UNIX PROGRAMMER'S MANUAL

Third Edition

K. Thompson

D. M. Ritchie

February, 1973

PREFACE
to the Third Edition

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

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

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

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

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

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

INTRODUCTION TO THIS MANUAL

This manual gives descriptions of the publicly available
features of UNIX. It provides neither a general overview
(see "The UNIX Time-sharing System" for that) nor details of
the implementation of the system (which remain to be dis-
closed).

Within the area it surveys, this manual attempts to be as
complete and timely as possible. A conscious decision was
made to describe each program in exactly the state it was in
at the time its manual section was prepared. In particular,
the desire to describe something as it should be, not as it
is, was resisted. Inevitably, this means that many sections
will soon be out of date. (The rate of change of the system
is so great that a dismayingly large number of early sec-
tions 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 man-
ual!)

This manual is divided into eight sections:

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

Commands are programs intended to be invoked directly by the
user, in contradistinction to subroutines, which are
intended to be called by the user's programs. Commands gen-
erally reside in directory /bin (for binary programs). This
directory is searched automatically by the command line
interpreter. Some programs classified as commands are
located elsewhere; this fact is indicated in the appropriate
sections.

System calls are entries into the UNIX supervisor. In
assembly language, they are coded with the use of the opcode
"sys", a synonym for the trap instruction.

A small assortment of subroutines is available; they are
described in section III. The binary form of most of them
is kept in the system library /usr/lib/liba.a.

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

The file formats section V documents the structure of par-
ticular 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 inter-
mediate files.

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

The miscellaneous section (VII) gathers odds and ends.

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

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

All entries have a common format.

> The <u>name</u> section repeats the entry name and gives a
> very short description of its purpose.
>
> The <u>synopsis</u> 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 them-
selves. 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 informa-
tion.

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 defi-
ciencies. Occasionally also the suggested fix is
described.

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

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

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

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

HOW TO GET STARTED

This section provides the basic information you need to get
started on UNIX: how to log in and log out, how to communi-
cate through your terminal, and how to run a program.

Logging in

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

To use UNIX, you must have a valid UNIX user name, which may
be obtained, together with the telephone number, from the
system administrators.

The same telephone number serves terminals operating at all
the standard speeds. After a data connection is estab-
lished, the login procedure depends on what kind of terminal
you are using.

TTY 37 terminal

UNIX will type out "login: "; you respond with your
user name. From the TTY 37 terminal, and any other
which has the "new-line" function (combined carriage
return and linefeed), terminate each line you type with
the "new line" key (not the "return" key).

300-baud terminals

Such terminals include the GE Terminet 300, most dis-
play terminals, Execuport, TI, and certain Anderson-
Jacobson terminals. These terminals generally have a
speed switch which should be set at "300" (or "30" for
30 characters per second) and a half/full duplex switch
which should be set at full-duplex. (Note that this
switch will often have to be changed since MH-TSS
requires half-duplex). When a connection with UNIX is
established, a few garbage characters are typed (the
login message at the wrong speed). Depress the "break"
key; this is a speed-independent signal to UNIX that a
300-baud terminal is in use. UNIX will type "login: "
at the correct speed; you type your user name, followed
by the "return" key. Henceforth, the "return", "new
line", or "linefeed" keys will give exactly the same
results. Each line must be terminated with one of
these keys; no one is listening to you until the return
is received.

Selectric terminals

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

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

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

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

Logging out

There are three ways to log out:

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

You can log out by typing an end-of-file indication
(EOT character, control "d") to the Shell. The Shell
will terminate and the "login: " message will appear
again.

You can also log in directly as another user by giving
a login command (login (I)).

How to communicate through your terminal

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

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

UNIX typewriter I/O is full-duplex (except for Selectric terminals). It has full read-ahead, which means that you can type at any time, even while a program is typing at you. Of course, if you type during output, the output will have the input characters interspersed. However, whatever you type will be saved up and interpreted in correct sequence.

There is a limit to the amount of read-ahead, but it is generous and not likely to be exceeded unless the system is in trouble. When the read-ahead limit is exceeded, the system stops echoing input characters, and starts echoing "#" no matter what you typed. The last character which was echoed correctly will be received correctly by the program to which you were talking; subsequent characters have been thrown away.

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

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

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

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

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

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

How to run a program; The Shell

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

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

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

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

The current directory

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

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

- x -

Path names

To reference files not in the current directory, you must
use a path name.

Full path names begin with "/", the name of the root direc-
tory of the whole file system. After the slash comes the
name of each directory containing the next sub-directory
(followed by a "/") until finally the file name is reached.
E.g.: "/usr/lem/filex" refers to file "filex" in directory
"lem"; "lem" is itself a sub-directory of "usr"; "usr"
springs directly from the root directory.

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

Without important exception, a path name may be used any-
where a file name is required.

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

For a fuller discussion of the file system, see
MM-71-1273-4. It may also be useful to glance through sec-
tion II of this manual, which discusses system calls, even
if you don't intend to deal with the system at the assembly-
language level.

Writing a program

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

When you have finally gone through this entire process with-
out provoking any diagnostics, the resulting program can be
run by giving its name to the Shell in response to the "%"
prompt.

The next command you will need is db(I). As a debugger, db

is better than average for assembly-language programs,
marginally useful for C programs (when completed, cdb(I)
will be a boon), and virtually useless for Fortran.

Your programs can receive arguments from the command line
just as system programs do. For assembly language programs,
see exec(II).

Text processing

Almost all text is entered through the editor. The commands
most often used to write text on a terminal are: cat(I),
pr(I), roff(I), or nroff(I).

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

Surprises

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

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

When you log in, a message-of-the-day may greet you before
the first "%".

TABLE OF CONTENTS

I. COMMANDS

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


II.  SYSTEM CALLS

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

III. SUBROUTINES

VIII. SYSTEM MAINTAINANCE

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

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

NAME   : -- place a label

SYNOPSIS   : [label]

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

FILES   --

SEE ALSO   goto(I)

DIAGNOSTICS   --

BUGS   --

NAME   ar -- archive

SYNOPSIS   <u>ar</u> key afile name918 ...

DESCRIPTION   <u>ar</u> maintains groups of files combined into a sin-
                gle 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>, option-
                ally concatenated with <u>v</u>. <u>afile</u> is the archive
                file. The <u>names</u> are constituent files in the ar-
                chive 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 ar-
                chive 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 tabled. If names are given, only those files
                are tabled.

                <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 modi-
                fied 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)

                              1

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

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

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

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

NAME   as -- assembler

SYNOPSIS   as [_] name918 ...

DESCRIPTION   as assembles the concatenation of name1, ... If
                the optional first argument _ is used, all unde-
                fined symbols in the assembly are treated as
                global.

                The output of the assembly is left on the file
                "a.out". It is executable if no errors occurred
                during the assembly.

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

SEE ALSO   ld(I), nm(I), un(I), db(I), a.out(V), "UNIX As-
                sembler Manual".

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

) parentheses error
                ] parentheses error
                < String not terminated properly
                * Indirection ("*") used illegally
                A error in Address
                B Branch instruction is odd or too remote
                E error in Expression
                F error in local ("F" or "b") type symbol
                G Garbage (unknown) character
                I End of file inside an If
                M Multiply defined symbol as label
                O Odd-- word quantity assembled at odd address
                P Phase error-- "." different in pass 1 and 2
                R Relocation error
                U Undefined symbol
                X syntaX error

BUGS   Symbol table overflow is not checked.

NAME   bas -- basic

SYNOPSIS   bas [file]

DESCRIPTION   bas is a dialect of basic [1]. If a file argu-
                ment is provided, the file is used for input be-
                fore 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-num-
                bered statements are immediately executed. The
                result of an immediate expression statement (that
                does not have '=' as its highest operator) is
                printed.

                Statements have the following syntax:

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

                    done
                        Return to system level.

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

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

                    erase
                        The 611 screen is erased.

                    for name = expression expression statement
                    for name = expression expression
                    next

                                    1

The <u>for</u> statement repetitively executes a
statement (first form) or a group of state-
ments (second form) under control of a
named variable. The variable takes on the
value of the first expression, then is in-
cremented by one on each loop, not to ex-
ceed the value of the second expression.

<u>goto</u> expression
    The expression is evaluated, truncated to
    an integer and execution goes to the corre-
    sponding integer numbered statment. If ex-
    ecuted from immediate mode, the internal
    statements are compiled first.

<u>if</u> expression statement
    The statement is executed if the expression
    evaluates to non-zero.

<u>list</u> [expression [expression]]
    <u>list</u> is used to print out the stored inter-
    nal 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.

<u>print</u> list
    The list of expressions and strings are
    concatenated and printed. (A string is de-
    limited by " characters.)

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

<u>run</u>
    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.

2

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 e̲ digits or e̲-
    digits.

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

expression operator expression
    Common functions of two arguments are ab-
    breviated by the two arguments separated by
    an operator denoting the function. A com-
    plete list of operators is given below.

expression (̲ [expression [,̲ expression ...]])̲
    Functions of an arbitrary number of argu-
    ments can be called by an expression fol-
    lowed by the arguments in parentheses sepa-
    rated by commas. The expression evaluates
    to the line number of the entry of the
    function in the internally stored state-
    ments. This causes the internal statements
    to be compiled. If the expression evalu-
    ates negative, a builtin function is
    called. The list of builtin functions ap-
    pears below.

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

The following is the list of operators:

=
    = is the assignment operator. The left op-
    erand must be a name or an array element.
    The result is the right operand. Assign-
    ment binds right to left, all other opera-
    tors 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 ze-
          ro 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 pa-
          rameter on the current level of function
          call.

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

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

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

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

    atn
          Atn(x) is the arctangent of x.

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

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

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

                              4

FILES   /tmp/btm?   temporary

SEE ALSO   [1] DEC-11-AJPB-D

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

BUGS   --

NAME   cat -- concatenate and print

SYNOPSIS   cat file918 ...

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

                    cat file

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

                    cat file1 file2 >file3

                is about the easiest way to concatenate files.

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

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

FILES   --

SEE ALSO   pr(I), cp(I)

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

BUGS   cat x y >x and cat x y >y cause strange re-
                sults.

NAME   cc -- C compiler

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

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

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

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

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

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

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

DIAGNOSTICS   Diagnostics are intended to be self-explanatory.

BUGS   --

NAME   cdb -- C debugger

SYNOPSIS   cdb [core [a.out]]

DESCRIPTION   cdb is a debugging program for use with C pro-
                grams. It is by no means completed, and this
                section is essentially only a placeholder for the
                actual description.

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

                Even the present cdb has one useful feature: the
                command

                        $

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

FILES   --

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

DIAGNOSTICS   "?"

BUGS   --

NAME   chdir -- change working directory

SYNOPSIS   chdir directory

DESCRIPTION   directory becomes the new working directory.

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

FILES   --

SEE ALSO   sh(I)

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

BUGS   --

NAME   chmod -- change mode

SYNOPSIS   <u>chmod</u> octal file918 ...

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

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

                Only the owner of a file may change its mode.

FILES   --

SEE ALSO   stat(I), ls(I)

DIAGNOSTICS   "?"

BUGS   --

NAME   chown -- change owner

SYNOPSIS   chown owner file918 ...

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

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

FILES   /etc/passwd

SEE ALSO   stat(I)

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

BUGS   --

NAME   cmp -- compare two files

SYNOPSIS   cmp file918 file928

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

FILES   --

SEE ALSO   proof(I)

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

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

NAME   cp -- copy

SYNOPSIS   cp file918 file928

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

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

FILES   --

SEE ALSO   cat(I), pr(I), mv(I)

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

BUGS   Copying a file onto itself destroys its contents.

NAME   cref -- make cross reference listing

SYNOPSIS   cref [-soi] 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 alpha-
                betic, '.', or '_').

                The output report is in four columns:

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

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

                CREF uses either an ignore file or an only file.
                If the -i option is given, it will take the next
                file name to be an ignore file; if the -o option
                is given, the next file name will be taken as an
                only file. Ignore and only files should be lists
                of symbols separated by new lines. If an ignore
                file is given, all the symbols in the file will
                be ignored in columns (1) and (3) of the output.
                If an only file is given, only symbols appearing
                in the file will appear in column (1), but column
                (3) will still contain the most recent name en-
                countered. 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. DE-
                STROYED) 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 di-
                rectory.

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

SEE ALSO   as(I)

DIAGNOSTICS   "line too long" -- input line >131 characters

                "symbol too long" -- symbol >20 characters

                "too many symbols" -- >10 symbols in line

                "cannot open t.?" -- bug; see LEM

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

"cannot sort" -- odd response from <u>sort</u>; 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 assem-
              bler 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 ev-
              ery eighth column.

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

NAME   crypt -- encode/decode

SYNOPSIS   <u>crypt</u> [password]

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

                  <u>crypt</u> reads from the standard input file and
                  writes on the standard output. For a given pass-
                  word, the encryption process is idempotent; that
                  is,

                          crypt znorkle <clear >cypher
                          crypt znorkle <cypher

                  will print the clear.

                  <u>crypt</u> is suitable for use as a filter:

                          pr <"crypt bandersnatch"<cypher

FILES   --

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

DIAGNOSTICS   --

BUGS   --

NAME   date -- print and set the date

SYNOPSIS   date [mmddhhmm]

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

                    date 10080045

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

FILES   --

SEE ALSO   --

DIAGNOSTICS   "?" if the argument is syntactically incorrect.

BUGS   --

NAME   db -- debug

SYNOPSIS   db [core [namelist]] [_]

DESCRIPTION   Unlike many debugging packages (including DEC's
                ODT, on which db is loosely based) db is not
                loaded as part of the core image which it is used
                to examine; instead it examines files. Typical-
                ly, the file will be either a core image produced
                after a fault or the binary output of the assem-
                bler. Core is the file being debugged; if omit-
                ted "core" is assumed. namelist is a file con-
                taining a symbol table. If it is omitted, the
                symbol table is obtained from the file being de-
                bugged, or if not there from a.out. If no appro-
                priate name list file can be found, db can still
                be used but some of its symbolic facilities be-
                come unavailable.

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

                The format for most db requests is an address
                followed by a one character command.

                Addresses are expressions built up as follows:

                     1. A name has the value assigned to it when
                     the input file was assembled. It may be
                     relocatable or not depending on the use of
                     the name during the assembly.

                     2. An octal number is an absolute quantity
                     with the appropriate value.

                     3. A decimal number immediately followed by
                     "." is an absolute quantity with the appro-
                     priate value.

                     4. An octal number immediately followed by
                     "r" is a relocatable quantity with the ap-
                     propriate value.

                     5. The symbol "." indicates the current
                     pointer of db. The current pointer is set
                     by many db requests.

                   6. A "*" before an expression forms an expres-
                   sion whose value is the number in the word
                   addressed by the first expression. A "*"
                   alone is equivalent to "*.".

                   6. Expressions separated by "+" or " " (blank)
                   are expressions with value equal to the sum

                                    1

of the components. At most one of the com-
ponents may be relocatable.

8. Expressions separated by "-" form an ex-
pression with value equal to the difference
to the components. If the right component
is relocatable, the left component must be
relocatable.

9. Expressions are evaluated left to right.

Names for registers are built in:

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

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

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

There are db commands for examining locations in-
terpreted as octal numbers, machine instructions,
ASCII characters, and addresses. For numbers and
characters, either bytes or words may be exam-
ined. The following commands are used to examine
the specified file.

        / The addressed word is printed in octal.

        \ The addressed byte is printed in octal.

        " The addressed word is printed as two
        ASCII characters.

    ` The addressed word is printed in decimal.

        ? The addressed word is interpreted as a
        machine instruction and a symbolic form of
        the instruction, including symbolic ad-
        dresses, 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

2

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 loca-
tion in the mode last specified by one of
the above requests.

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

% Exit.

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

The address portion of any of the above commands
may be followed by a comma and then by an expres-
sion. 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 val-
ue 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, fol-
lowed 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 ex-
pression. The value of the expression is
stored at the location addressed by the
current value of ".". The opcodes do not
appear in the symbol table, so the user
must assemble them by hand.

