	"	<u>-full</u>	map upper case to lower case	<u>lcase</u>		<u>-ucase</u>	do not map case	<u>ucase</u>		<u>-lcase</u>	map tabs into spaces	<u>space</u>		<u>-tab</u>	do not map tabs	<u>tab</u>		<u>-space</u>	calculate cr and tab delays.	<u>delay</u>		<u>-delay</u>	no cr/tab delays	<u>ebcdic</u>	ebcdic ball conversion (2741 only)	<u>-corres</u>		<u>corres</u>	correspondence ball conversion (2741 only)	<u>-ebcdic</u>	
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3/15/72

NAME su -- become privileged user

SYNOPSIS su password

DESCRIPTION su allows one to become the super-user, who has all sorts of marvelous powers. In order for su to do its magic, the user must pass as an argument 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.

FILES --

SEE ALSO sh(I)

DIAGNOSTICS "Sorry" if password is wrong

BUGS --

OWNER dmr, ken

3/15/72

NAME sum -- sum file

SYNOPSIS sum name₁ ...

DESCRIPTION sum sums the contents of one or more files. A separate sum is printed for each file specified, along with the number of whole or partial 512-word 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

OWNER ken

6/12/72

NAME tacct -- login accounting by date
SYNOPSIS tacct [wtmp]
DESCRIPTION tacct will produce a printout giving daily connect time and total number of connects for all transactions found in the wtmp file. If no wtmp file is given, /tmp/wtmp is used.
FILES /tmp/wtmp
SEE ALSO init(VII), acct(I), login(I), wtmp(V)
DIAGNOSTICS "Cannot open 'wtmp'"
BUGS acct(I) and tacct(I) should be combined
OWNER dmr, ken

3/15/72

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.

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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, a, 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 a.

- 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 and a.

- 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, a, and d no change has been made to the tape.

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

- i ignore tape errors. It is suggested that this option be used with caution to read damaged tapes.

FILES /dev/tap?

SEE ALSO mt(I)

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

TAP (I)

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

BUGS The i
 The m option does not work correctly.
 option is not yet implemented.

OWNER ken

3/15/72

NAME tm -- provide time information

SYNOPSIS tm [command arg₁]

DESCRIPTION tm is used to provide timing information. When used without an argument, 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 tim row is total real time (hours:minutes:seconds); unlike the other times, its origin is the creation date of tm's temporary file. 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).

tm can be invoked with arguments which are assumed to constitute a command to be timed. In this case the output is as follows:

tim	2.7
ovh	0.3
swp	0.5
dsk	1.8
idl	0.0
usr	0.0

The given times represent the number of seconds spent in each category during execution of the command.

FILES /tmp/ttmp, /dev/rf0 (for absolute times) contains the information used to calculate the differential times.

SEE ALSO file system(V)

DIAGNOSTICS "?" if the command cannot be executed; "can't creat temp file" if trouble with ttmp; "cant read super-block" if times cannot be read from system.

BUGS (1) when invoked with a command argument,

TM (I)

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everything going on at the moment is counted, not just the command itself. (2) Two users doing tm simultaneously interfere with each other's use of the temporary file.

OWNER

ken, dmr

3/15/72

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/DACCOPY
~s file send file to HIS routine CSR/DACCOPY

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

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

SYSTEM? CSR/DACCOPY (r) AFTname
Receive Fncoded 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.

OWNER csr

3/15/72

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 --

OWNER dmr, ken

6/12/72

TYPE (I)

NAME type — type on single sheet paper

SYNOPSIS type name, ...

DESCRIPTION type copies its input files to the standard output. After every 66 lines, 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 --

OWNER dmr

3/15/72

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.
only the super-user may issue this command.

FILES --

SEE ALSO mount(I)

DIAGNOSTICS "?"

BUGS This command is not, in fact, restricted to the
super-user.

OWNER ken, dmr

3/15/72

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 --

OWNER dmr, ken

3/15/72

NAME wc -- get (English) word count

SYNOPSIS wc name₁ ...

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

A text line is a sequence of characters not begin-
ning with "." and ended by a new-line. A roff
control line is a line beginning with ". ". 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.

FILES --

SEE ALSO roff(I)

DIAGNOSTICS none; arguments not found are ignored.

BUGS --

OWNER jfo

3/15/72

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 all logins and logouts since the creation of the wtmp file.

FILES /tmp/utmp

SEE ALSO login(I), init(VII)

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

BUGS --

OWNER dmr, ken

3/15/72

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 mesq 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 --

OWNER dmr, ken

3/15/72

BREAK (II)

NAME break --- set program break

SYNOPSIS sys break; addr / break = 17.

DESCRIPTION break sets the system's idea of the highest location used by the program to addr. Locations greater than addr and below the stack pointer are not swapped and are thus liable to unexpected modification.

An argument of 0 is taken to mean 8K words. If the argument is higher than the stack pointer the entire user core area is swapped.

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

FILES --

SEE ALSO exec(II)

DIAGNOSTICS none; strange addresses cause the break to be set to include all of core.

BUGS --

OWNER ken, dmr

3/15/72

NAME cemt -- catch emt traps

SYNOPSIS sys cemt; arg / cemt = 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.
Prior to the use of this call, the result of an emt instruction is a simulated rts instruction. The operand field is interpreted as a register, and an rts instruction is simulated for that register (after verifying that various registers have appropriate values). This feature is useful for debugging, since the most dangerous program bugs usually involve an rts with bad data on the stack or in a register.

FILES --

SEE ALSO --

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

3/15/72

NAME chdir -- change working directory

SYNOPSIS sys chdir; dirname / chdir = 12.

DESCRIPTION dirname is address of the pathname of a directory, terminated by a 0 byte. chdir causes this directory to become the current working directory.

FILES --

SEE ALSO chdir(I)

DIAGNOSTICS The error bit (c-bit) is set if the given name is not that of a directory.

BUGS --

OWNER ken, dmr

3/15/72

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.

FILES --

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 --

OWNER ken, dmr

3/15/72

CHOWN (II)

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 able to misuse other's files.

FILES --

SEE ALSO chown(I), uids(V)

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

BUGS --

OWNER ken, dmr

3/15/72

CLOSE (II)

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 simultaneously open files, close is necessary to programs which deal with many files.

FILES --

SEE ALSO **creat(II), open(II)**

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

BUGS --

OWNER ken, dmr

3/15/72

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 writing. Then if a second instance of the program attempts a creat, an error is returned and the program knows that the name is unusable for the moment.

If the last link to an open file is removed, the file is not destroyed until the file is closed.

FILES --

SEE ALSO `write(II), close(II)`

DIAGNOSTICS The error bit (c-bit) may be set if: a needed directory 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 unwritable; the file is a directory.

