

groff

The GNU implementation of `troff`
Edition 1.18
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This manual documents GNU `troff` version 1.18.

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1 Introduction

GNU **troff** (or **groff**) is a system for typesetting documents. **troff** is very flexible and has been in existence (and use) for about 3 decades. It is quite widespread and firmly entrenched in the UNIX community.

1.1 What Is **groff**?

groff belongs to an older generation of document preparation systems, which operate more like compilers than the more recent interactive WYSIWYG¹ systems. **groff** and its contemporary counterpart, **T_EX**, both work using a *batch* paradigm: The input (or *source*) files are normal text files with embedded formatting commands. These files can then be processed by **groff** to produce a typeset document on a variety of devices.

Likewise, **groff** should not be confused with a *word processor*, since that term connotes an integrated system that includes an editor and a text formatter. Also, many word processors follow the WYSIWYG paradigm discussed earlier.

Although WYSIWYG systems may be easier to use, they have a number of disadvantages compared to **troff**:

- They must be used on a graphics display to work on a document.
- Most of the WYSIWYG systems are either non-free or are not very portable.
- **troff** is firmly entrenched in all UNIX systems.
- It is difficult to have a wide range of capabilities available within the confines of a GUI/window system.
- It is more difficult to make global changes to a document.

“GUIs normally make it simple to accomplish simple actions and impossible to accomplish complex actions.” –Doug Gwyn
(22/Jun/91 in `comp.unix.wizards`)

1.2 History

troff can trace its origins back to a formatting program called **runoff**, written by J. E. Saltzer, which ran on MIT’s CTSS operating system in the mid-sixties. This name came from the common phrase of the time “I’ll run off a document.” Bob Morris ported it to the 635 architecture and called the program **roff** (an abbreviation of **runoff**). It was rewritten as **rf** for the PDP-7 (before having UNIX), and at the same time (1969), Doug McIlroy rewrote an extended and simplified version of **roff** in the BCPL programming language.

¹ What You See Is What You Get

The first version of UNIX was developed on a PDP-7 which was sitting around Bell Labs. In 1971 the developers wanted to get a PDP-11 for further work on the operating system. In order to justify the cost for this system, they proposed that they would implement a document formatting system for the AT&T patents division. This first formatting program was a reimplementaion of McIlroy's `roff`, written by J. F. Ossanna.

When they needed a more flexible language, a new version of `roff` called `nroff` ("Newer `roff`") was written. It had a much more complicated syntax, but provided the basis for all future versions. When they got a Graphic Systems CAT Phototypesetter, Ossanna wrote a version of `nroff` that would drive it. It was dubbed `troff`, for "typesetter `roff`", although many people have speculated that it actually means "Times `roff`" because of the use of the Times font family in `troff` by default. As such, the name `troff` is pronounced 't-roff' rather than 'trough'.

With `troff` came `nroff` (they were actually the same program except for some `#ifdef`'s), which was for producing output for line printers and character terminals. It understood everything `troff` did, and ignored the commands which were not applicable (e.g. font changes).

Since there are several things which cannot be done easily in `troff`, work on several preprocessors began. These programs would transform certain parts of a document into `troff`, which made a very natural use of pipes in UNIX.

The `eqn` preprocessor allowed mathematical formulæ to be specified in a much simpler and more intuitive manner. `tbl` is a preprocessor for formatting tables. The `refer` preprocessor (and the similar program, `bib`) processes citations in a document according to a bibliographic database.

Unfortunately, Ossanna's `troff` was written in PDP-11 assembly language and produced output specifically for the CAT phototypesetter. He rewrote it in C, although it was now 7000 lines of uncommented code and still dependent on the CAT. As the CAT became less common, and was no longer supported by the manufacturer, the need to make it support other devices became a priority. However, before this could be done, Ossanna was killed in a car accident.

So, Brian Kernighan took on the task of rewriting `troff`. The newly rewritten version produced device independent code which was very easy for postprocessors to read and translate to the appropriate printer codes. Also, this new version of `troff` (called `ditroff` for "device independent `troff`") had several extensions, which included drawing functions.

Due to the additional abilities of the new version of `troff`, several new preprocessors appeared. The `pic` preprocessor provides a wide range of drawing functions. Likewise the `ideal` preprocessor did the same, although via a much different paradigm. The `grap` preprocessor took specifications for graphs, but, unlike other preprocessors, produced `pic` code.

James Clark began work on a GNU implementation of `ditroff` in early 1989. The first version, `groff` 0.3.1, was released June 1990. `groff` included:

- A replacement for `ditroff` with many extensions.
- The `soelim`, `pic`, `tbl`, and `eqn` preprocessors.
- Postprocessors for character devices, `POSTSCRIPT`, `TEX DVI`, and `X Windows`. GNU `troff` also eliminated the need for a separate `nroff` program with a postprocessor which would produce ASCII output.
- A version of the ‘`me`’ macros and an implementation of the ‘`man`’ macros.

Also, a front-end was included which could construct the, sometimes painfully long, pipelines required for all the post- and preprocessors.

Development of GNU `troff` progressed rapidly, and saw the additions of a replacement for `refer`, an implementation of the ‘`ms`’ and ‘`mm`’ macros, and a program to deduce how to format a document (`grog`).

It was declared a stable (i.e. non-beta) package with the release of version 1.04 around November 1991.

Beginning in 1999, `groff` has new maintainers (the package was an orphan for a few years). As a result, new features and programs like `grn`, a preprocessor for gremlin images, and an output device to produce HTML output have been added.

1.3 `groff` Capabilities

So what exactly is `groff` capable of doing? `groff` provides a wide range of low-level text formatting operations. Using these, it is possible to perform a wide range of formatting tasks, such as footnotes, table of contents, multiple columns, etc. Here’s a list of the most important operations supported by `groff`:

- text filling, adjusting, and centering
- hyphenation
- page control
- font and glyph size control
- vertical spacing (e.g. double-spacing)
- line length and indenting
- macros, strings, diversions, and traps
- number registers
- tabs, leaders, and fields
- input and output conventions and character translation
- overstrike, bracket, line drawing, and zero-width functions
- local horizontal and vertical motions and the width function
- three-part titles

- output line numbering
- conditional acceptance of input
- environment switching
- insertions from the standard input
- input/output file switching
- output and error messages

1.4 Macro Packages

Since **groff** provides such low-level facilities, it can be quite difficult to use by itself. However, **groff** provides a *macro* facility to specify how certain routine operations (e.g. starting paragraphs, printing headers and footers, etc.) should be done. These macros can be collected together into a *macro package*. There are a number of macro packages available; the most common (and the ones described in this manual) are ‘**man**’, ‘**mdoc**’, ‘**me**’, ‘**ms**’, and ‘**mm**’.

1.5 Preprocessors

Although **groff** provides most functions needed to format a document, some operations would be unwieldy (e.g. to draw pictures). Therefore, programs called *preprocessors* were written which understand their own language and produce the necessary **groff** operations. These preprocessors are able to differentiate their own input from the rest of the document via markers.

To use a preprocessor, UNIX pipes are used to feed the output from the preprocessor into **groff**. Any number of preprocessors may be used on a given document; in this case, the preprocessors are linked together into one pipeline. However, with **groff**, the user does not need to construct the pipe, but only tell **groff** what preprocessors to use.

groff currently has preprocessors for producing tables (**tbl**), typesetting equations (**eqn**), drawing pictures (**pic** and **grn**), and for processing bibliographies (**refer**). An associated program which is useful when dealing with preprocessors is **soelim**.

A free implementation of **grap**, a preprocessor for drawing graphs, can be obtained as an extra package; **groff** can use **grap** also.

There are other preprocessors in existence, but, unfortunately, no free implementations are available. Among them are preprocessors for drawing mathematical pictures (**ideal**) and chemical structures (**chem**).

1.6 Output Devices

groff actually produces device independent code which may be fed into a postprocessor to produce output for a particular device. Currently,

`groff` has postprocessors for POSTSCRIPT devices, character terminals, X Windows (for previewing), T_EX DVI format, HP LaserJet 4 and Canon LBP printers (which use CAPSL), and HTML.

1.7 Credits

Large portions of this manual were taken from existing documents, most notably, the manual pages for the `groff` package by James Clark, and Eric Allman's papers on the `'me'` macro package.

The section on the `'man'` macro package is partly based on Susan G. Kleinmann's `'groff_man'` manual page written for the Debian GNU/Linux system.

Larry Kollar contributed the section in the `'ms'` macro package.

2 Invoking `groff`

This section focuses on how to invoke the `groff` front end. This front end takes care of the details of constructing the pipeline among the preprocessors, `gtroff` and the postprocessor.

It has become a tradition that GNU programs get the prefix ‘g’ to distinguish it from its original counterparts provided by the host (see [Section 2.2 \[Environment\]](#), page 11, for more details). Thus, for example, `geqn` is GNU `eqn`. On operating systems like GNU/Linux or the Hurd, which don’t contain proprietary versions of `troff`, and on MS-DOS/MS-Windows, where `troff` and associated programs are not available at all, this prefix is omitted since GNU `troff` is the only used incarnation of `troff`. Exception: ‘`groff`’ is never replaced by ‘`roff`’.

In this document, we consequently say ‘`gtroff`’ when talking about the GNU `troff` program. All other implementations of `troff` are called AT&T `troff` which is the common origin of all `troff` derivatives (with more or less compatible changes). Similarly, we say ‘`gpic`’, ‘`geqn`’, etc.

2.1 Options

`groff` normally runs the `gtroff` program and a postprocessor appropriate for the selected device. The default device is ‘`ps`’ (but it can be changed when `groff` is configured and built). It can optionally preprocess with any of `gpic`, `geqn`, `gtbl`, `ggrn`, `grap`, `grefer`, or `gsoelim`.

This section only documents options to the `groff` front end. Many of the arguments to `groff` are passed on to `gtroff`, therefore those are also included. Arguments to pre- or postprocessors can be found in [Section 6.3.1 \[Invoking `gpic`\]](#), page 163, [Section 6.1.1 \[Invoking `geqn`\]](#), page 163, [Section 6.2.1 \[Invoking `gtbl`\]](#), page 163, [Section 6.4.1 \[Invoking `ggrn`\]](#), page 163, [Section 6.6.1 \[Invoking `grefer`\]](#), page 163, [Section 6.7.1 \[Invoking `gsoelim`\]](#), page 163, [Section 7.2.1 \[Invoking `grotty`\]](#), page 165, [Section 7.3.1 \[Invoking `grops`\]](#), page 165, [Section 7.7.1 \[Invoking `grohtml`\]](#), page 165, [Section 7.4.1 \[Invoking `grodvi`\]](#), page 165, [Section 7.5.1 \[Invoking `grolj4`\]](#), page 165, [Section 7.6.1 \[Invoking `grolbp`\]](#), page 165, and [Section 7.8.1 \[Invoking `gxditview`\]](#), page 166.

The command line format for `groff` is:

```
groff [ -abceghilpstvzCEGNRSUVXZ ] [ -Fdir ] [ -mname ]
      [ -Tdef ] [ -ffam ] [ -wname ] [ -Wname ]
      [ -Mdir ] [ -dcs ] [ -rcn ] [ -nnum ]
      [ -olist ] [ -Parg ] [ -Larg ] [ -Idir ]
      [ files... ]
```

The command line format for `gtroff` is as follows.

```
gtroff [ -abcivzCERU ] [ -wname ] [ -Wname ] [ -dcs ]
      [ -ffam ] [ -mname ] [ -nnum ]
      [ -olist ] [ -rcn ] [ -Tname ]
      [ -Fdir ] [ -Mdir ] [ files... ]
```

Obviously, many of the options to `gtroff` are actually passed on to `gtroff`.

Options without an argument can be grouped behind a single ‘-’. A filename of ‘-’ denotes the standard input. It is possible to have whitespace between an option and its parameter.

The `grog` command can be used to guess the correct `gtroff` command to format a file.

Here’s the description of the command-line options:

- ‘-h’ Print a help message.
- ‘-e’ Preprocess with `geqn`.
- ‘-t’ Preprocess with `gtbl`.
- ‘-g’ Preprocess with `ggrn`.
- ‘-G’ Preprocess with `grap`.
- ‘-p’ Preprocess with `gpic`.
- ‘-s’ Preprocess with `gsoelim`.
- ‘-c’ Suppress color output.
- ‘-R’ Preprocess with `grefer`. No mechanism is provided for passing arguments to `grefer` because most `grefer` options have equivalent commands which can be included in the file. See [Section 6.6 \[grefer\], page 163](#), for more details.
Note that `gtroff` also accepts a ‘-R’ option, which is not accessible via `gtroff`. This option prevents the loading of the ‘`troffrc`’ and ‘`troffrc-end`’ files.
- ‘-v’ Make programs run by `gtroff` print out their version number.
- ‘-V’ Print the pipeline on `stdout` instead of executing it.
- ‘-z’ Suppress output from `gtroff`. Only error messages are printed.
- ‘-Z’ Do not postprocess the output of `gtroff`. Normally `gtroff` automatically runs the appropriate postprocessor.
- ‘-Parg’ Pass `arg` to the postprocessor. Each argument should be passed with a separate ‘-P’ option. Note that `gtroff` does not prepend ‘-’ to `arg` before passing it to the postprocessor.
- ‘-l’ Send the output to a spooler for printing. The command used for this is specified by the `print` command in the device description file (see [Section 8.2 \[Font Files\], page 180](#), for more info). If not present, ‘-l’ is ignored.

<code>-Larg</code>	Pass <i>arg</i> to the spooler. Each argument should be passed with a separate <code>-L</code> option. Note that <code>groff</code> does not prepend a <code>-</code> to <i>arg</i> before passing it to the postprocessor. If the <code>print</code> keyword in the device description file is missing, <code>-L</code> is ignored.
<code>-Tdev</code>	Prepare output for device <i>dev</i> . The default device is <code>ps</code> , unless changed when <code>groff</code> was configured and built. The following are the output devices currently available:
<code>ps</code>	For POSTSCRIPT printers and previewers.
<code>dvi</code>	For \TeX DVI format.
<code>X75</code>	For a 75 dpi X11 previewer.
<code>X75-12</code>	For a 75 dpi X11 previewer with a 12 pt base font in the document.
<code>X100</code>	For a 100 dpi X11 previewer.
<code>X100-12</code>	For a 100 dpi X11 previewer with a 12 pt base font in the document.
<code>ascii</code>	For typewriter-like devices using the (7-bit) ASCII character set.
<code>latin1</code>	For typewriter-like devices that support the Latin-1 (ISO 8859-1) character set.
<code>utf8</code>	For typewriter-like devices which use the Unicode (ISO 10646) character set with UTF-8 encoding.
<code>cp1047</code>	For typewriter-like devices which use the EBCDIC encoding IBM cp1047.
<code>lj4</code>	For HP LaserJet4-compatible (or other PCL5-compatible) printers.
<code>lbp</code>	For Canon CAPSL printers (LBP-4 and LBP-8 series laser printers).
<code>html</code>	To produce HTML output. Note that the HTML driver consists of two parts, a preprocessor (<code>pre-grohtml</code>) and a postprocessor (<code>post-grohtml</code>).

The predefined `gtroff` string register `.T` contains the current output device; the read-only number register `.T` is set to 1 if this option is used (which is always true if `groff` is used to call `gtroff`). See [Section 5.7.5 \[Built-in Registers\]](#), page 66.

The postprocessor to be used for a device is specified by the `postpro` command in the device description file. (See [Section 8.2 \[Font Files\]](#), page 180, for more info.) This can be overridden with the `-X` option.

- ‘-X’ Preview with `gxditview` instead of using the usual postprocessor. This is unlikely to produce good results except with ‘-Tps’. Note that this is not the same as using ‘-TX75’ or ‘-TX100’ to view a document with `gxditview`: The former uses the metrics of the specified device, whereas the latter uses X-specific fonts and metrics.
- ‘-N’ Don’t allow newlines with `eqn` delimiters. This is the same as the ‘-N’ option in `geqn`.
- ‘-S’ Safer mode. Pass the ‘-S’ option to `gpic` and disable the `open`, `opena`, `pso`, `sy`, and `pi` requests. For security reasons, this is enabled by default.
- ‘-U’ Unsafe mode. This enables the `open`, `opena`, `pso`, `sy`, and `pi` requests.
- ‘-a’ Generate an ASCII approximation of the typeset output. The read-only register `.A` is then set to 1. See [Section 5.7.5 \[Built-in Registers\]](#), page 66. A typical example is


```
groff -a -man -Tdvi troff.man | less
```

 which shows how lines are broken for the DVI device. Note that this option is rather useless today since graphic output devices are available virtually everywhere.
- ‘-b’ Print a backtrace with each warning or error message. This backtrace should help track down the cause of the error. The line numbers given in the backtrace may not always be correct: `gtroff` can get confused by `as` or `am` requests while counting line numbers.
- ‘-i’ Read the standard input after all the named input files have been processed.
- ‘-wname’ Enable warning *name*. Available warnings are described in [Section 5.34 \[Debugging\]](#), page 154. Multiple ‘-w’ options are allowed.
- ‘-Wname’ Inhibit warning *name*. Multiple ‘-W’ options are allowed.
- ‘-E’ Inhibit all error messages.
- ‘-C’ Enable compatibility mode. See [Section 5.35 \[Implementation Differences\]](#), page 159, for the list of incompatibilities between `groff` and AT&T `troff`.
- ‘-dcs’
- ‘-dname=s’ Define *c* or *name* to be a string *s*. *c* must be a one-letter name; *name* can be of arbitrary length. All string assignments happen before loading any macro file (including the start-up file).

- '`-ffam`' Use *fam* as the default font family. See [Section 5.18.2 \[Font Families\]](#), page 96.
- '`-mname`' Read in the file '`name.tmac`'. Normally `groff` searches for this in its macro directories. If it isn't found, it tries '`tmac.name`' (searching in the same directories).
- '`-nnum`' Number the first page *num*.
- '`-olist`' Output only pages in *list*, which is a comma-separated list of page ranges; '*n*' means print page *n*, '*m-n*' means print every page between *m* and *n*, '`-n`' means print every page up to *n*, '`n-`' means print every page beginning with *n*. `groff` exits after printing the last page in the list. All the ranges are inclusive on both ends.
 Within `groff`, this information can be extracted with the '`.P`' register. See [Section 5.7.5 \[Built-in Registers\]](#), page 66.
 If your document restarts page numbering at the beginning of each chapter, then `groff` prints the specified page range for each chapter.
- '`-rcn`'
'`-rname=n`' Set number register *c* or *name* to the value *n*. *c* must be a one-letter name; *name* can be of arbitrary length. *n* can be any `groff` numeric expression. All register assignments happen before loading any macro file (including the start-up file).
- '`-Fdir`' Search '*dir*' for subdirectories '`devname`' (*name* is the name of the device), for the 'DESC' file, and for font files before looking in the standard directories (see [Section 2.4 \[Font Directories\]](#), page 13). This option is passed to all pre- and postprocessors using the `GROFF_FONT_PATH` environment variable.
- '`-Mdir`' Search directory '*dir*' for macro files before the standard directories (see [Section 2.3 \[Macro Directories\]](#), page 12).
- '`-Idir`' This option is as described in [Section 6.7 \[gsoelim\]](#), page 163. It implies the '`-s`' option.

2.2 Environment

There are also several environment variables (of the operating system, not within `groff`) which can modify the behavior of `groff`.

GROFF_COMMAND_PREFIX

If this is set to *X*, then `groff` runs `Xtroff` instead of `groff`. This also applies to `tbl`, `pic`, `eqn`, `grn`, `refer`, and `soelim`. It does not apply to `grops`, `grodvi`, `grotty`, `pre-grohtml`, `post-grohtml`, `grolj4`, and `gxditview`.