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

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

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

For some purposes, it is important to know how
addresses typed by the user correspond with loca-
tions 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. There-
fore, 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 ap-
pears 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 head-
er 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 ad-
dressed at apparent locations 160000-160777.

If one wants to examine a file which has an asso-
ciated 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 fea-
ture is used most frequently in examining the
memory file /dev/mem.

FILES   --

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

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

BUGS   --

NAME   dc -- desk calculator

SYNOPSIS   dc [file]

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

                number
                    The value of the number is pushed on the
                    stack. A number is an unbroken string of the
                    digits 0-9. It may be preceded by an under-
                    score (_) to input a negative number.

                + - * / % ^
                    The top two values on the stack are added (+),
                    subtracted (-), multiplied (*), divided (/),
                    remaindered (%) or exponentiated (^). The two
                    entries are popped off the stack; the result
                    is pushed on the stack in their place.

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

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

                d
                    The top value on the stack is pushed on the
                    stack. Thus the top value is duplicated.

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

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

                q
                    exits the program. If executing a string, the
                    nesting level is popped by two.

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

                [...]

                                   1

puts the bracketed ascii string onto the top
of the stack.

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

<u>v</u>

   replaces the top element on the stack by its
   square root.

<u>!</u>

   interprets the rest of the line as a UNIX com-
   mand.

<u>c</u>

   All values on the stack are popped.

<u>i</u>

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

<u>o</u>

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

<u>z</u>
   the stack level is pushed onto the stack.

<u>?</u>
   a line of input is taken from the input source
   (usually the console) and executed.

new-line
   ignored except as the name of a register or to
   end the response to a <u>?</u>.

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

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

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

```
10000
100*     (now in cents)
dsa      (non-destructive store)
12/      (pennies per month)
la52/    (pennies per week)
```

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

An example which prints the first ten values of n! is
```
    [la1+dsa*pla10>x]sx
    0sa1
    lxx
```

FILES   --

SEE ALSO   msh(VII), salloc(III)

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

BUGS   --

NAME   df -- disk free

SYNOPSIS   df [filesystem]

DESCRIPTION   df prints out the number of free blocks available
                on a file system. If the file system is unspeci-
                fied, the free space on all of the normally
                mounted file systems is printed.

FILES   /dev/rf?, /dev/rk?, /dev/rp?

SEE ALSO   check(VIII)

DIAGNOSTICS   --

BUGS   --

NAME   dsw -- delete interactively

SYNOPSIS   dsw [directory]

DESCRIPTION   For each file in the given directory ("." if not
                specified) dsw types its name. If "y" is typed,
                the file is deleted; if "x", dsw exits; if any-
                thing else, the file is not removed.

FILES   --

SEE ALSO   rm(I)

DIAGNOSTICS   "?"

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

NAME   du -- summarize disk usage

SYNOPSIS   du [-s] [-a] [name ...]

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

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

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

FILES   .

SEE ALSO   --

DIAGNOSTICS   --

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

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

NAME   echo -- echo arguments

SYNOPSIS   <u>echo</u> [arg89918 ...]

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   --

NAME

      ed -- editor

SYNOPSIS

      ed [name]

DESCRIPTION

ed is the standard text editor.

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

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

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

In general, only one command may appear on a line. Cer-
tain 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 mere-
ly collected. Input mode is left by typing a period (.)
alone at the beginning of a line.

ed supports a limited form of regular expression nota-
tion. A regular expression is an expression which speci-
fies a set of strings of characters. A member of this
set of strings is said to be matched by the regular ex-
pression. The regular expressions allowed by ed are con-
structed 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 ex-
       pression matches the null character at the begin-
       ning of a line.

    3. A currency symbol ($) at the end of a regular ex-
       pression matches the null character at the end of a
       line.

    4. A period (.) matches any character but a new-line

character.

5. A regular expression followed by an asterisk (*)
   matches any number of adjacent occurrences (includ-
   ing 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 charac-
   ters in the string.

7. The concatenation of regular expressions is a regu-
   lar expression which matches the concatenation of
   the strings matched by the components of the regu-
   lar expression.

8. The null regular expression standing alone is
   equivalent to the last regular expression encoun-
   tered.

Regular expressions are used in addresses to specify
lines and in one command (s, see below) to specify a por-
tion 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 charac-
ter bounding the regular expression (often "/") and to
"\" itself.

Addresses are constructed as follows. To understand ad-
dressing 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 dis-
cussed under the description of the command.

1. The character "." addresses the current line.

2. The character "^" addresses the line immediately
   before the current line.

3. The character "$" addresses the last line of the
   buffer.

4. A decimal number n addresses the nth line of the
   buffer.

6. A regular expression enclosed in slashes "/" ad-
   dresses the first line found by searching toward
   the end of the buffer and stopping at the first
   line containing a string matching the regular ex-

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

5. A regular expression enclosed in queries "?" ad-
   dresses 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 num-
   ber 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 print-
   able character. Lines may be marked with the "k"
   command described below.

Commands may require zero, one, or two addresses. Com-
mands 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 ac-
cepted) 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 ad-
dress.

In the following list of ed commands, the default ad-
dresses 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 ad-
       dressed line. Address "0" is legal for this com-

        mand; text is placed at the beginning of the buf-
        fer.

    (.,.)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 buf-
        fer. The number of characters read is typed.
        "filename" is remembered for possible use as a de-
        fault file name in a subsequent r or w command.

    f filename
        The filename command prints the currently remem-
        bered file name. If "filename" is given, the cur-
        rently remembered file name is changed to "file-
        name".

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

    (.)i
    <text>
    This command inserts the given text before the ad-
        dressed 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.

4

(.)kx
   The ma<u>rk</u> 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 <u>n</u> com-
   mand.

(.,.)mA
   The <u>m</u>ove 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 mark<u>n</u>ames command will print the current mark
   names.

(.,.)p
   The <u>p</u>rint command prints the addressed lines. "."
   is left at the last line printed. The <u>p</u> command
   <u>may</u> be placed on the same line after any command.

<u>q</u>
   The <u>q</u>uit command causes <u>ed</u> to exit. No automatic
   write of a file is done.

($)r filename
   The <u>r</u>ead command reads in the given file after the
   addressed line. If no file name is given, the re-
   membered file name, if any, is used (see <u>e</u> and <u>f</u>
   commands). The remembered file name is not changed
   unless "filename" is the very first file name men-
   tioned. Address "0" is legal for <u>r</u> 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 <u>s</u>ubstitute command searches each addressed line
   for an occurrence of the specified regular expres-
   sion. 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

5

substituted.

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

(1,$)v/regular expression/command list
   This command is the same as the global command ex-
   cept 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 every-
   one). The remembered file name is not changed un-
   less "filename" is the very first file name men-
   tioned. 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 un-
   changed.

(.+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 charac-
ters in a line, in a global's command list, and in a re-
membered 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 com-
mand list, and 64 characters per file name.

6

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

SEE ALSO   --

DIAGNOSTICS   "?" for any error

BUGS   --

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

NAME   exit -- terminate command file

SYNOPSIS   exit

DESCRIPTION   exit performs a seek to the end of its standard
                input file. Thus, if it is invoked inside a file
                of commands, upon return from exit the shell will
                discover an end-of-file and terminate.

FILES   --

SEE ALSO   if(I), goto(I), sh(I)

DIAGNOSTICS   --

BUGS   --

NAME   factor -- discover prime factors of a number

SYNOPSIS   <u>factor</u>

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

                Maximum time to factor is proportional to sqrt(n)
                and occurs when n is prime. It takes 1 minute to
                factor a prime near 10^13.

FILES   --

SEE ALSO   --

DIAGNOSTICS   "Ouch." for input out of range or for garbage in-
                put.

BUGS   --

NAME   fc -- fortran compiler

SYNOPSIS   fc [-c] sfile1.f ... ofile1 ...

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

                Arguments whose names end with ".f" are assumed
                to be Fortran source program units; they are com-
                piled, 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, typi-
                cally produced by an earlier fc run, or perhaps
                libraries of Fortran-compatible routines. These
                programs, together with the results of any compi-
                lations specified, are loaded (in the order giv-
                en) 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 sec-
                tion):

                1. Arbitrary combination of types is allowed in
                   expressions. Not all combinations are expect-
                   ed 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 recog-
                   nized.

                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

                                  1

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 <u>nn</u> corresponds to file
"fort<u>nn</u>;" (e.g. unit 9 is file "fort09"). For
input, the file must exist; for output, it will
be created.

Unit 5 is permanently associated with the stan-
dard input file; unit 6 with the standard output
file.

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

SEE ALSO   ANSI standard

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

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

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

Runtime diagnostics:

```
1         invalid log argument
2         bad arg count to amod
3         bad arg count to atan2
4         excessive argument to cabs
5         exp too large in cexp
6         bad arg count to cmplx
7         bad arg count to dim
8         excessive argument to exp
9         bad arg count to idim
10        bad arg count to isign
11        bad arg count to mod
12        bad arg count to sign
13        illegal argument to sqrt
14        assigned/computed goto out of range
15        subscript out of range
```

3

```
          16        real**real overflow

          100       illegal I/O unit number
          101       inconsistent use of I/O unit
          102       cannot create output file
          103       cannot open input file
          104       EOF on input file
          105       illegal character in format
          106       format does not begin with (
          107       no conversion in format but non-empty
                    list
          108       excessive parenthesis depth in format
          109       illegal format specification
          110       illegal character in input field
          111       end of format in hollerith specification
          999       unimplemented input conversion
```

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

            arithmetic statement functions

            backspace, endfile, rewind runtime

            binary I/O

            no scale factors on input

NAME

      fed -- edit associative memory for form letter

SYNOPSIS

      fed

DESCRIPTION

      fed is used to edit a form letter associative
memory file, form.m, which consists of named
strings. Commands consist of single letters fol-
lowed by a list of string names separated by a
single space and ending with a new line. The
conventions of the Shell with respect to '*' and
'?' hold for all commands but _m_ where literal
string names are expected. The commands are:

e name918 ...

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

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

      To dump a string onto a file:

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

d [name918 ...]

      _d_eletes a string and its name from the memo-
ry. When called with no arguments _d_ oper-
ates in a verbose mode typing each string
name and deleting only if a 'y' is typed. A
'q' response returns to fed's command level.
Any other response does nothing.

m name918 name928 ...

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

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

n [name918 ...]

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

p name918 ...

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

q (quit) returns to the system.

c [p] [f]

checks the associative memory file for con-
sistency and reports the number of free
headers and blocks. The optional arguments
do the following:

p causes any unaccounted for string to be
printed

f fixes broken memories by adding unac-
counted-for headers to free storage and
removing references to released headers
from associative memory.

FILES   /tmp/ftmp?   temporary
                form.m associative memory

SEE ALSO   form(I), ed(I), sh(I)

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

BUGS   --

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

2

NAME

      form -- form letter generator

SYNOPSIS

      form proto arg918 ...

DESCRIPTION

      form generates a form letter from a prototype
letter, an associative memory, arguments and in a
special case, the current date.

      If form is invoked with the proto argument 'x',
the associative memory is searched for an entry
with name 'x' and the contents filed under that
name are used as the prototype. If the search
fails, the message "[x]:" is typed on the console
and whatever text is typed in from the console,
terminated by two new lines, is used as the pro-
totype.

      If the prototype argument is missing, '{letter}'
is assumed.

      Basically, form is a copy process from the proto-
type to the output file. If an element of the
form [n] (where n is a digit from 1 to 9) is en-
countered, the nth argument arg9n8 is inserted in
its place, and that argument is then rescanned.
If [0] is encountered, the current date is in-
serted. 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 argu-
ment.

      If an element of the form [name] or {name} is en-
countered, the name is looked up in the associa-
tive memory. If it is found, the contents of the
memory under this name replaces the original ele-
ment (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 en-
closed 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 preced-
ed by a \, it loses its special character.

If a file named "forma" already exists in the
users directory, "formb" is used as the output
file and so forth to "formz".

The file "form.m" is created if none exists. Be-
cause 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.

NAME   forml -- form letter generator processor

SYNOPSIS   forml [name] ...

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

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

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

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

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

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

BUGS   --

NAME   goto -- command transfer

SYNOPSIS   goto label

DESCRIPTION   goto is only allowed when the Shell is taking
                commands from a file. The file is searched (from
                the beginning) for a line beginning with ":" fol-
                lowed by one or more spaces followed by the la-
                bel. 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 ef-
                fect is to cause the Shell to transfer to the la-
                belled line.

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

FILES   --

SEE ALSO   sh(I), :(I)

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

BUGS   --

NAME   hyphen -- find hyphenated words

SYNOPSIS   hyphen file1 ...

DESCRIPTION   It finds all of the words in a document which are
                hyphenated across lines and prints them back at
                you in a convenient format.

                If no arguments are given, the standard output is
                used. Thus hyphen may be used as a filter.

FILES   --

SEE ALSO   --

DIAGNOSTICS   yes

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

NAME   if -- conditional command

SYNOPSIS   if expr command [arg918 ...]

DESCRIPTION   if evaluates the expression expr, and if its val-
                ue is true, executes the given command with the
                given arguments.

                The following primitives are used to construct
                the expr:

                    -r file
                        true if the file exists and is readable.

                    -w file
                        true if the file exists and is writable

                    s1 = s2
                        true if the strings s1 and s2 are equal.

                    s1 != s2
                        true if the strings s1 and s2 are not
                        equal.

                These primaries may be combined with the follow-
                ing operators:

                    !
                        unary negation operator

                    -a
                        binary and operator

                    -o
                        binary or operator

                    (expr)
                        parentheses for grouping.

                -a has higher precedence than -o. Notice that
                all the operators and flags are separate argu-
                ments to if and hence must be surrounded by spa-
                ces.

FILES   --

SEE ALSO   sh(I)

DIAGNOSTICS   "if error", if the expression has the wrong syn-
                tax; "command not found."

BUGS   --

                              1

NAME   ld -- link editor

SYNOPSIS   ld [-sulxr] name1 ...

DESCRIPTION   ld combines several object programs into one;
                resolves external references; and searches li-
                braries. In the simplest case the names of sev-
                eral object programs are given, and ld combines
                them, producing an object module which can be ei-
                ther executed or become the input for a further
                ld run. In the latter case, the "-r" option must
                be given to preserve the relocation bits.

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

                If any argument is a library, it is searched ex-
                actly once. Only those routines defining an un-
                resolved external reference are loaded. If a
                routine from a library references another routine
                in the library, the referenced routine must ap-
                pear after the referencing routine in the li-
                brary. Thus the order of programs within li-
                braries is important.

                ld understands several flag arguments which are
                written preceded by a "-":

                    -s "squash" the output, that is, remove the
                       symbol table and relocation bits to save
                       space (but impair the usefulness of the de-
                       bugger). This information can also be re-
                       moved by strip.

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

                    -l This option is an abbreviation for a li-
                       brary name. "-l" alone stands for
                       "/usr/lib/liba.a", which is the standard
                       system library for assembly language pro-
                       grams. "-lx" stands for "/usr/lib/libx.a"
                       where x is any character. There are li-
                       braries for Fortran (x="f"), C (x="c"), Ex-
                       plor (x="e") and B (x="b").

                    -x Do not preserve local (non-.globl) symbols
                       in the output symbol table; only enter ex-

                                      1

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

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

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

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

SEE ALSO   as(I), ar(I)

DIAGNOSTICS   "file not found"-- bad argument

                "bad format"-- bad argument

                "relocation error"-- bad argument (relocation
bits corrupted)

                "multiply defined"-- same symbol defined twice in
same load

                "un"-- stands for "undefined symbol"

                "symbol not found"-- loader bug

                "can't move output file"-- can't move temporary
to a.out file

                "no relocation bits"-- an input file lacks relo-
cation information

                "too many symbols"-- too many references to ex-
ternal symbols in a given routine

                "premature EOF"

                "can't create l.out"-- cannot make temporary file

                "multiple entry point"-- more than one entry
point specified (not possible yet).