BUGS --

OWNER ken, dmr

3/15/72

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 passed as follows. The stack pointer points to 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 60000(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.

3/15/72

EXEC (II)

FILES

--

SEE ALSO

fork(II)

DIAGNOSTICS

If the file cannot be read or if it is not executable, a return from exec constitutes the diagnostic. The error bit (c-bit) is set.

BUGS

--

OWNER

ken, dmr

EXIT (II)

3/15/72

NAME exit -- terminate process

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

DESCRIPTION exit is the normal means of terminating a process. All files are closed and the parent process is notified if it is executing a wait. The low byte of r0 is available as status to the parent process.

This call can never return.

FILES --

SEE ALSO wait(II)

DIAGNOSTICS -

BUGS --

OWNER ken, dmr

3/15/72

FORK (II)

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 pro-
cess. This process ID is used by `wait`.

FILES --

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 destruc-
 tion.

OWNER ken, dmr

3/15/72

FSTAT (II)

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.

FILES --

SEE ALSO stat(II)

DIAGNOSTICS The error bit (c-bit) is set if the file descrip-
 tor is unknown.

BUGS --

OWNER ken, dmr

3/15/72

GETUID (II)

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.

FILES `/etc/uids` can be used to map the user ID number into a name.

SEE ALSO `setuid(II)`

DIAGNOSTICS ---

BUGS ---

OWNER ken, dmr

3/15/72

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 descriptor is given in `r0`. The format is the same as that passed by `stty`.

FILES `--`

SEE ALSO `stty(II)`

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

BUGS `--`

OWNER ken, dmr

3/15/72

NAME hog -- set program in low priority

SYNOPSIS sys hog / hog = 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. A higher priority will be reinstated as soon as the process is dismissed for any reason other than quantum overflow.

FILES --

SEE ALSO --

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

3/15/72

ILGINS (II)

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.

FILES --

SEE ALSO fptrap(III)

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

3/15/72

NAME	intr -- set interrupt handling
SYNOPSIS	sys intr; arg / intr = 27.
DESCRIPTION	When <u>arg</u> is 0, interrupts (ASCII DELETE) are ignored. When <u>arg</u> is 1, interrupts cause their normal result, that is, force an <u>exit</u> . When <u>arg</u> 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 <u>rti</u> 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.
FILES	--
SEE ALSO	quit(II)
DIAGNOSTICS	--
BUGS	It should be easier to resume after an interrupt, but I don't know how to make it work.
OWNER	ken, dmr

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.

FILES --

SEE ALSO --

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

BUGS kill has been known to be ineffective.

OWNER ken, dmr

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.

FILES --

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 --

OWNER ken, dmr

3/15/72

MAKDIR (II)

NAME makdir -- make a directory

SYNOPSIS sys makdir; name; mode / makdir = 14.

DESCRIPTION makdir 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.

makdir can only be invoked by the super-user.

FILES --

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 --

OWNER ken, dmr

3/15/72

MDATE (II)

NAME	mdate -- set modified date on file
SYNOPSIS	(time to AC-MQ) sys mdate; file / mdate = 30.
DESCRIPTION	<u>File</u> 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 AC-MQ registers. This call is allowed only to the super-user or to the owner of the file.
FILES	--
SEE ALSO	--
DIAGNOSTICS	Error bit is set if the user is not the super-user or if the file cannot be found.
BUGS	--
OWNER	ken, dmr

3/15/72

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 `special`; from now on, references to file `name` will refer to the root file on the newly mounted file system. `Special` and `name` are pointers to null-terminated strings containing the appropriate path names.

`Name` must exist already. If it had useful contents, they are inaccessible while the file system is mounted.

Almost always, `name` should be a directory so that an entire file system, not just one file, may exist on the removable device.

FILES --

SEE ALSO `mount(I), umount(II)`

DIAGNOSTICS Error bit (c-bit) set if `special` is inaccessible or `dir` does not exist.

BUGS At most two removable devices can be mounted at a time. The use of this call should be restricted to the super-user.

OWNER ken, dmr

3/15/72

OPEN (II)

NAME	open -- open for reading or writing
SYNOPSIS	sys open; name; mode / open = 5. (descriptor in r0)
DESCRIPTION	<p><u>open</u> opens the file <u>name</u> for reading (if <u>mode</u> is 0) or writing (if <u>mode</u> is non-zero). <u>name</u> is the address of a string of ASCII characters representing a path name, terminated by a null character.</p> <p>The file descriptor should be saved for subsequent calls to read (or write) and close.</p> <p>In both the read and write case the file pointer is set to the beginning of the file.</p> <p>If the last link to an open file is removed, the file is not destroyed until it is closed.</p>
FILES	--
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, or if the file is not readable.
BUGS	--
OWNER	ken, dmr

3/15/72

QUIT (II)

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 1, quits are re-enabled, and cause execution to cease and a core image to be produced. When flag is an address in the program, a quit causes control to be sent to that address.
Quits should be turned off only with due consideration.

FILES --

SEE ALSO intr(II)

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

3/15/72

READ (II)

NAME read -- read from file

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

DESCRIPTION A file descriptor is a word returned from a successful open call.

Buffer is the location of nchars contiguous bytes into which the input will be placed. It is not guaranteed that all nchars bytes will be read, however; 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.

FILES --

SEE ALSO open(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, all rare, can generate an error: physical I/O errors, bad buffer address, preposterous nchars, file descriptor not that of an input file.

BUGS --

OWNER ken, dmr

3/15/72

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.
FILES	--
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	ken, dmr

3/15/72

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 (or 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.

FILES --

SEE ALSO tell(II)

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 tape files and RK and RF. Something is going to be done about this.

OWNER ken, dmr

3/15/72

SETUID (II)

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.

FILES --

SEE ALSO getuid(II)

DIAGNOSTICS Error bit (c-bit) is set if the current user ID is not that of the super-user.

BUGS --

OWNER ken, dmr

3/15/72

SLEEP (II)

NAME	sleep -- stop execution for interval
SYNOPSIS	(60ths of a second in r0) sys sleep / sleep = 35.; not in assembler
DESCRIPTION	The current process is suspended from execution for the number of 60ths of a second specified by the contents of register 0.
FILES	--
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.
OWNER	ken, dmr

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

FILES --

SEE ALSO stat(I), fstat(II)

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

BUGS The format is going to change someday.

OWNER ken, dmr

3/15/72

NAME stime -- set time

SYNOPSIS (time in AC-MQ)
sys stime / stime = 25.

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

FILES --

SEE ALSO date(I), time(II)

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

BUGS --

OWNER ken, dmr

6/12/72

STTY (II)

NAME **stty** -- set mode of typewriter

SYNOPSIS (file descriptor in r0)
 sys stty; arg / stty = 31.