The default command prefix is determined during the installation process. If a non-GNU troff system is found, prefix ‘g’ is used, none otherwise.

GROFF_TMAC_PATH

A colon-separated list of directories in which to search for macro files (before the default directories are tried). See [Section 2.3 \[Macro Directories\]](#), page 12.

GROFF_TYPESETTER

The default output device.

GROFF_FONT_PATH

A colon-separated list of directories in which to search for the `devname` directory (before the default directories are tried). See [Section 2.4 \[Font Directories\]](#), page 13.

GROFF_BIN_PATH

This search path, followed by `PATH`, is used for commands executed by `groff`.

GROFF_TMPDIR

The directory in which `groff` creates temporary files. If this is not set and `TMPDIR` is set, temporary files are created in that directory. Otherwise temporary files are created in a system-dependent default directory (on Unix and GNU/Linux systems, this is usually `/tmp`). `grops`, `grefer`, `pre-grohtml`, and `post-grohtml` can create temporary files in this directory.

Note that MS-DOS and MS-Windows ports of `groff` use semi-colons, rather than colons, to separate the directories in the lists described above.

2.3 Macro Directories

All macro file names must be named `name.tmac` or `tmac.name` to make the `-mname` command line option work. The `mso` request doesn’t have this restriction; any file name can be used, and `gtroff` won’t try to append or prepend the `‘tmac’` string.

Macro files are kept in the *tmac directories*, all of which constitute the *tmac path*. The elements of the search path for macro files are (in that order):

- The directories specified with `gtroff`’s or `groff`’s `‘-M’` command line option.
- The directories given in the `GROFF_TMAC_PATH` environment variable.
- The current directory (only if in unsafe mode using the `‘-U’` command line switch).
- The home directory.

- A platform-dependent directory, a site-specific (platform-independent) directory, and the main `tmac` directory; the default locations are

```

/usr/local/lib/groff/site-tmac
/usr/local/share/groff/site-tmac
/usr/local/share/groff/1.18/tmac

```

assuming that the version of `groff` is 1.18, and the installation prefix was `‘/usr/local’`. It is possible to fine-tune those directories during the installation process.

2.4 Font Directories

Basically, there is no restriction how font files for `groff` are named and how long font names are; however, to make the font family mechanism work (see [Section 5.18.2 \[Font Families\]](#), page 96), fonts within a family should start with the family name, followed by the shape. For example, the Times family uses ‘T’ for the family name and ‘R’, ‘B’, ‘I’, and ‘BI’ to indicate the shapes ‘roman’, ‘bold’, ‘italic’, and ‘bold italic’, respectively. Thus the final font names are ‘TR’, ‘TB’, ‘TI’, and ‘TBI’.

All font files are kept in the *font directories* which constitute the *font path*. The file search functions will always append the directory `devname`, where *name* is the name of the output device. Assuming, say, DVI output, and `‘/foo/bar’` as a font directory, the font files for `grodvi` must be in `‘/foo/bar/devdvi’`.

The elements of the search path for font files are (in that order):

- The directories specified with `gtroff`’s or `groff`’s `‘-F’` command line option. All device drivers and some preprocessors also have this option.
- The directories given in the `GROFF_FONT_PATH` environment variable.
- A site-specific directory and the main font directory; the default locations are

```

/usr/local/share/groff/site-font
/usr/local/share/groff/1.18/font

```

assuming that the version of `groff` is 1.18, and the installation prefix was `‘/usr/local’`. It is possible to fine-tune those directories during the installation process.

2.5 Invocation Examples

This section lists several common uses of `groff` and the corresponding command lines.

```
groff file
```

This command processes `‘file’` without a macro package or a preprocessor. The output device is the default, `‘ps’`, and the output is sent to `stdout`.

```
groff -t -mandoc -Tascii file | less
```

This is basically what a call to the `man` program does. `gtroff` processes the manual page ‘file’ with the ‘mandoc’ macro file (which in turn either calls the ‘man’ or the ‘mdoc’ macro package), using the `tbl` preprocessor and the ASCII output device. Finally, the `less` pager displays the result.

```
groff -X -m me file
```

Preview ‘file’ with `gxeditview`, using the ‘me’ macro package. Since no ‘-T’ option is specified, use the default device (‘ps’). Note that you can either say ‘-m me’ or ‘-me’; the latter is an anachronism from the early days of UNIX.¹

```
groff -man -rD1 -z file
```

Check ‘file’ with the ‘man’ macro package, forcing double-sided printing – don’t produce any output.

2.5.1 grog

`grog` reads files, guesses which of the `groff` preprocessors and/or macro packages are required for formatting them, and prints the `groff` command including those options on the standard output. It generates one or more of the options ‘-e’, ‘-man’, ‘-me’, ‘-mm’, ‘-mom’, ‘-ms’, ‘-mdoc’, ‘-mdoc-old’, ‘-p’, ‘-R’, ‘-g’, ‘-G’, ‘-s’, and ‘-t’.

A special file name ‘-’ refers to the standard input. Specifying no files also means to read the standard input. Any specified options are included in the printed command. No space is allowed between options and their arguments. The only options recognized are ‘-C’ (which is also passed on) to enable compatibility mode, and ‘-v’ to print the version number and exit.

For example,

```
grog -Tdvi paper.ms
```

guesses the appropriate command to print ‘paper.ms’ and then prints it to the command line after adding the ‘-Tdvi’ option. For direct execution, enclose the call to `grog` in backquotes at the UNIX shell prompt:

```
‘grog -Tdvi paper.ms’ > paper.dvi
```

As seen in the example, it is still necessary to redirect the output to something meaningful (i.e. either a file or a pager program like `less`).

¹ The same is true for the other main macro packages that come with `groff`: ‘man’, ‘mdoc’, ‘ms’, ‘mm’, and ‘mandoc’. This won’t work in general; for example, to load ‘trace.tmac’, either ‘-mtrace’ or ‘-m trace’ must be used.

3 Tutorial for Macro Users

Most users tend to use a macro package to format their papers. This means that the whole breadth of `groff` is not necessary for most people. This chapter covers the material needed to efficiently use a macro package.

3.1 Basics

This section covers some of the basic concepts necessary to understand how to use a macro package.¹ References are made throughout to more detailed information, if desired.

`gtroff` reads an input file prepared by the user and outputs a formatted document suitable for publication or framing. The input consists of text, or words to be printed, and embedded commands (*requests* and *escapes*), which tell `gtroff` how to format the output. For more detail on this, see [Section 5.6 \[Embedded Commands\], page 56](#).

The word *argument* is used in this chapter to mean a word or number which appears on the same line as a request, and which modifies the meaning of that request. For example, the request

```
.sp
```

spaces one line, but

```
.sp 4
```

spaces four lines. The number 4 is an argument to the `sp` request which says to space four lines instead of one. Arguments are separated from the request and from each other by spaces (*no* tabs). More details on this can be found in [Section 5.6.1.1 \[Request Arguments\], page 57](#).

The primary function of `gtroff` is to collect words from input lines, fill output lines with those words, justify the right-hand margin by inserting extra spaces in the line, and output the result. For example, the input:

```
Now is the time
for all good men
to come to the aid
of their party.
Four score and seven
years ago, etc.
```

is read, packed onto output lines, and justified to produce:

```
Now is the time for all good men to come to the aid of their party.
Four score and seven years ago, etc.
```

Sometimes a new output line should be started even though the current line is not yet full; for example, at the end of a paragraph. To do this it is possible to cause a *break*, which starts a new output line. Some requests

¹ This section is derived from *Writing Papers with nroff using -me* by Eric P. Allman.

cause a break automatically, as normally do blank input lines and input lines beginning with a space.

Not all input lines are text to be formatted. Some input lines are requests which describe how to format the text. Requests always have a period (‘.’) or an apostrophe (‘’) as the first character of the input line.

The text formatter also does more complex things, such as automatically numbering pages, skipping over page boundaries, putting footnotes in the correct place, and so forth.

Here are a few hints for preparing text for input to `gtroff`.

- First, keep the input lines short. Short input lines are easier to edit, and `gtroff` packs words onto longer lines anyhow.
- In keeping with this, it is helpful to begin a new line after every comma or phrase, since common corrections are to add or delete sentences or phrases.
- End each sentence with two spaces – or better, start each sentence on a new line. `gtroff` recognizes characters that usually end a sentence, and inserts sentence space accordingly.
- Do not hyphenate words at the end of lines – `gtroff` is smart enough to hyphenate words as needed, but is not smart enough to take hyphens out and join a word back together. Also, words such as “mother-in-law” should not be broken over a line, since then a space can occur where not wanted, such as “mother- in-law”.

`gtroff` double-spaces output text automatically if you use the request `‘.ls 2’`. Reactivate single-spaced mode by typing `‘.ls 1’`.²

A number of requests allow to change the way the output looks, sometimes called the *layout* of the output page. Most of these requests adjust the placing of *whitespace* (blank lines or spaces).

The `bp` request starts a new page, causing a line break.

The request `‘.sp N’` leaves *N* lines of blank space. *N* can be omitted (meaning skip a single line) or can be of the form *Ni* (for *N* inches) or *Nc* (for *N* centimeters). For example, the input:

```
.sp 1.5i
My thoughts on the subject
.sp
```

leaves one and a half inches of space, followed by the line “My thoughts on the subject”, followed by a single blank line (more measurement units are available, see [Section 5.3 \[Measurements\], page 51](#)).

Text lines can be centered by using the `ce` request. The line after `ce` is centered (horizontally) on the page. To center more than one line, use

² If you need finer granularity of the vertical space, use the `pvs` request (see [Section 5.19.1 \[Changing Type Sizes\], page 109](#)).

'`.ce N`' (where N is the number of lines to center), followed by the N lines. To center many lines without counting them, type:

```
.ce 1000
lines to center
.ce 0
```

The '`.ce 0`' request tells `groff` to center zero more lines, in other words, stop centering.

All of these requests cause a break; that is, they always start a new line. To start a new line without performing any other action, use `br`.

3.2 Common Features

`groff` provides very low-level operations for formatting a document. There are many common routine operations which are done in all documents. These common operations are written into *macros* and collected into a *macro package*.

All macro packages provide certain common capabilities which fall into the following categories.

3.2.1 Paragraphs

One of the most common and most used capability is starting a paragraph. There are a number of different types of paragraphs, any of which can be initiated with macros supplied by the macro package. Normally, paragraphs start with a blank line and the first line indented, like the text in this manual. There are also block style paragraphs, which omit the indentation:

```
Some men look at constitutions with sanctimonious
reverence, and deem them like the ark of the covenant, too
sacred to be touched.
```

And there are also indented paragraphs which begin with a tag or label at the margin and the remaining text indented.

```
one This is the first paragraph. Notice how the first
line of the resulting paragraph lines up with the
other lines in the paragraph.
```

```
longlabel
This paragraph had a long label. The first
character of text on the first line does not line up
with the text on second and subsequent lines,
although they line up with each other.
```

A variation of this is a bulleted list.

- . Bulleted lists start with a bullet. It is possible to use other glyphs instead of the bullet. In nroff mode using the ASCII character set for output, a dot is used instead of a real bullet.

3.2.2 Sections and Chapters

Most macro packages supply some form of section headers. The simplest kind is simply the heading on a line by itself in bold type. Others supply automatically numbered section heading or different heading styles at different levels. Some, more sophisticated, macro packages supply macros for starting chapters and appendices.

3.2.3 Headers and Footers

Every macro package gives some way to manipulate the *headers* and *footers* (also called *titles*) on each page. This is text put at the top and bottom of each page, respectively, which contain data like the current page number, the current chapter title, and so on. Its appearance is not affected by the running text. Some packages allow for different ones on the even and odd pages (for material printed in a book form).

The titles are called *three-part titles*, that is, there is a left-justified part, a centered part, and a right-justified part. An automatically generated page number may be put in any of these fields with the ‘%’ character (see [Section 5.16 \[Page Layout\]](#), [page 91](#), for more details).

3.2.4 Page Layout

Most macro packages let the user specify top and bottom margins and other details about the appearance of the printed pages.

3.2.5 Displays

Displays are sections of text to be set off from the body of the paper. Major quotes, tables, and figures are types of displays, as are all the examples used in this document.

Major quotes are quotes which are several lines long, and hence are set in from the rest of the text without quote marks around them.

A *list* is an indented, single-spaced, unfilled display. Lists should be used when the material to be printed should not be filled and justified like normal text, such as columns of figures or the examples used in this paper.

A *keep* is a display of lines which are kept on a single page if possible. An example for a keep might be a diagram. Keeps differ from lists in that lists may be broken over a page boundary whereas keeps are not.

Floating keeps move relative to the text. Hence, they are good for things which are referred to by name, such as “See figure 3”. A floating keep appears at the bottom of the current page if it fits; otherwise, it appears at the top of the next page. Meanwhile, the surrounding text ‘flows’ around the keep, thus leaving no blank areas.

3.2.6 Footnotes and Annotations

There are a number of requests to save text for later printing.

Footnotes are printed at the bottom of the current page.

Delayed text is very similar to a footnote except that it is printed when called for explicitly. This allows a list of references to appear (for example) at the end of each chapter, as is the convention in some disciplines.

Most macro packages which supply this functionality also supply a means of automatically numbering either type of annotation.

3.2.7 Table of Contents

Tables of contents are a type of delayed text having a tag (usually the page number) attached to each entry after a row of dots. The table accumulates throughout the paper until printed, usually after the paper has ended. Many macro packages provide the ability to have several tables of contents (e.g. a standard table of contents, a list of tables, etc).

3.2.8 Indices

While some macro packages use the term *index*, none actually provide that functionality. The facilities they call indices are actually more appropriate for tables of contents.

To produce a real index in a document, external tools like the `makeindex` program are necessary.

3.2.9 Paper Formats

Some macro packages provide stock formats for various kinds of documents. Many of them provide a common format for the title and opening pages of a technical paper. The ‘`mm`’ macros in particular provide formats for letters and memoranda.

3.2.10 Multiple Columns

Some macro packages (but not ‘`man`’) provide the ability to have two or more columns on a page.

3.2.11 Font and Size Changes

The built-in font and size functions are not always intuitive, so all macro packages provide macros to make these operations simpler.

3.2.12 Predefined Strings

Most macro packages provide various predefined strings for a variety of uses; examples are sub- and superscripts, printable dates, quotes and various special characters.

3.2.13 Preprocessor Support

All macro packages provide support for various preprocessors and may extend their functionality.

For example, all macro packages mark tables (which are processed with `gtbl`) by placing them between `TS` and `TE` macros. The `'ms'` macro package has an option, `'.TS H'`, that prints a caption at the top of a new page (when the table is too long to fit on a single page).

3.2.14 Configuration and Customization

Some macro packages provide means of customizing many of the details of how the package behaves. This ranges from setting the default type size to changing the appearance of section headers.

4 Macro Packages

This chapter documents the main macro packages that come with `groff`.

4.1 ‘man’

This is the most popular and probably the most important macro package of `groff`. It is easy to use, and a vast majority of manual pages are based on it.

4.1.1 Options

The command line format for using the ‘man’ macros with `groff` is:

```
groff -m man [ -rLL=length ] [ -rLT=length ]
           [ -rcR=1 ] [ -rC1 ] [ -rD1 ] [ -rPnnn ]
           [ -rSxx ] [ -rXnnn ] [ files... ]
```

It is possible to use ‘-man’ instead of ‘-m man’.

`-rLL=length`

Set line length to *length*. If not specified, the line length defaults to 78 en in `nroff` mode (this is 78 characters per line) and 6.5 inch otherwise.

`-rLT=length`

Set title length to *length*. If not specified, the title length defaults to 78 en in `nroff` mode (this is 78 characters per line) and 6.5 inch otherwise.

`-rcR=1`

This option (the default if a TTY output device is used) creates a single, very long page instead of multiple pages. Use `-rcR=0` to disable it.

`-rC1`

If more than one manual page is given on the command line, number the pages continuously, rather than starting each at 1.

`-rD1`

Double-sided printing. Footers for even and odd pages are formatted differently.

`-rPnnn`

Page numbering starts with *nnn* rather than with 1.

`-rSxx`

Use *xx* (which can be 10, 11, or 12 pt) as the base document font size instead of the default value of 10 pt.

`-rXnnn`

After page *nnn*, number pages as *nnna*, *nnnb*, *nnnc*, etc. For example, the option ‘-rX2’ produces the following page numbers: 1, 2, 2a, 2b, 2c, etc.

4.1.2 Usage

This section describes the available macros for manual pages. For further customization, put additional macros and requests into the file ‘`man.local`’ which is loaded immediately after the ‘`man`’ package.

.TH *title section* [*extra1* [*extra2* [*extra3*]]] Macro

Set the title of the man page to *title* and the section to *section*, which must have a value between 1 and 8. The value of *section* may also have a string appended, e.g. ‘`.pm`’, to indicate a specific subsection of the man pages.

Both *title* and *section* are positioned at the left and right in the header line (with *section* in parentheses immediately appended to *title*. *extra1* is positioned in the middle of the footer line. *extra2* is positioned at the left in the footer line (or at the left on even pages and at the right on odd pages if double-sided printing is active). *extra3* is centered in the header line.

For HTML output, headers and footers are completely suppressed.

Additionally, this macro starts a new page; the new line number is 1 again (except if the ‘`-rC1`’ option is given on the command line) – this feature is intended only for formatting multiple man pages; a single man page should contain exactly one TH macro at the beginning of the file.

.SH [*heading*] Macro

Set up an unnumbered section heading sticking out to the left. Prints out all the text following SH up to the end of the line (or the text in the next line if there is no argument to SH) in bold face, one size larger than the base document size. Additionally, the left margin for the following text is reset to its default value.

.SS [*heading*] Macro

Set up an unnumbered (sub)section heading. Prints out all the text following SS up to the end of the line (or the text in the next line if there is no argument to SS) in bold face, at the same size as the base document size. Additionally, the left margin for the following text is reset to its default value.

.TP [*nnn*] Macro

Set up an indented paragraph with label. The indentation is set to *nnn* if that argument is supplied (the default unit is ‘`n`’ if omitted), otherwise it is set to the default indentation value.

The first line of text following this macro is interpreted as a string to be printed flush-left, as it is appropriate for a label. It is not interpreted as part of a paragraph, so there is no attempt to fill the first line with text from the following input lines. Nevertheless, if the label is not as

wide as the indentation, then the paragraph starts at the same line (but indented), continuing on the following lines. If the label is wider than the indentation, then the descriptive part of the paragraph begins on the line following the label, entirely indented. Note that neither font shape nor font size of the label is set to a default value; on the other hand, the rest of the text has default font settings.

<code>.LP</code>	Macro
<code>.PP</code>	Macro
<code>.P</code>	Macro

These macros are mutual aliases. Any of them causes a line break at the current position, followed by a vertical space downwards by the amount specified by the `PD` macro. The font size and shape are reset to the default value (10pt roman if no `'-rS'` option is given on the command line). Finally, the current left margin is restored.

<code>.IP</code> [<i>designator</i> [<i>nnn</i>]]	Macro
--	-------

Set up an indented paragraph, using *designator* as a tag to mark its beginning. The indentation is set to *nnn* if that argument is supplied (default unit is 'n'), otherwise the default indentation value is used. Font size and face of the paragraph (but not the designator) are reset to their default values. To start an indented paragraph with a particular indentation but without a designator, use `""` (two double quotes) as the first argument of `IP`.

For example, to start a paragraph with bullets as the designator and 4 en indentation, write

```
.IP \(\bu 4
```

<code>.HP</code> [<i>nnn</i>]	Macro
---------------------------------	-------

Set up a paragraph with hanging left indentation. The indentation is set to *nnn* if that argument is supplied (default unit is 'n'), otherwise the default indentation value is used. Font size and face are reset to their default values.