BUGS   --

NAME   ln -- make a link

SYNOPSIS   ln name1 [name2]

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

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

FILES   --

SEE ALSO   rm(I)

DIAGNOSTICS   "?"

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

NAME   login -- sign onto UNIX

SYNOPSIS   login [username [password]]

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

                If login is invoked without an argument, it will
                ask for a user name, and, if appropriate, a pass-
                word. 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 di-
                rectly (without forking).

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

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

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

BUGS   --

NAME   ls -- list contents of directory

SYNOPSIS   ls [-ltasd] name1 ...

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

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

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

                    -a list all entries; usually those beginning
                       with "." are suppressed

                    -s give size in blocks for each entry

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

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

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

SEE ALSO   stat(I)

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

BUGS   --

NAME   m6 -- general purpose macro processor

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

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

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

                #meta,arg1,arg2: transfers the role of metachar-
                acter arg1 to character arg2. If two metacharac-
                ters become identical thereby, the outcome of
                further processing is not guaranteed. For exam-
                ple, to make []{} play the roles of #:<> type

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

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

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

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

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

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

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

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

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

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

NAME   mail -- send mail to another user

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

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

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

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

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

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

SEE ALSO   login(I)

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

BUGS   --

1

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. Ti-
                tle is the the desired part of the manual. Sec-
                tion is the section number of the manual. (In
                Arabic, not Roman numerals.) If section is miss-
                ing, 1 is assumed. For example,

                        man man

                would reproduce this page.

FILES   /sys/man/man?/*

SEE ALSO   sh(I), roff(I)

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

BUGS   --

NAME   mesg -- permit or deny messages

SYNOPSIS   mesg [n][y]

DESCRIPTION   mesg n forbids messages via write by revoking
                non-user write permission on the user's typewrit-
                er. mesg y reinstates permission. mesg with no
                argument reverses the current permission. In all
                cases the previous state is reported.

FILES   /dev/tty?

SEE ALSO   write(I)

DIAGNOSTICS   "?" if the standard input file is not a typewrit-
                er

BUGS   --

NAME   mkdir -- make a directory

SYNOPSIS   mkdir dirname ...

DESCRIPTION   mkdir creates specified directories in mode 17.

                The standard entries "." and ".." are made auto-
                matically.

FILES   --

SEE ALSO   rmdir(I)

DIAGNOSTICS   "dirname ?"

BUGS   --

NAME   mt -- manipulate magtape

SYNOPSIS   mt [key] [name ...]

DESCRIPTION   mt saves and restores selected portions of the
                file system hierarchy on magtape. Its actions
                are controlled by the key argument. The key is a
                string of characters containing at most one func-
                tion 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, to-
                      gether 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 hierar-
                      chically 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 avail-
                      able 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 de-
                      fault.

                   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.

                                      1

f   causes new entries copied on tape to be
    'fake' in that only the entries, not the
    data associated with the entries are updat-
    ed. 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.

FILES   /dev/mt?

SEE ALSO   tap(I), tap(V)

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

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

NAME   mv -- move or rename a file

SYNOPSIS   mv name1 name2

DESCRIPTION   mv changes the name of name1 to name2. If name2
                is a directory, name1 is moved to that directory
                with its original file-name. Directories may on-
                ly be moved within the same parent directory
                (just renamed).

FILES   --

SEE ALSO   --

DIAGNOSTICS   yes

BUGS   --

NAME   nm -- print name list

SYNOPSIS   nm [name]

DESCRIPTION   nm prints the symbol table from the output file
                of an assembler or loader run. Each symbol name
                is preceded by its value (blanks if undefined)
                and one of the letters "U" (undefined) "A" (abso-
                lute) "T" (text segment symbol), "D" (data seg-
                ment symbol), or "B" (bss segment symbol). Glob-
                al 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   --

1

NAME   nroff -- format text

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

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

                    +N Output will commence at the first page
                       whose page number is N (independent of
                       whether or not the page number is being
                       printed).

                    -s Stop between pages. Printing will halt pri-
                       or to each page (including the first) to
                       permit paper loading and changing. Printing
                       is restarted by typing either a "newline"
                       or "delete" character.

                    -h High-speed output. During output, strings
                       of space characters are replaced where pos-
                       sible with tab characters to speed up out-
                       put. Futhermore, if the output is directed
                       into a file or a pipe, this mode effective-
                       ly reduces the total number of characters
                       in the file or pipe; this is especially im-
                       portant in multi-column output where the
                       temporary file(s) or pipe(s) would other-
                       wise contain a large number of space char-
                       acters.

                    -q The prompt names for insertions are not
                       printed and the bell character is sent in-
                       stead; in addition, the insertion is not
                       echoed. This mode permits insertions during
                       the actual output printing

                    -i Index mode. NROFF creates a file called
                       "index" containing every word output to-
                       gether with the line and page number. The
                       format is word, tab, page, tab, line, new-
                       line, etc. Invoking this mode slows down
                       the execution of NROFF considerably.

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

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

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

DIAGNOSTICS   none

BUGS   -

REQUEST REFERENCE AND INDEX

Request Form	Initial Value	If no Argument	Cause Break	Explanation
I. Page Control				
.pl +N	N=66	N=66	no	Page Length.
.bp +N	N=1	–	yes	Begin Page.
.pn +N	N=1	ignored	no	Page Number.
.po +N	N=0	N=prev	no	Page Offset.
.ne N	–	N=1	no	NEed N lines.
II. Text Filling, Adjusting, and Centering				
.br	–	–	yes	BReak.
.fi	fill	–	yes	FIll output lines.
.nf	fill	–	yes	NoFill.
.ad c	adj,norm	adjust	no	ADjust mode on.
.na	adjust	–	no	NoAdjust.
.ce N	off	N=1	yes	CEnter N input text lines.
III. Line Spacing and Blank Lines				
.ls +N	N=1	N=prev	no	Line Spacing.
.sp N	–	N=1	yes	SPace N lines
.lv N	–	N=1	no	OR–
.sv N	–	N=1	no	SaVe N lines.
.os	–	–	no	Output Saved lines.
.ns	space	–	no	No-Space mode on.
.rs	–	–	no	Restore Spacing.
.xh	off	–	no	EXtra-Half-line mode on.
IV. Line Length and Indenting				
.ll +N	N=65	N=prev	no	Line Length.
.in +N	N=0	N=prev	yes	INdent.
.ti +N	–	N=1	yes	Temporary Indent.
V. Macros, Diversion, and Line Traps				
.de xx	–	ignored	no	DEfine or redefine a macro.
.rm xx	–	–	no	ReMove macro name.
.di xx	–	end	no	DIvert output to macro "xx".
.wh −N xx	–	–	no	WHen; set a line trap.
.ch −N −M	–	–	no	OR–
.ch xx −M	–	–	no	OR–
.ch −N y	–	–	no	OR–
.ch xx y	–	–	no	CHange trap line.
VI. Number Registers				
.nr a +N −M	–		no	OR–
.nr ab +N −M	–		no	Number Register.

```
.tl ''%''
```

```
.nc c    \n        \n       no    Number Character.
.ar      arabic    -        no    Arabic numbers.
.ro      arabic    -        no    Roman numbers.
.RO      arabic    -        no    ROMAN numbers.
```

VII.   Input and Output Conventions and Character Translations

```
.ta N,M,...        none      no   PseudoTAbs setting.
.tc c    space     space     no   Tab replacement Character.
.lc c    .         .         no   Leader replacement Character.
.ul N    -         N=1       no   UNderline input text lines.
.cc c    .         .         no   Basic Control Character.
.c2 c    '         '         no   Nobreak control character.
.li N    -         N=1       no   Accept input lines LIterally.
.tr abcd....       -         no   TRanslate on output.
```

VIII.   Hyphenation.

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

IX.   Three Part Titles.

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

X.   Output Line Numbering.

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

XI.   Conditional Input Line Acceptance

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

XII.   Environment Switching.

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

XIII.   Insertions from the Standard Input Stream

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

XIV.   Input File Switching

```
.so filename       -         no   Switch SOurce file (push down).
.nx filename       -         no   NeXt file.
.sp
```
XV.   Miscellaneous

```
.tl ''%''
```

```
.ig       –       –           no    IGnore.
.fl       –       –           no    FLush output buffer.
.ab       –       –           no    ABort.
```

NAME   od -- octal dump

SYNOPSIS   od [−abcdho] [file] [[±]offset[.][b]]

DESCRIPTION   od dumps file in one or more formats as selected
                by the first argument. (If the first argument is
                missing, −o is default.) The meanings of the
                format argument characters are:

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

                    b interprets bytes in octal.

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

                    d interprets words in decimal.

                    h interprets words in hex.

                    o interprets words in octal.

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

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

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

FILES   --

SEE ALSO   db(I)

DIAGNOSTICS   --

BUGS   --

NAME   opr -- off line print

SYNOPSIS   opr [--] [-] [+] [+-]file918 ...

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

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

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

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

SEE ALSO   dpd(I), passwd(V)

DIAGNOSTICS   --

BUGS   --

NAME   ov -- overlay pages

SYNOPSIS   ov [file]

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

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

FILES   none

SEE ALSO   nroff(I), pr(I)

DIAGNOSTICS   none

BUGS   Other page lengths should be permitted.

NAME   passwd -- set login password

SYNOPSIS   passwd name password

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

FILES   /etc/passwd

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

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

BUGS   --

NAME   pr -- print file

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

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

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

                    -c print current date
                    -m print date file last modified (default)

                    -n produce n-column output

                    +n begin printing with page n

                    -h treats the next argument as a header

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

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

FILES   /dev/tty? to suspend messages.

SEE ALSO   cat(I), cp(I)

DIAGNOSTICS   none (files not found are ignored)

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

NAME   proof -- compare two text files

SYNOPSIS   proof oldfile newfile

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

FILES   --

SEE ALSO   cmp(I)

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

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

NAME   reloc -- relocate object files

SYNOPSIS   reloc file [-]octal [-]

DESCRIPTION   reloc modifies the named object program file so
                that it will operate correctly at a different
                core origin than the one for which it was assem-
                bled or loaded.

                The new core origin is the old origin increased
                by the given octal number (or decreased if the
                number has a "-" sign).

                If the object file was generated by the link-edi-
                tor ld, the "-r" ld option must have been given
                to preserve the relocation information in the
                file.

                If the optional last argument is given, then any
                "setd" instruction at the start of the file will
                be replaced by a no-op.

                The purpose of this command is to simplify the
                preparation of object programs for systems which
                have no relocation hardware. It is hard to imag-
                ine a situation in which it would be useful to
                attempt directly to execute a program treated by
                reloc.

FILES   --

SEE ALSO   as(I), ld(I), a.out(V)

DIAGNOSTICS   As appropriate

BUGS   --

NAME   rew -- rewind tape

SYNOPSIS   rew [[m]digit]

DESCRIPTION   rew rewinds DECtape or magtape drives. The digit
                is the logical tape number, and should range from
                0 to 7. If the digit is preceded by 'm', rew ap-
                plies to magtape rather than DECtape. A missing
                digit indicates drive 0.

FILES   /dev/tap?
                /dev/mt?

SEE ALSO   --

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

BUGS   --

NAME   rm -- remove (unlink) files

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

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

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

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

FILES   /etc/glob to implement -r flag

SEE ALSO   rmdir(I)

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

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

NAME   rmdir -- remove directory

SYNOPSIS   rmdir dir1 ...

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

FILES   none

SEE ALSO   --

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

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

BUGS   --

NAME   roff -- format text

SYNOPSIS   <u>roff</u> [+number] [<u>-s</u>] [<u>-h</u>] file1 ...

DESCRIPTION   <u>roff</u> formats text according to control lines em-
                bedded in the text in file918, ... Encounter-
                ing a nonexistent file terminates printing. The
                optional argument "+number" causes printing to
                begin at the first page with that number. The
                optional argument "<u>-s</u>" causes printing to stop
                before each page including the first to allow pa-
                per manipulation; printing is resumed upon re-
                ceipt of an interrupt signal. The optional argu-
                ment "-h" causes the output to contain horizontal
                tabs for two or more spaces that end on a tab
                stop. An interrupt signal received during print-
                ing terminates all printing. Incoming intercon-
                sole messages are turned off during printing, and
                the original message acceptance state is restored
                upon termination.

                At the present time, there is no document de-
                scribing ROFF in full. A Request Summary is at-
                tached.

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

SEE ALSO   --

DIAGNOSTICS   none

BUGS   -

REQUEST SUMMARY

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

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

NAME   sh -- shell (command interpreter)

SYNOPSIS   <u>sh</u> [name [arg1 ... [arg9]]]

DESCRIPTION
        <u>sh</u> is the standard command interpreter. It is the pro-
        gram which reads and arranges the execution of the com-
        mand lines typed by most users. It may itself be called
        as a command to interpret files of commands. Before dis-
        cussing the arguments to the shell used as a command, the
        structure of command lines themselves will be given.

        <u>Command</u> <u>lines</u>

        Command lines are sequences of commands separated by com-
        mand delimiters. Each command is a sequence of non-blank
        command arguments separated by blanks. The first argu-
        ment specifies the name of a command to be executed. Ex-
        cept for certain types of special arguments discussed be-
        low, the arguments other than the command name are passed
        without interpretation to the invoked command.

        If the first argument is the name of an executable file,
        it is invoked; otherwise the string "/bin/" is prepended
        to the argument. (In this way most standard commands,
        which reside in "/bin", are found.) If no such command
        is found, the string "/usr" is further prepended (to give
        "/usr/bin/command") and another attempt is made to exe-
        cute the resulting file. (Certain "overflow" commands
        live in "/usr/bin".) If the "/usr/bin" file exists, but
        is not executable, it is used by the shell as a command
        file. That is to say it is executed as though it were
        typed from the console. If all attempts fail, a diagnos-
        tic is printed.

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

        <u>Command</u> <u>delimiters</u>

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

                coma; comb

        causes the execution first of command <u>coma</u>, then of <u>comb</u>.
        The ampersand "&" causes simultaneous execution:

                coma & comb

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

                                   1

        coma &

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

<u>Termination</u> <u>Reporting</u>

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

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

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

<u>Redirection</u> <u>of</u> <u>I/O</u>

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 <u>arg</u> 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.

<u>Pipes</u> <u>and</u> <u>Filters</u>

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

        command >filter>

More generally, special arguments of the form

>f1>f2>...>

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

>f1>f2>...>file

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

In exactly analogous manner input filtering can be speci-
fied via one of

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

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

For example:

ls >pr>

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

ls >pr>xx

puts the paginated listing into the file xx.

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

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

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

<u>Generation of argument lists</u>

If any argument contains any of the characters "?", "*"
or '[', it is treated specially as follows. The current
directory is searched for files which <u>match</u> the given ar-
gument.

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

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name.

Square brackets "[...]" specify a class of characters
which matches any single file-name character in the
class. Within the brackets, each ordinary character is
taken to be a member of the class. A pair of characters
separated by "-" places in the class each character lexi-
cally greater than or equal to the first and less than or
equal to the second member of the pair.

Other characters match only the same character in the
file name.

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

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

In any event, a list of names is obtained which match the
argument. This list is sorted into alphabetical order,
and the resulting sequence of arguments replaces the sin-
gle argument containing the "*", "[", or "?". The same
process is carried out for each argument (the resulting
lists are not merged) and finally the command is called
with the resulting list of arguments.

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

        as /usr/dmr/a?.s

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

Quoting

The character "\" causes the immediately following char-
acter to lose any special meaning it may have to the
shell; in this way "<", ">", and other characters mean-
ingful 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

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"\" is translated into a blank.

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

Argument passing

When the shell is invoked as a command, it has additional
string processing capabilities. Recall that the form in
which the shell is invoked is

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

The name is the name of a file which will be read and in-
terpreted. If not given, this subinstance of the shell
will continue to read the standard input file.