 ...
arg: dcrsr; dcpsr; 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 dcpsr 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 arguments 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

6/12/72

STTY (II)

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 key-
board). 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.

FILES	--
SEE ALSO	stty(I), gtty(II)
DIAGNOSTICS	The error bit (c-bit) is set if the file descrip- tor does not refer to a typewriter.
BUGS	This call should be used with care. It is all too easy to turn off your typewriter.
OWNER	ken, dmr

6/12/72

SYNC (II)

NAME	sync -- update super-block
SYNOPSIS	sys sync / sync = 36.; not in assembler
DESCRIPTION	<p><u>sync</u> 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.</p> <p>It should be used by programs which examine a file system, for example check, df, tm, etc.</p>
FILES	--
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	ken

3/15/72

TELL (II)

NAME tell -- get file pointer

SYNOPSIS (file descriptor in r0)
sys tell; offset; ptrname / tell = 20.
(value returned in r0)

DESCRIPTION The file descriptor refers to an open file. The value returned in r0 is one of:

if ptrname is 0, the value returned is offset;

if ptrname is 1, the value is the current pointer plus offset;

if ptrname is 2, the value returned is the number of bytes in the file plus offset.

FILES --

SEE ALSO seek(II)

DIAGNOSTICS The error bit (c-bit) is set if the file descriptor is unknown.

BUGS Tell doesn't work. Complain if you need it.

OWNER ken, dmr

3/15/72

TIME (II)

NAME time -- get time of year

SYNOPSIS sys time / time = 13.
(time AC-MQ)

DESCRIPTION time returns the time since 00:00:00, Jan. 1,
 1971, measured in sixtieths of a second. The
 high order word is in the AC register and the low
 order is in the MQ.

FILES --

SEE ALSO date(I), stime(II)

DIAGNOSTICS --

BUGS The chronological-minded user will note that
 2^{32} sixtieths of a second is only about 2.5
 years.

OWNER ken, dmr

3/15/72

UMOUNT (II)

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.

FILES --

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.

OWNER ken, dmr

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.

FILES --

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 Probably write permission should be required to remove the last link to a file, but this gets in other problems (namely, one can donate an undeletable file to someone else).
If the system crashes while a file is waiting to be deleted because it is open, the space is lost.

OWNER ken, dmr

NAME wait -- wait for process to die

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

DESCRIPTION wait causes its caller to delay until one of its child processes terminates. If any child has already died, return is immediate; if there are no children, return is immediate with the error bit set. In the case of several children several waits are needed to learn of all the deaths.

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

0	exit
1	bus error
2	trace trap
3	illegal instruction
4	IOT trap
5	power fail trap
6	EMT trap
7	bad system call
8	quit
9	interrupt
10	kill (see kill(II))
+16	core image produced

FILES --

SEE ALSO exit(II), fork(II)

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

BUGS A child which dies but is never waited for is not really gone in that it still consumes disk swap and system table space. This can make it impossible to create new processes. The bug can be noticed when several "&" separators are given to the shell not followed by a command without an ampersand. Ordinarily things clean themselves up when an ordinary command is typed, but it is possible to get into a situation in which no commands are accepted, so no waits are done; the system is then hung.

The fix, probably, is to have a new kind of fork which creates a process for which no wait is necessary (or possible); also to limit the number of active or inactive descendants allowed to a process.

3/15/72

NAME write -- write on file

SYNOPSIS (file descriptor in r0)
 sys write; buffer; nchars / 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 nchars 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.

For disk and tape files, writes which are multiples of 512 characters long and begin on a 512-byte boundary are more efficient than any others.

FILES --

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 --

OWNER ken, dmr

3/15/72

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 zero to pi/2. The atan2 entry returns the arc tangent of fr0/fr1 in fr0. The range is -pi to pi. The floating point simulation should be active in either floating or double mode, but in single precision integer mode.

FILES kept in /usr/lib/liba.a

SEE ALSO fptrap(III)

DIAGNOSTICS --

BUGS --

OWNER rhm, dmr, ken

3/15/72

ATOF (III)

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 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 floating point simulation should be active in either floating or double mode, but in single precision integer mode.

FILES kept in /usr/lib/liba.a

SEE ALSO fptrap(III)

DIAGNOSTICS --

BUGS The subroutine subr should not disturb any registers.

OWNER ken

3/15/72

NAME atoi -- ascii to integer

SYNOPSIS jsr r5,atoi; subr

DESCRIPTION atoi will convert an ascii stream to a binary number returned in mq. The subroutine subr 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.

FILES kept in /usr/lib/liba.a

SEE ALSO --

DIAGNOSTICS --

BUGS The subroutine subr should not disturb any registers.

OWNER ken

3/15/72

CONST (III)

NAME const -- floating point constants

SYNOPSIS --

DESCRIPTION The following floating point constants are correctly represented in double precision.

one 1.0
pi2 0.5*3.1415...

FILES kept in /usr/lib/liba.a

SEE ALSO fptrap(III)

DIAGNOSTICS --

BUGS --

OWNER rhm, dmr, ken

3/15/72

CTIME (III)

NAME ctime -- convert date and time to ASCII

SYNOPSIS (move time to AC-MQ)
mov \$buffer,r0
jsr pc,ctime

DESCRIPTION The buffer is 15 characters long. The time has the format

Oct 9 17:32:24

The input time is in the AC and MQ registers in the form returned by sys time.

FILES kept in /usr/lib/liba.a

SEE ALSO ptime(III), time(II)

DIAGNOSTICS --

BUGS --

OWNER dmr

3/15/72

NAME exp -- exponential function

SYNOPSIS jsr r5,exp

DESCRIPTION The exponential of fr0 is returned in fr0. The floating point simulation should be active in either floating or double mode, but in single precision integer mode.

FILES kept in /usr/lib/liba.a

SEE ALSO fptrap(III)

DIAGNOSTICS The c-bit is set if the result is not representable.

BUGS --

OWNER rhm, dmr, ken

3/15/72

NAME fptrap -- PDP-11/45 floating point simulator

SYNOPSIS

```
.globl fptrap
sys ilgins; fptrap
```

DESCRIPTION

fptrap is a package which picks up instructions which are illegal for the PDP-11/20, and if they correspond to 11/45 floating point instructions, simulates their operation. The following instructions are supported:

cfcc	
setf	
seti	
setd	
setl	
clrf	fdst
tstf	fsrc
absf	fdst
negf	fdst
mulf	fsrc,fr
modf	fsrc,fr
addf	fsrc,fr
movf	fsrc,fr (=ldf)
movf	fr,fdst (=stf)
subf	fsrc,fr
cmpf	fsrc,fr
divf	fsrc,fr
movfi	fr,dst (=stcfi)
movif	src,fr (=ldcif)
movfo	fr,fdst (=stcxy)
movof	fsrc,fr (=ldcyx)

Here src and dst stand for source and destination, fsrc and fdst for floating source and destination, and fr for floating register. Notice that the names of several of the opcodes have changed. The only strange instruction is movf, which turns into stf if its source operand is a floating register, and into ldf if not.