<code>.RS</code> [<i>nnn</i>]	Macro
---------------------------------	-------

Move the left margin to the right by the value *nnn* if specified (default unit is 'n'); otherwise the default indentation value is used. Calls to the `RS` macro can be nested.

<code>.RE</code> [<i>nnn</i>]	Macro
---------------------------------	-------

Move the left margin back to level *nnn*; if no argument is given, it moves one level back. The first level (i.e., no call to `RS` yet) has number 1, and each call to `RS` increases the level by 1.

To summarize, the following macros cause a line break with the insertion of vertical space (which amount can be changed with the PD macro): SH, SS, TP, LP (PP, P), IP, and HP.

The macros RS and RE also cause a break but do not insert vertical space.

Finally, the macros SH, SS, LP (PP, P), and RS reset the indentation to its default value.

4.1.3 Macros to set fonts

The standard font is roman; the default text size is 10 point. If command line option ‘-rS=*n*’ is given, use *n*pt as the default text size.

- | | |
|---|-------|
| .SM [<i>text</i>] | Macro |
| Set the text on the same line or the text on the next line in a font that is one point size smaller than the default font. | |
| .SB [<i>text</i>] | Macro |
| Set the text on the same line or the text on the next line in bold face font, one point size smaller than the default font. | |
| .BI <i>text</i> | Macro |
| Set its arguments alternately in bold face and italic. Thus, | |
| .BI this "word and" that | |
| would set “this” and “that” in bold face, and “word and” in italics. | |
| .IB <i>text</i> | Macro |
| Set its arguments alternately in italic and bold face. | |
| .RI <i>text</i> | Macro |
| Set its arguments alternately in roman and italic. | |
| .IR <i>text</i> | Macro |
| Set its arguments alternately in italic and roman. | |
| .BR <i>text</i> | Macro |
| Set its arguments alternately in bold face and roman. | |
| .RB <i>text</i> | Macro |
| Set its arguments alternately in roman and bold face. | |
| .B [<i>text</i>] | Macro |
| Set <i>text</i> in bold face. If no text is present on the line where the macro is called, then the text of the next line appears in bold face. | |
| .I [<i>text</i>] | Macro |
| Set <i>text</i> in italic. If no text is present on the line where the macro is called, then the text of the next line appears in italic. | |

4.1.4 Miscellaneous macros

The default indentation is 7.2 en for all output devices except for `grohtml` which ignores indentation.

`.DT` Macro
 Set tabs every 0.5 inches. Since this macro is always executed during a call to the `TH` macro, it makes sense to call it only if the tab positions have been changed.

`.PD [nnn]` Macro
 Adjust the empty space before a new paragraph (or section). The optional argument gives the amount of space (default unit is ‘v’); without parameter, the value is reset to its default value (1 line for TTY devices, 0.4 v otherwise).

This affects the macros `SH`, `SS`, `TP`, `LP` (as well as `PP` and `P`), `IP`, and `HP`.

4.1.5 Predefined strings

The following strings are defined:

`*[S]` String
 Switch back to the default font size.

`*[R]` String
 The ‘registered’ sign.

`*[Tm]` String
 The ‘trademark’ sign.

`*[lq]` String
`*[rq]` String
 Left and right quote. This is equal to `\(lq` and `\(rq`, respectively.

4.1.6 Preprocessors in ‘man’ pages

If a preprocessor like `gtbl` or `geqn` is needed, it has become common usage to make the first line of the man page look like this:

```
'\" word
```

Note the single space character after the double quote. `word` consists of letters for the needed preprocessors: ‘e’ for `geqn`, ‘r’ for `grefer`, ‘t’ for `gtbl`. Modern implementations of the `man` program read this first line and automatically call the right preprocessor(s).

4.2 ‘mdoc’

See the *groff_mdoc(7)* man page (type `man groff_mdoc` at the command line).

4.3 ‘ms’

The ‘-ms’ macros are suitable for reports, letters, books, user manuals, and so forth. The package provides macros for cover pages, section headings, paragraphs, lists, footnotes, pagination, and a table of contents.

4.3.1 Introduction to ‘ms’

The original ‘-ms’ macros were included with AT&T `troff` as well as the ‘man’ macros. While the ‘man’ package is intended for brief documents that can be read on-line as well as printed, the ‘ms’ macros are suitable for longer documents that are meant to be printed rather than read on-line.

The ‘ms’ macro package included with `groff` is a complete, bottom-up re-implementation. Several macros (specific to AT&T or Berkeley) are not included, while several new commands are. See [Section 4.3.7 \[Differences from AT&T ms\]](#), page 47, for more information.

4.3.2 General structure of an ‘ms’ document

The ‘ms’ macro package expects a certain amount of structure, but not as much as packages such as ‘man’ or ‘mdoc’.

The simplest documents can begin with a paragraph macro (such as LP or PP), and consist of text separated by paragraph macros or even blank lines. Longer documents have a structure as follows:

Document type

If you invoke the RP (report) macro on the first line of the document, `groff` prints the cover page information on its own page; otherwise it prints the information on the first page with your document text immediately following. Other document formats found in AT&T `troff` are specific to AT&T or Berkeley, and are not supported in `groff`.

Format and layout

By setting number registers, you can change your document’s type (font and size), margins, spacing, headers and footers, and footnotes. See [Section 4.3.3 \[ms Document Control Registers\]](#), page 27, for more details.

Cover page

A cover page consists of a title, the author's name and institution, an abstract, and the date.¹ See [Section 4.3.4 \[ms Cover Page Macros\]](#), page 29, for more details.

Body

Following the cover page is your document. You can use the 'ms' macros to write reports, letters, books, and so forth. The package is designed for structured documents, consisting of paragraphs interspersed with headings and augmented by lists, footnotes, tables, and other common constructs. See [Section 4.3.5 \[ms Body Text\]](#), page 31, for more details.

Table of contents

Longer documents usually include a table of contents, which you can invoke by placing the TC macro at the end of your document. The 'ms' macros have minimal indexing facilities, consisting of the IX macro, which prints an entry on standard error. Printing the table of contents at the end is necessary since **groff** is a single-pass text formatter, thus it cannot determine the page number of each section until that section has actually been set and printed. Since 'ms' output is intended for hardcopy, you can manually relocate the pages containing the table of contents between the cover page and the body text after printing.

4.3.3 Document control registers

The following is a list of document control number registers. For the sake of consistency, set registers related to margins at the beginning of your document, or just after the RP macro. You can set other registers later in your document, but you should keep them together at the beginning to make them easy to find and edit as necessary.

Margin Settings

<code>\n[PO]</code>	Register
Defines the page offset (i.e. the left margin). There is no explicit right margin setting; the combination of the PO and LL registers implicitly define the right margin width.	
Effective: next page.	
Default value: 1 i.	
<code>\n[LL]</code>	Register
Defines the line length (i.e. the width of the body text).	
Effective: next paragraph.	
Default: 6 i.	

¹ Actually, only the title is required.

`\n[LT]` Register
 Defines the title length (i.e. the header and footer width). This is usually the same as `LL`, but not necessarily.
 Effective: next paragraph.
 Default: 6 i.

`\n[HM]` Register
 Defines the header margin height at the top of the page.
 Effective: next page.
 Default: 1 i.

`\n[FM]` Register
 Defines the footer margin height at the bottom of the page.
 Effective: next page.
 Default: 1 i.

Text Settings

`\n[PS]` Register
 Defines the point size of the body text.
 Effective: next paragraph.
 Default: 10 p.

`\n[VS]` Register
 Defines the space between lines (line height plus leading).
 Effective: next paragraph.
 Default: 12 p.

Paragraph Settings

`\n[PI]` Register
 Defines the initial indent of a `.PP` paragraph.
 Effective: next paragraph.
 Default: 5 n.

`\n[PD]` Register
 Defines the space between paragraphs.
 Effective: next paragraph.
 Default: 0.3 v.

`\n[QI]` Register
 Defines the indent on both sides of a quoted (`.QP`) paragraph.
 Effective: next paragraph.
 Default: 5 n.

Footnote Settings

<code>\n[FL]</code>	Register
Defines the length of a footnote.	
Effective: next footnote.	
Default: $\n[LL] * 5/6$.	
<code>\n[FI]</code>	Register
Defines the footnote indent.	
Effective: next footnote.	
Default: $2 n$.	
<code>\n[FF]</code>	Register
The footnote format:	
0	Prints the footnote number as a superscript; indents the footnote (default).
1	Prints the number followed by a period (like 1.) and indents the footnote.
2	Like 1, without an indent.
3	Like 1, but prints the footnote number as a hanging paragraph.
Effective: next footnote.	
Default: 0.	

Miscellaneous Number Registers

<code>\n[MINGW]</code>	Register
Defines the minimum width between columns in a multi-column document.	
Effective: next page.	
Default: $2 n$.	

4.3.4 Cover page macros

Use the following macros to create a cover page for your document in the order shown.

<code>.RP [no]</code>	Macro
Specifies the report format for your document. The report format creates a separate cover page. The default action (no <code>.RP</code> macro) is to print a subset of the cover page on page 1 of your document.	
If you use the word <code>no</code> as an optional argument, <code>groff</code> prints a title page but does not repeat any of the title page information (title, author, abstract, etc.) on page 1 of the document.	

- .DA** [...] Macro
 (optional) Print the current date, or the arguments to the macro if any, on the title page (if specified) and in the footers. This is the default for **nroff**.
- .ND** [...] Macro
 (optional) Print the current date, or the arguments to the macro if any, on the title page (if specified) but not in the footers. This is the default for **troff**.
- .TL** Macro
 Specifies the document title. **groff** collects text following the **.TL** macro into the title, until reaching the author name or abstract.
- .AU** Macro
 Specifies the author's name, which appears on the line (or lines) immediately following. You can specify multiple authors as follows:
- ```

 .AU
 John Doe
 .AI
 University of West Bumblefuzz
 .AU
 Martha Buck
 .AI
 Monolithic Corporation
 ...

```
- .AI** Macro  
 Specifies the author's institution. You can specify multiple institutions in the same way that you specify multiple authors.
- .AB** [**no**] Macro  
 Begins the abstract. The default is to print the word **ABSTRACT**, centered and in italics, above the text of the abstract. The word **no** as an optional argument suppresses this heading.
- .AE** Macro  
 End the abstract.

The following is example mark-up for a title page.

```
.RP
.TL
The Inevitability of Code Bloat
in Commercial and Free Software
.AU
J. Random Luser
.AI
University of West Bumblefuzz
.AB
This report examines the long-term growth
of the code bases in two large, popular software
packages; the free Emacs and the commercial
Microsoft Word.
While differences appear in the type or order
of features added, due to the different
methodologies used, the results are the same
in the end.
.PP
The free software approach is shown to be
superior in that while free software can
become as bloated as commercial offerings,
free software tends to have fewer serious
bugs and the added features are in line with
user demand.
.AE

... the rest of the paper follows ...
```

### 4.3.5 Body text

This section describes macros used to mark up the body of your document. Examples include paragraphs, sections, and other groups.

#### 4.3.5.1 Paragraphs

The following paragraph types are available.

- |                  |                                          |       |
|------------------|------------------------------------------|-------|
| <code>.PP</code> | Sets a paragraph with an initial indent. | Macro |
| <code>.LP</code> | Sets a paragraph with no initial indent. | Macro |

**.QP** Macro  
 Sets a paragraph that is indented at both left and right margins. The effect is identical to the HTML `<BLOCKQUOTE>` element. The next paragraph or heading returns margins to normal.

**.XP** Macro  
 Sets a paragraph whose lines are indented, except for the first line. This is a Berkeley extension.

The following markup uses all four paragraph macros.

```
.NH 2
Cases used in the study
.LP
The following software and versions were
considered for this report.
.PP
For commercial software, we chose
.B "Microsoft Word for Windows" ,
starting with version 1.0 through the
current version (Word 2000).
.PP
For free software, we chose
.B Emacs ,
from its first appearance as a standalone
editor through the current version (v20).
See [Bloggs 2002] for details.
.QP
Franklin's Law applied to software:
software expands to outgrow both
RAM and disk space over time.
.LP
Bibliography:
.XP
Bloggs, Joseph R.,
.I "Everyone's a Critic" ,
Underground Press, March 2002.
A definitive work that answers all questions
and criticisms about the quality and usability of
free software.
```

### 4.3.5.2 Headings

Use headings to create a hierarchical structure for your document. The ‘ms’ macros print headings in **bold**, using the same font family and point size as the body text.

The following describes the heading macros:

`.NH curr-level` Macro  
`.NH S level0 . . .` Macro

Numbered heading. The argument is either a numeric argument to indicate the level of the heading, or the letter **S** followed by numeric arguments to set the heading level explicitly.

If you specify heading levels out of sequence, such as invoking ‘.NH 3’ after ‘.NH 1’, **groff** prints a warning on standard error.

`.SH` Macro  
 Unnumbered subheading.

### 4.3.5.3 Highlighting

The ‘ms’ macros provide a variety of methods to highlight or emphasize text:

`.B [txt [post [pre]]]` Macro

Sets its first argument in **bold type**. If you specify a second argument, **groff** prints it in the previous font after the bold text, with no intervening space (this allows you to set punctuation after the highlighted text without highlighting the punctuation). Similarly, it prints the third argument (if any) in the previous font **before** the first argument. For example,

```
.B foo) (
```

prints (**foo**).

If you give this macro no arguments, **groff** prints all text following in bold until the next highlighting, paragraph, or heading macro.

`.R [txt [post [pre]]]` Macro

Sets its first argument in roman (or regular) type. It operates similarly to the B macro otherwise.

`.I [txt [post [pre]]]` Macro

Sets its first argument in *italic type*. It operates similarly to the B macro otherwise.

`.CW [txt [post [pre]]]` Macro

Sets its first argument in a **constant width face**. It operates similarly to the B macro otherwise.

- .BI** [*txt* [*post* [*pre*]]] Macro  
 Sets its first argument in bold italic type. It operates similarly to the B macro otherwise.
- .BX** [*txt*] Macro  
 Prints its argument and draws a box around it. If you want to box a string that contains spaces, use a digit-width space (`\0`).
- .UL** [*txt* [*post*]] Macro  
 Prints its first argument with an underline. If you specify a second argument, **groff** prints it in the previous font after the underlined text, with no intervening space.
- .LG** Macro  
 Prints all text following in larger type (two points larger than the current point size) until the next font size, highlighting, paragraph, or heading macro. You can specify this macro multiple times to enlarge the point size as needed.
- .SM** Macro  
 Prints all text following in smaller type (two points smaller than the current point size) until the next type size, highlighting, paragraph, or heading macro. You can specify this macro multiple times to reduce the point size as needed.
- .NL** Macro  
 Prints all text following in the normal point size (that is, the value of the PS register).

#### 4.3.5.4 Lists

The `.IP` macro handles duties for all lists.

- .IP** [*marker* [*width*]] Macro  
 The *marker* is usually a bullet glyph (`\[bu]`) for unordered lists, a number (or auto-incrementing number register) for numbered lists, or a word or phrase for indented (glossary-style) lists.  
 The *width* specifies the indent for the body of each list item; its default unit is ‘n’. Once specified, the indent remains the same for all list items in the document until specified again.

The following is an example of a bulleted list.

```
A bulleted list:
.IP \[bu] 2
lawyers
.IP \[bu]
guns
.IP \[bu]
money
```

Produces:

```
A bulleted list:

o lawyers

o guns

o money
```

The following is an example of a numbered list.

```
.nr step 1 1
A numbered list:
.IP \n[step] 3
lawyers
.IP \n+[step]
guns
.IP \n+[step]
money
```

Produces:

```
A numbered list:

1. lawyers

2. guns

3. money
```

Note the use of the auto-incrementing number register in this example.

The following is an example of a glossary-style list.

```
A glossary-style list:
.IP lawyers 0.4i
Two or more attorneys.
.IP guns
Firearms, preferably
large-caliber.
.IP money
Gotta pay for those
lawyers and guns!
```

Produces:

```
A glossary-style list:

lawyers
 Two or more attorneys.

guns Firearms, preferably large-caliber.

money
 Gotta pay for those lawyers and guns!
```

In the last example, the IP macro places the definition on the same line as the term if it has enough space; otherwise, it breaks to the next line and starts the definition below the term. This may or may not be the effect you want, especially if some of the definitions break and some do not. The following examples show two possible ways to force a break.

The first workaround uses the `br` request to force a break after printing the term or label.

```
A glossary-style list:
.IP lawyers 0.4i
Two or more attorneys.
.IP guns
.br
Firearms, preferably large-caliber.
.IP money
Gotta pay for those lawyers and guns!
```

The second workaround uses the `\p` escape to force the break. Note the space following the escape; this is important. If you omit the space, `groff` prints the first word on the same line as the term or label (if it fits) **then** breaks the line.

```
A glossary-style list:
.IP lawyers 0.4i
Two or more attorneys.
.IP guns
\p Firearms, preferably large-caliber.
.IP money
Gotta pay for those lawyers and guns!
```

To set nested lists, use the `RS` and `RE` macros. See [Section 4.3.5.5 \[Indents in ms\]](#), page 38, for more information.

For example:

```
.IP \[bu] 2
Lawyers:
.RS
.IP \[bu]
Dewey,
.IP \[bu]
Cheatham,
.IP \[bu]
and Howe.
.RE
.IP \[bu]
Guns
```

Produces:

- o Lawyers:
  - o Dewey,
  - o Cheatham,
  - o and Howe.
- o Guns

### 4.3.5.5 Indents

In many situations, you may need to indent a section of text while still wrapping and filling. See [Section 4.3.5.4 \[Lists in ms\]](#), page 34, for an example of nested lists.

`.RS` Macro  
`.RE` Macro

These macros begin and end an indented section. The PI register controls the amount of indent, allowing the indented text to line up under hanging and indented paragraphs.

See [Section 4.3.5.7 \[ms Displays and Keeps\]](#), page 38, for macros to indent and turn off filling.

### 4.3.5.6 Tab Stops

Use the `ta` request to define tab stops as needed. See [Section 5.11 \[Tabs and Fields\]](#), page 77.

`.TA` Macro

Use this macro to reset the tab stops to the default for ‘`ms`’ (every 5n). You can redefine the TA macro to create a different set of default tab stops.

### 4.3.5.7 Displays and keeps

Use displays to show text-based examples or figures (such as code listings).

Displays turn off filling, so lines of code are displayed as-is without inserting `br` requests in between each line. Displays can be *kept* on a single page, or allowed to break across pages.

`.DS L` Macro  
`.LD` Macro  
`.DE` Macro

Left-justified display. The ‘`.DS L`’ call generates a page break, if necessary, to keep the entire display on one page. The LD macro allows the display to break across pages. The DE macro ends the display.

`.DS I` Macro  
`.ID` Macro  
`.DE` Macro

Indents the display as defined by the DI register. The ‘`.DS I`’ call generates a page break, if necessary, to keep the entire display on one page. The ID macro allows the display to break across pages. The DE macro ends the display.

|                    |       |
|--------------------|-------|
| <code>.DS B</code> | Macro |
| <code>.BD</code>   | Macro |
| <code>.DE</code>   | Macro |

Sets a block-centered display: the entire display is left-justified, but indented so that the longest line in the display is centered on the page. The ‘`.DS B`’ call generates a page break, if necessary, to keep the entire display on one page. The `BD` macro allows the display to break across pages. The `DE` macro ends the display.

|                    |       |
|--------------------|-------|
| <code>.DS C</code> | Macro |
| <code>.CD</code>   | Macro |
| <code>.DE</code>   | Macro |

Sets a centered display: each line in the display is centered. The ‘`.DS C`’ call generates a page break, if necessary, to keep the entire display on one page. The `CD` macro allows the display to break across pages. The `DE` macro ends the display.

|                    |       |
|--------------------|-------|
| <code>.DS R</code> | Macro |
| <code>.RD</code>   | Macro |
| <code>.DE</code>   | Macro |

Right-justifies each line in the display. The ‘`.DS R`’ call generates a page break, if necessary, to keep the entire display on one page. The `RD` macro allows the display to break across pages. The `DE` macro ends the display.