In command lines in the file (not in command input),
character sequences of the form "$n", where n is a digit
0, ..., 9, are replaced by the nth argument to the invo-
cation of the shell (argn). "$0" is replaced by name.

End of file

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

Special commands

Two commands are treated specially by the shell.

"Chdir" is done without spawning a new process by execut-
ing 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 sys-
tem. It is a rewarding exercise to work out why.

Command file errors; interrupts

Any shell-detected error, or an interrupt signal, during
the execution of a command file causes the shell to cease
execution of that file.

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

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

DIAGNOSTICS

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

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

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

NAME   size -- size of an object file

SYNOPSIS   size [object ...]

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

FILES   a.out   default

SEE ALSO   --

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

BUGS   --

NAME   sno -- SNOBOL interpreter

SYNOPSIS   sno [file]

DESCRIPTION   sno is a SNOBOL III (with slight differences)
                compiler and interpreter. sno obtains input from
                the concatenation of file and the standard input.
                All input through a statement containing the la-
                bel 'end' is considered program and is compiled.
                The rest is available to 'syspit'.

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

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

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

                    No back referencing

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

                    Different function declaration. The function
                    declaration is done at compile time by the use
                    of the label 'define'. Thus there is no abil-
                    ity to define functions at run time and the
                    use of the name 'define' is preempted. There
                    is also no provision for 'automatic' variables
                    other than the parameters.

                        define f()
                                or
                        define f(a,b,c)

                    All labels except 'define' (even 'end') must
                    have a non-empty statement.

                    If 'start' is a label in the program, program
                    execution will start there. If not, execution
                    begins with the first executable statement.
                    ('define' is not an executable statement)

                    There are no builtin functions

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

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

                                        1

cause of this, the arithmetic operators '/'
and '*' must be set off by space.

The right side of assignments must be non-emp-
ty.

Either ' or " may be used for literal quotes.

The pseudo-variable 'sysppt' is not available.

FILES   --

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

DIAGNOSTICS   As appropriate

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

NAME   sort -- sort a file

SYNOPSIS   sort [_] [input [output]]

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

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

                The optional argument _ will cause a reverse
                sort.

                sort is implemented in such a way that

                        sort /dev/mt0

                works correctly provided the tape is not too big.

FILES   /tmp/stm?

SEE ALSO   --

DIAGNOSTICS   --

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

NAME   speak -- word to voice translator

SYNOPSIS   speak [-] [vocabulary]

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

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

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

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

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

                A phonetic line of comma only will delete the en-
                try for the working word.

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

                The - option suppresses all utterances.

FILES   /etc/speak.m

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

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

                                    1

NAME   split -- split a file into pieces

SYNOPSIS   split [[file1] file2]

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

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

FILES   -

SEE ALSO   --

DIAGNOSTICS   yes

BUGS   Watch out for 8-character file names.

NAME   stat -- get file status

SYNOPSIS   stat name1 ...

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

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

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

                    1 s: file is small (smaller than 4096 bytes)
                      l: file is large

                    2 d: file is a directory
                      x: file is executable
                      u: set user ID on execution
                      -: none of the above

                    3 r: owner can read
                      -: owner cannot read

                    4 w: owner can write
                      -: owner cannot write

                    5 r: non-owner can read
                      -: non-owner cannot read

                    6 w: non-owner can write
                      -: non-owner cannot write

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

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

FILES   /etc/passwd

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

DIAGNOSTICS   "name?" for any error.

NAME   strip -- remove symbols and relocation bits

SYNOPSIS   strip name1 ...

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

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

FILES   /tmp/stm?   temporary file

SEE ALSO   ld(I), as(I)

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

BUGS   --

NAME   stty -- set teletype options

SYNOPSIS   stty option918 ...

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

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

FILES   standard output.

SEE ALSO   stty(II)

DIAGNOSTICS   "Bad options"

BUGS   --

NAME   sum -- sum file

SYNOPSIS   sum name1 ...

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

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

FILES   none

SEE ALSO   --

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

BUGS   none

NAME   tap -- manipulate DECtape

SYNOPSIS   tap [key] [name ...]

DESCRIPTION   tap saves and restores selected portions of the
                file system hierarchy on DECtape. Its actions
                are controlled by the key argument. The key is a
                string of characters containing at most one func-
                tion 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, to-
                        gether 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 com-
                        mand 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 hierar-
                        chically 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 avail-
                        able information about the listed files.

                                    1

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 de-
       fault.

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

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

     The _v_ option can be used with _r_, _u_, _d_, and
     _x_ only.

  c means a fresh dump is being created; the
     tape directory will be zeroed before begin-
     ning. Usable only with _r_ and _u_.

  f causes new entries copied on tape to be
     'fake' in that no data is present for these
     entries. Such fake entries cannot be ex-
     tracted. Usable only with _r_ and _u_.

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

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

FILES   /dev/tap?

SEE ALSO   mt(I)

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

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

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

NAME   time -- time a command

SYNOPSIS   <u>time</u> command

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

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

FILES   --

SEE ALSO   tm (VIII)

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

NAME   tmg -- compiler compiler

SYNOPSIS   tmg name

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

                        a.out input [output]

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

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

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

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

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

NAME   tss -- interface to Honeywell TSS

SYNOPSIS   tss

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

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

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

                ~<file insert input from named UNIX file

                ~>file deliver tss output to named UNIX file

                ~p   pop the output file

                ~q   disconnect from tss (quit)

                ~r file receive from HIS routine CSR/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 fash-
                ion. 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 Encoded File ~r file

FILES   /dev/dn0, /dev/dp0

SEE ALSO   --

DIAGNOSTICS   DONE when communication is broken.

BUGS   When diagnostic problems occur, tss exits rather
                abruptly.

1

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   --

NAME   type -- type on single sheet paper

SYNOPSIS   <u>type</u> file918 ...

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

FILES   --

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

NAME   typo -- find possible typo's

SYNOPSIS   typo [-] file1 ...

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

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

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

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

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

SEE ALSO   --

DIAGNOSTICS   yes, lots

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

NAME   un -- undefined symbols

SYNOPSIS   un [name]

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

FILES   a.out

SEE ALSO   as(I), ld(I)

DIAGNOSTICS   "?" if the file cannot be found.

BUGS   --

NAME   uniq -- report repeated lines in a file

SYNOPSIS   uniq [-ud] [input [output]]

DESCRIPTION   uniq reads the input file comparing adjacent
                lines. In the normal case, the second and suc-
                ceeding copies of repeated lines are removed; the
                remainder is written on the output file. Note
                that repeated lines must be adjacent in order to
                be found. (See sort(I)) If the -u flag is used,
                just the lines that are not repeated in the orig-
                inal file are output. The -d option specifies
                that one copy of just the repeated lines is to be
                written. Note that the normal mode output is the
                union of the -u and -d mode outputs.

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

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

FILES   --

SEE ALSO   sort(I)

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

BUGS   --

1

NAME   vs -- phoneme list to voice synthesizer

SYNOPSIS   <u>vs</u>

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

                     a0,o1,t,r,1ai,1ay,d,j,ih,u1,%2s

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

FILES   -

SEE ALSO   vsp(VII), speak(I)

DIAGONOSTICS   -

BUGS   -

NAME   wc -- get (English) word count

SYNOPSIS   wc name918 ...

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

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

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

FILES   --

SEE ALSO   roff(I)

DIAGNOSTICS   none; arguments not found are ignored.

BUGS   --

NAME   who -- who is on the system

SYNOPSIS   who [who-file]

DESCRIPTION   who, without an argument, lists the name, type-
                writer channel, and login time for each current
                UNIX user.

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

                Each login is listed with user name, last charac-
                ter of input device name (with /dev/tty sup-
                pressed), date and time. Certain logouts produce
                a similar line without a user name. Reboots pro-
                duce a line with "x" in the place of the device
                name, and a fossil time indicative of when the
                system went down.

FILES   /tmp/utmp

SEE ALSO   login(I), init(VII)

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

BUGS   --

1

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 inter-
                  rupt is sent. At that point write writes "EOT"
                  on the other terminal.

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

                  If the character "!" is found at the beginning of
                  a line, write calls the mini-shell msh to execute
                  the rest of the line as a command.

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

FILES   /tmp/utmp   to find user
                  /etc/msh   to execute !

SEE ALSO   mesg(I), msh(VII)

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

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

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

NAME   boot -- reboot UNIX

SYNOPSIS   sys boot   / boot = 39. not in assembler

DESCRIPTION   UNIX will clean up outstanding IO, and then exe-
                cute the reboot read-only program. This call is
                restricted to the super-user. All users will be
                logged out.

SEE ALSO   boot procedures (VII)

DIAGNOSTICS   the c-bit is set if you are not the super-user

BUGS   It often doesn't work (for unknown reasons).
                It depends on switch settings.

1

NAME   break -- set program break

SYNOPSIS   sys break; addr / break = 17.

DESCRIPTION   break sets the system's idea of the highest loca-
                  tion 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 16K bytes. 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.

SEE ALSO   exec(II)

DIAGNOSTICS   none; strange addresses cause the break to be set
                  at 16K bytes.

BUGS   --

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.

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

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

1

NAME   chdir -- change working directory

SYNOPSIS   sys chdir; dirname / chdir = 12.

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

SEE ALSO   chdir(I)

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

BUGS   --

NAME   chmod -- change mode of file

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

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

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

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

SEE ALSO   chmod(I)

DIAGNOSTICS   Error bit (c-bit) set if name cannot be found or
                if current user is neither the owner of the file
                nor the super-user.

BUGS   --

1

NAME   chown -- change owner of file

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

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

SEE ALSO   chown(I), uids(V)

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

BUGS   --

1

NAME   close -- close a file

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

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

SEE ALSO   creat(II), open(II)

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

BUGS   --

NAME   creat -- create a new file

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

DESCRIPTION   creat creates a new file or prepares to rewrite
                an existing file called name; name is the address
                of a null-terminated string. If the file did not
                exist, it is given mode mode; if it did exist,
                its mode and owner remain unchanged but it is
                truncated to 0 length.

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

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

SEE ALSO   write(II), close(II)

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

BUGS   --

1

NAME   csw -- read console switches

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

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

SEE ALSO   --

DIAGNOSTICS   none

BUGS   Currently the buttons are unavailable.

NAME   dup -- duplicate an open file descriptor

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

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

                Dup is used more to manipulate the value of file
                descriptors than to genuinely duplicate a file
                descriptor. Since the algorithm to allocate file
                descriptors is known to use the lowest available
                value between 0 and 9, combinations of dup and
                close can be used to manipulate file descriptors
                in a general way. This is handy for manipulating
                standard input and/or standard output.

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

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

BUGS   --

NAME   exec -- execute a file

SYNOPSIS   sys exec; name; args / exec = 11.
        name: <...\0>
        args: arg1; arg2; ...; 0
        arg1: <...\0>

DESCRIPTION   <u>exec</u> overlays the calling process with the named
                file, then transfers to the beginning of the core
                image of the file. The first argument to <u>exec</u> 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. Conven-
                tionally, 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 argu-
                ments are available as follows. The stack point-
                er points to a word containing the number of ar-
                guments. Just above this number is a list of
                pointers to the argument strings.

                  sp-> nargs   arg1   ...
                       argn

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

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

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

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

SEE ALSO   fork(II)

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

                              1

cutable, a return from _exec_ constitutes the diag-
nostic. The error bit (c-bit) is set.

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

NAME   exit -- terminate process

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

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

                This call can never return.

SEE ALSO   wait(II)

DIAGNOSTICS   –

BUGS   --

NAME   fork -- spawn new process

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

DESCRIPTION   <u>fork</u> is the only way new processes are created.
                The new process's core image is a copy of that of
                the caller of <u>fork</u>; the only distinction is the
                return location and the fact that r0 in the old
                process contains the process ID of the new
                process. This process ID is used by <u>wait</u>.

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 subtile bug in process de-
                struction.

NAME   fpe -- set floating exception handling

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

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

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

SEE ALSO   --

DIAGNOSTICS   --

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

1

NAME   fstat -- get status of open file

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

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

SEE ALSO   stat(II)

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

BUGS   --

NAME   getuid -- get user identification

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

DESCRIPTION   getuid returns the real user ID of the current
                process. The real user ID identifies the person
                who is logged in, in contradistinction to the ef-
                fective user ID, which determines his access per-
                mission at each moment. It is thus useful to
                programs which operate using the "set user ID"
                mode, to find out who invoked them.

SEE ALSO   setuid(II)

DIAGNOSTICS   --

BUGS   --

NAME   gtty -- get typewriter status

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

DESCRIPTION   gtty stores in the three words addressed by arg
                the status of the typewriter whose file descrip-
                tor is given in r0. The format is the same as
                that passed by stty.

SEE ALSO   stty(II)

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

BUGS   --

NAME   ilgins -- catch illegal instruction trap

SYNOPSIS   sys ilgins; arg / ilgins = 33.

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

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

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

SEE ALSO   PDP-11 manual

DIAGNOSTICS   --

BUGS   --

NAME   intr -- set interrupt handling

SYNOPSIS   sys intr; arg / intr = 27.

DESCRIPTION   When _arg_ is 0, interrupts (ASCII DELETE) are ig-
                nored. When _arg_ is 1, interrupts cause their
                normal result, that is, force an _exit_. When _arg_
                is a location within the program, control is
                transferred to that location when an interrupt
                occurs.

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

SEE ALSO   quit(II)

DIAGNOSTICS   --

BUGS   --

1

NAME   kill -- destroy process

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

DESCRIPTION   kill destroys a process, given its process num-
                    ber. The process leaves a core image.

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

SEE ALSO   --

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

BUGS   Under strange circumstances, kill is ineffective.

NAME   link -- link to a file

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

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

SEE ALSO   link(I), unlink(II)

DIAGNOSTICS   The error bit (c-bit) is set when name1 cannot be
                found; when name2 already exists; when the direc-
                tory of name2 cannot be written; when an attempt
                is made to link to a directory by a user other
                than the super-user.

BUGS   --

NAME   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 may be invoked only by the super-user.

SEE ALSO   mkdir(I)

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

BUGS   --

NAME   mdate -- set modified date on file

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

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

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

SEE ALSO   --

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

BUGS   --

1

NAME   mount -- mount file system

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

DESCRIPTION   <u>mount</u> announces to the system that a removable
                file system has been mounted on special file spe-
                <u>cial</u>; from now on, references to file <u>name</u> will
                refer to the root file on the newly mounted file
                system. <u>Special</u> and <u>name</u> are pointers to null-
                terminated strings containing the appropriate
                path names.

                <u>Name</u> must exist already. If it had contents,
                they are inaccessible while the file system is
                mounted.

SEE ALSO   mount(I), umount(II)

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

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

NAME   nice -- set program in low priority

SYNOPSIS   sys nice / nice = 34.

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

SEE ALSO   formerly known as "hog"

DIAGNOSTICS   --

BUGS   --

NAME   open -- open for reading or writing

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

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

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

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

SEE ALSO   creat(II), read(II), write(II), close(II)

DIAGNOSTICS   The error bit (c-bit) is set if the file does not
                exist, if one of the necessary directories does
                not exist or is unreadable, if the file is not
                readable (resp. writable), or if 10 files are
                open.

BUGS   --

NAME   pipe -- create a pipe

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

DESCRIPTION   The pipe system call creates an I/O mechanism
                called a pipe. The file descriptor returned can
                be used in both read and write operations. When
                the pipe is written, the data is buffered up to
                504 bytes at which time the writing process is
                suspended. A read on the pipe will pick up the
                buffered data.

                It is assumed that after the pipe has been set
                up, two (or more) cooperating processes (created
                by subsequent fork calls) will pass data through
                the pipe with read and write calls.

                The shell has a syntax to set up a linear array
                of processes connected by pipes.

                Read calls on an empty pipe (no buffered data)
                with only one end (no synonymous file descriptors
                resulting from fork or dup) return an end-of-
                file. Write calls under similar conditions are
                ignored.