The simulator sets the floating condition codes on both ldf and stf. The 11/45 hardware does not set the fcc on stf.

Short and long format for both floating point numbers and integers is supported. Truncation mode is always in effect. Traps for overflow and other arithmetic errors are not supported. Illegal instructions or addresses cause a simulated trap so that a core image is produced.

The condition code bits are maintained correctly.

For floating-point source operands, immediate mode ((pc)+) is not supported, since the

PDP-11/45 handbook is not clear on what to do about it.

After an arithmetic error the result is generally meaningless.

The arithmetic is always done in double-precision, so exact but unrounded results are to be expected in single-precision mode. Double precision results are probably less correct than the hardware will be.

The lower parts of the floating registers become meaningless during single-precision operations.

FILES kept in /usr/lib/liba.a

SEE ALSO PDP-11/45 handbook, ilgins(II)

DIAGNOSTICS trap, c-bit, v-bit

BUGS see above

OWNER ken, dmr

3/15/72

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 [-]d.ddddddd[-]dd*. The floating point simulator should be active in either floating or double mode, but in single integer mode. For each character generated by ftoa, the subroutine subr is called on register r5 with the character in r0.

FILES kept in /usr/lib/liba.a

SEE ALSO fptrap(III)

DIAGNOSTICS --

BUGS The subroutine subr should not disturb any registers.

OWNER ken

3/15/72

NAME connect, gerts -- Gerts communication over 201

SYNOPSIS jsr r5,connect
(error return)/
...
jsr r5,gerts; fc; oc; ibuf; obuf
(error return)
...

DESCRIPTION The GECOS GERTS interface is so bad that a
description here is inappropriate. Anyone needing
to use this interface should contact the owner.