On occasion, you may want to *keep* other text together on a page. For example, you may want to keep two paragraphs together, or a paragraph that refers to a table (or list, or other item) immediately following. The ‘`ms`’ macros provide the `KS` and `KE` macros for this purpose.

|                  |       |
|------------------|-------|
| <code>.KS</code> | Macro |
| <code>.KE</code> | Macro |

The `KS` macro begins a block of text to be kept on a single page, and the `KE` macro ends the block.

|                  |       |
|------------------|-------|
| <code>.KF</code> | Macro |
| <code>.KE</code> | Macro |

Specifies a *floating keep*; if the keep cannot fit on the current page, `groff` holds the contents of the keep and allows text following the keep (in the source file) to fill in the remainder of the current page. When the page breaks, whether by an explicit `bp` request or by reaching the end of the page, `groff` prints the floating keep at the top of the new page. This is useful for printing large graphics or tables that do not need to appear exactly where specified.

You can also use the `ne` request to force a page break if there is not enough vertical space remaining on the page.

Use the following macros to draw a box around a section of text (such as a display).

`.B1` Macro  
`.B2` Macro

Marks the beginning and ending of text that is to have a box drawn around it. The `B1` macro begins the box; the `B2` macro ends it. Text in the box is automatically placed in a diversion (`keep`).

#### 4.3.5.8 Tables, figures, equations, and references

The ‘`ms`’ macros support the standard `groff` preprocessors: `tbl`, `pic`, `eqn`, and `refer`. You mark text meant for preprocessors by enclosing it in pairs of tags as follows.

`.TS [H]` Macro  
`.TE` Macro

Denotes a table, to be processed by the `tbl` preprocessor. The optional argument `H` to `TS` instructs `groff` to create a running header with the information up to the `TH` macro. `groff` prints the header at the beginning of the table; if the table runs onto another page, `groff` prints the header on the next page as well.

`.PS` Macro  
`.PE` Macro

Denotes a graphic, to be processed by the `pic` preprocessor. You can create a `pic` file by hand, using the AT&T `pic` manual available on the Web as a reference, or by using a graphics program such as `xfig`.

`.EQ [align]` Macro  
`.EN` Macro

Denotes an equation, to be processed by the `eqn` preprocessor. The optional `align` argument can be `C`, `L`, or `I` to center (the default), left-justify, or indent the equation.

`.[` Macro  
`.]` Macro

Denotes a reference, to be processed by the `refer` preprocessor. The GNU `refer(1)` man page provides a comprehensive reference to the preprocessor and the format of the bibliographic database.

### 4.3.5.9 An example multi-page table

The following is an example of how to set up a table that may print across two or more pages.

```
.TS H
allbox expand;
cb | cb .
Text ...of heading...
-
.TH
.T&
l | l .
... the rest of the table follows...
.CW
.TE
```

#### 4.3.5.10 Footnotes

The ‘ms’ macro package has a flexible footnote system. You can specify either numbered footnotes or symbolic footnotes (that is, using a marker such as a dagger symbol).

`\*[*]` String  
 Specifies the location of a numbered footnote marker in the text.

`.FS` Macro  
`.FE` Macro

Specifies the text of the footnote. The default action is to create a numbered footnote; you can create a symbolic footnote by specifying a *mark* glyph (such as `\[dg]` for the dagger glyph) in the body text and as an argument to the `FS` macro, followed by the text of the footnote and the `FE` macro.

You can control how `groff` prints footnote numbers by changing the value of the `FF` register. See [Section 4.3.3 \[ms Document Control Registers\]](#), page 27.

### 4.3.6 Page layout

The default output from the ‘ms’ macros provides a minimalist page layout: it prints a single column, with the page number centered at the top of each page. It prints no footers.

You can change the layout by setting the proper number registers and strings.

### 4.3.6.1 Headers and footers

For documents that do not distinguish between odd and even pages, set the following strings:

|                     |        |
|---------------------|--------|
| <code>\*[LH]</code> | String |
| <code>\*[CH]</code> | String |
| <code>\*[RH]</code> | String |

Sets the left, center, and right headers.

|                     |        |
|---------------------|--------|
| <code>\*[LF]</code> | String |
| <code>\*[CF]</code> | String |
| <code>\*[RF]</code> | String |

Sets the left, center, and right footers.

For documents that need different information printed in the even and odd pages, use the following macros:

|                                        |       |
|----------------------------------------|-------|
| <code>.OH 'left' center 'right'</code> | Macro |
| <code>.EH 'left' center 'right'</code> | Macro |
| <code>.OF 'left' center 'right'</code> | Macro |
| <code>.EF 'left' center 'right'</code> | Macro |

The `OH` and `EH` macros define headers for the odd and even pages; the `OF` and `EF` macros define footers for the odd and even pages. This is more flexible than defining the individual strings.

You can replace the quote (') marks with any character not appearing in the header or footer text.

### 4.3.6.2 Margins

You control margins using a set of number registers. See [Section 4.3.3 \[ms Document Control Registers\]](#), page 27, for details.

### 4.3.6.3 Multiple columns

The `'ms'` macros can set text in as many columns as will reasonably fit on the page. The following macros are available; all of them force a page break if a multi-column mode is already set. However, if the current mode is single-column, starting a multi-column mode does **not** force a page break.

|                  |       |
|------------------|-------|
| <code>.1C</code> | Macro |
|------------------|-------|

Single-column mode.

- `.2C` Macro  
Two-column mode.
- `.MC` [*width* [*gutter*]] Macro  
Multi-column mode. If you specify no arguments, it is equivalent to the `2C` macro. Otherwise, *width* is the width of each column and *gutter* is the space between columns. The `MINGW` number register controls the default gutter width.

#### 4.3.6.4 Creating a table of contents

The facilities in the ‘`ms`’ macro package for creating a table of contents are semi-automated at best. Assuming that you want the table of contents to consist of the document’s headings, you need to repeat those headings wrapped in `XS` and `XE` macros.

- `.XS` [*page*] Macro  
`.XA` [*page*] Macro  
`.XE` Macro

These macros define a table of contents or an individual entry in the table of contents, depending on their use. The macros are very simple; they cannot indent a heading based on its level. The easiest way to work around this is to add tabs to the table of contents string. The following is an example:

```
.NH 1
Introduction
.XS
Introduction
.XE
.LP
...
.CW
.NH 2
Methodology
.XS
Methodology
.XE
.LP
...
```

You can manually create a table of contents by beginning with the `XS` macro for the first entry, specifying the page number for that entry as the

argument to `XS`. Add subsequent entries using the `XA` macro, specifying the page number for that entry as the argument to `XA`. The following is an example:

```
.XS 1
Introduction
.XA 2
A Brief History of the Universe
.XA 729
Details of Galactic Formation
...
.XE
```

`.TC [no]` Macro

Prints the table of contents on a new page, setting the page number to `i` (Roman numeral one). You should usually place this macro at the end of the file, since `groff` is a single-pass formatter and can only print what has been collected up to the point that the `TC` macro appears.

The optional argument `no` suppresses printing the title specified by the string register `TOC`.

`.PX [no]` Macro

Prints the table of contents on a new page, using the current page numbering sequence. Use this macro to print a manually-generated table of contents at the beginning of your document.

The optional argument `no` suppresses printing the title specified by the string register `TOC`.

The *Groff and Friends HOWTO* includes a `sed` script that automatically inserts `XS` and `XE` macro entries after each heading in a document.

Altering the `NH` macro to automatically build the table of contents is perhaps initially more difficult, but would save a great deal of time in the long run if you use ‘`ms`’ regularly.

### 4.3.6.5 Strings and Special Characters

The ‘`ms`’ macros provide the following predefined strings. You can change the string definitions to help in creating documents in languages other than English.

`\*[REFERENCES]` String

Contains the string printed at the beginning of the references (bibliography) page. The default is ‘`References`’.

|                                                                                          |        |
|------------------------------------------------------------------------------------------|--------|
| <code>\*[ABSTRACT]</code>                                                                | String |
| Contains the string printed at the beginning of the abstract. The default is ‘ABSTRACT’. |        |
| <code>\*[TOC]</code>                                                                     | String |
| Contains the string printed at the beginning of the table of contents.                   |        |
| <code>\*[MONTH1]</code>                                                                  | String |
| <code>\*[MONTH2]</code>                                                                  | String |
| <code>\*[MONTH3]</code>                                                                  | String |
| <code>\*[MONTH4]</code>                                                                  | String |
| <code>\*[MONTH5]</code>                                                                  | String |
| <code>\*[MONTH6]</code>                                                                  | String |
| <code>\*[MONTH7]</code>                                                                  | String |
| <code>\*[MONTH8]</code>                                                                  | String |
| <code>\*[MONTH9]</code>                                                                  | String |
| <code>\*[MONTH10]</code>                                                                 | String |
| <code>\*[MONTH11]</code>                                                                 | String |
| <code>\*[MONTH12]</code>                                                                 | String |
| Prints the full name of the month in dates. The default is ‘January’, ‘February’, etc.   |        |

The following special characters are available<sup>2</sup>:

|                                                                                                                                        |        |
|----------------------------------------------------------------------------------------------------------------------------------------|--------|
| <code>\*[-]</code>                                                                                                                     | String |
| Prints an em dash.                                                                                                                     |        |
| <code>\*[*Q]</code>                                                                                                                    | String |
| <code>\*[*U]</code>                                                                                                                    | String |
| Prints typographer’s quotes in troff, plain quotes in nroff. <code>*Q</code> is the left quote and <code>*U</code> is the right quote. |        |

Improved accent marks are available in the ‘ms’ macros.

|                                                                                                                                            |       |
|--------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <code>.AM</code>                                                                                                                           | Macro |
| Specify this macro at the beginning of your document to enable extended accent marks and special characters. This is a Berkeley extension. |       |
| To use the accent marks, place them <b>after</b> the character being accented.                                                             |       |

The following accent marks are available after invoking the `AM` macro:

|                    |        |
|--------------------|--------|
| <code>\*[']</code> | String |
| Acute accent.      |        |

---

<sup>2</sup> For an explanation what special characters are see [Section 7.1 \[Special Characters\]](#), page 165.

|                                                                                                    |        |
|----------------------------------------------------------------------------------------------------|--------|
| <code>\*[‘]</code><br>Grave accent.                                                                | String |
| <code>\*[^]</code><br>Circumflex.                                                                  | String |
| <code>\*[,]</code><br>Cedilla.                                                                     | String |
| <code>\*[~]</code><br>Tilde.                                                                       | String |
| <code>\*[:]</code><br>Umlaut.                                                                      | String |
| <code>\*[v]</code><br>Hacek.                                                                       | String |
| <code>\*[_]</code><br>Macron (overbar).                                                            | String |
| <code>\*[.]</code><br>Underdot.                                                                    | String |
| <code>\*[o]</code><br>Ring above.                                                                  | String |
| <p>The following are standalone characters available after invoking the <code>AM</code> macro:</p> |        |
| <code>\*[?]</code><br>Upside-down question mark.                                                   | String |
| <code>\*[!]</code><br>Upside-down exclamation point.                                               | String |
| <code>\*[8]</code><br>German ß ligature.                                                           | String |
| <code>\*[3]</code><br>Yogh.                                                                        | String |
| <code>\*[Th]</code><br>Uppercase thorn.                                                            | String |

|                                              |        |
|----------------------------------------------|--------|
| <code>\*[th]</code><br>Lowercase thorn.      | String |
| <code>\*[D-]</code><br>Uppercase eth.        | String |
| <code>\*[d-]</code><br>Lowercase eth.        | String |
| <code>\*[q]</code><br>Hooked o.              | String |
| <code>\*[ae]</code><br>Lowercase æ ligature. | String |
| <code>\*[Ae]</code><br>Uppercase Æ ligature. | String |

### 4.3.7 Differences from AT&T ‘ms’

This section lists the (minor) differences between the `groff -ms` macros and AT&T `troff -ms` macros.

#### 4.3.7.1 troff macros not appearing in groff

Macros missing from `groff -ms` are cover page macros specific to Bell Labs. The macros known to be missing are:

|                  |                                                    |
|------------------|----------------------------------------------------|
| <code>.TM</code> | Technical memorandum; a cover sheet style          |
| <code>.IM</code> | Internal memorandum; a cover sheet style           |
| <code>.MR</code> | Memo for record; a cover sheet style               |
| <code>.MF</code> | Memo for file; a cover sheet style                 |
| <code>.EG</code> | Engineer’s notes; a cover sheet style              |
| <code>.TR</code> | Computing Science Tech Report; a cover sheet style |
| <code>.OK</code> | Other keywords                                     |
| <code>.CS</code> | Cover sheet information                            |
| <code>.MH</code> | A cover sheet macro                                |

### 4.3.7.2 groff macros not appearing in AT&T troff

The `groff -ms` macros have a few minor extensions compared to the AT&T `troff -ms` macros.

- .AM
Macro
- Improved accent marks. See [Section 4.3.6.5 \[ms Strings and Special Characters\]](#), page 44, for details.
  
- .DS I
Macro
- Indented display. The default behavior of AT&T `troff -ms` was to indent; the `groff` default prints displays flush left with the body text.
  
- .CW
Macro
- Print text in `constant width` (Courier) font.
  
- .IX
Macro
- Indexing term (printed on standard error). You can write a script to capture and process an index generated in this manner.

The following additional number registers appear in `groff -ms`:

- \n[MINGW]
Register
- Specifies a minimum space between columns (for multi-column output); this takes the place of the `GW` register that was documented but apparently not implemented in AT&T `troff`.

Several new string registers are available as well. You can change these to handle (for example) the local language. See [Section 4.3.6.5 \[ms Strings and Special Characters\]](#), page 44, for details.

## 4.4 ‘me’

See the `meintro.me` and `meref.me` documents in `groff`’s `doc` directory.

## 4.5 ‘mm’

See the `groff_mm(7)` man page (type `man groff_mm` at the command line).

## 5 `gtroff` Reference

This chapter covers **all** of the facilities of `gtroff`. Users of macro packages may skip it if not interested in details.

### 5.1 Text

`gtroff` input files contain text with control commands interspersed throughout. But, even without control codes, `gtroff` still does several things with the input text:

- filling and adjusting
- adding additional space after sentences
- hyphenating
- inserting implicit line breaks

#### 5.1.1 Filling and Adjusting

When `gtroff` reads text, it collects words from the input and fits as many of them together on one output line as it can. This is known as *filling*.

Once `gtroff` has a *filled* line, it tries to *adjust* it. This means it widens the spacing between words until the text reaches the right margin (in the default adjustment mode). Extra spaces between words are preserved, but spaces at the end of lines are ignored. Spaces at the front of a line cause a *break* (breaks are explained in [Section 5.1.5 \[Implicit Line Breaks\]](#), page 50).

See [Section 5.8 \[Manipulating Filling and Adjusting\]](#), page 68.

#### 5.1.2 Hyphenation

Since the odds are not great for finding a set of words, for every output line, which fit nicely on a line without inserting excessive amounts of space between words, `gtroff` hyphenates words so that it can justify lines without inserting too much space between words. It uses an internal hyphenation algorithm (a simplified version of the algorithm used within `TEX`) to indicate which words can be hyphenated and how to do so. When a word is hyphenated, the first part of the word is added to the current filled line being output (with an attached hyphen), and the other portion is added to the next line to be filled.

See [Section 5.9 \[Manipulating Hyphenation\]](#), page 71.

#### 5.1.3 Sentences

Although it is often debated, some typesetting rules say there should be different amounts of space after various punctuation marks. For example, the *Chicago typesetting manual* says that a period at the end of a sentence

should have twice as much space following it as would a comma or a period as part of an abbreviation.

`gtroff` does this by flagging certain characters (normally ‘!’, ‘?’, and ‘.’) as *end-of-sentence* characters. When `gtroff` encounters one of these characters at the end of a line, it appends a normal space followed by a *sentence space* in the formatted output. (This justifies one of the conventions mentioned in [Section 5.2 \[Input Conventions\]](#), page 51.)

In addition, the following characters and symbols are treated transparently while handling end-of-sentence characters: ‘”’, ‘’’, ‘)’, ‘]’, ‘\*’, `\[dg]`, and `\[rq]`.

See the `cflags` request in [Section 5.18.4 \[Using Symbols\]](#), page 99, for more details.

To prevent the insertion of extra space after an end-of-sentence character (at the end of a line), append `\&`.

### 5.1.4 Tab Stops

`gtroff` translates *tabulator characters*, also called *tabs* (normally code point ASCII 0x09 or EBCDIC 0x05), in the input into movements to the next tabulator stop. These tab stops are initially located every half inch across the page. Using this, simple tables can be made easily. However, it can often be deceptive as the appearance (and width) of the text on a terminal and the results from `gtroff` can vary greatly.

Also, a possible sticking point is that lines beginning with tab characters are still filled, again producing unexpected results. For example, the following input

```

1 2 3
 4 5
```

produces

```

1 2 3 4 5
```

See [Section 5.11 \[Tabs and Fields\]](#), page 77.

### 5.1.5 Implicit Line Breaks

An important concept in `gtroff` is the *break*. When a break occurs, `gtroff` outputs the partially filled line (unjustified), and resumes collecting and filling text on the next output line.

There are several ways to cause a break in `gtroff`. A blank line not only causes a break, but it also outputs a one-line vertical space (effectively a blank line). Note that this behaviour can be modified with the blank line macro request `blm`. See [Section 5.25.4 \[Blank Line Traps\]](#), page 136.

A line that begins with a space causes a break and the space is output at the beginning of the next line. Note that this space isn’t adjusted, even in fill mode.

The end of file also causes a break – otherwise the last line of the document may vanish!

Certain requests also cause breaks, implicitly or explicitly. This is discussed in [Section 5.8 \[Manipulating Filling and Adjusting\]](#), page 68.

## 5.2 Input Conventions

Since `gtroff` does filling automatically, it is traditional in `groff` not to try and type things in as nicely formatted paragraphs. These are some conventions commonly used when typing `gtroff` text:

- Break lines after punctuation, particularly at the end of a sentence and in other logical places. Keep separate phrases on lines by themselves, as entire phrases are often added or deleted when editing.
- Try to keep lines less than 40-60 characters, to allow space for inserting more text.
- Do not try to do any formatting in a WYSIWYG manner (i.e., don't try using spaces to get proper indentation).

## 5.3 Measurements

`gtroff` (like many other programs) requires numeric parameters to specify various measurements. Most numeric parameters<sup>1</sup> may have a *measurement unit* attached. These units are specified as a single character which immediately follows the number or expression. Each of these units are understood, by `gtroff`, to be a multiple of its *basic unit*. So, whenever a different measurement unit is specified `gtroff` converts this into its *basic units*. This basic unit, represented by a ‘u’, is a device dependent measurement which is quite small, ranging from 1/75 th to 1/72000 th of an inch. The values may be given as fractional numbers; however, fractional basic units are always rounded to integers.

Some of the measurement units are completely independent of any of the current settings (e.g. type size) of `gtroff`.