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

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

BUGS   --

NAME   quit -- turn off quit signal

SYNOPSIS   sys quit; flag / quit = 26.

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

                Quits should be turned off only with due consid-
                eration.

SEE ALSO   intr(II)

DIAGNOSTICS   --

BUGS   --

1

NAME   read -- read from file

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

DESCRIPTION   A file descriptor is a word returned from a suc-
                cessful open or creat call.

                Buffer is the location of nbytes contiguous bytes
                into which the input will be placed. It is not
                guaranteed that all nbytes bytes will be read;
                for example if the file refers to a typewriter at
                most one line will be returned. In any event the
                number of characters read is returned in r0.

                If r0 returns with value 0, then end-of-file has
                been reached.

SEE ALSO   open(II), creat(II)

DIAGNOSTICS   As mentioned, r0 is 0 on return when the end of
                the file has been reached. If the read was
                otherwise unsuccessful the error bit (c-bit) is
                set. Many conditions, can generate an error:
                physical I/O errors, bad buffer address, prepos-
                terous nbytes, file descriptor not that of an in-
                put file.

BUGS   --

1

NAME   rele -- release processor

SYNOPSIS   sys rele / rele = 0; not in assembler

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

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

NAME   seek -- move read/write pointer

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

DESCRIPTION   The file descriptor refers to a file open for
                reading or writing. The read (resp. write)
                pointer for the file is set as follows:

                    if ptrname is 0, the pointer is set to offset.

                    if ptrname is 1, the pointer is set to its
                    current location plus offset.

                    if ptrname is 2, the pointer is set to the
                    size of the file plus offset.

SEE ALSO   --

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

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

NAME   setuid -- set process ID

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

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

SEE ALSO   getuid(II)

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

BUGS   --

NAME   sleep -- stop execution for interval

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

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

SEE ALSO   --

DIAGNOSTICS   --

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

NAME   stat -- get file status

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

DESCRIPTION   name points to a null-terminated string naming a
                file; buf is the address of a 34(10) byte buffer
                into which information is placed concerning the
                file. It is unnecessary to have any permissions
                at all with respect to the file, but all directo-
                ries leading to the file must be readable.

                After stat, buf has the following format:

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

                The flags are as follows:

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

SEE ALSO   stat(I), fstat(II)

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

BUGS   --

NAME   stime -- set time

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

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

SEE ALSO   date(I), time(II)

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

BUGS   --

NAME   stty -- set mode of typewriter

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

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

                The mode argument contains several bits which de-
                termine 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 imme-
                diately to the program. No erase or kill pro-
                cessing 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 Ter-
                miNet 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 ter-
                minal 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

                              1

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.

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.

NAME   sync -- update super-block

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

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

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

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

NAME   time -- get time of year

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

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

SEE ALSO   date(I), mdate(II)

DIAGNOSTICS   --

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

NAME   times -- get process times

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

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

                After the call, the buffer will appear as fol-
                lows:

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

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

                child: .=.+24.

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

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

FILES   --

SEE ALSO   time(II), time(I)

DIAGNOSTICS   --

BUGS   --

NAME   umount -- dismount file system

SYNOPSIS   sys umount; special / umount = 22.

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

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

SEE ALSO   umount(I), mount(II)

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

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

1

NAME   unlink -- remove directory entry

SYNOPSIS   sys unlink; name / unlink = 10.

DESCRIPTION   <u>Name</u> points to a null-terminated string. <u>Unlink</u>
                removes the entry for the file pointed to by <u>name</u>
                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 de-
                struction is delayed until it is closed, even
                though the directory entry has disappeared.

SEE ALSO   rm(I), rmdir(I), link(II)

DIAGNOSTICS   The error bit (c-bit) is set to indicate that the
                file does not exist or that its directory cannot
                be written. Write permission is not required on
                the file itself. It is also illegal to unlink a
                directory (except for the super-user).

BUGS   --

1

NAME   wait -- wait for process to die

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

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

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

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

SEE ALSO   exit(II), fork(II)

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

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

NAME   write -- write on file

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

DESCRIPTION   A file descriptor is a word returned from a suc-
                cessful open or creat call.

                buffer is the address of nbytes contiguous bytes
                which are written on the output file. The number
                of characters actually written is returned in r0.
                It should be regarded as an error if this is not
                the same as requested.

                Writes which are multiples of 512 characters long
                and begin on a 512-byte boundary are more effi-
                cient than any others.

SEE ALSO   creat(II), open(II)

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

BUGS   --

1

NAME   atan -- arc tangent function

SYNOPSIS   jsr   r5,atan[2]

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

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

FILES   kept in /lib/liba.a

SEE ALSO   --

DIAGNOSTICS   there is no error return

BUGS   --

                                1

NAME   atof -- ascii to floating

SYNOPSIS   jsr   r5,atof; subr

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

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

                The only numbers recognized are: an optional mi-
                nus sign followed by a string of digits optional-
                ly containing one decimal point, then followed
                optionally by the letter "e" followed by a signed
                integer.

                The subroutine subr must not disturb any regis-
                ters.

FILES   kept in /lib/liba.a

SEE ALSO   Calls atoi (III)

DIAGNOSTICS   There are none; overflow results in a very large
                number and garbage characters terminate the scan.

BUGS   The routine should accept initial "+", initial
                blanks, and "E" for "e".

                Overflow should be signalled with the carry bit.

NAME   atoi -- ascii to integer

SYNOPSIS   jsr   r5,atoi; subr

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

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

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

                The subroutine subr must not disturb any regis-
                ters.

FILES   kept in /lib/liba.a

SEE ALSO   --

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

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

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

NAME   compar -- default comparison routine for qsort

SYNOPSIS   jsr pc,compar

DESCRIPTION   Compar is the default comparison routine called
                by qsort and is separated out so that the user
                can supply his own comparison.

                The routine is called with the width (in bytes)
                of an element in r3 and it compares byte-by-byte
                the element pointed to by r0 with the element
                pointed to by r4.

                Return is via the condition codes, which are
                tested by the instructions "blt" and "bgt". That
                is, in the absence of overflow, then the condi-
                tion (r0) < (r4) should leave the Z-bit off and
                N-bit on while (r0) > (r4) should leave Z and N
                off. Still another way of putting it is that
                for elements of length 1 the instruction

                        cmpb   (r0),(r4)

                suffices.

                Only r0 is changed by the call.

FILES   kept in /lib/liba.a

SEE ALSO   qsort (III)

DIAGNOSTICS   --

BUGS   It could be recoded to run faster.

NAME   crypt -- password encoding

SYNOPSIS   mov $key,r0
                jsr pc,crypt

DESCRIPTION   On entry, r0 should point to a string of charac-
                ters terminated by an ASCII NULL. The routine
                performs an operation on the key which is diffi-
                cult to invert (i.e. encrypts it) and leaves the
                resulting eight bytes of ASCII alphanumerics in a
                global cell called "word".

                Login uses this result as a password.

FILES   kept in /lib/liba.a

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

DIAGNOSTICS   there are none; garbage is accepted.

BUGS   --

NAME   ctime -- convert date and time to ASCII

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

DESCRIPTION   The output buffer is 16 characters long and the
                time has the format

                    Oct 9 17:32:24\0

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

FILES   kept in /lib/liba.a

SEE ALSO   ptime(III), time(II)

DIAGNOSTICS   --

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

NAME   ddsput -- put a character on display data set

SYNOPSIS   (file descriptor in r0)
                    jsr   pc,ddsinit

                    (character in r0)
                    jsr   pc,ddsput

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

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

                    Thereafter, characters may be displayed by call-
                    ing ddsput. To the extent possible, ddsput simu-
                    lates an ordinary terminal. Characters falling
                    to the right of the 22X22 screen area are ig-
                    nored; the 23rd line on the screen causes the
                    screen to be erased and that line to be put at
                    the top of the new display. Certain ASCII char-
                    acters are interpreted specially as follows:

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

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

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

FILES   kept in /lib/liba.a

1

SEE ALSO   AT&T writeup on DDS

DIAGNOSTICS   --

BUGS   yes

NAME   ecvt, fcvt -- output conversion

SYNOPSIS   jsr pc,ecvt

                or

                jsr pc,fcvt

DESCRIPTION   Ecvt is called with a floating point number in
                fr0.

                On exit, the number has been converted into a
                string of ascii digits in a buffer pointed to by
                r0. The number of digits produced is controlled
                by a global variable "_ndigits".

                Moreover, the position of the decimal point is
                contained in r2: r2=0 means the d.p. is at the
                left hand end of the string of digits; r2>0 means
                the d.p. is within or to the right of the string.

                The sign of the number is indicated by r1 (0 for
                +; 1 for -).

                The low order digit has suffered decimal rounding
                (i. e. may have been carried into).

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

FILES   kept in /lib/liba.a

SEE ALSO   ftoa(III)

DIAGNOSTICS   --

BUGS   --

NAME   exp -- exponential function

SYNOPSIS   jsr   r5,exp

DESCRIPTION   The exponential of fr0 is returned in fr0.

FILES   kept in /lib/liba.a

SEE ALSO   --

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

                Zero is returned if the result would underflow.

BUGS   ---

NAME   ftoa -- floating to ascii conversion

SYNOPSIS   jsr   r5,ftoa; subr

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

                    [-]ddddd.dd*

                if possible, otherwise in the form

                    [-]d.dddddddde[-]dd*.

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

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

                The subroutine subr must not disturb any regis-
                ters.

FILES   kept in /lib/liba.a

SEE ALSO   ecvt(III), itoa(III)

DIAGNOSTICS   --

BUGS   --

NAME   ftoo -- floating to octal conversion

SYNOPSIS   jsr   r5,ftoo; subr

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

                    000000;000000;000000;000000

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

                The subroutine subr must not disturb any regis-
                ters.

FILES   kept in /lib/liba.a

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

NAME   connect, gerts -- Gerts communication over 201

SYNOPSIS   jsr   r5,connect
              (error return)

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

              other entry points: gcset, gout

DESCRIPTION   The GCOS GERTS interface is so bad that a de-
              scription here is inappropriate. Anyone needing
              to use this interface should seek divine guid-
              ance.

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

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

DIAGNOSTICS   --

BUGS   --

NAME   getw, getc, fopen -- buffered input

SYNOPSIS   mov $filename,r0
                jsr   r5,fopen; iobuf

                jsr   r5,getc; iobuf
                (character in r0)

                jsr   r5,getw; iobuf
                (word in r0)

DESCRIPTION   These routines are used to provide a buffered in-
                put 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 er-
                ror.

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

                iobuf must be provided by the user; it must be on
                a word boundary.

                To reuse the same buffer for another file, it is
                sufficient to close the original file and call
                fopen again.

FILES   kept in /lib/liba.a

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

DIAGNOSTICS   c-bit set on EOF or error

BUGS   --

1

NAME   hypot -- calculate hypotenuse

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

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

FILES   kept in /lib/liba.a

SEE ALSO   sqrt(III)

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

BUGS   --

NAME   itoa -- integer to ascii conversion

SYNOPSIS   jsr   r5,itoa; subr

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

                The subroutine <u>subr</u> must not disturb any regis-
                ters.

FILES   kept in /lib/liba.a

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

NAME   log -- logarithm (base e)

SYNOPSIS   jsr   r5,log

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

FILES   kept in /lib/liba.a

SEE ALSO   --

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

BUGS   --

NAME   mesg -- write message on typewriter

SYNOPSIS   jsr   r5,mesg; <Now is the time\0>; .even

DESCRIPTION   mesg writes the string immediately following its
                call onto the standard output file. The string
                must be terminated by an ASCII NULL byte.

FILES   kept in /lib/liba.a

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

NAME   nlist -- get entries from name list

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

DESCRIPTION   <u>nlist</u> will examine the name list in the given as-
                sembler output file and selectively extract a
                list of values. The name list consists of a list
                of 8-character names (null padded) each followed
                by two words. The list is terminated with a ze-
                ro. 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 sys-
                tem name list kept in the file /sys/sys/unix. In
                this way programs can obtain system 'magic' num-
                bers that are up to date.

FILES   kept in /lib/liba.a

SEE ALSO   a.out(V)

DIAGNOSTICS   All type entries are set to -1 if the file cannot
                be found or if it is not a valid namelist.

BUGS   --

NAME   pow -- floating exponentiation x^y

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

DESCRIPTION   The value of x^y (i.e. xy) is returned in fr0.

                0^x returns zero for all x.

                (-x)^y returns a result only if y is an integer.

FILES   kept in /lib/liba.a

SEE ALSO   exp(III), log(III)

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

BUGS   --

NAME   ptime -- print date and time

SYNOPSIS   sys   time
                mov   file,r2
                jsr   pc,ptime

DESCRIPTION   ptime prints the date and time in the form

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

FILES   kept in /lib/liba.a

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

DIAGNOSTICS   --

BUGS   see ctime

```
NAME              putc, putw, fcreat, flush  --  buffered output

SYNOPSIS          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
```

DESCRIPTION   fcreat creates the given file (mode 17) and sets
                  up the buffer iobuf (size 518(10) bytes); putc
                  and putw write a byte or word respectively onto
                  the file; flush forces the contents of the buffer
                  to be written, but does not close the file. The
                  format of the buffer is:

```
iobuf:  .=.+2            / file descriptor
        .=.+2            / characters unused in buffer
        .=.+2            / ptr to next free character
        .=.+512.         / buffer
```

                  fcreat sets the error bit (c-bit) if the file
                  creation failed; none of the other routines re-
                  turn error information.

                  Before terminating, a program should call flush
                  to force out the last of the output.

                  The user must supply iobuf, which should begin on
                  a word boundary.

                  To write a new file using the same buffer, it
                  suffices to call flush, close the file, and call
                  fcreat again.

FILES   kept in /lib/liba.a

SEE ALSO   creat(II), write(II), getc(III)

DIAGNOSTICS   error bit possible on fcreat call

BUGS   --

                              1

NAME   qsort -- quicker sort

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

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

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

FILES   kept in /lib/liba.a

SEE ALSO   compar(III)

DIAGNOSTICS   --

BUGS   It scribbles on r4.

NAME   rand -- random number generator

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

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

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

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

FILES   kept in /lib/liba.a

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

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

NAME   salloc -- string manipulation routines

SYNOPSIS   (get size in r0)
                jsr   pc,allocate

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

                jsr   pc,wc

                (all following instructions assume r1 contains pointer)

                jsr   pc,release

                (get character in r0)
                jsr   pc,putchar

                jsr   pc,lookchar
                (character in r0)

                jsr   pc,getchar
                (character in r0)

                (get character in r0)
                jsr   pc,alterchar

                (get position in r0)
                jsr   pc,seekchar

                jsr   pc,backspace
                (character in r0)

                (get word in r0)
                jsr   pc,putword

                jsr   pc,lookword
                (word in r0)

                jsr   pc,getword
                (word in r0)

                (get word in r0)
                jsr   pc,alterword

                jsr   pc,backword
                (word in r0)

                jsr   pc,length
                (length in r0)

                jsr   pc,position
                (position in r0)

                                1

```
        jsr     pc,rewind

        jsr     pc,create

        jsr     pc,fsfile

        jsr     pc,zero
```

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

                For each string there is a header of four words,
                namely a write pointer, a read pointer and point-
                ers to the beginning and end of the block con-
                taining 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 de-
                stroyed 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 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 respec-
                tively into the string and advance the write
                pointer.

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

                getchar and getword read a byte or word respec-
                tively from the string and advance the read
                pointer.

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

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

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

                                    2

<u>seekchar</u> moves the read pointer to the offset specified in r0.

<u>length</u> returns the current length of the string (beginning pointer to write pointer) in r0.

<u>position</u> returns the current offset of the read pointer in r0.

<u>rewind</u> moves the read pointer to the beginning of the string.

<u>create</u> returns the read and write pointers to the beginning of the string.

<u>fsfile</u> moves the read pointer to the current position of the write pointer.

<u>zero</u> zeros the whole string and sets the write pointer to the beginning of the string.