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

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

DIAGNOSTICS --

BUGS --

OWNER ken

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:

```
ioptr: .=..+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.

FILES kept in /usr/lib/liba.a

SEE ALSO

DIAGNOSTICS

BUGS

OWNER

6/12/72

NAME hypot -- calculate hypotenuse

SYNOPSIS (A in fr0)
(B in fr0)
jsr r5,hypot

DESCRIPTION The square root of fr0*fr0 + fr1*fr1 is returned in fr0. The calculation is done in such a way that overflow will not occur unless the answer is not representable in floating point.

The floating point simulator should be active in either single or double mode.

FILES kept in /usr/lib/liba.a

SEE ALSO fptrap(III)

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

BUGS --

OWNER ken, dmr

3/15/72

NAME itoa -- integer to ascii conversion

SYNOPSIS jsr r5,itoa; subr

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

FILES kept in /usr/lib/liba.a

SEE ALSO --

DIAGNOSTICS --

BUGS The subroutine subr should not disturb any registers.

OWNER ken

NAME log -- logarithm base e
SYNOPSIS jsr r5,log
DESCRIPTION The logarithm base e of fr0 is returned in fr0.
The floating point simulation should be active in
either floating or double mode, but in single
precision integer mode.
FILES kept in /usr/lib/liba.a
SEE ALSO fptrap
DIAGNOSTICS The error bit (c-bit) is set if the input argu-
ment is less than or equal to zero.
BUGS --
OWNER ken

3/15/72

NAME mesg -- write message on typewriter
SYNOPSIS jsr r5,mesg; <Now is the time\0>; .even
DESCRIPTION mesq writes the string immediately following its
 call onto the standard output file. The string
 is terminated by a 0 byte.
FILES kept in /usr/lib/liba.a
SEE ALSO --
DIAGNOSTICS --
BUGS --
OWNER ken, dmr

NAME nlist -- get entries from name list

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

DESCRIPTION nlist will examine the name list in an assembler output file and selectively extract a list of values. The file name is a standard UNIX path name. 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 /usr/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 --

OWNER ken

3/15/72

NAME ptime -- print date and time

SYNOPSIS (move time to ac-mq)
mov file,r0
jsr pc,ptime

DESCRIPTION ptime prints the date and time in the form
Oct 9 17:20:33
on the file whose file descriptor is in r0. The string is 15 characters long. The time to be printed is placed in the AC and MQ registers in the form returned by sys time.

FILES kept in /usr/lib/liba.a

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

DIAGNOSTICS --

BUGS see ctime

OWNER dmr, ken

6/12/72

PUTC, PUTW, FCREAT, FLUSH (III)

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>
FILES	kept in /usr/lib/liba.a
SEE ALSO	<u>creat</u> (II), <u>write</u> (II), <u>getc</u> (III)
DIAGNOSTICS	error bit possible on <u>fcreat</u> call
BUGS	--
OWNER	dmr

6/12/72

NAME qsort -- quicker sort

SYNOPSIS (base of data in r1)
 (end 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 byte strings. 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, AC and MQ are destroyed.

FILES --

SEE ALSO --

DIAGNOSTICS --

BUGS The user should be able to supply his own comparison routine.

OWNER ken

6/15/72

SALLOC (III)

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,backword
(word in r0)

jsr pc,length
(length in r0)

jsr pc,position
(position in r0)

jsr pc,rewind

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```

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 backward 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.

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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 current position of the write pointer.

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

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

The allocator proper is in /usr/l1c/alloc/alloca.

The archive /usr/l1c/alloc/allocb contains the individual routines discussed above.

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

FILES

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

1

OWNER

llc, rhm

3/15/72

SIN, COS (III)

NAME sin, cos -- sine cosine
SYNOPSIS jsr r5,sin (cos)
DESCRIPTION The sine (cosine) of fr0 (radians) is returned in fr0. The floating point simulation should be active in either floating or double mode, but in single precision integer mode. All floating registers are used.
FILES kept in /usr/lib/liba.a
SEE ALSO fptrap(III)
DIAGNOSTICS --
BUGS Size of the argument should be checked to make sure the result is meaningful.
OWNER ken, dmr

3/15/72

SQRT (III)

NAME sqrt -- square root function
SYNOPSIS jsr r5,sqrt
DESCRIPTION The square root of fr0 is returned in fr0. The floating point simulation should be active in either floating or double mode, but in single precision integer mode.
FILES kept in /usr/lib/liba.a
SEE ALSO fptrap(III)
DIAGNOSTICS The c-bit is set on negative arguments.
BUGS --
OWNER rhm, dmr, ken

NAME switch -- switch on value

SYNOPSIS `(switch value in r0)`
 `jsr r5,switch; swtab`
 `(not-found return)`

swtab: `...`
 `val1; lab1;`
 `...`
 `valn; labn`
 `..; 0`

DESCRIPTION switch compares the value of r0 against each of
 the val_i; if a match is found, control is
 transferred to the corresponding lab_i (after pop-
 ping the stack once). If no match has been found
 by the time a null lab_i occurs, switch returns.

FILES kept in /usr/lib/liba.a

SEE ALSO --

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

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NAME dn0 -- dn-11 ACU interface

SYNOPSIS --

DESCRIPTION dn0 is a write-only file. Bytes written on dn0 must be ASCII digits. Each digit corresponds to a digit of a telephone number to be called. The entire telephone number must be presented in a single write system call. The call must complete with the last digit.

FILES found in /dev

SEE ALSO dp0(IV), write(II)

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

3/15/72

NAME dp0 -- dp-11 201 data-phone interface

SYNOPSIS --

DESCRIPTION dp0 is a 201 data-phone interface file. read and write calls to dp0 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 found in /dev

SEE ALSO dn0(IV), gerts(III)

DIAGNOSTICS --

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

OWNER ken, dmr

6/12/72

NAME /dev/lpr -- line printer

SYNOPSIS --

DESCRIPTION The line printer special file is the UNIX interface to a DEC LP-11 line printer. This file may only be opened (or creat'ed) for writing. Anything written on this file is printed on the line printer. The following special cases for the printer are handled:

On opening and on closing, the paper is slewed to the top of the next page.

For the 64 character printer (LP11-FA), all lower case letters are converted to upper case.

Tabs are converted to align on every eighth column.

New lines and form feeds are ignored when the printer is at the top of a page. This is done so that pr and roff output may be directed to the printer and sync on page boundaries even with automatic page slew.

Carriage return and back space can cause multiple printing on a single line to allow for overstruck graphics.

FILES found in /dev

SEE ALSO --

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

NAME mem -- core memory

SYNOPSIS --

DESCRIPTION mem maps the core memory of the computer into a file. 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 numbered 0 to 65,535.

FILES found in /dev

SEE ALSO --

DIAGNOSTICS --

BUGS If a location not corresponding to implemented memory is read or written, the system will incur a bus-error trap and, in panic, will reboot itself.

OWNER ken, dmr

6/12/72

NAME mt0 -- magtape

SYNOPSIS --

DESCRIPTION mt0 is the DEC TU10/TM11 magtape. When opened for reading or writing, the magtape is rewound. A tape consists of a series of 256 word records terminated by an end-of-file. Reading less than 256 words (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.

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

FILES found in /dev

DIAGNOSTICS --

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.

OWNER ken, dmr

NAME ppt -- punched paper tape

SYNOPSIS --

DESCRIPTION ppt refers to the 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 characters will usually appear at the beginning of the file; they correspond to the tape leader. 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 and are effectively ignored (however, the read/write pointers are maintained and an arbitrary sequence of reads or writes intermixed with seeks will give apparently correct results when checked with tell).

FILES found in /dev

SEE ALSO --

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

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NAME rf0 -- RF11-RS11 fixed-head disk file

SYNOPSIS --

DESCRIPTION This file refers to the entire RF disk. It may be either read or written, although writing is inherently very dangerous, since a file system resides there.

The disk contains 1024 256-word blocks, numbered 0 to 1023. Like the other block-structured devices (tape, RK disk) 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 found in /dev

SEE ALSO tap0(IV), rk0(IV)

DIAGNOSTICS --

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 and tell) are single-precision numbers. This really has to be changed but unfortunately the repercussions are serious.

OWNER ken, dmr

3/15/72

NAME rk0 -- RK03 (or RK05) disk

SYNOPSIS --

DESCRIPTION rk0 refers to the 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 rf0(IV) section.

FILES found in /dev

SEE ALSO rf0(IV), tap0(IV)

DIAGNOSTICS --

BUGS See rf0(IV)

OWNER ken, dmr

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NAME rp0 -- RP11/RP02 disk

SYNOPSIS --

DESCRIPTION rp0 refers to the entire RP02 disk as a single sequentially-addressed file. Its 256-word blocks are numbered 0 to 40599. Like the RF disk and the tape files, its addressing is block-oriented. Consult the rf0(IV) section.

FILES found in /dev

SEE ALSO rf0(IV), tap0(IV)

DIAGNOSTICS --

BUGS See rf0(IV)
Due to a hardware bug, block 40599 on the RP cannot be accessed.

OWNER ken, dmr

NAME tap0 ... tap7

SYNOPSIS --

DESCRIPTION These files refer to 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.

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.

Like the RK and RF special files, addressing on the tape files is block-oriented. See the RF0 section.