- |   |                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| i | Inches. An antiquated measurement unit still in use in certain backwards countries with incredibly low-cost computer equipment. One inch is equal to 2.54 cm. |
| c | Centimeters. One centimeter is equal to 0.3937 in.                                                                                                            |
| p | Points. This is a typesetter's measurement used for measure type size. It is 72 points to an inch.                                                            |
| P | Pica. Another typesetting measurement. 6 Picas to an inch (and 12 points to a pica).                                                                          |

---

<sup>1</sup> those that specify vertical or horizontal motion or a type size

- s**  
**z** See [Section 5.19.2 \[Fractional Type Sizes\]](#), page 111, for a discussion of these units.
- f** Fractions. Value is 65536. See [Section 5.29 \[Colors\]](#), page 144, for usage.

The other measurements understood by `gtroff` depend on settings currently in effect in `gtroff`. These are very useful for specifying measurements which should look proper with any size of text.

- m** Ems. This unit is equal to the current font size in points. So called because it is *approximately* the width of the letter ‘m’ in the current font.
- n** Ens. In `groff`, this is half of an em.
- v** Vertical space. This is equivalent to the current line spacing. See [Section 5.19 \[Sizes\]](#), page 109, for more information about this.
- M** 100ths of an em.

### 5.3.1 Default Units

Many requests take a default unit. While this can be helpful at times, it can cause strange errors in some expressions. For example, the line length request expects em units. Here are several attempts to get a line length of 3.5 inches and their results:

```

3.5i ⇒ 3.5i
7/2 ⇒ 0i
7/2i ⇒ 0i
(7 / 2)u ⇒ 0i
7i/2 ⇒ 0.1i
7i/2u ⇒ 3.5i

```

Everything is converted to basic units first. In the above example it is assumed that 1i equals 240 u, and 1m equals 10p (thus 1m equals 33u). The value 7i/2 is first handled as 7i/2m, then converted to 1680u/66u which is 25u, and this is approximately 0.1i. As can be seen, a scaling indicator after a closing parenthesis is simply ignored.

Thus, the safest way to specify measurements is to always attach a scaling indicator. If you want to multiply or divide by a certain scalar value, use ‘u’ as the unit for that value.

## 5.4 Expressions

`gtroff` has most arithmetic operators common to other languages:

- Arithmetic: ‘+’ (addition), ‘-’ (subtraction), ‘/’ (division), ‘\*’ (multiplication), ‘%’ (modulo).  
`gtroff` only provides integer arithmetic. The internal type used for computing results is ‘`int`’, which is usually a 32 bit signed integer.
- Comparison: ‘<’ (less than), ‘>’ (greater than), ‘<=’ (less than or equal), ‘>=’ (greater than or equal), ‘=’ (equal), ‘==’ (the same as ‘=’).
- Logical: ‘&’ (logical and), ‘.’ (logical or).
- Unary operators: ‘-’ (negating, i.e. changing the sign), ‘+’ (just for completeness; does nothing in expressions), ‘!’ (logical not; this works only within `if` and `while` requests). See below for the use of unary operators in motion requests.
- Extrema: ‘>?’ (maximum), ‘<?’ (minimum).

Example:

```
.nr x 5
.nr y 3
.nr z (\n[x] >? \n[y])
```

The register `z` now contains 5.

- Scaling: (`c`; `e`). Evaluate `e` using `c` as the default scaling indicator. If `c` is missing, ignore scaling indicators in the evaluation of `e`.

Parentheses may be used as in any other language. However, in `gtroff` they are necessary to ensure order of evaluation. `gtroff` has no operator precedence; expressions are evaluated left to right. This means that `gtroff` evaluates ‘`3+5*4`’ as if it were parenthesized like ‘`(3+5)*4`’, not as ‘`3+(5*4)`’, as might be expected.

For many requests which cause a motion on the page, the unary operators ‘+’ and ‘-’ work differently if leading an expression. They then indicate a motion relative to the current position (down or up, respectively).

Similarly, a leading ‘|’ operator indicates an absolute position. For vertical movements, it specifies the distance from the top of the page; for horizontal movements, it gives the distance from the beginning of the *input* line.

‘+’ and ‘-’ are also treated differently by the following requests and escapes: `bp`, `in`, `ll`, `lt`, `nm`, `nr`, `pl`, `pn`, `po`, `ps`, `pvs`, `rt`, `ti`, `\H`, `\R`, and `\S`. Here, leading plus and minus signs indicate increments and decrements.

See [Section 5.7.1 \[Setting Registers\]](#), [page 61](#), for some examples.

`\B` ‘*anything*’

Escape

Return 1 if *anything* is a valid numeric expression; or 0 if *anything* is empty or not a valid numeric expression.

Due to the way arguments are parsed, spaces are not allowed in expressions, unless the entire expression is surrounded by parentheses.

See [Section 5.6.1.1 \[Request Arguments\]](#), page 57, and [Section 5.21 \[Conditionals and Loops\]](#), page 117.

## 5.5 Identifiers

Like any other language, **gtroff** has rules for properly formed *identifiers*. In **gtroff**, an identifier can be made up of almost any printable character, with the exception of the following characters:

- Whitespace characters (spaces, tabs, and newlines).
- Backspace (ASCII 0x08 or EBCDIC 0x16) and character code 0x01.
- The following input characters are invalid and are ignored if **groff** runs on a machine based on ASCII, causing a warning message of type ‘input’ (see [Section 5.34 \[Debugging\]](#), page 154, for more details): 0x00, 0x0B, 0x0D-0x1F, 0x80-0x9F.

And here are the invalid input characters if **groff** runs on an EBCDIC host: 0x00, 0x08, 0x09, 0x0B, 0x0D-0x14, 0x17-0x1F, 0x30-0x3F.

Currently, some of these reserved codepoints are used internally, thus making it non-trivial to extend **gtroff** to cover Unicode or other character sets and encodings which use characters of these ranges.

Note that invalid characters are removed before parsing; an identifier **foo**, followed by an invalid character, followed by **bar** is treated as **foobar**.

For example, any of the following is valid.

```
br
pp
(1
end-list
@_
```

Note that identifiers longer than two characters with a closing bracket (‘]’) in its name can’t be accessed with escape sequences which expect an identifier as a parameter. For example, ‘\[[foo]]’ accesses the glyph ‘foo’, followed by ‘]’, whereas ‘\C’foo]’ really asks for glyph ‘foo]’.

To avoid problems with the **refer** preprocessor, macro names should not start with ‘[’ or ‘]’. Due to backwards compatibility, everything after ‘.[’ and ‘.]’ is handled as a special argument to **refer**. For example, ‘.[foo]’ makes **refer** to start a reference, using ‘foo’ as a parameter.

**\A’ident’**

Escape

Test whether an identifier *ident* is valid in **gtroff**. It expands to the character 1 or 0 according to whether its argument (usually delimited by quotes) is or is not acceptable as the name of a string, macro, diversion, number register, environment, or font. It returns 0 if no argument is

given. This is useful for looking up user input in some sort of associative table.

```
\A'end-list'
⇒ 1
```

See [Section 5.6.3 \[Escapes\]](#), page 58, for details on parameter delimiting characters.

Identifiers in `gtroff` can be any length, but, in some contexts, `gtroff` needs to be told where identifiers end and text begins (and in different ways depending on their length):

- Single character.
- Two characters. Must be prefixed with ‘(’ in some situations.
- Arbitrary length (`gtroff` only). Must be bracketed with ‘[’ and ‘]’ in some situations. Any length identifier can be put in brackets.

Unlike many other programming languages, undefined identifiers are silently ignored or expanded to nothing. When `gtroff` finds an undefined identifier, it emits a warning, doing the following:

- If the identifier is a string, macro, or diversion, `gtroff` defines it as empty.
- If the identifier is a number register, `gtroff` defines it with a value of 0.

See [Section 5.34.1 \[Warnings\]](#), page 157., [Section 5.7.2 \[Interpolating Registers\]](#), page 63, and [Section 5.20 \[Strings\]](#), page 113.

Note that macros, strings, and diversions share the same name space.

```
.de xxx
. nop foo
..
.
.di xxx
bar
.br
.di
.
.xxx
⇒ bar
```

As can be seen in the previous example, `gtroff` reuses the identifier ‘xxx’, changing it from a macro to a diversion. No warning is emitted! The contents of the first macro definition is lost.

See [Section 5.7.2 \[Interpolating Registers\]](#), page 63, and [Section 5.20 \[Strings\]](#), page 113.

## 5.6 Embedded Commands

Most documents need more functionality beyond filling, adjusting and implicit line breaking. In order to gain further functionality, `gtroff` allows commands to be embedded into the text, in two ways.

The first is a *request* which takes up an entire line, and does some large-scale operation (e.g. break lines, start new pages).

The other is an *escape* which can be usually embedded anywhere in the text; most requests can accept it even as an argument. Escapes generally do more minor operations like sub- and superscripts, print a symbol, etc.

### 5.6.1 Requests

A request line begins with a control character, which is either a single quote (‘’’, the *no-break control character*) or a period (‘.’’, the normal *control character*). These can be changed; see [Section 5.12 \[Character Translations\]](#), [page 82](#), for details. After this there may be optional tabs or spaces followed by an identifier which is the name of the request. This may be followed by any number of space-separated arguments (*no* tabs here).

Since a control character followed by whitespace only is ignored, it is common practice to use this feature for structuring the source code of documents or macro packages.

```
.de foo
. tm This is foo.
..
.
.
.de bar
. tm This is bar.
..
```

Another possibility is to use the blank line macro request `blm` by assigning an empty macro to it.

```
.de do-nothing
..
.blm do-nothing \" activate blank line macro

.de foo
. tm This is foo.
..

.de bar
. tm This is bar.
..

.blm \" deactivate blank line macro
```

See [Section 5.25.4 \[Blank Line Traps\]](#), page 136.

To begin a line with a control character without it being interpreted, precede it with `\&`. This represents a zero width space, which means it does not affect the output.

In most cases the period is used as a control character. Several requests cause a break implicitly; using the single quote control character prevents this.

### 5.6.1.1 Request Arguments

Arguments to requests (and macros) are processed much like the shell: The line is split into arguments according to spaces.<sup>2</sup> An argument which is intended to contain spaces can either be enclosed in double quotes, or have the spaces *escaped* with backslashes.

Here are a few examples:

```
.uh The Mouse Problem
.uh "The Mouse Problem"
.uh The\ Mouse\ Problem
```

The first line is the `uh` macro being called with 3 arguments, ‘The’, ‘Mouse’, and ‘Problem’. The latter two have the same effect of calling the `uh` macro with one argument, ‘The Mouse Problem’.<sup>3</sup>

A double quote which isn’t preceded by a space doesn’t start a macro argument. If not closing a string, it is printed literally.

For example,

---

<sup>2</sup> Plan 9’s `troff` implementation also allows tabs for argument separation – `gtroff` intentionally doesn’t support this.

<sup>3</sup> The last solution, i.e., using escaped spaces, is “classical” in the sense that it can be found in most `troff` documents. Nevertheless, it is not optimal in all situations, since ‘\ ’ inserts a fixed-width, non-breaking space character which can’t stretch. `gtroff` provides a different command `\~` to insert a stretchable, non-breaking space.

```
.xxx a" "b c" "de"fg"
```

has the arguments ‘a’’, ‘b c’’, ‘de’’, and ‘fg’’’. Don’t rely on this obscure behaviour!

There are two possibilities to get a double quote reliably.

- Enclose the whole argument with double quotes and use two consecutive double quotes to represent a single one. This traditional solution has the disadvantage that double quotes don’t survive argument expansion again if called in compatibility mode (using the ‘-C’ option of `groff`):

```
.de xx
. tm xx: ‘\ $1’ ‘\ $2’ ‘\ $3’
.
. yy "\ $1" "\ $2" "\ $3"
..
.de yy
. tm yy: ‘\ $1’ ‘\ $2’ ‘\ $3’
..
.xx A "test with ""quotes"" .
 ⇒ xx: ‘A’ ‘test with "quotes"’ ‘.’
 ⇒ yy: ‘A’ ‘test with ’ ‘quotes"”’
```

If not in compatibility mode, you get the expected result

```
xx: ‘A’ ‘test with "quotes"’ ‘.’
yy: ‘A’ ‘test with "quotes"’ ‘.’
```

since `gtroff` preserves the input level.

- Use the double quote glyph `\(dq`. This works with and without compatibility mode enabled since `gtroff` doesn’t convert `\(dq` back to a double quote input character.

Not that this method won’t work with UNIX `troff` in general since the glyph ‘dq’ isn’t defined normally.

Double quotes in the `ds` request are handled differently. See [Section 5.20 \[Strings\]](#), page 113, for more details.

## 5.6.2 Macros

`gtroff` has a *macro* facility for defining a series of lines which can be invoked by name. They are called in the same manner as requests – arguments also may be passed in the same manner.

See [Section 5.22 \[Writing Macros\]](#), page 121, and [Section 5.6.1.1 \[Request Arguments\]](#), page 57.

## 5.6.3 Escapes

Escapes may occur anywhere in the input to `gtroff`. They usually begin with a backslash and are followed by a single character which indicates

the function to be performed. The escape character can be changed; see [Section 5.12 \[Character Translations\]](#), page 82.

Escape sequences which require an identifier as a parameter accept three possible syntax forms.

- The next single character is the identifier.
- If this single character is an opening parenthesis, take the following two characters as the identifier. Note that there is no closing parenthesis after the identifier.
- If this single character is an opening bracket, take all characters until a closing bracket as the identifier.

Examples:

```
\fB
\n(XX
\[TeX]
```

Other escapes may require several arguments and/or some special format. In such cases the argument is traditionally enclosed in single quotes (and quotes are always used in this manual for the definitions of escape sequences). The enclosed text is then processed according to what that escape expects.

Example:

```
\l'1.5i\(\bu'
```

Note that the quote character can be replaced with any other character which does not occur in the argument (even a newline or a space character) in the following escapes: `\o`, `\b`, and `\X`. This makes e.g.

```
A caf
\o
e\'
```

```
in Paris
⇒ A café in Paris
```

possible, but it is better not to use this feature to avoid confusion.

The following escapes sequences (which are handled similarly to characters since they don't take a parameter) are also allowed as delimiters: `\%`, `\'`, `\|`, `\^`, `\{`, `\}`, `\'`, `\'`, `\-`, `\_`, `\!`, `\?`, `\@`, `\)`, `\/`, `\,`, `\&`, `\:`, `\~`, `\0`, `\a`, `\c`, `\d`, `\e`, `\E`, `\p`, `\r`, `\t`, and `\u`. Again, don't use these if possible.

No newline characters as delimiters are allowed in the following escapes: `\A`, `\B`, `\Z`, `\C`, and `\w`.

Finally, the escapes `\D`, `\h`, `\H`, `\l`, `\L`, `\N`, `\R`, `\s`, `\S`, `\v`, and `\x` can't use the following characters as delimiters:

- The digits 0-9.
- The (single-character) operators `'+-/*%<>=&:() .'`.
- The space, tab, and newline characters.

- All escape sequences except `\%`, `\:`, `\{`, `\}`, `\'`, `\'`, `\-`, `\_`, `\!`, `\@`, `\/`, `\c`, `\e`, and `\p`.

To have a backslash (actually, the current escape character) appear in the output several escapes are defined: `\\`, `\e` or `\E`. These are very similar, and only differ with respect to being used in macros or diversions. See Section 5.12 [Character Translations], page 82, for an exact description of those escapes.

See Section 5.35 [Implementation Differences], page 159, Section 5.22.1 [Copy-in Mode], page 123, and Section 5.26 [Diversions], page 137, Section 5.5 [Identifiers], page 54, for more information.

### 5.6.3.1 Comments

Probably one of the most<sup>4</sup> common forms of escapes is the comment.

`\"` Escape

Start a comment. Everything to the end of the input line is ignored.

This may sound simple, but it can be tricky to keep the comments from interfering with the appearance of the final output.

If the escape is to the right of some text or a request, that portion of the line is ignored, but the space leading up to it is noticed by `gtroff`. This only affects the `ds` and `as` request and its variants.

One possibly irritating idiosyncrasy is that tabs must not be used to line up comments. Tabs are not treated as whitespace between the request and macro arguments.

A comment on a line by itself is treated as a blank line, because after eliminating the comment, that is all that remains:

```

 Test
 \" comment
 Test
produces
 Test

```

```

 Test

```

To avoid this, it is common to start the line with `.\"` which causes the line to be treated as an undefined request and thus ignored completely.

Another commenting scheme seen sometimes is three consecutive single quotes (`'''`) at the beginning of a line. This works, but `gtroff` gives a warning about an undefined macro (namely `'''`), which is harmless, but irritating.

---

<sup>4</sup> Unfortunately, this is a lie. But hopefully future `gtroff` hackers will believe it :-)

`\#` Escape

To avoid all this, `gtroff` has a new comment mechanism using the `\#` escape. This escape works the same as `\` except that the newline is also ignored:

```
 Test
 \# comment
 Test
produces
```

```
 Test Test
as expected.
```

`.ig yy` Request

Ignore all input until `gtroff` encounters the macro named `.yy` on a line by itself (or `..` if `yy` is not specified). This is useful for commenting out large blocks of text:

```
 text text text...
 .ig
 This is part of a large block
 of text that has been
 temporarily(?) commented out.
```

```

 We can restore it simply by removing
 the .ig request and the ".." at the
 end of the block.
```

```
 ..
 More text text text...
```

produces

```
 text text text... More text text text...
```

Note that the commented-out block of text does not cause a break.

The input is read in copy-mode; auto-incremented registers *are* affected (see [Section 5.7.3 \[Auto-increment\]](#), page 64).

## 5.7 Registers

Numeric variables in `gtroff` are called *registers*. There are a number of built-in registers, supplying anything from the date to details of formatting parameters.

See [Section 5.5 \[Identifiers\]](#), page 54, for details on register identifiers.

### 5.7.1 Setting Registers

Define or set registers using the `nr` request or the `\R` escape.

|                                            |  |         |
|--------------------------------------------|--|---------|
| <code>.nr <i>ident</i> <i>value</i></code> |  | Request |
| <code>\R'<i>ident</i> <i>value</i>'</code> |  | Escape  |

Set number register *ident* to *value*. If *ident* doesn't exist, `gtroff` creates it.

The argument to `\R` usually has to be enclosed in quotes. See [Section 5.6.3 \[Escapes\]](#), page 58, for details on parameter delimiting characters.

The `\R` escape doesn't produce an input token in `gtroff`; with other words, it vanishes completely after `gtroff` has processed it.

For example, the following two lines are equivalent:

```
.nr a (((17 + (3 * 4))) % 4)
\R'a (((17 + (3 * 4))) % 4)'
⇒ 1
```

Both `nr` and `\R` have two additional special forms to increment or decrement a register.

|                                             |  |         |
|---------------------------------------------|--|---------|
| <code>.nr <i>ident</i> +<i>value</i></code> |  | Request |
| <code>.nr <i>ident</i> -<i>value</i></code> |  | Request |
| <code>\R'<i>ident</i> +<i>value</i>'</code> |  | Escape  |
| <code>\R'<i>ident</i> -<i>value</i>'</code> |  | Escape  |

Increment (decrement) register *ident* by *value*.

```
.nr a 1
.nr a +1
\na
⇒ 2
```

To assign the negated value of a register to another register, some care must be taken to get the desired result:

```
.nr a 7
.nr b 3
.nr a -\nb
\na
⇒ 4

.nr a (-\nb)
\na
⇒ -3
```

The surrounding parentheses prevent the interpretation of the minus sign as a decrementing operator. An alternative is to start the assignment with a '0':

```
.nr a 7
.nr b -3
.nr a \nb
\na
⇒ 4
.nr a 0\nb
\na
⇒ -3
```

`.rr ident` Request  
 Remove number register *ident*. If *ident* doesn't exist, the request is ignored.

`.rnn ident1 ident2` Request  
 Rename number register *ident1* to *ident2*. If either *ident1* or *ident2* doesn't exist, the request is ignored.