<u>copy</u> 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.

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

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

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

SEE ALSO   --

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

BUGS   --

3

NAME   sin, cos -- sine cosine

SYNOPSIS   jsr   r5,sin (cos)

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

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

FILES   kept in /lib/liba.a

SEE ALSO   --

DIAGNOSTICS   there are none

BUGS   --

NAME   sqrt -- square root function

SYNOPSIS   jsr   r5,sqrt

DESCRIPTION   The square root of fr0 is returned in fr0.

FILES   kept in /lib/liba.a

SEE ALSO   --

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

BUGS   --

NAME   switch -- switch on value

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

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

FILES   kept in /lib/liba.a

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

NAME   ttyn -- return name of current tty

SYNOPSIS   jsr pc,ttyn

DESCRIPTION   The routine hunts up the name of the input tty
                attached to the process (one byte from the set
                {012345678abc} at present) and returns it in r0.

                "x" is returned if no genuine input tty is at-
                tached to the process.

FILES   kept in /lib/liba.a

SEE ALSO   fstat(II)

DIAGNOSTICS   --

BUGS   --

NAME   dc -- DC-11 communications interfaces

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

        When one of these files is opened, it causes the process
        to wait until a connection is established. (In practice,
        however, user's programs seldom open these files; they
        are opened by init and become a user's standard input and
        output file.) The very first typewriter file open in a
        process becomes the control typewriter for that process.
        The control typewriter plays a special role in handling
        quit or interrupt signals, as discussed below. The con-
        trol typewriter is inherited by a child process during a
        fork.

        A terminal associated with one of these files ordinarily
        operates in full-duplex mode. Characters may be typed at
        any time, even while output is occurring, and are only
        lost when the system's character input buffers become
        completely choked, which is rare, or when the user has
        accumulated the maximum allowed number of input charac-
        ters which have not yet been read by some program. Cur-
        rently this limit is 150 characters. When this is hap-
        pening the character "#" is echoed for every lost input
        character.

        When first opened, the interface mode is ASCII charac-
        ters; 150 baud; even parity only accepted; 10 bits/char-
        acter (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 Ter-
        miNet 300. Most of these operating states can be changed
        by using the system call stty(II). In particular the
        following hardware states are program settable indepen-
        dently for input and output (see DC11 manual): 134.5,
        150, 300, or 1200 baud; one or two stop bits on output;
        and 5, 6, 7, or 8 data bits/character. In addition, the
        following software modes can be invoked: acceptance of
        even parity, odd parity, or both; a raw mode in which all
        characters may be read one at a time; a carriage return
        (CR) mode in which CR is mapped into newline on input and
        either CR or line feed (LF) cause echoing of the sequence
        LF-CR; mapping of upper case letters into lower case;
        suppression of echoing; suppression of delays after func-
        tion characters; the printing of tabs as spaces; and set-
        ting 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 how-
ever necessary to read a whole line at once; any number
of characters may be requested in a read, even one, with-
out losing information.

During input, erase and kill processing is normally done.
The character "#" erases the last character typed, except
that it will not erase beyond the beginning of a line or
an EOT. The character "@" kills the entire line up to
the point where it was typed, but not beyond an EOT.
Both these characters operate on a keystroke basis inde-
pendently 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 read-
ing is awakened on each character. In raw mode, no erase
or kill processing is done; and the EOT, quit and inter-
rupt 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 sig-
nal. The EOT is not passed on except in raw mode.

When the carrier signal from the dataset drops (usually
because the user has hung up his terminal) any read re-
turns with an end-of-file indication. Thus programs
which read a typewriter and test for end-of-file on their
input can terminate appropriately when hung up on.

Two characters have a special meaning when typed. The
ASCII DEL character (sometimes called "rubout") is the
interrupt signal. When this character is received from a
given typewriter, a search is made for all processes
which have this typewriter as their control typewriter,
and which have not informed the system that they wish to
ignore interrupts. If there is more than one such
process, one of these is selected, for practical purposes
at random. The process is either forced to exit or a
trap is simulated to an agreed-upon location in the
process. See intr(II).

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

2

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

Output is prosaic compared to input. When one or more
characters are written, they are actually transmitted to
the terminal as soon as previously-written characters
have finished typing. Input characters are echoed by
putting them in the output queue as they arrive. When a
process produces characters more rapidly than they can be
typed, it will be suspended when its output queue exceeds
some limit. When the queue has drained down to some
threshold the program is resumed. Even-parity is always
generated on output. The EOT character is not transmit-
ted to prevent terminals which respond to it from being
hung up.

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

```
FILES           /dev/tty[01234567ab]    113B dataphones
                /dev/ttyc               display data set
                /dev/ttyd               113B with /dev/dn1


SEE ALSO        kl(IV), getty(VII)


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

NAME   dn -- dn-11 ACU interface

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

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

                  The entire telephone number must be presented in
                  a single <u>write</u> system call.

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

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

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

BUGS   --

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

DESCRIPTION   dp? is a 201 data-phone interface file. read and
                write calls to dp? are limited to a maximum of
                400 bytes. Each write call is sent as a single
                record. Seven bits from each byte are written
                along with an eighth odd parity bit. The sync
                must be user supplied. Each read call returns
                characters received from a single record. Seven
                bits are returned unaltered; the eighth bit is
                set if the byte was not received in odd parity.
                A 20 second time out is set and a zero byte
                record is returned if nothing is received in that
                time.

FILES   /dev/dp0   201 dataphone used to call GCOS

SEE ALSO   dn(IV), gerts(III)

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

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

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

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

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

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

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

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

SEE ALSO   dc(IV), init(VII)

BUGS   --

NAME   mem -- core memory

DESCRIPTION   mem is a special file that is an image of the
                core memory of the computer. It may be used, for
                example, to examine, and even to patch the system
                using the debugger.

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

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

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

FILES   /dev/mem

SEE ALSO   --

BUGS   --

NAME   pc -- PC-11 paper tape reader/punch

DESCRIPTION   ppt refers to the PC-11 paper tape reader or
                punch, depending on whether it is read or writ-
                ten.

                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 char-
                acters 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 sev-
                eral null leader characters will usually appear
                at the beginning of the file. Likewise several
                nulls are likely to appear at the end. End-of-
                file is generated when the tape runs out.

                Seek calls for this file are meaningless.

FILES   /dev/ppt

SEE ALSO   --

BUGS   --

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

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

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

FILES   /dev/rf0

SEE ALSO   tc(IV), rk(IV)

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

NAME   rk -- RK-11/RK03 (or RK05) disk

DESCRIPTION   rk? refers to an entire RK03 disk as a single se-
                quentially-addressed file. Its 256-word blocks
                are numbered 0 to 4871. Like the RF disk and the
                tape files, its addressing is block-oriented.
                Consult the rf(IV) section.

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

SEE ALSO   rf(IV), tc(IV)

BUGS   See rf(IV)

NAME   tc -- TC-11/TU56 DECtape

DESCRIPTION   The files tap0 ... tap7 refer to the TC-11/TU56
                DECtape drives 0 to 7. Since the logical drive
                number can be manually set, all eight files exist
                even though at present there are fewer physical
                drives.

                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 oth-
                erwise. An error is returned if a transaction is
                attempted for a block which does not exist.

                Addressing on the tape files, like that on the RK
                and RF disks, is block-oriented.

FILES   /dev/tap?

SEE ALSO   rf(IV), tap(I)

BUGS   see rf(IV)

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

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

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

FILES   /dev/mt0   selected drive 0

SEE ALSO   mt(I)

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

NAME   vt -- 11/20 (vt01) interface

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

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

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

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

        The graphic and sonic commands are:

        order (1); 1 parameter byte
             The parameter indicates a subcommand, possibly fol-
             lowed by subparameter bytes, as follows:

             erase (1)
                  The screen is erased. This action may be de-
                  layed, as explained below, until a pushbutton
                  is depressed.

                              1

label (2); several subparameter bytes
     The following bytes up to a null character are
     taken as a label and typed on the console TTY.
     One of the console switches gives labels a spe-
     cial interpretation, as explained below.

display label (3); several subparameter bytes
     The following bytes up to a null byte are
     printed as ASCII text on the screen. The ori-
     gin of the text is the last previous point
     plotted; or the upper left hand of the screen
     if there were none.

point (2); 4 parameter bytes
     The 4 parameter bytes are taken as a pair of coordi-
     nates representing a point to be plotted.

line (3); 8 parameter bytes
     The parameter bytes are taken as 2 pairs of coordi-
     nates representing the ends of a line segment which
     is plotted. Only the portion lying within the
     screen is displayed.

frame (4); 1 parameter byte
     The parameter byte is taken as a number of sixtieths
     of a second; an externally-available lead is assert-
     ed for that time. Typically the lead is connected
     to an automatic camera which advances its film and
     opens the shutter for the specified time.

circle (5); 6 parameter bytes
     The parameter bytes are taken as a coordinate pair
     representing the origin, and a word representing the
     radius of a circle. That portion of the circle
     which lies within the screen is plotted.

arc (6); 12 parameter bytes
     The first 4 parameter bytes are taken to be a coor-
     dinate-pair representing the center of a circle.
     The next 4 represent a coordinate-pair specifying a
     point on this circle. The last 4 should represent
     another point on the circle. An arc is drawn
     counter-clockwise from the first circle point to the
     second. If the two points are the same, the whole
     circle is drawn. For the second point, only the
     smaller in magnitude of its two coordinates is sig-
     nificant; the other is used only to find the quad-
     rant of the end of the arc. In any event only
     points within the screen limits are plotted.

dot-line (7); at least 6 parameter bytes
     The first 4 parameter bytes are taken as a coordi-
     nate-pair representing the origin of a dot-line.
     The next byte is taken as a signed x-increment. The

2

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

speak(8); several parameter bytes
    The following bytes up to a null byte are taken to
    represent phonemes which are fed to the voice syn-
    thesizer. vsp(VII) gives the encoding.

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

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

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

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

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

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

FILES   /dev/vt0

SEE ALSO   csw(II), vsp(VII)

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

NAME   a.out --   assembler and link editor output

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

        This file has four sections: a header, the program and
        data text, a symbol table, and relocation bits (in that
        order). The last two may be empty if the program was
        loaded with the "-s" option of ld or if the symbols and
        relocation have been removed by strip.

        The header always contains 8 words:

            1   A magic number (407(8))
            2   The size of the program text segment
            3   The size of the initialized data segment
            4   The size of the uninitialized (bss) segment
            5   The size of the symbol table
            6   The entry location (always 0 at present)
            7   The stack size required (0 at present)
            8   A flag indicating relocation bits have been sup-
                pressed

        The sizes of each segment are in bytes but are even. The
        size of the header is not included in any of the other
        sizes.

        When a file produced by the assembler or loader is loaded
        into core for execution, three segments are set up: the
        text segment, the data segment, and the bss (uninitial-
        ized data) segment, in that order. The text segment be-
        gins at the lowest location in the core image; the header
        is not loaded. The data segment begins immediately after
        the text segment, and the bss segment immediately after
        the data segment. The bss segment is initialized by 0's.
        In the future the text segment will be write-protected
        and shared.

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

        The symbol table consists of 6-word entries. The first
        four contain the ASCII name of the symbol, null-padded.
        The next word is a flag indicating the type of symbol.
        The following values are possible:

            00 undefined symbol

```
     01   absolute symbol
     02   text segment symbol
     03   data segment symbol
     04   bss segment symbol
     40   undefined external (.globl) symbol
     41   absolute external symbol
     42   text segment external symbol
     43   data segment external symbol
     44   bss segment external symbol
```

Values other than those given above may occur if the user
has defined some of his own instructions.

The last word of a symbol table entry contains the value
of the symbol.

If the symbol's type is undefined external, and the value
field is non-zero, the symbol is interpreted by the load-
er ld as the name of a common region whose size is indi-
cated by the value of the symbol.

The value of a word in the text or data portions which is
not a reference to an undefined external symbol is exact-
ly that value which will appear in core when the file is
executed. If a word in the text or data portion involves
a reference to an undefined external symbol, as indicated
by the relocation bits for that word, then the value of
the word as stored in the file is an offset from the as-
sociated external symbol. When the file is processed by
the link editor and the external symbol becomes defined,
the value of the symbol will be added into the word in
the file.

If relocation information is present, it amounts to one
word per word of program text or initialized data. There
is no relocation information if the "suppress relocation"
flag in the header is on.

Bits 3-1 of a relocation word indicate the segment re-
ferred to by the text or data word associated with the
relocation word:

```
   00   indicates the reference is absolute
   02   indicates the reference is to the text segment
   04   indicates the reference is to the data segment
   06   indicates the reference is to the bss segment
   10   indicates the reference is to an undefined external
        symbol.
```

Bit 0 of the relocation word indicates if on that the
reference is relative to the pc (e.g. "clr x"); if off,
the reference is to the actual symbol (e.g., "clr *$x").

The remainder of the relocation word (bits 15-4) contains

2

a symbol number in the case of external references, and
is unused otherwise. The first symbol is numbered 0, the
second 1, etc.

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

NAME   archive (library) file format

DESCRIPTION   The archive command <u>ar</u> is used to combine several
                files into one. Archives are used mainly as li-
                braries to be searched by the link-editor <u>ld</u>.

                A file produced by <u>ar</u> has a "magic number" at the
                start, followed by the constituent files, each
                preceded by a file header. The magic number is
                177555(8) (it was chosen to be unlikely to occur
                anywhere else). The header of each file is 16
                bytes long:

                  0-7
                     file name, null padded on the right

                  8-11
                     Modification time of the file

                  12
                     User ID of file owner

                  13
                     file mode

                  14-15
                     file size

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

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

SEE ALSO   <u>ar</u>, <u>ld</u>

NAME   format of core image

DESCRIPTION   UNIX writes out a core image of a terminated
                process when any of various errors occur. See
                <u>wait</u>(II) for the list of reasons; the most common
                are memory violations, illegal instructions, bus
                errors, and user-generated quit signals.

                The core image is called "core" and is written in
                the process's working directory (provided it can
                be; normal access controls apply).

                The size and structure of the core image file de-
                pend to some extent on which system is involved.
                In general there is a 512-byte area at the end
                which contains the system's per-process data for
                that process. (64 bytes in older systems). The
                remainder represents the actual contents of the
                user's core area when the core image was written.
                In the current system, this area is variable in
                size in that only the locations from user 0 to
                the program break, plus the stack, are dumped.

                When any fatal trap occurs, all the useful regis-
                ters are stored on the stack. In the current
                system, which has relocation and protection hard-
                ware, the stack used is the system stack, which
                is kept in the per-process area; in older sys-
                tems, there is only one stack, and it is located
                in the user's core area.

                The actual format of the information is compli-
                cated because it depends on what hardware is
                present (EAE, floating-point option), whether
                single- or double-precision floating mode is in
                effect, and also involves relocating addresses in
                the system's address space. A guru will have to
                be consulted if enlightenment is required.

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

SEE ALSO   db(I), wait(II)

1

NAME   format of directories

DESCRIPTION   A directory behaves exactly like an ordinary
                  file, save that no user may write into a directo-
                  ry. The fact that a file is a directory is indi-
                  cated by a bit in the flag word of its i-node en-
                  try.

                  Directory entries are 10 bytes long. The first
                  word is the i-number of the file represented by
                  the entry, if non-zero; if zero, the entry is
                  empty.

                  Bytes 2-9 represent the (8-character) file name,
                  null padded on the right. These bytes are not
                  cleared for empty slots.

                  By convention, the first two entries in each di-
                  rectory 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 re-
                  movable file systems. In the first case, there
                  is no parent, and in the second, the system does
                  not permit off-device references. Therefore in
                  both cases ".." has the same meaning as ".".

SEE ALSO   file system (V)

NAME   format of file system

DESCRIPTION
        Every file system storage volume (e.g. RF disk, RK disk,
        DECtape reel) has a common format for certain vital in-
        formation.

        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 num-
        bered 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(mod 8) bits
        from the right. Notice that bits exist for the su-
        perblock and the i-list, even though they are never allo-
        cated 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 nev-
        er 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) (mod
        8) bits from the right; unlike the free map, a "0" bit
        indicates an available i-node.

        I-numbers begin at 1, and the storage for i-nodes begins
        at block 2. Also, i-nodes are 32 bytes long, so 16 of
        them fit into a block. Therefore, i-node i is located in
        block (i+31)/16 of the file system, and begins
        32.((i+31)(mod 16)) bytes from its start.

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

        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 di-
vided 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 cor-
responding to b is the bth entry in the address portion
of the i-node.

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

For block b in a file to exist, it is not necessary that
all blocks less than b exist. A zero block number either
in the address words of the i-node or in an indirect
block indicates that the corresponding block has never
been allocated. Such a missing block reads as if it con-
tained all zero words.

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

NAME   passwd -- password file

DESCRIPTION   passwd contains for each user the following in-
                formation:

                     name (login name, contains no upper case)
                     encrypted password
                     numerical user ID
                     GCOS job number and box number
                     initial working directory
                     program to use as Shell

                This is an ASCII file. Each field within each
                user's entry is separated from the next by a
                colon. The job and box numbers are separated by
                a comma. Each user is separated from the next by
                a new-line. If the password field is null, no
                password is demanded; if the Shell field is null,
                the Shell itself is used.

                This file resides in directory /etc. Because of
                the encrypted passwords, it can and does have
                general read permission and can be used, for ex-
                ample, to map numerical user ID's to names.

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

NAME   tap -- DEC/mag tape formats

DESCRIPTION   The DECtape command tap and the magtape command
                mt dump and extract files to and from their re-
                spective tape media. The formats of these tapes
                are the same except that magtapes have larger di-
                rectories.

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

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

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

                The path name entry is the path name of the file
                when put on the tape. If the pathname starts
                with a zero word, the entry is empty. It is at
                most 32 bytes long and ends in a null byte.
                Mode, uid, size and time modified are the same as
                described under i-nodes (see file system (V)) The
                tape address is the tape block number of the
                start of the contents of the file. Every file
                starts on a block boundary. The file occupies
                (size+511)/512 blocks of continuous tape. The
                checksum entry has a value such that the sum of
                the 32 words of the directory entry is zero.

                Blocks 25 (resp. 147) on are available for file
                storage.

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

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

NAME   /tmp/utmp -- user information

DESCRIPTION   This file allows one to discover information
                about who is currently using UNIX. The file is
                binary; each entry is 16(10) bytes long. The
                first eight bytes contain a user's login name or
                are null if the table slot is unused. The low
                order byte of the next word contains the last
                character of a typewriter name. The next two
                words contain the user's login time. The last
                word is unused.

                This file resides in directory /tmp.

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

NAME   /tmp/wtmp -- user login history

DESCRIPTION   This file records all logins and logouts. Its
                format is exactly like utmp(V) except that a null
                user name indicates a logout on the associated
                typewriter, and the typewriter name 'x' indicates
                that UNIX was rebooted at that point.

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

                This file resides in directory /tmp.

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

NAME   bc -- B interpreter

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

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

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

                Other arguments (except for "-c") are assumed to
                be either loader flag arguments, or B-compatible
                object programs, typically produced by an earlier
                bc run, or perhaps libraries of B-compatible rou-
                tines. These programs, together with the results
                of any compilations specified, are loaded (in the
                order given) to produce an executable program
                with name a.out.

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

                The language itself is described in [1].

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

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

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

DIAGNOSTICS   see [1].

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

NAME   bj -- the game of black jack

SYNOPSIS   /usr/games/bj

DESCRIPTION
        bj is a serious attempt at simulating the dealer in the
        game of black jack (or twenty-one) as might be found in
        Reno. The following rules apply:

        The bet is $2 every hand.

        A player 'natural' (black jack) pays $3. A dealer
        natural loses $2. Both dealer and player naturals is
        a 'push' (no money exchange).

        If the dealer has an ace up, the player is allowed to
        make an 'insurance' bet against the chance of a dealer
        natural. If this bet is not taken, play resumes as
        normal. If the bet is taken, it is a side bet where
        the player wins $2 if the dealer has a natural and
        loses $1 if the dealer does not.

        If the player is dealt two cards of the same value, he
        is allowed to 'double'. He is allowed to play two
        hands, each with one of these cards. (The bet is dou-
        bled 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 ques-
        tions will be asked at appropriate times. Each question
        is answered by y followed by a new line for 'yes', or
        just new line for 'no'.

        ?   (means, "do you want a hit?")
        Insurance?
        Double down?

        Every time the deck is shuffled, the dealer so states and
        the 'action' (total bet) and 'standing' (total won or

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

NAME   ptx -- permuted index

SYNOPSIS   ptx input output

DESCRIPTION   ptx generates a permuted index from file input on
                file output. It has three phases: the first does
                the permutation, generating one line for each
                keyword in an input line. The keyword is rotated
                to the front. The permuted file is then sorted.
                Finally the sorted lines are rotated so the key-
                word comes at the middle of the page.

                input should be edited to remove useless lines.
                The following words are suppressed: "a", "and",
                "as", "is", "for", "of", "on", "or", "the", "to",
                "up".

                The index for this manual was generated using
                ptx.

FILES   --

SEE ALSO   sort(I)

DIAGNOSTICS   some

BUGS   --

NAME   yacc -- yet another compiler compiler

SYNOPSIS   /crp/scj/yacc [<grammar]

DESCRIPTION   Yacc converts a context-free grammar into a set
                of tables for a simple automaton which executes
                an LR(1) parsing algorithm. The tables are pro-
                vided in readable form on the standard output and
                in b-compiler format on file actn.b; the program
                /crp/scj/bpar.b will parse strings using the
                actn.b file.

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

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

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

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

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

NAME   ascii -- map of ASCII character set

SYNOPSIS   cat /usr/pub/ascii

DESCRIPTION   ascii is a map of the ASCII character set, to be
                printed as needed. It contains:

```
|000 nul|001 soh|002 stx|003 etx|004 eot|005 enq|006 ack|007 bel|
|010 bs |011 ht |012 nl |013 vt |014 np |015 cr |016 so |017 si |
|020 dle|021 dc1|022 dc2|023 dc3|024 dc4|025 nak|026 syn|027 etb|
|030 can|031 em |032 sub|033 esc|034 fs |035 gs |036 rs |037 us |
|040 sp |041  ! |042  " |043  # |044  $ |045  % |046  & |047  ' |
|050  ( |051  ) |052  * |053  + |054  , |055  - |056  . |057  / |
|060  0 |061  1 |062  2 |063  3 |064  4 |065  5 |066  6 |067  7 |
|070  8 |071  9 |072  : |073  ; |074  < |075  = |076  > |077  ? |
|100  @ |101  A |102  B |103  C |104  D |105  E |106  F |107  G |
|110  H |111  I |112  J |113  K |114  L |115  M |116  N |117  O |
|120  P |121  Q |122  R |123  S |124  T |125  U |126  V |127  W |
|130  X |131  Y |132  Z |133  [ |134  \ |135  ] |136  ^ |137  _ |
|140  ` |141  a |142  b |143  c |144  d |145  e |146  f |147  g |
|150  h |151  i |152  j |153  k |154  l |155  m |156  n |157  o |
|160  p |161  q |162  r |163  s |164  t |165  u |166  v |167  w |
|170  x |171  y |172  z |173  { |174  | |175  } |176  ~ |177 del|
```

FILES   found in /usr/pub

NAME   dpd -- spawn data phone daemon

SYNOPSIS   /etc/dpd

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

                dpd uses the directory /usr/dpd. The file lock
                in that directory is used to prevent two daemons
                from becoming active. After the daemon has suc-
                cessfully 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 spec-
                ify 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 con-
                    verting that to decimal concatenated with the
                    station ID.

                    L specifies that the remainder of the line is
                    to be sent as a literal.

                    B specifies that the rest of the line is a
                    file name. That file is to be sent as binary
                    cards.

                    F is the same as B except a form feed is
                    prepended to the file.

                    U specifies that the rest of the line is a
                    file name. After the job has been transmit-
                    ted, 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   --

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

SYNOPSIS   /etc/getty

DESCRIPTION

getty is invoked by init (VII) immediately after a type-
writer 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 at-
tempts to adapt the system to the speed and type of ter-
minal being used.

getty initially sets the speed of the interface to 150
baud, specifies that raw mode is to be used (break on ev-
ery character), that echo is to be suppressed, and either
parity allowed. It types the "login:" message (which in-
cludes the characters which put the 37 Teletype terminal
into full-duplex and unlock its keyboard). Then the us-
er'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 se-
quence 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" char-
acter by pushing the attention key or by typing return;
at 150 baud, this character looks like the ascii "˜"
(174988). Upon receipt of the "eot", the system is set
to operate 2741s and a "login: " message is typed.

The user's name is terminated by a new-line or carriage-
return character. The latter results in the system being
set to to treat carriage returns appropriately (see
stty(II)).

The user's name is scanned to see if it contains any low-
er-case alphabetic characters; if not, and if the name is
nonempty, the system is told to map any future upper-case
characters into the corresponding lower-case characters.
Thus UNIX is usable from upper-case-only terminals.

Finally, login is called with the user's name as argu-
ment.

FILES   --

1

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

NAME   glob -- generate command arguments

SYNOPSIS   /etc/glob

DESCRIPTION   glob is used to expand arguments to the shell
                containing "*", '[', or "?". It is passed the
                argument list containing the metacharacters; glob
                expands the list and calls the command itself.
                The actions of glob are detailed in the Shell
                writeup.

FILES   found in /etc/glob

SEE ALSO   sh(I)

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

BUGS   If any of original command line, even the quoted
                metacharacters are expanded.

                glob gives the "No match" diagnostic only if no
                arguments at all result. This is never the case
                if there is any argument without a metacharacter.

NAME   greek -- graphics for extended ascii type box

SYNOPSIS   cat /usr/pub/greek

DESCRIPTION   greek gives the mapping from ascii to the "shift
                out" graphics in effect between SO and SI on mod-
                el 37 teletypes with a 128-character type box.
                It contains:

                alpha   A A │ beta   B B │ gamma   \ \
                GAMMA   G G │ delta   D D │ DELTA   W W
                epsilon S S │ zeta   Q Q │ eta   N N
                theta   T T │ THETA   O O │ lambda   L L
                LAMBDA   E E │ mu   M M │ nu   @ @
                xi   X X │ pi   J J │ PI   P P
                rho   K K │ sigma   Y Y │ SIGMA   R R
                tau   I I │ phi   U U │ PHI   F F
                psi   V V │ PSI   H H │ omega   C C
                OMEGA   Z Z │ nabla   [[│ not   _ _
                partial]] │ integral ^ ^ │

FILES   --

SEE ALSO   ascii (VII)

DIAGNOSTICS   --

BUGS   --

1

NAME   init -- process control initialization

SYNOPSIS   /etc/init

DESCRIPTION

init is invoked inside UNIX as the last step in the boot
procedure. Generally its role is to create a process for
each typewriter on which a user may log in.

First, init checks to see if the console switches contain
173030. (This number is likely to vary between systems.)
If so, the console typewriter tty is opened for reading
and writing and the shell is invoked immediately. This
feature is used to bring up a test system, or one which
does not contain DC-11 communications interfaces. When
the system is brought up in this way, the getty and login
routines mentioned below and described elsewhere are not
needed.

Otherwise, init does some housekeeping: the mode of each
DECtape file is changed to 17 (in case the system crashed
during a tap command); directory /usr is mounted on the
RK0 disk; directory /sys is mounted on the RK1 disk. Al-
so a data-phone daemon is spawned to restart any jobs be-
ing 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 wait-
ing for such an event, wakes up and removes the appropri-
ate entry from the file utmp, which records current
users, and makes an entry in wtmp, which maintains a his-
tory of logins and logouts. Then the appropriate type-
writer is reopened and getty reinvoked.

FILES   /dev/tap?, /dev/tty, /dev/tty?, /tmp/utmp,
                /tmp/wtmp

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

DIAGNOSTICS   none possible

1

BUGS   none possible

NAME   msh -- mini-shell

SYNOPSIS   /etc/msh

DESCRIPTION   msh is a heavily simplified version of the Shell.
                It reads one line from the standard input file,
                interprets it as a command, and calls the com-
                mand.

                The mini-shell supports few of the advanced fea-
                tures of the Shell; none of the following charac-
                ters 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 in-
                teractive sub-systems.

FILES   --

SEE ALSO   sh(I), glob(VII)

DIAGNOSTICS   "?"

BUGS   --

NAME   tabs -- set tab stops

SYNOPSIS   cat /usr/pub/tabs

DESCRIPTION   When printed on a suitable terminal, this file
                will set tab stops every 8 columns. Suitable
                terminals include the Teletype model 37 and the
                GE TermiNet 300.

                These tab stop settings are desirable because
                UNIX assumes them in calculating delays.

FILES   --

SEE ALSO   --

DIAGNOSTICS   --

BUGS   --

NAME   vsp -- voice synthesizer code

SYNOPSIS   cat /usr/pub/vsp

DESCRIPTION   vsp contains a list of phonemes understood by the
                voice synthesizer on device vt. Phonemes are
                usually written in the form

                        comma inflection phoneme

                The inflection and the phoneme codes are or-ed
                together. The phoneme codes are as follows (num-
                bers in octal).

0	= 300	strong inflection	p = 32	penny pound
1	= 200		a0 = 33	contact car
2	= 100		a1 = 52	connect
3	= 000	weak inflection	ai = 37	name came
			aj = 71	namely
aw	= 02	awful law	s = 40	seven six
ie	= 03	zero	d = 41	do diet
e0	= 04	enter met	f = 42	four five
e1	= 76	seven	g = 43	get grand
e2	= 77	seven	h = 44	hello how
er	= 05	weather	j = 45	judge edge
th	= 06	three thick	k = 46	came lock
dh	= 07	this then	l = 47	hello light
yu	= 27	use you	oo = 50	look book
iu	= 10	unite	ou = 51	good shoud
ju	= 11	new you	ng = 53	ring angle
o0	= 31	only no	z = 55	zero hazy
o1	= 12	hello	sh = 56	show ship
o2	= 13	notice	ch = 57	chair chime
u0	= 14	but must	v = 60	seven even
u1	= 15	uncle	b = 61	ball bed
u2	= 16	stirrup	n = 62	nine seven
u3	= 34	app_le ab_le	m = 63	mile men
ae	= 21	cat sat	iy = 66	lie
ea	= 20	antenna	zh = 70	azure pleasure
w	= 22	won wish	ih = 72	station condition
ee	= 23	three	ay = 36	may lay
r	= 24	radio radar		
t	= 25	two time	-0 = 35	long space
ey	= 26	sixty eighty	-1 = 17	
i0	= 30	six mix	-2 = 01	
i1	= 64	inept inside	-3 = 74	short delay
i2	= 65	cryptic static		

SEE ALSO   speak(I), vt(IV)

1

NAME   20boot -- install new 11/20 system

SYNOPSIS   20boot [x]

DESCRIPTION   This shell command file copies the current ver-
                sion of the 11/20 program used to run the VT01
                display onto the /dev/vt0 file.

                If no argument is given, the 11/20 program should
                be executing but idle; the 11/20 program is sent
                preceded by a "reboot" command. If an argument
                is given, the 11/20 should have been restarted at
                its ROM location 777300.

FILES   /dev/vt0;
                /sys/mdec/20.o (11/20 program)

SEE ALSO   vt0 (IV)

DIAGNOSTICS   --

NAME   acct -- login accounting

SYNOPSIS   acct [-w wtmp] [-p] [-d] people

DESCRIPTION   acct produces a printout giving connect time for
                each user who has logged in during the life of
                the current wtmp file. A total is also produced.
                -w is used to specify an alternate wtmp file. -p
                prints individual totals; without this option,
                only totals are printed. -d causes a printout
                for each midnight to midnight period. The people
                argument will limit the printout to only the
                specified login names. If no wtmp file is given,
                /usr/adm/wtmp is used.

FILES   /usr/adm/wtmp

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

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

BUGS   --

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

DESCRIPTION
        On the RF disk, the highest 16K words are reserved for
        stand-alone programs. These 16K words are allocated as
        follows:

        bos   (1K)
        Warm UNIX   (7K)
        Cold UNIX   (8K)

        The program bos (Bootstrap Operating System) examines the
        console switches and executes one of several internal
        programs depending on the setting. The following set-
        tings are currently recognized:

        ???   Will read Warm UNIX from the RF into core loca-
                tion 0 and transfer to 600.

        1   Will read Cold UNIX from the RF into core loca-
                tion 0 and transfer to 600.

        10   Will dump all of memory from core location 0 onto
                DECtape drive 7 and then halt.

        20   Will read 256 words from RK0 into core 0 and
                transfer to zero. This is the procedure to boot
                DOS from an RK.

        40   This is the same as 10 above, but instead of
                halting, UNIX warm is loaded.

        0   Will load a standard UNIX binary paper tape into
                core location 0 and transfer to 0.

        77500   Will load the standard DEC absolute and binary
                loaders and transfer to 77500.

        All manual methods of booting the system involve manipu-
        lation of the console switches. In order for this to be
        possible, the panel must be unlocked and the machine must
        be halted. Also, remember that at the time UNIX comes
        up, the console switches must contain 773030 for a sin-
        gle-user system; anything else gives a multi-user system.

        There are four temperatures of boots. They are:

            Hot boot: restart the system without refreshing its
            code, that is simply by transferring to its start.
            The only use for this procedure is if the system has
            been patched and one doesn't wish to redo the patch-
            es. The procedure is:

                    600 in switches   Load address

                    (773030 in switches for single-user system)
                    start

          Warm boot: refresh system code from the RF disk, but
          the "panic" routine must be in core. Best for gener-
          al use if it works, since outstanding I/O is cleaned
          up. Procedure:

                    602 in switches   load address
                    (773030 in switches for single-user system)
                    start (flushes any I/O, then executes bos)

          Cool boot: RF disk is OK, but nothing in core. Pro-
          cedure:

                    UTIL DECtape on drive 0   773030 in
          switches   load address   (602 in switch-
          es for multi-user system)   start   type
          "boot" on console tty to load bos

          Cold boot: nothing in core, nothing on RF. Best to
          have an expert around for this one. Procedure:

                    INIT DECtape on drive 0   773030 in
          switches   load address   1 in switches
                    start   (machine halts. last chance to
          preserve RF!)   773030 in switches
                    continue   (reads in basic files)

          UNIX is then up, but for various reasons, one should
          do a warm boot (single user) right away. At this
          point also, one might consider whether the INIT tape
          UNIX is the latest version. If there is reason for
          doubt, mount the /sys disk pack, change to directory
          /sys/sys, do "msys u unix", and reboot. Then get the
          /bin-/etc-/lib tape which contains the rest of of the
          RF disk, and do an "mt x". Conceivably, "create er-
          rors" due to lack of some directories will occur;
          make the directories, then try again. Set the date
          correctly; the system starts off at time 0.

          At this point UNIX is in full operation and can be
          rebooted for a multi-user system.

     Here is what happens during a cold boot: the INIT tape
     contains a program called vcboot. The ROM program reads
     vcboot from the tape into core location 0 and transfers
     to it. vcboot then reads 16K words from the DECtape
     (blocks 1-32) and copies the data to the highest 16K
     words of the RF. Thus this initializes the read-only
     part of the RF. vcboot then reads in bos and executes
     it. bos reads in Cold UNIX and executes that. Cold UNIX
     halts for a last chance before it completely initializes
     the RF file system. When continue is pressed, Cold UNIX

                              2

initializes the RF. It then reads the DECtape for ini-
tialization files starting from block 33. Normal opera-
tion then commences with the execution of "/etc/init".

The INIT tape is made by the program <u>maki</u> running under
UNIX. <u>maki</u> writes <u>vcboot</u> on block 0 of <u>/dev/tap7.</u> It
then copies the RF 16K words (using <u>/dev/rf0)</u> onto blocks
1 thru 32. It has internally a list of files to be
copied from block 33 on. This list follows:

        /etc/init
        /bin/chmod
        /bin/date
        /bin/login
        /bin/ls
        /bin/mkdir
        /etc/mount
        /bin/sh
        /bin/tap
        /bin/mt

Thus this is the set of programs available after a cold
boot. <u>init</u> and <u>sh</u> are mandatory. For multi-user UNIX,
<u>getty</u> and <u>login</u> are also necessary. <u>mkdir</u> is necessary
due to a bug in <u>tap</u>. <u>mt</u>, <u>tap</u> and <u>mount</u> are useful to
bring in new files. As soon as possible, <u>date</u> should be
done. That leaves <u>ls</u> and <u>chmod</u> as frosting.

The last link in this incestuous daisy chain is the pro-
gram <u>msys</u>.

    <u>msys</u> char file

will copy the file <u>file</u> onto the RF read only slot speci-
fied by the character <u>char</u>. Char is taken from the fol-
lowing set:

    <u>b</u> bos
    <u>u</u> Warm UNIX
    <u>1</u> Cold UNIX

FILES   /dev/rf0, /dev/tap?

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

DIAGNOSTICS   --

BUGS   This section is very configuration dependent.

NAME   check -- file system consistency check

SYNOPSIS   check [filesystem [blockno918 ...]]

DESCRIPTION   check will examine a file system, build a bit map
                of used blocks, and compare this bit map against
                the bit map maintained on the file system. If
                the file system is not specified, a check of all
                of the normally mounted file systems is per-
                formed. Output includes the number of files on
                the file system, the number of these that are
                'large', the number of indirect blocks, the num-
                ber of used blocks, and the number of free
                blocks.

                check works by examining the i-nodes on the file
                system and is entirely independent of its direc-
                tory hierarchy. The file system may be, but need
                not be, mounted.

FILES   /dev/rf?, /dev/rk?, /dev/rp?

SEE ALSO   find(I), ds(I)

DIAGNOSTICS   Diagnostics are produced for blocks missing, du-
                plicated, and bad block addresses. Diagnostics
                are also produced for block numbers passed as pa-
                rameters. In each case, the block number, i-num-
                ber, 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, extra-
                neous diagnostics may occur.

NAME   chk -- check + dcheck

SYNOPSIS   chk

DESCRIPTION   This command file does a check and a dcheck of
              all of the normally mounted file systems.

FILES   /dev/[fkp]*

SEE ALSO   check (VIII), dcheck (VIII)

DIAGNOSTICS   see "SEE ALSO"

NAME   clri -- clear i-node

SYNOPSIS   clri i-number [file system]

DESCRIPTION   clri writes zeros on the 32 bytes occupied by the
                i-node numbered i-number. If the file system ar-
                gument is given, the i-node resides on the given
                device, otherwise on a default file system. The
                file system argument must be a special file name
                referring to a device containing a file system.

                After clri, any blocks in the affected file will
                show up as "missing" in a check of the file sys-
                tem.

                Read and write permission is required on the
                specified file system device. The i-node becomes
                allocatable.

                The primary purpose of this routine is to remove
                a file which for some reason appears in no direc-
                tory.

DIAGNOSTICS   "error"

1

NAME   dcheck -- directory consistency check

SYNOPSIS   dcheck [-l] [device]

DESCRIPTION   dcheck builds an image of the directory hierarchy
                of the specified device by reading all its direc-
                tories (using physical I/O guided by the i-nodes
                on the device). A list entry is made for each
                file encountered. A second pass reads the i-
                nodes and for each file compares the number of
                links specified in its i-node with the number of
                entries actually seen. All discrepancies are
                noted.

                If no device is specified, a default device is
                assumed.

                The argument -l causes a complete listing of the
                file names on the device in i-node order.

FILES   /dev/rk?

SEE ALSO   check(VIII)

DIAGNOSTICS   inconsistent i-numbers, unnamed files, unreach-
                able files, loops in directory "hierarchy".

BUGS   Unreachable files and loops are discovered only
                under the "-l" option.

NAME   dli -- load DEC binary paper tapes

SYNOPSIS   dli output [input]

DESCRIPTION   dli will load a DEC binary paper tape into the
                  output file. The binary format paper tape is
                  read from the input file (/dev/ppt is default.)

FILES   /dev/ppt

SEE ALSO   --

DIAGNOSTICS   "checksum"

BUGS   --

NAME   istat -- get inode status

SYNOPSIS   istat [filesystem] inumber1 ...

DESCRIPTION   istat gives information about one or more i-nodes
                on the given file system or on /dev/rk0 if no
                file system is given.

                The information is in exactly the same form as
                that for stat(I), except that mode letter "a" is
                used to indicate that the i-node is allocated,
                "u" that it is unallocated.

FILES   /etc/uids, /dev/rk0

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

DIAGNOSTICS   --

BUGS   istat ignores any read error and pretends to give
                status even if the file system is not physically
                present.

NAME   kill -- terminate process with extreme prejudice

SYNOPSIS   /usr/adm/kill processnumber

DESCRIPTION   After ps (q.v.) has given you the unique ID of a
                process, you can terminate it by this command. A
                core image is produced in the process's working
                directory.

                Only the super-user can exercise this privilege.

FILES   --

SEE ALSO   ps (VIII)

DIAGNOSTICS   yes

BUGS   If the process has executed sys nice (II) and
                there is another process which has not, but which
                loops, the first process cannot be done in prop-
                erly, since it has to be swapped in so as cooper-
                ate in its own murder.

                It would also be nice if ordinary people could
                kill their own processes.

1

NAME   mount -- mount file system

SYNOPSIS   /etc/mount special file

DESCRIPTION   mount announces to the system that a removable
                file system is present on the device correspond-
                ing to special file special (which must refer to
                a disk or possibly DECtape). The file must exist
                already; it becomes the name of the root of the
                newly mounted file system.

FILES   --

SEE ALSO   umount(VIII)

DIAGNOSTICS   "?", if the special file is already in use, can-
                not be read, or if file does not exist.

BUGS   Should be usable only by the super-user. Mount-
                ing file systems full of garbage can crash the
                system.

NAME   ps -- process status

SYNOPSIS   /usr/adm/ps [-xlt]

DESCRIPTION
        ps prints certain facts about active processes. The in-
        formation is columnar and consists of:

            The (numerical) ID of the user associated with the
            process;

            The last character of the control typewriter of the
            process or "x" if there is no control typewriter; "x"
            lines are suppressed unless the "x" option is given.

            The number of 512-byte disk blocks holding the core
            image of the process;

            The process's unique ID (only with "l" option)

            The number of hours (mod 100) and minutes of system,
            disk, and user-process time accumulated by the process
            and all its terminated descendants (only with "t" op-
            tion)

            An educated guess as to the command line which caused
            the process to be created.

        Some caveats:

        The guess as to the command name and arguments is ob-
        tained by examining the process's stack. The process is
        entitled to destroy this information. Also, only pro-
        cesses whose core images are on disk have visible names.
        The ps command in particular does not, nor does any other
        process which happens to be in core at the same time. ps
        tries to overcome this limitation by spawning a subpro-
        cess designed to take up the other core slot, and is usu-
        ally successful. Because ps examines a dynamically
        changing data structure, it can produce incorrect re-
        sults, for example if a process's core image moves be-
        tween the time ps gets its disk address and reads its
        stack.

        Besides its utility for simple spying, ps is the only
        plausible way to find the process number of someone you
        are trying to kill (VIII).

FILES   /dev/rf0, /sys/sys/unix (to get magic numbers).

SEE ALSO   kill (VIII)

DIAGNOSTICS   "Bad RF", if a bad swap address turns up; various
                missing-file diagnostics.

                                    1

BUGS   As described.

NAME   salv -- file system salvage

SYNOPSIS   /etc/salv filesystem [-akfs]

DESCRIPTION
        salv will place a given file system in a consistent state
        with almost no loss of information. This is the first
        step in putting things together after a bad crash. Salv
        performs the following functions:

            A valid free list is constructed.

        The previous step is always performed; the following
        steps are performed only if the "a" option is given. If
        the file system's only defect is missing blocks, "a"
        should not be specified.

            All bad pointers in the file system are zeroed.

            All duplicate pointers to the same block are resolved
            by changing one of the pointers to point at a new
            block containing a copy of the data.

            Inodes (not directory entries) for special files are
            generated (mode 16).

            Files whose size is too large for the number of blocks
            they contain (after bad pointers are zeroed) have
            their size revised downward.

        The file system should be unmounted while it is being
        salvaged. In cases of extreme need the permanently
        mounted file system may be salvaged; in such a case the
        system must be rebooted before it has a chance to write
        out the old, bad super-block.

        The "k", "f", and "s" options tell salv what magic num-
        bers to use to generate the size of the free list and the
        i-node map. "k" is default (RK disk); "f" is RF; "s" is
        RK with swap space on it. If salv is to be used away
        from the mother system its code should be cheked to veri-
        fy the numbers.

        After a salv, files may be safely created and removed
        without causing more trouble. If the "a" option had to
        be used, a dcheck (VIII) should be done to find the de-
        gree of the damage to the hierarchy.

FILES   /dev/rk0

SEE ALSO   check(I), ds(I)

DIAGNOSTICS   --

BUGS   In only one (known) way does <u>salv</u> destroy infor-
                mation: if some random block appears to be an in-
                direct block for a file, all "bad pointers" (for
                example, ASCII text) in it will be zeroed. If
                the block also appears in another file, it may be
                scribbled on before it is copied.

2

NAME   su -- become privileged user

SYNOPSIS   <u>su</u>

DESCRIPTION   su allows one to become the super-user, who has
                all sorts of marvelous (and correspondingly dan-
                gerous) powers. In order for su to do its magic,
                the user must supply a password. If the password
                is correct, su will execute the shell with the
                UID set to that of the super-user. To restore
                normal UID privileges, type an end-of-file to the
                super-user shell.

                To remind the super-user of his responsibilities,
                the shell substitutes "#" for its usual prompt
                "%".

FILES   --

SEE ALSO   sh(I)

DIAGNOSTICS   "Sorry" if password is wrong

BUGS   --

NAME   swtmp -- update accounting file

SYNOPSIS   swtmp

DESCRIPTION   This shell sequence concatenates /tmp/wtmp onto
                /usr/adm/wtmp and truncates /tmp/wtmp. It should
                be used before using acct(VIII) and every so of-
                ten in any case if accounting is to be main-
                tained.

FILES   /tmp/wtmp, /usr/adm/wtmp

SEE ALSO   acct(VIII), wtmp(V)

NAME   tm -- provide time information

SYNOPSIS   tm

DESCRIPTION   tm is used to provide timing information. Output
                like the following is given:

                        tim 371:51:09   2:00.8
                        ovh 20:00:33   17.0
                        swp 13:43:20   4.6
                        dsk 27:14:35   4.5
                        idl 533:08:03   1:33.3
                        usr 24:53:50   1.2
                        der   0, 54   0,   0

                The first column of numbers gives totals in the
                named categories since the last time the system
                was cold-booted; the second column gives the
                changes since the last time tm was invoked. The
                top left number is badly truncated and should be
                ignored. ovh is time spent executing in the sys-
                tem; 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 er-
                ror count (right number).

FILES   /dev/rf0 (for absolute times); /tmp/ttmp for dif-
                ferential timing history.

SEE ALSO   time(I), file system(V)

DIAGNOSTICS   --

BUGS   --

                                    1

NAME   umount -- dismount file system

SYNOPSIS   /etc/umount special

DESCRIPTION   umount announces to the system that the removable
                file system previously mounted on special file
                special is to be removed.

                The user must take care not only that all I/O ac-
                tivity on the file system has ceased, but that no
                one has his current directory on it.

                Only the super-user may issue this command.

FILES   --

SEE ALSO   mount(VIII)

DIAGNOSTICS   "?"

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