FILES found in /dev

SEE ALSO /dev/rf0, /dev/rk0

DIAGNOSTICS --

BUGS see /dev/rf0

OWNER ken, dmr

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TTY (IV)

NAME tty -- console typewriter

SYNOPSIS --

DESCRIPTION tty (as distinct from tty0, ..., ttn) refers to the console typewriter hard-wired to the PDP-11. Generally, the disciplines involved in dealing with tty are similar to those for tty0 ... and the appropriate section should be consulted. The following differences are salient:

The system calls stty and qetty 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 tty0...) 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 found in /dev

SEE ALSO tty0(IV), init(VII)

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

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NAME	tty0 ... tty7 -- communications interfaces
SYNOPSIS	—
DESCRIPTION	These files refer to DC11 asynchronous communications interfaces. At the moment there are eight 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 <u>init</u> and become a user's standard input and output file.) The very first typewriter file open in a process becomes the <u>control typewriter</u> 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 <u>fork</u> .
	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 standard interface mode assumed includes: ASCII characters; 150 baud; even parity accepted; 10 bits/character (one stop bit); and newline action character. The system delays transmission after sending certain function characters; delays for horizontal tab, newline, and form feed are calculated for the Teletype Model 37; the delay for carriage return is calculated for the GE TermiNet 300. Most of these operating states can be changed by using the system call <u>stty(II)</u> . In particular the following hardware states are program settable independently for input and output (see DC11 manual): 110, 134.5, 150, 300, 600, or 1200 baud; one or two stop bits on output; and 5, 6, 7, or 8 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 echoing of input 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 EOF. The character "@" kills the entire line up to the point where it was typed, but not beyond an EOF. 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 wakened on each character. The program waits only until at least one character has been typed. 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.

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 "rub-out") 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. If interrupts aren't being ignored, 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)*.

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 program 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;

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"\\" is used for "\\"; "-" for "^\\"; "'" for both
"\\" and "-" on output; and "';" maps into "','" on
input. Similar mappings occur with correspon-
dence code output.

FILES found in /dev

SEE ALSO tty(I), getty(VII)

DIAGNOSTICS --

BUGS The primarily Model 37 oriented delays may not be
appropriate for all other ASCII terminals.

OWNER ken, dmr, jfo

NAME a.out -- assembler and link editor output

SYNOPSIS --

DESCRIPTION a.out is the output file of the assembler as and the link editor ld. In both cases, a.out is executable 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 "br .+20" instruction (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 logical segments are set up: the text segment, the data segment, and the uninitialized 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+S_t (the size of the text) the start of the relocation information is 20+S_t+S_d; the start of the symbol table is 20+2(S_t+S_d) if the relocation information is present, 20+S_t+S_d if not.

The symbol table consists of 6-word entries. The first four 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.

If a.out contains no unresolved global references, the text portions are exactly as they will appear in core when the file is executed. If the value of a word in the text portion involves a reference to an undefined global, the word is replaced by the offset to be added to the symbol's value when it becomes defined.

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").

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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.

FILES --

SEE ALSO as, ld, strip, nm, un(I)

DIAGNOSTICS --

BUGS --

OWNER dmr

NAME archive (library) file format

SYNOPSIS --

DESCRIPTION The archive command ar is used to combine several files into one. Its use has three benefits: when files are combined, the file space consumed by the breakage at the end of each file (256 bytes on the average) is saved; directories are smaller and less confusing; archive files of object programs may be searched as libraries by the loader 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 -147(10), or 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.

FILES --

SEE ALSO ar, ld

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

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NAME	format of core image
SYNOPSIS	--
DESCRIPTION	<p>Three conditions cause UNIX to write out the core image of an executing program: the program generates an unexpected trap (by a bus error or illegal instruction); the user sends a "quit" signal (which has not been turned off by the program); a trap is simulated by the floating point simulator. The core image is called "core" and is written in the current 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. 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, is dumped.</p> <p>When any trap which is not an I/O interrupt occurs, all the useful registers are stored on the stack. After all the registers have been stored, the contents of <u>sp</u> are placed in the first cell of the user area; this cell is called <u>u.sp</u>. Therefore, within the core image proper, there is an area which contains the following registers in the following order (increasing addresses):</p> <pre>(u.sp)->sc mq ac r5 r4 r3 r2 r1 r0 pc (at time of fault) processor status (at time of fault)</pre>

The last two are stored by the hardware. It follows that the contents of sp at the time of the fault were (u.sp) plus 22(10).

The actual location of this data depends on which system is being used. In the current system, which has relocation and protection hardware, the stack discussed above is the system stack, and is kept in the per-user area; in older systems,

there is only one stack, and it is located in the user's core area.

In general the debugger db(I) should be used to deal with core images.

FILES	--
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	ken, dmr

NAME format of directories

SYNOPSIS --

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-node 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 necessarily 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 without a mount system call. Therefore in both cases "... " has the same meaning as "...".

FILES --

SEE ALSO file system format

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

NAME format of file system

SYNOPSIS --

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 $k \pmod{8}$ 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 $(i-41) \pmod{8}$ 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 $32 \cdot ((i+31) \pmod{16})$ 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. The swap areas are at the high addresses on the device. It would be convenient if these addresses did not appear in the free list, but in fact this is not so. Therefore a certain number of blocks at the top of the device appear in the free map, are not marked free, yet do not appear within any file. These are the blocks that show up "missing" in a check of the RF disk.

Again on the primary file system device, there

are several pieces of information following that previously discussed. They contain basically the information typed by the tm command; namely, the times spent since a cold boot in various categories, and a count of I/O errors. In particular, there are two words with the calendar time (measured since 00:00 Jan 1, 1971); 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.

If the file is large, b is divided by 256 to yield a number which must be less than 8 (or the file is too large for UNIX to handle). The corresponding slot in the i-node address portion gives the physical block number of an indirect block. The residue mod 256 of b is multiplied by two (to give a byte offset in the indirect block) and the word found there is the physical address of the block corresponding to b.

If block b in a file exists, 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.

FILES	--
SEE ALSO	format of directories
DIAGNOSTICS	--
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.
OWNER	--

NAME ident -- IDENT card file

SYNOPSIS --

DESCRIPTION ident is a file used to generate GECOS \$IDENT cards by the off-line print program opr(I). There is one entry per line in the following style:

05:m1234,m789,name

which causes the following \$IDENT card to be generated:

\$ IDENT m1234,m789,name

FILES kept in /etc/ident.

SEE ALSO opr(I)

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

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PASSWD (v)

NAME passwd -- password file
SYNOPSIS --
DESCRIPTION passwd contains for each user the following information:
name (login name)
password
numerical user ID
default 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. 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, naturally, is inaccessible to anyone but the super-user.

This file resides in directory /etc.

FILES --
SEE ALSO /etc/init
DIAGNOSTICS --
BUGS --
OWNER super-user

NAME **tap** -- DEC/mag tape formats

SYNOPSIS --

DESCRIPTION The DECTape command **tap** and the magtape command **mt** dump and extract files to and from their respective tape media. The format of these tapes are the same.

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

Blocks 1 thru 24 contain a directory of the tape. There are 192 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 inodes (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 is zero.

Blocks 25 on are available for file storage.

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

FILES --