`.aln ident1 ident2` Request  
 Create an alias *ident1* for a number register *ident2*. The new name and the old name are exactly equivalent. If *ident1* is undefined, a warning of type 'reg' is generated, and the request is ignored. See [Section 5.34 \[Debugging\]](#), page 154, for information about warnings.

## 5.7.2 Interpolating Registers

Numeric registers can be accessed via the `\n` escape.

|                               |        |
|-------------------------------|--------|
| <code>\ni</code>              | Escape |
| <code>\n(<i>id</i></code>     | Escape |
| <code>\n[<i>ident</i>]</code> | Escape |

Interpolate number register with name *ident* (one-character name *i*, two-character name *id*). This means that the value of the register is expanded in-place while `gtroff` is parsing the input line. Nested assignments (also called indirect assignments) are possible.

```
.nr a 5
.nr as \na+\na
\n(as
⇒ 10
```

```
.nr a1 5
.nr ab 6
.ds str b
.ds num 1
\n[a\n[num]]
⇒ 5
\n[a*[str]]
⇒ 6
```

### 5.7.3 Auto-increment

Number registers can also be auto-incremented and auto-decremented. The increment or decrement value can be specified with a third argument to the `nr` request or `\R` escape.

```
.nr ident value incr Request
Set number register ident to value; the increment for auto-incrementing
is set to incr. Note that the \R escape doesn't support this notation.
```

To activate auto-incrementing, the escape `\n` has a special syntax form.

|                         |        |
|-------------------------|--------|
| <code>\n+i</code>       | Escape |
| <code>\n-i</code>       | Escape |
| <code>\n(+id</code>     | Escape |
| <code>\n(-id</code>     | Escape |
| <code>\n+(id</code>     | Escape |
| <code>\n-(id</code>     | Escape |
| <code>\n[+ident]</code> | Escape |
| <code>\n[-ident]</code> | Escape |
| <code>\n+[ident]</code> | Escape |
| <code>\n-[ident]</code> | Escape |

Before interpolating, increment or decrement *ident* (one-character name *i*, two-character name *id*) by the auto-increment value as specified with the `nr` request (or the `\R` escape). If no auto-increment value has been specified, these syntax forms are identical to `\n`.

For example,

```
.nr a 0 1
.nr xx 0 5
.nr foo 0 -2
\n+a, \n+a, \n+a, \n+a, \n+a
.br
\n-(xx, \n-(xx, \n-(xx, \n-(xx, \n-(xx
.br
\n+[foo], \n+[foo], \n+[foo], \n+[foo], \n+[foo]
```

produces

```
1, 2, 3, 4, 5
-5, -10, -15, -20, -25
-2, -4, -6, -8, -10
```

To change the increment value without changing the value of a register (*a* in the example), the following can be used:

```
.nr a \na 10
```

### 5.7.4 Assigning Formats

When a register is used in the text of an input file (as opposed to part of an expression), it is textually replaced (or interpolated) with a representation of that number. This output format can be changed to a variety of formats (numbers, Roman numerals, etc.). This is done using the `af` request.

`.af` *ident format* Request

Change the output format of a number register. The first argument *ident* is the name of the number register to be changed, and the second argument *format* is the output format. The following output formats are available:

- |       |                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Decimal arabic numbers. This is the default format: 0, 1, 2, 3, . . . .                                                                                                                                                                                                                                                                                                                              |
| 0...0 | Decimal numbers with as many digits as specified. So, '00' would result in printing numbers as 01, 02, 03, . . . .<br><br>In fact, any digit instead of zero will do; <code>gtroff</code> only counts how many digits are specified. As a consequence, <code>af</code> 's default format '1' could be specified as '0' also (and exactly this is returned by the <code>\g</code> escape, see below). |
| I     | Upper-case Roman numerals: 0, I, II, III, IV, . . . .                                                                                                                                                                                                                                                                                                                                                |
| i     | Lower-case Roman numerals: 0, i, ii, iii, iv, . . . .                                                                                                                                                                                                                                                                                                                                                |
| A     | Upper-case letters: 0, A, B, C, . . . , Z, AA, AB, . . . .                                                                                                                                                                                                                                                                                                                                           |
| a     | Lower-case letters: 0, a, b, c, . . . , z, aa, ab, . . . .                                                                                                                                                                                                                                                                                                                                           |

Omitting the number register format causes a warning of type 'missing'. See [Section 5.34 \[Debugging\], page 154](#), for more details. Specifying a nonexistent format causes an error.

The following example produces '10, X, j, 010':

```
.nr a 10
.af a 1 \" the default format
\na,
.af a I
\na,
.af a a
\na,
.af a 001
\na
```

The largest number representable for the ‘i’ and ‘I’ formats is 39999 (or –39999); UNIX `troff` uses ‘z’ and ‘w’ to represent 10000 and 5000 in Roman numerals, and so does `gtroff`. Currently, the correct glyphs of Roman numeral five thousand and Roman numeral ten thousand (Unicode code points U+2182 and U+2181, respectively) are not available.

If *ident* doesn’t exist, it is created.

Changing the output format of a read-only register causes an error. It is necessary to first copy the register’s value to a writeable register, then apply the `af` request to this other register.

|                        |        |
|------------------------|--------|
| <code>\gi</code>       | Escape |
| <code>\g(id</code>     | Escape |
| <code>\g[ident]</code> | Escape |

Return the current format of the specified register *ident* (one-character name *i*, two-character name *id*). For example, ‘\ga’ after the previous example would produce the string ‘000’. If the register hasn’t been defined yet, nothing is returned.

### 5.7.5 Built-in Registers

The following lists some built-in registers which are not described elsewhere in this manual. Any register which begins with a ‘.’ is read-only. A complete listing of all built-in registers can be found in appendix E [Register Index], page 205.

|                      |                                                                                                                                                                        |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>.F</code>      | This string-valued register returns the current input file name.                                                                                                       |
| <code>.H</code>      | Horizontal resolution in basic units.                                                                                                                                  |
| <code>.V</code>      | Vertical resolution in basic units.                                                                                                                                    |
| <code>seconds</code> | The number of seconds after the minute, normally in the range 0 to 59, but can be up to 61 to allow for leap seconds. Initialized at start-up of <code>gtroff</code> . |
| <code>minutes</code> | The number of minutes after the hour, in the range 0 to 59. Initialized at start-up of <code>gtroff</code> .                                                           |
| <code>hours</code>   | The number of hours past midnight, in the range 0 to 23. Initialized at start-up of <code>gtroff</code> .                                                              |

- `dw` Day of the week (1-7).
- `dy` Day of the month (1-31).
- `mo` Current month (1-12).
- `year` The current year.
- `yr` The current year minus 1900. Unfortunately, the documentation of UNIX Version 7's `troff` had a year 2000 bug: It incorrectly claimed that `yr` contains the last two digits of the year. That claim has never been true of either AT&T `troff` or GNU `troff`. Old `troff` input that looks like this:
- ```
'\" The following line stopped working after 1999
This document was formatted in 19\n(yr.
```
- can be corrected as follows:
- ```
This document was formatted in \n[year].
```
- or, to be portable to older `troff` versions, as follows:
- ```
.nr y4 1900+\n(yr
This document was formatted in \n(y4.
```
- `.c` The current *input* line number. Register `‘.c’` is read-only, whereas `‘c.’` (a `gtroff` extension) is writable also, affecting both `‘.c’` and `‘c.’`.
- `ln` The current *output* line number after a call to the `nm` request to activate line numbering.
See [Section 5.32 \[Miscellaneous\]](#), page 150, for more information about line numbering.
- `.x` The major version number. For example, if the version number is 1.03 then `.x` contains `‘1’`.
- `.y` The minor version number. For example, if the version number is 1.03 then `.y` contains `‘03’`.
- `.Y` The revision number of `groff`.
- `$$` The process ID of `gtroff`.
- `.g` Always 1. Macros should use this to determine whether they are running under GNU `troff`.
- `.A` If the command line option `‘-a’` is used to produce an ASCII approximation of the output, this is set to 1, zero otherwise. See [Section 2.1 \[Groff Options\]](#), page 7.
- `.P` This register is set to 1 (and to 0 otherwise) if the current page is actually being printed, i.e., if the `‘-o’` option is being used to only print selected pages. See [Section 2.1 \[Groff Options\]](#), page 7, for more information.

- .T** If `gtroff` is called with the ‘-T’ command line option, the number register `.T` is set to 1, and zero otherwise. See [Section 2.1 \[Groff Options\]](#), page 7.
- Additionally, `gtroff` predefines a single read-write string register `.T` which contains the current output device (for example, ‘latin1’ or ‘ps’).

5.8 Manipulating Filling and Adjusting

Various ways of causing *breaks* were given in [Section 5.1.5 \[Implicit Line Breaks\]](#), page 50. The `br` request likewise causes a break. Several other requests also cause breaks, but implicitly. These are `bp`, `ce`, `cf`, `fi`, `fl`, `in`, `nf`, `rj`, `sp`, `ti`, and `trf`.

- .br** Request
 Break the current line, i.e., the input collected so far is emitted without adjustment.
- If the no-break control character is used, `gtroff` suppresses the break:
- ```

a
'br
b
⇒ a b
```

Initially, `gtroff` fills and adjusts text to both margins. Filling can be disabled via the `nf` request and re-enabled with the `fi` request.

- .fi** Request  
`\n[.u]` Register
- Activate fill mode (which is the default). This request implicitly enables adjusting; it also inserts a break in the text currently being filled. The read-only number register `.u` is set to 1.
- The fill mode status is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).
- See [Section 5.15 \[Line Control\]](#), page 90, for interaction with the `\c` escape.

- .nf** Request
- Activate no-fill mode. Input lines are output as-is, retaining line breaks and ignoring the current line length. This command implicitly disables adjusting; it also causes a break. The number register `.u` is set to 0.
- The fill mode status is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).
- See [Section 5.15 \[Line Control\]](#), page 90, for interaction with the `\c` escape.

`.ad [mode]` Request  
`\n[.j]` Register

Set adjusting mode.

Activation and deactivation of adjusting is done implicitly with calls to the `fi` or `nf` requests.

`mode` can have one of the following values:

`l` Adjust text to the left margin. This produces what is traditionally called ragged-right text.

`r` Adjust text to the right margin, producing ragged-left text.

`c` Center filled text. This is different to the `ce` request which only centers text without filling.

`b`

`n` Justify to both margins. This is the default used by `gtroff`.

With no argument, `gtroff` adjusts lines in the same way it did before adjusting was deactivated (with a call to `na`, for example).

```
text
.ad r
text
.ad c
text
.na
text
.ad \" back to centering
text
```

The current adjustment mode is available in the read-only number register `.j`; it can be stored and subsequently used to set adjustment.

The adjustment mode status is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

`.na` Request

Disable adjusting. This request won't change the current adjustment mode: A subsequent call to `ad` uses the previous adjustment setting.

The adjustment mode status is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

`.brp` Request  
`\p` Escape

Adjust the current line and cause a break.

In most cases this produces very ugly results since `gtroff` doesn't have a sophisticated paragraph building algorithm (as `TEX` have, for example); instead, `gtroff` fills and adjusts a paragraph line by line:

```

This is an uninteresting sentence.
This is an uninteresting sentence.\p
This is an uninteresting sentence.

```

is formatted as

```

This is an uninteresting sentence. This is an
uninteresting sentence.
This is an uninteresting sentence.

```

|                       |                              |                                    |          |
|-----------------------|------------------------------|------------------------------------|----------|
| <code>.ss</code>      | <code>word_space_size</code> | <code>[sentence_space_size]</code> | Request  |
| <code>\n[.ss]</code>  |                              |                                    | Register |
| <code>\n[.sss]</code> |                              |                                    | Register |

Change the minimum size of a space between filled words. It takes its units as one twelfth of the space width parameter for the current font. Initially both the `word_space_size` and `sentence_space_size` are 12.

If two arguments are given to the `ss` request, the second argument sets the sentence space size. If the second argument is not given, sentence space size is set to `word_space_size`. The sentence space size is used in two circumstances: If the end of a sentence occurs at the end of a line in fill mode, then both an inter-word space and a sentence space are added; if two spaces follow the end of a sentence in the middle of a line, then the second space is a sentence space. If a second argument is never given to the `ss` request, the behaviour of UNIX `troff` is the same as that exhibited by GNU `troff`. In GNU `troff`, as in UNIX `troff`, a sentence should always be followed by either a newline or two spaces.

The read-only number registers `.ss` and `.sss` hold the values of the parameters set by the first and second arguments of the `ss` request.

The word space and sentence space values are associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

Contrary to AT&T `troff`, this request is *not* ignored if a TTY output device is used; the given values are then rounded down to a multiple of 12 (see [Section 5.35 \[Implementation Differences\]](#), page 159).

The request is ignored if there is no parameter.

|                      |                    |          |
|----------------------|--------------------|----------|
| <code>.ce</code>     | <code>[nnn]</code> | Request  |
| <code>\n[.ce]</code> |                    | Register |

Center text. While the `.ad c` request also centers text, it fills the text as well. `ce` does not fill the text it affects. This request causes a break. The number of lines still to be centered is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

The following example demonstrates the differences. Here the input:

```
.ll 4i
.ce 1000
This is a small text fragment which shows the differences
between the '.ce' and the '.ad c' request.
.ce 0

.ad c
This is a small text fragment which shows the differences
between the '.ce' and the '.ad c' request.
```

And here the result:

```
 This is a small text fragment which
 shows the differences
between the '.ce' and the '.ad c' request.
```

```
 This is a small text fragment which
shows the differences between the '.ce'
 and the '.ad c' request.
```

With no arguments, `ce` centers the next line of text. `nnn` specifies the number of lines to be centered. If the argument is zero or negative, centering is disabled.

The basic length for centering text is the line length (as set with the `ll` request) minus the indentation (as set with the `in` request). Temporary indentation is ignored.

As can be seen in the previous example, it is a common idiom to turn on centering for a large number of lines, and to turn off centering after text to be centered. This is useful for any request which takes a number of lines as an argument.

The `.ce` read-only number register contains the number of lines remaining to be centered, as set by the `ce` request.

```
.rj [nnn] Request
\n[.rj] Register
```

Justify unfilled text to the right margin. Arguments are identical to the `ce` request. The `.rj` read-only number register is the number of lines to be right-justified as set by the `rj` request. This request causes a break. The number of lines still to be right-justified is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

## 5.9 Manipulating Hyphenation

As discussed in [Section 5.1.2 \[Hyphenation\]](#), page 49, `gtroff` hyphenates words. There are a number of ways to influence hyphenation.

`.hy [mode]` Request  
`\n[.hy]` Register

Enable hyphenation. The request has an optional numeric argument, *mode*, to restrict hyphenation if necessary:

- |   |                                                                                                                                          |
|---|------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | The default argument if <i>mode</i> is omitted. Hyphenate without restrictions. This is also the start-up value of <code>gtroff</code> . |
| 2 | Do not hyphenate the last word on a page or column.                                                                                      |
| 4 | Do not hyphenate the last two characters of a word.                                                                                      |
| 8 | Do not hyphenate the first two characters of a word.                                                                                     |

Values in the previous table are additive. For example, the value 12 causes `gtroff` to neither hyphenate the last two nor the first two characters of a word.

The current hyphenation restrictions can be found in the read-only number register `‘.hy’`.

The hyphenation mode is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

`.nh` Request

Disable hyphenation (i.e., set the hyphenation mode to zero). Note that the hyphenation mode of the last call to `hy` is not remembered.

The hyphenation mode is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

`.hlm [nnn]` Request  
`\n[.hlm]` Register  
`\n[.hlc]` Register

Set the maximum number of consecutive hyphenated lines to *nnn*. If this number is negative, there is no maximum. The default value is `-1` if *nnn* is omitted. This value is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141). Only lines output from a given environment count towards the maximum associated with that environment. Hyphens resulting from `\%` are counted; explicit hyphens are not.

The current setting of `hlm` is available in the `.hlm` read-only number register. Also the number of immediately preceding consecutive hyphenated lines are available in the read-only number register `‘.hlc’`.

`.hw word1 word2 . . .` Request

Define how *word1*, *word2*, etc. are to be hyphenated. The words must be given with hyphens at the hyphenation points. For example:

```
.hw in-sa-lub-rious
```

Besides the space character, any character whose hyphenation code value is zero can be used to separate the arguments of `hw` (see the documentation

for the `hcode` request below for more information). In addition, this request can be used more than once.

Hyphenation exceptions specified with the `hw` request are associated with the current hyphenation language; it causes an error if there is no current hyphenation language.

This request is ignored if there is no parameter.

In old versions of `troff` there was a limited amount of space to store such information; fortunately, with `gtroff`, this is no longer a restriction.

|                 |        |
|-----------------|--------|
| <code>\%</code> | Escape |
| <code>\:</code> | Escape |

To tell `gtroff` how to hyphenate words on the fly, use the `\%` escape, also known as the *hyphenation character*. Preceding a word with this character prevents it from being hyphenated; putting it inside a word indicates to `gtroff` that the word may be hyphenated at that point. Note that this mechanism only affects that one occurrence of the word; to change the hyphenation of a word for the entire document, use the `hw` request.

The `\:` escape inserts a zero-width break point (that is, the word breaks but without adding a hyphen).

```
... check the /var/log/\:httpd/\:access_log file ...
```

Note that `\X` and `\Y` start a word, that is, the `\%` escape in (say) `'\X'...' \%foobar'` and `'\Y'...' \%foobar'` no longer prevents hyphenation but inserts a hyphenation point at the beginning of `'foobar'`; most likely this isn't what you want to do.

|                         |         |
|-------------------------|---------|
| <code>.hc [char]</code> | Request |
|-------------------------|---------|

Change the hyphenation character to *char*. This character then works the same as the `\%` escape, and thus, no longer appears in the output. Without an argument, `hc` resets the hyphenation character to be `\%` (the default) only.

The hyphenation character is associated with the current environment (see Section 5.27 [Environments], page 141).

|                                |         |
|--------------------------------|---------|
| <code>.hpf pattern_file</code> | Request |
|--------------------------------|---------|

|                                 |         |
|---------------------------------|---------|
| <code>.hpfa pattern_file</code> | Request |
|---------------------------------|---------|

|                                     |         |
|-------------------------------------|---------|
| <code>.hpfcode a b [c d ...]</code> | Request |
|-------------------------------------|---------|

Read in a file of hyphenation patterns. This file is searched for in the same way as `'name.tmac'` (or `'tmac.name'`) is searched for if the `'-mname'` option is specified.

It should have the same format as (simple)  $\text{T}_{\text{E}}\text{X}$  patterns files. More specifically, the following scanning rules are implemented.

- A percent sign starts a comment (up to the end of the line) even if preceded by a backslash.

- No support for ‘digraphs’ like `\$`.
- `^^xx` ( $x$  is 0-9 or a-f) and `^^x` (character code of  $x$  in the range 0-127) are recognized; other use of `^` causes an error.
- No macro expansion.
- `hpf` checks for the expression `\patterns{...}` (possibly with white-space before and after the braces). Everything between the braces is taken as hyphenation patterns. Consequently, `{` and `}` are not allowed in patterns.
- Similarly, `\hyphenation{...}` gives a list of hyphenation exceptions.
- `\endinput` is recognized also.
- For backwards compatibility, if `\patterns` is missing, the whole file is treated as a list of hyphenation patterns (only recognizing the `%` character as the start of a comment).

If no `hpf` request is specified (either in the document or in a macro package), `gtroff` won’t hyphenate at all.

The `hpfa` request appends a file of patterns to the current list.

The `hpfcode` request defines mapping values for character codes in hyphenation patterns. `hpf` or `hpfa` then apply the mapping (after reading the patterns) before replacing or appending them to the current list of patterns. Its arguments are pairs of character codes – integers from 0 to 255. The request maps character code  $a$  to code  $b$ , code  $c$  to code  $d$ , and so on. You can use character codes which would be invalid otherwise.

The set of hyphenation patterns is associated with the current language set by the `hla` request. The `hpf` request is usually invoked by the ‘`troffrc`’ or ‘`troffrc-end`’ file; by default, ‘`troffrc`’ loads hyphenation patterns for American English (in file ‘`hyphen.us`’).

A second call to `hpf` (for the same language) will replace the hyphenation patterns with the new ones.

Invoking `hpf` causes an error if there is no current hyphenation language.

`.hcode c1 code1 c2 code2 ...` Request

Set the hyphenation code of character  $c1$  to  $code1$ , that of  $c2$  to  $code2$ , etc. A hyphenation code must be a single input character (not a special character) other than a digit or a space. Initially each lower-case letter (‘`a`’-‘`z`’) has its hyphenation code set to itself, and each upper-case letter (‘`A`’-‘`Z`’) has a hyphenation code which is the lower-case version of itself.

This request is ignored if it has no parameter.

`.hym [length]` Request  
`\n[.hym]` Register

Set the (right) hyphenation margin to  $length$ . If the current adjustment mode is not ‘`b`’ or ‘`n`’, the line is not hyphenated if it is shorter than  $length$ . Without an argument, the hyphenation margin is reset to its

default value, which is 0. The default scaling indicator for this request is ‘m’. The hyphenation margin is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

A negative argument resets the hyphenation margin to zero, emitting a warning of type ‘range’.

The current hyphenation margin is available in the `.hym` read-only number register.

`.hys` [*hyphenation\_space*] Request  
`\n[.hys]` Register

Set the hyphenation space to *hyphenation\_space*. If the current adjustment mode is ‘b’ or ‘n’, don’t hyphenate the line if it can be justified by adding no more than *hyphenation\_space* extra space to each word space. Without argument, the hyphenation space is set to its default value, which is 0. The default scaling indicator for this request is ‘m’. The hyphenation space is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

A negative argument resets the hyphenation space to zero, emitting a warning of type ‘range’.

The current hyphenation space is available in the `.hys` read-only number register.

`.shc` [*glyph*] Request

Set the *soft hyphen character* to *glyph*.<sup>5</sup> If the argument is omitted, the soft hyphen character is set to the default glyph `\(hy` (this is the start-up value of `gtroff` also). The soft hyphen character is the glyph that is inserted when a word is hyphenated at a line break. If the soft hyphen character does not exist in the font of the character immediately preceding a potential break point, then the line is not broken at that point. Neither definitions (specified with the `char` request) nor translations (specified with the `tr` request) are considered when finding the soft hyphen character.

`.hla` *language* Request  
`\n[.hla]` Register

Set the current hyphenation language to the string *language*. Hyphenation exceptions specified with the `hw` request and hyphenation patterns specified with the `hpf` and `hpfa` requests are both associated with the current hyphenation language. The `hla` request is usually invoked by the ‘`troffrc`’ or the ‘`troffrc-end`’ files; ‘`troffrc`’ sets the default language to ‘us’.

The current hyphenation language is available as a string in the read-only number register ‘.hla’.

---

<sup>5</sup> *Soft hyphen character* is a misnomer since it is an output glyph.

```
.ds curr_language \n[.hla]
*[curr_language]
⇒ us
```

## 5.10 Manipulating Spacing

**.sp** [*distance*] Request  
 Space downwards *distance*. With no argument it advances 1 line. A negative argument causes **gtroff** to move up the page the specified distance. If the argument is preceded by a ‘|’ then **gtroff** moves that distance from the top of the page. This request causes a line break. The default scaling indicator is ‘v’.

**.ls** [*nnn*] Request  
**\n**[.L] Register  
 Output *nnn*−1 blank lines after each line of text. With no argument, **gtroff** uses the previous value before the last **ls** call.

```
.ls 2 \" This causes double-spaced output
.ls 3 \" This causes triple-spaced output
.ls \" Again double-spaced
```

The line spacing is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

The read-only number register **.L** contains the current line spacing setting.

See [Section 5.19.1 \[Changing Type Sizes\]](#), page 109, for the requests **vs** and **pvs** as alternatives to **ls**.

**\x**’*spacing*’ Escape  
**\n**[.a] Register

Sometimes, extra vertical spacing is only needed occasionally, e.g. to allow space for a tall construct (like an equation). The **\x** escape does this. The escape is given a numerical argument, usually enclosed in quotes (like ‘**\x**’3p’); the default scaling indicator is ‘v’. If this number is positive extra vertical space is inserted below the current line. A negative number adds space above. If this escape is used multiple times on the same line, the maximum of the values is used.

See [Section 5.6.3 \[Escapes\]](#), page 58, for details on parameter delimiting characters.

The **.a** read-only number register contains the most recent (nonnegative) extra vertical line space.

Using **\x** can be necessary in combination with the **\b** escape, as the following example shows.

```

This is a test with the \[rs]b escape.
.br
This is a test with the \[rs]b escape.
.br
This is a test with \b'xyz'\x'-1m'\x'1m'.
.br
This is a test with the \[rs]b escape.
.br
This is a test with the \[rs]b escape.

```

produces

```

This is a test with the \b escape.
This is a test with the \b escape.
 x
This is a test with y.
 z
This is a test with the \b escape.
This is a test with the \b escape.

```

|                      |          |
|----------------------|----------|
| <code>.ns</code>     | Request  |
| <code>.rs</code>     | Request  |
| <code>\n[.ns]</code> | Register |

Enable *no-space mode*. In this mode, spacing (either via `sp` or via blank lines) is disabled. The `bp` request to advance to the next page is also disabled, except if it is accompanied by a page number (see [Section 5.17 \[Page Control\]](#), page 93, for more information). This mode ends when actual text is output or the `rs` request is encountered which ends no-space mode. The read-only number register `.ns` is set to 1 as long as no-space mode is active.

This request is useful for macros that conditionally insert vertical space before the text starts (for example, a paragraph macro could insert some space except when it is the first paragraph after a section header).

## 5.11 Tabs and Fields

A tab character (ASCII char 9, EBCDIC char 5) causes a horizontal movement to the next tab stop (much like it did on a typewriter).

|                 |        |
|-----------------|--------|
| <code>\t</code> | Escape |
|-----------------|--------|

This escape is a non-interpreted tab character. In copy mode (see [Section 5.22.1 \[Copy-in Mode\]](#), page 123), `\t` is the same as a real tab character.

`.ta [n1 n2 ... nn T r1 r2 ... rn]` Request Register  
`\n[.tabs]`

Change tab stop positions. This request takes a series of tab specifiers as arguments (optionally divided into two groups with the letter ‘T’) which indicate where each tab stop is to be (overriding any previous settings).

Tab stops can be specified absolutely, i.e., as the distance from the left margin. For example, the following sets 6 tab stops every one inch.

```
.ta 1i 2i 3i 4i 5i 6i
```

Tab stops can also be specified using a leading ‘+’ which means that the specified tab stop is set relative to the previous tab stop. For example, the following is equivalent to the previous example.

```
.ta 1i +1i +1i +1i +1i +1i
```

`gtroff` supports an extended syntax to specify repeat values after the ‘T’ mark (these values are always taken as relative) – this is the usual way to specify tabs set at equal intervals. The following is, yet again, the same as the previous examples. It does even more since it defines an infinite number of tab stops separated by one inch.

```
.ta T 1i
```

Now we are ready to interpret the full syntax given at the beginning: Set tabs at positions  $n1$ ,  $n2$ , ...,  $nn$  and then set tabs at  $nn+r1$ ,  $nn+r2$ , ...,  $nn+rn$  and then at  $nn+rn+r1$ ,  $nn+rn+r2$ , ...,  $nn+rn+rn$ , and so on.

Example: ‘4c +6c T 3c 5c 2c’ is equivalent to ‘4c 10c 13c 18c 20c 23c 28c 30c ...’.

The material in each tab column (i.e., the column between two tab stops) may be justified to the right or left or centered in the column. This is specified by appending ‘R’, ‘L’, or ‘C’ to the tab specifier. The default justification is ‘L’. Example:

```
.ta 1i 2iC 3iR
```

Some notes:

- The default unit of the `ta` request is ‘m’.
- A tab stop is converted into a non-breakable horizontal movement which can be neither stretched nor squeezed. For example,

```
.ds foo a\tb\tc
.ta T 5i
\[foo]
```

creates a single line which is a bit longer than 10 inches (a string is used to show exactly where the tab characters are). Now consider the following:

```
.ds bar a\tb b\tc
.ta T 5i
\[bar]
```

`gtroff` first converts the tab stops of the line into unbreakable horizontal movements, then splits the line after the second ‘b’ (assuming a sufficiently short line length). Usually, this isn’t what the user wants.

- Superfluous tabs (i.e., tab characters which do not correspond to a tab stop) are ignored except the first one which delimits the characters belonging to the last tab stop for right-justifying or centering. Consider the following example

```
.ds Z foo\tbar\tfoo
.ds ZZ foo\tbar\tfoobar
.ds ZZZ foo\tbar\tfoo\tbar
.ta 2i 4iR
\[Z]
.br
\[ZZ]
.br
\[ZZZ]
.br
```

which produces the following output:

```
foo bar foo
foo bar foobar
foo bar foobar
```

The first line right-justifies the second ‘foo’ relative to the tab stop. The second line right-justifies ‘foobar’. The third line finally right-justifies only ‘foo’ because of the additional tab character which marks the end of the string belonging to the last defined tab stop.

- Tab stops are associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).
- Calling `ta` without an argument removes all tab stops.
- The start-up value of `gtroff` is ‘T 0.5i’ in troff mode and ‘T 0.8i’ in nroff mode (the latter is done with an explicit call to the `ta` request in the file ‘`tty.tmac`’).

The read-only number register `.tabs` contains a string representation of the current tab settings suitable for use as an argument to the `ta` request.

```
.ds tab-string \n[.tabs]
\[tab-string]
⇒ T120u
```

The troff version of the Plan 9 operating system uses register `.S` for the same purpose.

- `.tc` [*fill-glyph*] Request  
Normally `gtroff` fills the space to the next tab stop with whitespace. This can be changed with the `tc` request. With no argument `gtroff` reverts

to using whitespace, which is the default. The value of this *tab repetition character* is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).<sup>6</sup>

`.linetabs n` Request  
`\n[.linetabs]` Register

If *n* is missing or not zero, enable *line-tabs* mode, or disable it otherwise (the default). In line-tabs mode, `gtroff` computes tab distances relative to the (current) output line instead of the input line.

For example, the following code:

```
.ds x a\t\c
.ds y b\t\c
.ds z c
.ta 1i 3i
*x
*y
*z
```

in normal mode, results in the output

```
a b c
```

in line-tabs mode, the same code outputs

```
a b c
```

Line-tabs mode is associated with the current environment. The read-only register `.linetabs` is set to 1 if in line-tabs mode, and 0 in normal mode.

### 5.11.1 Leaders

Sometimes it may be desirable to use the `tc` request to fill a particular tab stop with a given glyph (for example dots in a table of contents), but also normal tab stops on the rest of the line. For this `gtroff` provides an alternate tab mechanism, called *leaders* which does just that.

A leader character (character code 1) behaves similarly to a tab character: It moves to the next tab stop. The only difference is that for this movement, the fill glyph defaults to a period character and not to space.

`\a` Escape  
 This escape is a non-interpreted leader character. In copy mode (see [Section 5.22.1 \[Copy-in Mode\]](#), page 123), `\a` is the same as a real leader character.

---

<sup>6</sup> *Tab repetition character* is a misnomer since it is an output glyph.

`.lc` [*fill-glyph*] Request  
 Declare the *leader repetition character*.<sup>7</sup> Without an argument, leaders act the same as tabs (i.e., using whitespace for filling). `gtroff`'s start-up value is a dot (‘.’). The value of the leader repetition character is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

For a table of contents, to name an example, tab stops may be defined so that the section number is one tab stop, the title is the second with the remaining space being filled with a line of dots, and then the page number slightly separated from the dots.

```
.ds entry 1.1\tFoo\a\t12
.lc .
.ta 1i 5i +.25i
*[entry]
```

This produces

```
1.1 Foo..... 12
```

## 5.11.2 Fields

*Fields* are a more general way of laying out tabular data. A field is defined as the data between a pair of *delimiting characters*. It contains substrings which are separated by *padding characters*. The width of a field is the distance on the *input* line from the position where the field starts to the next tab stop. A padding character inserts stretchable space similar to `TeX`'s `\hss` command (thus it can even be negative) to make the sum of all substring lengths plus the stretchable space equal to the field width. If more than one padding character is inserted, the available space is evenly distributed among them.

`.fc` [*delim-char* [*padding-char*]] Request  
 Define a delimiting and a padding character for fields. If the latter is missing, the padding character defaults to a space character. If there is no argument at all, the field mechanism is disabled (which is the default). Note that contrary to e.g. the tab repetition character, delimiting and padding characters are *not* associated to the current environment (see [Section 5.27 \[Environments\]](#), page 141).

Example:

```
.fc # ^
.ta T 3i
#foo^bar^smurf#
.br
#foo^^bar^smurf#
```

---

<sup>7</sup> *Leader repetition character* is a misnomer since it is an output glyph.

and here the result:

```
foo bar smurf
foo bar smurf
```

## 5.12 Character Translations

The control character (‘.’) and the no-break control character (‘’’) can be changed with the `cc` and `c2` requests, respectively.

`.cc [c]` Request  
 Set the control character to *c*. With no argument the default control character ‘.’ is restored. The value of the control character is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

`.c2 [c]` Request  
 Set the no-break control character to *c*. With no argument the default control character ‘’ is restored. The value of the no-break control character is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

`.eo` Request  
 Disable the escape mechanism completely. After executing this request, the backslash character ‘\’ no longer starts an escape sequence. This request can be very helpful in writing macros since it is not necessary then to double the escape character. Here an example:

```
.\ " This is a simplified version of the
.\ " .BR request from the man macro package
.eo
.de BR
. ds result \&
. while (\n[.$] >= 2) \{\
. as result \fB\${1}\fR\${2}
. shift 2
. \}
. if \n[.$] .as result \fB\${1}
*[result]
. ft R
..
.ec
```

`.ec [c]` Request  
 Set the escape character to *c*. With no argument the default escape character ‘\’ is restored. It can be also used to re-enable the escape mechanism after an `eo` request.

Note that changing the escape character globally will likely break macro packages since `gtroff` has no mechanism to ‘intern’ macros, i.e., to convert a macro definition into an internal form which is independent of its representation (`TEX` has this mechanism). If a macro is called, it is executed literally.

`.ecs` Request  
`.ecr` Request

The `ecs` request saves the current escape character in an internal register. Use this request in combination with the `ec` request to temporarily change the escape character.

The `ecr` request restores the escape character saved with `ecs`. Without a previous call to `ecs`, this request sets the escape character to `\`.

`\\` Escape  
`\e` Escape  
`\E` Escape

Print the current escape character (which is the backslash character ‘`\`’ by default).

`\\` is a ‘delayed’ backslash; more precisely, it is the default escape character followed by a backslash, which no longer has special meaning due to the leading escape character. It is *not* an escape sequence in the usual sense! In any unknown escape sequence `\X` the escape character is ignored and `X` is printed. But if `X` is equal to the current escape character, no warning is emitted.

As a consequence, only at top-level or in a diversion a backslash glyph is printed; in copy-in mode, it expands to a single backslash which then combines with the following character to an escape sequence.

The `\E` escape differs from `\e` by printing an escape character that is not interpreted in copy mode. Use this to define strings with escapes that work when used in copy mode (for example, as a macro argument). The following example defines strings to begin and end a superscript:

```
.ds { \v'-.3m'\s'\Es[.s]*60/100'
.ds } \s0\v'.3m'
```

Another example to demonstrate the differences between the various escape sequences, using a strange escape character, ‘-’.

```
.ec -
.de xxx
--A'123'
..
.xxx
⇒ -A'foo'
```

The result is surprising for most users, expecting ‘1’ since ‘foo’ is a valid identifier. What has happened? As mentioned above, the leading escape

character makes the following character ordinary. Written with the default escape character the sequence ‘--’ becomes ‘\-' – this is the minus sign.

If the escape character followed by itself is a valid escape sequence, only \E yields the expected result:

```
.ec -
.de xxx
-EA'123'
..
.xxx
⇒ 1
```

\. Escape  
 Similar to \\, the sequence \. isn't a real escape sequence. As before, a warning message is suppressed if the escape character is followed by a dot, and the dot itself is printed.

```
.de foo
. nop foo
.
. de bar
. nop bar
\\.
.
..
.foo
.bar
⇒ foo bar
```

The first backslash is consumed while the macro is read, and the second is swallowed while executing macro `foo`.

A *translation* is a mapping of an input character to an output glyph. The mapping occurs at output time, i.e., the input character gets assigned the metric information of the mapped output character right before input tokens are converted to nodes (see [Section 5.33 \[Gtroff Internals\]](#), page 152, for more on this process).

```
.tr abcd... Request
.trin abcd... Request
```

Translate character *a* to glyph *b*, character *c* to glyph *d*, etc. If there is an odd number of arguments, the last one is translated to an unstretchable space (‘\ ’).

The `trin` request is identical to `tr`, but when you unformat a diversion with `asciify` it ignores the translation. See [Section 5.26 \[Diversions\]](#), page 137, for details about the `asciify` request.

Some notes:

- Special characters (`\(xx`, `\[xxx]`, `\C'xxx'`, `\'`, `\'`, `\-`, `\_`), glyphs defined with the `char` request, and numbered glyphs (`\N'xxx'`) can be translated also.
- The `\e` escape can be translated also.
- Characters can be mapped onto the `\%` and `\~` escapes (but `\%` and `\~` can't be mapped onto another glyph).
- The following characters can't be translated: space (with one exception, see below), backspace, newline, leader (and `\a`), tab (and `\t`).
- Translations are not considered for finding the soft hyphen character set with the `shc` request.
- The pair `'c\&'` (this is an arbitrary character `c` followed by the zero width space character) maps this character to nothing.

```
.tr a\&
foo bar
⇒ foo br
```

It is even possible to map the space character to nothing:

```
.tr aa \&
foo bar
⇒ foobar
```

As shown in the example, the space character can't be the first character/glyph pair as an argument of `tr`. Additionally, it is not possible to map the space character to any other glyph; requests like `'tr aa x'` undo `'tr aa \&'` instead.

If justification is active, lines are justified in spite of the 'empty' space character (but there is no minimal distance, i.e. the space character, between words).

- After an output glyph has been constructed (this happens at the moment immediately before the glyph is appended to an output glyph list, either by direct output, in a macro, diversion, or string), it is no longer affected by `tr`.
- Translating character to glyphs where one of them or both are undefined is possible also; `tr` does not check whether the entities in its argument do exist.

See [Section 5.33 \[Gtroff Internals\]](#), page 152.

- `troff` no longer has a hard-coded dependency on Latin-1; all `charXXX` entities have been removed from the font description files. This has a notable consequence which shows up in warnings like `can't find character with input code XXX` if the `tr` request isn't handled properly.

Consider the following translation:

```
.tr éÉ
```

This maps input character `é` onto glyph `É`, which is identical to glyph `char201`. But this glyph intentionally doesn't exist! Instead, `\[char201]` is treated as an input character entity and is by default mapped onto `\['E]`, and `gtroff` doesn't handle translations of translations.

The right way to write the above translation is

```
.tr é\['E]
```

With other words, the first argument of `tr` should be an input character or entity, and the second one a glyph entity.

- Without an argument, the `tr` request is ignored.

`.trnt abcd...` Request

`trnt` is the same as the `tr` request except that the translations do not apply to text that is transparently throughput into a diversion with `\!`. See [Section 5.26 \[Diversions\], page 137](#), for more information.