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

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

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UIDS (v)

NAME	/etc/uids -- map user names to user IDs
SYNOPSIS	--
DESCRIPTION	This file allows programs to map user names into user numbers and vice versa. Anyone can read it. It resides in directory /etc, and should be updated along with the password file when a user is added or deleted. The format is an ASCII name, followed by a colon, followed by a decimal ASCII user ID number.
FILES	--
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	dmr, ken

NAME /tmp/utmp -- user information

SYNOPSIS --

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 (currently, '0' to '5' for /dev/tty0 to /dev/tty5). The next two words contain the user's login time. The last word is unused.

This file resides in directory /tmp.

FILES --

SEE ALSO /etc/init, which maintains the file.

DIAGNOSTICS --

BUGS --

OWNER ken, dmr

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NAME	/tmp/wtmp — user login history
SYNOPSIS	--
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.
FILES	--
SEE ALSO	init(VII), login(I), tacct(I), acct(I)
DIAGNOSTICS	--
BUGS	--
OWNER	ken, dmr

NAME **basic** -- DEC supplied BASIC

SYNOPSIS **basic [file]**

DESCRIPTION Basic is the standard BASIC V000 distributed as a stand alone program. The optional file argument is read before the console. See DEC-11-AJPB-D manual.

Since bas is smaller and faster, basic is not maintained on line.

FILES --

SEE ALSO bas

DIAGNOSTICS See manual

BUGS GOK

OWNER dmr

NAME	<code>bc -- B interpreter</code>																
SYNOPSIS	<code>bc [-c] sfile₁.b ... ofile₁ ...</code>																
DESCRIPTION	<code>bc</code> 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 <code>sfile₁.o</code> (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 <code>bc</code> 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 <u>a.out</u> . 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	<table border="0"> <tr> <td><code>file.b</code></td> <td>input file</td> </tr> <tr> <td><code>a.out</code></td> <td>loaded output</td> </tr> <tr> <td><code>b.tmp1</code></td> <td>temporary (deleted)</td> </tr> <tr> <td><code>b.tmp2</code></td> <td>temporary (deleted)</td> </tr> <tr> <td><code>/usr/lang/bdir/b[ca]</code></td> <td>translator</td> </tr> <tr> <td><code>/usr/lang/bdir/brt[12]</code></td> <td>runtime initialization</td> </tr> <tr> <td><code>/usr/lib/libb.a</code></td> <td>builtin functions, etc.</td> </tr> <tr> <td><code>/usr/lang/bdir/bilib.a</code></td> <td>interpreter library</td> </tr> </table>	<code>file.b</code>	input file	<code>a.out</code>	loaded output	<code>b.tmp1</code>	temporary (deleted)	<code>b.tmp2</code>	temporary (deleted)	<code>/usr/lang/bdir/b[ca]</code>	translator	<code>/usr/lang/bdir/brt[12]</code>	runtime initialization	<code>/usr/lib/libb.a</code>	builtin functions, etc.	<code>/usr/lang/bdir/bilib.a</code>	interpreter library
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<code>/usr/lib/libb.a</code>	builtin functions, etc.																
<code>/usr/lang/bdir/bilib.a</code>	interpreter library																
SEE ALSO	[1] K. Thompson; MM-72-1271-1; Users' Reference to B. <code>c(I)</code>																
DIAGNOSTICS	see [1].																
BUGS	Certain external initializations are illegal. (In particular: strings and addresses of externals.)																
OWNER	ken, dmr																

NAME bj -- the game of black jack

SYNOPSIS /usr/games/bj

DESCRIPTION Black jack 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?

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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.

FILES	--
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	ken

NAME cal -- print calendar
SYNOPSIS /usr/ken/cal year
DESCRIPTION Cal will print a calendar for the given year.
 The year can be between 0 (really 1 BC) and 9999.
 For years when several calendars were in vogue in
 different countries, the calendar of England (and
 therefore her colonies) is printed.

P.S. try cal of 1752.

FILES ---
SEE ALSO ---
DIAGNOSTICS ---
BUGS ---
OWNER ken

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CHASH (VI)

NAME chash -- precompile a hash table for cref

SYNOPSIS chash file1 file2

DESCRIPTION CHASH takes symbols (character sequences; one per line) from file1 and compiles a hash table for the use of cref. The table is written on file2.

A subroutine suitable for searching such a hash table is available from the author.

FILES ---

SEE ALSO cref

DIAGNOSTICS ---

BUGS There can only be 199 symbols; they may total only 600 characters of text.

OWNER lem

NAME cref -- make cross reference listing

SYNOPSIS cref [-soi] name1 ...

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. Either ignore or only files must be made by chash (q.v.). 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.

SEE ALSO chash(VI); 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 author

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"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.

OWNER

lem

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DAS (VI)

NAME das -- disassembler
SYNOPSIS --
DESCRIPTION A PDP-11 disassembler exists. Contact the owner
for more information.
FILES --
SEE ALSO --
DIAGNOSTICS --
BUGS --
OWNER ken

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DLI (VI)

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 --
OWNER dmr

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DPT (VI)

NAME dpt -- read DEC ASCII paper tape
SYNOPSIS dpt output [input]
DESCRIPTION dpt reads the input file (/dev/ppt default) assuming the format is a DEC generated ASCII paper tape of an assembly language program. The output is a UNIX ASCII assembly program.
FILES /dev/ppt
SEE ALSO --
DIAGNOSTICS --
BUGS Almost always a hand pass is required to get a correct output.
OWNER ken, dmr

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MOO (VI)

NAME	moo -- a game
SYNOPSIS	/usr/games/moo
DESCRIPTION	<u>moo</u> is a guessing game imported from England.
FILES	--
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	ken

NAME ptx — permuted index

SYNOPSIS ptx1 input temp1
sort temp1 temp2
ptx2 temp2 output

DESCRIPTION ptx generates a permuted index from file input on file output. It is in two pieces: 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 must then be sorted. ptx2 then rotates each line around 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

DIAGNOSTICS --

BUGS --

OWNER dmr

NAME `tmq -- compiler compiler`

SYNOPSIS `tmq name`

DESCRIPTION `tmq` produces a translator for the language whose syntactic 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.

The `tmq` language is described in (Reference).

FILES `/etc/tmg -- the compiler-compiler`
 `/etc/tmga,/etc/tmgb,/etc/tmgc -- libraries`
 `/etc/tmg0.s -- global definitions`

SEE ALSO --

DIAGNOSTICS `???` -- illegal input, offending line follows fatal error codes, appear in `tmq` and `a.out`:
`ad` -- address out of bounds
`so` -- stack overflow
`ga` -- address out of bounds while generating
`ko` -- too much parse without output
`to` -- symbol table overflow
`gn` -- getnam on symbol not in table
`co` -- character string overflow

BUGS --

OWNER doug

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TTT (VI)

NAME	ttt -- tic-tac-toe
SYNOPSIS	/usr/games/ttt
DESCRIPTION	<u>ttt</u> is the X's and O's game popular in 1st grade. This is a learning program that never makes the same mistake twice.
FILES	ttt.k -- old mistakes
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	ken

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NAME ascii -- map of ASCII character set

SYNOPSIS cat /usr/pub/asciiDESCRIPTION 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	ø	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

SEE ALSO --

DIAGNOSTICS --

BUGS --

OWNER jfo

NAME bos, maki, rom, vcboot, msys, et al

SYNOPSIS --

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 UNIX read only memory (ROM) is home cut with 2 programs of 16 words each. The first (address 173000) reads bos from the RF disk into core location 154000 and transfers to 154000. The other ROM program (address 173040) reads a DECTape sitting in the end-zone on drive 0 into core location 0 and transfers to 0. This latter operation is compatible with part of DEC's standard ROM. The disassembled code for the UNIX ROM follows:

173000:	mov \$177472,r0	12700;177472
	mov \$3,-(r0)	12740;3
	mov \$140000,-(r0)	12740;140000
	mov \$154000,-(r0)	12740;154000
	mov \$-2000,-(r0)	12740;176000
	mov \$5,-(r0)	12740;5
	tstb (r0)	105710
	bge .-2	2376
	jmp *\$154000	137;154000
173040:	mov \$177350,r0	12700;177350
	clr -(r0)	5040
	mov r0,-(r0)	10040
	mov \$3,-(r0)	12740;3
	tstb (r0)	105710
	bge .-2	2376
	tst *\$177350	5737;177350
	bne .	1377
	movb \$5,(r0)	112710;5
	tstb (r0)	105710
	bge .-2	2376
	clr pc	5007

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 RKO 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.

Thus we come to the UNIX warm boot procedure: put 173000 into the switches, push load address and then push start. The alternate switch setting of 173030 that will load warm UNIX is used as a signal to bring up a single user system for special purposes. See init(VII). For systems without a rom, UNIX (both warm and cold) have a copy of the disk boot program at location 602. This is probably a better warm boot procedure because the program at 602 also attempts to complete outstanding I/O.

Cold boots can be accomplished with the Cold UNIX program, but they're not. Thus the Cold UNIX slot on the RF may have any program desired. This slot is, however, used during a cold boot. Mount the UNIX INIT DECtape on drive 0 positioned in the end-zone. Put 173040 into the switches. Push load address. Put 1 into the switches. Push start. This reads a program called 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 then reads in Cold UNIX and executes that. Cold UNIX halts for a last chance before it completely initializes the RF file system. Push continue, and Cold UNIX will initialize the RF. It then sets into execution a user program that reads the DECtape for initialization files starting from block 33. When this is done, the program executes /etc/init which should have been on the tape.

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
```

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. 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:

<u>b</u>	bos
<u>w</u>	Warm UNIX
<u>c</u>	Cold UNIX

Due to their rarity of use, maki and msys are maintained off line and must be reassembled before used.

FILES /dev/rf0, /dev/tap?

SEE ALSO init(VII), tap(I), sh(I), mkdir(I)

DIAGNOSTICS --

BUGS This section is very configuration dependent. Thus, it does not describe the boot procedure for any one machine.

OWNER ken

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

SYNOPSIS --

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 "⁷⁴~" (174₈). 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, 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.

GETTY (VII)

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FILES /etc/getty
SEE ALSO init(VII), login(I), stty(II)
DIAGNOSTICS ---
BUGS ---
OWNER dmr, ken, jfo

NAME glob -- generate command arguments

SYNOPSIS --

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.

FILES found in /etc/glob

SEE ALSO sh(I)

DIAGNOSTICS "No match", "No command", "No directory"

BUGS If any of '*', '[', or '?' occurs both quoted and unquoted in the 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.

OWNER dmr

NAME init -- process control initialization

SYNOPSIS --

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 kept in /etc/init; uses /dev/tap, /dev/tty, /dev/tty?, /tmp/utmp, /tmp/wtmp

SEE ALSO login(I), login(VII), getty(VII), sh(I), dpd(I)

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INIT (VII)

DIAGNOSTICS none possible
BUGS none possible
OWNER ken, dmr

6/15/72

NAME	<code>kbd -- keyboard map</code>
SYNOPSIS	<code>cat /usr/pub/kbd</code>
DESCRIPTION	<p><u>kbd</u> contains a map to the keyboard for model 37 Teletype terminals with the extended character set feature. If <u>kbd</u> is printed on such a terminal, the following will appear:</p> <pre><[1234567890-_]^>qwertyuiop@ asdfghjkl;: zxcvbnm,./ <▽1234567890--δ∫γ > ν ;: ,./ <{!"#\$%&'() =_}~ >QWERTYUIOP` ASDFGHJKL+* ZXCVBNM,.? < !"#\$%&'() =- >γΔΛΣθσφτθΠ αεδΦΓΨπρλ+* Ωξωψβημ,.?</pre>
FILES	--
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	jfo

NAME logging in and logging out

SYNOPSIS --

DESCRIPTION UNIX must be called from an appropriate terminal. UNIX supports ASCII terminals typified by the Teletype M37, the GE Terminet 300, the Memorex 1240, and various graphical terminals on the one hand, and IBM 2741-type terminals on the other.

Not all installations support all these terminals. Often the M33/35 Teletype is supported instead of the 2741. Depending on the hardware installed, most terminals operating at 110, 134.5, 150, or 300 baud can be accommodated.

To use UNIX, it is also necessary to have a valid UNIX user ID and (if desired) password. These may be obtained, together with the telephone number, from the system administrators.

The same telephone number serves terminals operating at all the standard speeds. The discussion below applies when the standard speeds of 134.5 (2741's) 150 (TTY 37's) and 300 (Terminet 300's) are available.

When a connection is established via a 150-baud terminal (e.g. TTY 37) UNIX types out "login: "; you respond with your user name, and, if requested, with a password. (The printer is turned off while you type the password.) If the login was successful, the "@" character is typed by the Shell to indicate login is complete and commands may be issued. A message of the day may be typed if there are any announcements. Also, if there is a file called "mailbox", you are notified that someone has sent you mail. (See the mail command.)

From a 300-baud terminal, the procedure is slightly different. Such terminals often have a full-duplex switch, which should be turned on (or conversely, half-duplex should be turned off). When a connection with UNIX is established, a few garbage characters are typed (these are the "login:" message at the wrong speed). You should depress the "break" key; this is a speed-independent signal to UNIX that a 300-baud terminal is in use. It will type "login:" (at the correct speed this time) and from then on the procedure is the same as described above.

From a 2741, no message will appear. After the telephone connection is established, press the "ATTN" button. UNIX should type "login:" as

described above. If the greeting does not appear after a few seconds, hang up and try again; something has gone wrong. If a password is required, the printer cannot be turned off, so it will appear on the paper when you type it.

For more information, consult getty(VII), which discusses the login sequence in more detail, and tty0(IV), which discusses typewriter I/O.

Logging out is simple by comparison (in fact, sometimes too simple). Simply generate an end-of-file at Shell level by using the EOT character; the "login:" message will appear again to indicate that you may log in again.

It is also possible to log out simply by hanging up the terminal; this simulates an end-of-file on the typewriter.

FILES /etc/motd may contain a message-of-the-day.

SEE ALSO init(VII), getty(VII), tty0(IV)

DIAGNOSTICS --

BUGS Hanging up on programs which never read the typewriter or which ignore end-of-files is very dangerous; in the worst cases, the programs can only be halted by restarting the system.

OWNER ken, dmr

NAME msh -- mini-shell

SYNOPSIS --

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 com-
mand.

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 pro-
vide a command-executing facility for various
interactive sub-systems.

FILES found in /etc/msh

SEE ALSO sh, glob

DIAGNOSTICS "?"

BUGS --

OWNER ken, dmr

6/15/72

TABS (VII)

NAME	tabs -- tab stop set
SYNOPSIS	cat /usr/pub/tabs
DESCRIPTION	When printed on a suitable terminal, this file will set tab stops at columns 8, 16, 24, 32, Suitable terminals include the Teletype model 37 and the GE TermiNet 300. These tabs stop settings are desirable because UNIX assumes them in calculating delays.
FILES	--
SEE ALSO	--
DIAGNOSTICS	--
BUGS	--
OWNER	ken