For example,

```
.tr ab
.di x
\!.tm a
.di
.x
```

prints 'b' to the standard error stream; if `trnt` is used instead of `tr` it prints 'a'.

## 5.13 Troff and Nroff Mode

Originally, `nroff` and `troff` were two separate programs, the former for TTY output, the latter for everything else. With GNU `troff`, both programs are merged into one executable, sending its output to a device driver (`grotty` for TTY devices, `grops` for POSTSCRIPT, etc.) which interprets the intermediate output of `gtroff`. For UNIX `troff` it makes sense to talk about *Nroff mode* and *Troff mode* since the differences are hardcoded. For GNU `troff`, this distinction is not appropriate because `gtroff` simply takes the information given in the font files for a particular device without handling requests specially if a TTY output device is used.

Usually, a macro package can be used with all output devices. Nevertheless, it is sometimes necessary to make a distinction between TTY and non-TTY devices: `gtroff` provides two built-in conditions 'n' and 't' for the `if`, `ie`, and `while` requests to decide whether `gtroff` shall behave like `nroff` or like `troff`.

`.troff` Request

Make the 't' built-in condition true (and the 'n' built-in condition false) for `if`, `ie`, and `while` conditional requests. This is the default if `gtroff`

(*not* `groff`) is started with the `-R` switch to avoid loading of the start-up files `troffrc` and `troffrc-end`. Without `-R`, `gtroff` stays in troff mode if the output device is not a TTY (e.g. `ps`).

### `.nroff`

Request

Make the `'n'` built-in condition true (and the `'t'` built-in condition false) for `if`, `ie`, and `while` conditional requests. This is the default if `gtroff` uses a TTY output device; the code for switching to `nroff` mode is in the file `tty.tmac` which is loaded by the start-up file `troffrc`.

See [Section 5.21 \[Conditionals and Loops\]](#), page 117, for more details on built-in conditions.

## 5.14 Line Layout

The following drawing shows the dimensions which `gtroff` uses for placing a line of output onto the page. They are labeled with the request which manipulates each dimension.

```

-->| in |<--
 |<-----ll----->|
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| : : : |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
-->| po |<--
 |<-----paper width----->|

```

These dimensions are:

- `po`      *Page offset* – this is the leftmost position of text on the final output, defining the *left margin*.
- `in`      *Indentation* – this is the distance from the left margin where text is printed.
- `ll`      *Line length* – this is the distance from the left margin to right margin.

A simple demonstration:

```

.ll 3i
This is text without indentation.
The line length has been set to 3~inch.
.in +.5i
.ll -.5i
Now the left and right margins are both increased.
.in
.ll
Calling .in and .ll without parameters restore
the previous values.

```

Result:

This is text without indentation. The line length has been set to 3 inch.

Now the left and right margins are both increased.

Calling `.in` and `.ll` without parameters restore the previous values.

|                           |          |
|---------------------------|----------|
| <code>.po [offset]</code> | Request  |
| <code>.po +offset</code>  | Request  |
| <code>.po -offset</code>  | Request  |
| <code>\n[.o]</code>       | Register |

Set horizontal page offset to *offset* (or increment or decrement the current value by *offset*). Note that this request does not cause a break, so changing the page offset in the middle of text being filled may not yield the expected result. The initial value is 1i. For TTY output devices, it is set to 0 in the startup file `'troffrc'`; the default scaling indicator is 'm' (and not 'v' as incorrectly documented in the original UNIX troff manual). The current page offset can be found in the read-only number register `'o'`.

If `po` is called without an argument, the page offset is reset to the previous value before the last call to `po`.

```
.po 3i
\n[.o]
⇒ 720
.po -1i
\n[.o]
⇒ 480
.po
\n[.o]
⇒ 720
```

|                           |          |
|---------------------------|----------|
| <code>.in [indent]</code> | Request  |
| <code>.in +indent</code>  | Request  |
| <code>.in -indent</code>  | Request  |
| <code>\n[.i]</code>       | Register |

Set indentation to *indent* (or increment or decrement the current value by *indent*). This request causes a break. Initially, there is no indentation.

If `in` is called without an argument, the indentation is reset to the previous value before the last call to `in`. The default scaling indicator is 'm'.

The indentation is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

If a negative indentation value is specified (which is not allowed), `gtroff` emits a warning of type `'range'` and sets the indentation to zero.

The effect of `in` is delayed until a partially collected line (if it exists) is output. A temporary indent value is reset to zero also.

The current indentation (as set by `in`) can be found in the read-only number register `'.i'`.

|                          |          |
|--------------------------|----------|
| <code>.ti offset</code>  | Request  |
| <code>.ti +offset</code> | Request  |
| <code>.ti -offset</code> | Request  |
| <code>\n[.in]</code>     | Register |

Temporarily indent the next output line by *offset*. If an increment or decrement value is specified, adjust the temporary indentation relative to the value set by the `in` request.

This request causes a break; its value is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141). The default scaling indicator is `'m'`. A call of `ti` without an argument is ignored.

If the total indentation value is negative (which is not allowed), `gtroff` emits a warning of type `'range'` and sets the temporary indentation to zero. 'Total indentation' is either *offset* if specified as an absolute value, or the temporary plus normal indentation, if *offset* is given as a relative value.

The effect of `ti` is delayed until a partially collected line (if it exists) is output.

The read-only number register `.in` is the indentation that applies to the current output line.

The difference between `.i` and `.in` is that the latter takes into account whether a partially collected line still uses the old indentation value or a temporary indentation value is active.

|                           |          |
|---------------------------|----------|
| <code>.ll [length]</code> | Request  |
| <code>.ll +length</code>  | Request  |
| <code>.ll -length</code>  | Request  |
| <code>\n[.l]</code>       | Register |
| <code>\n[.ll]</code>      | Register |

Set the line length to *length* (or increment or decrement the current value by *length*). Initially, the line length is set to 6.5i. The effect of `ll` is delayed until a partially collected line (if it exists) is output. The default scaling indicator is `'m'`.

If `ll` is called without an argument, the line length is reset to the previous value before the last call to `ll`. If a negative line length is specified (which

is not allowed), `gtroff` emits a warning of type ‘`range`’ and sets the line length to zero.

The line length is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

The current line length (as set by `ll`) can be found in the read-only number register ‘`.l`’. The read-only number register `.ll` is the line length that applies to the current output line.

Similar to `.i` and `.in`, the difference between `.l` and `.ll` is that the latter takes into account whether a partially collected line still uses the old line length value.

## 5.15 Line Control

It is important to understand how `gtroff` handles input and output lines. Many escapes use positioning relative to the input line. For example, this

```
This is a \h'|1.2i'test.
```

```
This is a
 \h'|1.2i'test.
```

produces

```
This is a test.
```

```
This is a test.
```

The main usage of this feature is to define macros which act exactly at the place where called.

```
.\ " A simple macro to underline a word
.de underline
. nop \\$1\l'|0\[ul]'
..
```

In the above example, ‘`|0`’ specifies a negative distance from the current position (at the end of the just emitted argument `\$1`) back to the beginning of the input line. Thus, the ‘`\l`’ escape draws a line from right to left.

`gtroff` makes a difference between input and output line continuation; the latter is also called *interrupting* a line.

|                       |          |
|-----------------------|----------|
| <code>\(RET)</code>   | Escape   |
| <code>\c</code>       | Escape   |
| <code>\n[.int]</code> | Register |

Continue a line. `\(RET)` (this is a backslash at the end of a line immediately followed by a newline) works on the input level, suppressing the effects of the following newline in the input.

```
This is a \
.test
⇒ This is a .test
```

The ‘|’ operator is also affected.

`\c` works on the output level. Anything after this escape on the same line is ignored, except `\R` which works as usual. Anything before `\c` on the same line will be appended to the current partial output line. The next non-command line after an interrupted line counts as a new input line.

The visual results depend on whether no-fill mode is active.

- If no-fill mode is active (using the `nf` request), the next input text line after `\c` will be handled as a continuation of the same input text line.

```
.nf
This is a \
test.
⇒ This is a test.
```

- If fill mode is active (using the `fi` request), a word interrupted with `\c` will be continued with the text on the next input text line, without an intervening space.

```
This is a te\
st.
⇒ This is a test.
```

Note that an intervening control line which causes a break is stronger than `\c`, flushing out the current partial line in the usual way.

The `.int` register contains a positive value if the last output line was interrupted with `\c`; this is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

## 5.16 Page Layout

`gtroff` provides some very primitive operations for controlling page layout.

|                                    |          |
|------------------------------------|----------|
| <code>.pl</code> [ <i>length</i> ] | Request  |
| <code>.pl</code> + <i>length</i>   | Request  |
| <code>.pl</code> - <i>length</i>   | Request  |
| <code>\n</code> [.p]               | Register |

Set the *page length* to *length* (or increment or decrement the current value by *length*). This is the length of the physical output page. The default scaling indicator is ‘v’.

The current setting can be found in the read-only number register ‘.p’.

Note that this only specifies the size of the page, not the top and bottom margins. Those are not set by `gtroff` directly. See [Section 5.25 \[Traps\]](#), [page 133](#), for further information on how to do this.

Negative `pl` values are possible also, but not very useful: No trap is sprung, and each line is output on a single page (thus suppressing all vertical spacing).

If no argument or an invalid argument is given, `pl` sets the page length to 11 i.

`gtroff` provides several operations which help in setting up top and bottom titles (or headers and footers).

`.tl 'left'center'right'` Request

Print a *title line*. It consists of three parts: a left justified portion, a centered portion, and a right justified portion. The argument separator ‘`’`’ can be replaced with any character not occurring in the title line. The ‘`%`’ character is replaced with the current page number. This character can be changed with the `pc` request (see below).

Without argument, `tl` is ignored.

Some notes:

- A title line is not restricted to the top or bottom of a page.
- `tl` prints the title line immediately, ignoring a partially filled line (which stays untouched).
- It is not an error to omit closing delimiters. For example, ‘`.tl /foo`’ is equivalent to ‘`.tl /foo///`’: It prints a title line with the left justified word ‘`foo`’; the centered and right justified parts are empty.
- `tl` accepts the same parameter delimiting characters as the `\A` escape; see [Section 5.6.3 \[Escapes\]](#), [page 58](#).

`.lt [length]` Request  
`.lt +length` Request  
`.lt -length` Request  
`\n[.lt]` Register

The title line is printed using its own line length, which is specified (or incremented or decremented) with the `lt` request. Initially, the title line length is set to 6.5 i. If a negative line length is specified (which is not allowed), `gtroff` emits a warning of type ‘`range`’ and sets the title line length to zero. The default scaling indicator is ‘`m`’. If `lt` is called without an argument, the title length is reset to the previous value before the last call to `lt`.

The current setting of this is available in the `.lt` read-only number register; it is associated with the current environment (see [Section 5.27 \[Environments\]](#), [page 141](#)).

|                        |          |
|------------------------|----------|
| <code>.pn page</code>  | Request  |
| <code>.pn +page</code> | Request  |
| <code>.pn -page</code> | Request  |
| <code>\n[.pn]</code>   | Register |

Change (increase or decrease) the page number of the *next* page. The only argument is the page number; the request is ignored without a parameter.

The read-only number register `.pn` contains the number of the next page: either the value set by a `pn` request, or the number of the current page plus 1.

|                    |          |
|--------------------|----------|
| <code>\n[%]</code> | Register |
|--------------------|----------|

A read-write register holding the current page number.

|                         |         |
|-------------------------|---------|
| <code>.pc [char]</code> | Request |
|-------------------------|---------|

Change the page number character (used by the `tl` request) to a different character. With no argument, this mechanism is disabled. Note that this doesn't affect the number register `%`.

See [Section 5.25 \[Traps\]](#), page 133.

## 5.17 Page Control

|                         |         |
|-------------------------|---------|
| <code>.bp [page]</code> | Request |
| <code>.bp +page</code>  | Request |
| <code>.bp -page</code>  | Request |

Stop processing the current page and move to the next page. This request causes a break. It can also take an argument to set (increase, decrease) the page number of the next page. The only difference between `bp` and `pn` is that `pn` does not cause a break or actually eject a page.

```
.de newpage \" define macro
'bp \" begin page
'sp .5i \" vertical space
.tl 'left top'center top'right top' \" title
'sp .3i \" vertical space
.. \" end macro
```

`bp` has no effect if not called within the top-level diversion (see [Section 5.26 \[Diversions\]](#), page 137).

|                          |         |
|--------------------------|---------|
| <code>.ne [space]</code> | Request |
|--------------------------|---------|

It is often necessary to force a certain amount of space before a new page occurs. This is most useful to make sure that there is not a single *orphan* line left at the bottom of a page. The `ne` request ensures that there is a certain distance, specified by the first argument, before the next page is triggered (see [Section 5.25 \[Traps\]](#), page 133, for further information).

The default scaling indicator for `ne` is ‘v’; the default value of `space` is 1 v if no argument is given.

For example, to make sure that no fewer than 2 lines get orphaned, do the following before each paragraph:

```
.ne 2
text text text
```

`ne` will then automatically cause a page break if there is space for one line only.

`.sv` [*space*] Request  
`.os` Request

`sv` is similar to the `ne` request; it reserves the specified amount of vertical space. If the desired amount of space exists before the next trap (or the bottom page boundary if no trap is set), the space is output immediately (ignoring a partially filled line which stays untouched). If there is not enough space, it is stored for later output via the `os` request. The default value is 1 v if no argument is given; the default scaling indicator is ‘v’.

Both `sv` and `os` ignore no-space mode. While the `sv` request allows negative values for `space`, `os` will ignore them.

`\n`[*nl*] Register

This register contains the current vertical position. If the vertical position is zero and the top of page transition hasn’t happened yet, `nl` is set to negative value. `gtroff` itself does this at the very beginning of a document before anything has been printed, but the main usage is to plant a header trap on a page if this page has already started.

Consider the following:

```
.de xxx
. sp
. tl ’Header’
. sp
..
.
First page.
.bp
.wh 0 xxx
.nr nl (-1)
Second page.
```

Result:

First page.

...

Header

Second page.

...

Without resetting `nl` to a negative value, the just planted trap would be active beginning with the *next* page, not the current one.

See [Section 5.26 \[Diversions\]](#), page 137, for a comparison with the `.h` and `.d` registers.

## 5.18 Fonts

`gtroff` can switch fonts at any point in the text.

The basic set of fonts is ‘R’, ‘I’, ‘B’, and ‘BI’. These are Times Roman, Italic, Bold, and Bold Italic. For non-TTY devices, there is also at least one symbol font which contains various special symbols (Greek, mathematics).

### 5.18.1 Changing Fonts

|                                  |         |
|----------------------------------|---------|
| <code>.ft</code> [ <i>font</i> ] | Request |
| <code>\ff</code>                 | Escape  |
| <code>\f</code> ( <i>fn</i> )    | Escape  |
| <code>\f</code> [ <i>font</i> ]  | Escape  |

The `ft` request and the `\f` escape change the current font to *font* (one-character name *f*, two-character name *fn*).

If *font* is a style name (as set with the `sty` request or with the `styles` command in the ‘DESC’ file), use it within the current font family (as set with the `fam` request, `\F` escape, or with the `family` command in the ‘DESC’ file).

With no argument or using ‘P’ as an argument, `.ft` switches to the previous font. Use `\f[]` to do this with the escape. The old syntax forms `\fP` or `\f[P]` are also supported.

Fonts are generally specified as upper-case strings, which are usually 1 to 4 characters representing an abbreviation or acronym of the font name. This is no limitation, just a convention.

The example below produces two identical lines.

```
eggs, bacon,
.ft B
spam
.ft
and sausage.
```

```
eggs, bacon, \fBspam\fP and sausage.
```

Note that `\f` doesn't produce an input token in `gtroff`. As a consequence, it can be used in requests like `mc` (which expects a single character as an argument) to change the font on the fly:

```
.mc \f[I]x\f[]
```

See [Section 5.18.3 \[Font Positions\]](#), page 98, for an alternative syntax.

|                                                                                                                                                                                                                                                                                                                                                                                                                                  |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <code>.ftr f [g]</code>                                                                                                                                                                                                                                                                                                                                                                                                          | Request |
| Translate font <i>f</i> to font <i>g</i> . Whenever a font named <i>f</i> is referred to in a <code>\f</code> escape sequence, or in the <code>ft</code> , <code>ul</code> , <code>bd</code> , <code>cs</code> , <code>tkf</code> , <code>special</code> , <code>fspecial</code> , <code>fp</code> , or <code>sty</code> requests, font <i>g</i> is used. If <i>g</i> is missing or equal to <i>f</i> the translation is undone. |         |

## 5.18.2 Font Families

Due to the variety of fonts available, `gtroff` has added the concept of *font families* and *font styles*. The fonts are specified as the concatenation of the font family and style. Specifying a font without the family part causes `gtroff` to use that style of the current family.

Currently, fonts for the devices `'-Tps'`, `'-Tdvi'`, and `'-Tlbp'` are set up to this mechanism. By default, `gtroff` uses the Times family with the four styles `'R'`, `'I'`, `'B'`, and `'BI'`.

This way, it is possible to use the basic four fonts and to select a different font family on the command line (see [Section 2.1 \[Groff Options\]](#), page 7).

|                            |          |
|----------------------------|----------|
| <code>.fam [family]</code> | Request  |
| <code>\n[.fam]</code>      | Register |
| <code>\Ff</code>           | Escape   |
| <code>\F(fm)</code>        | Escape   |
| <code>\F[family]</code>    | Escape   |
| <code>\n[.fn]</code>       | Register |

Switch font family to *family* (one-character name *f*, two-character name *fm*). If no argument is given, switch back to the previous font family. Use `\F[]` to do this with the escape. Note that `\FP` doesn't work; it selects font family `'P'` instead.

The value at start-up is `'T'`. The current font family is available in the read-only number register `'fam'` (this is a string-valued register); it is associated with the current environment.

```

spam,
.fam H \" helvetica family
spam, \" used font is family H + style R = HR
.ft B \" family H + style B = font HB
spam,
.fam T \" times family
spam, \" used font is family T + style B = TB
.ft AR \" font AR (not a style)
baked beans,
.ft R \" family T + style R = font TR
and spam.

```

Note that `\F` doesn't produce an input token in `gtroff`. As a consequence, it can be used in requests like `mc` (which expects a single character as an argument) to change the font family on the fly:

```
.mc \F[P]x\F[]
```

The `.fn` register contains the current *real font name* of the current font. This is a string-valued register. If the current font is a style, the value of `\n[.fn]` is the proper concatenation of family and style name.

#### `.sty n style`

Request

Associate *style* with font position *n*. A font position can be associated either with a font or with a style. The current font is the index of a font position and so is also either a font or a style. If it is a style, the font that is actually used is the font which name is the concatenation of the name of the current family and the name of the current style. For example, if the current font is 1 and font position 1 is associated with style 'R' and the current font family is 'T', then font 'TR' will be used. If the current font is not a style, then the current family is ignored. If the requests `cs`, `bd`, `tkf`, `uf`, or `fspecial` are applied to a style, they will instead be applied to the member of the current family corresponding to that style. *n* must be a non-negative integer value.

The default family can be set with the `-f` option (see [Section 2.1 \[Groff Options\]](#), page 7). The `styles` command in the `'DESC'` file controls which font positions (if any) are initially associated with styles rather than fonts. For example, the default setting for POSTSCRIPT fonts

```
styles R I B BI
```

is equivalent to

```

.sty 1 R
.sty 2 I
.sty 3 B
.sty 4 BI

```

`fam` and `\F` always check whether the current font position is valid; this can give surprising results if the current font position is associated with a style.

In the following example, we want to access the POSTSCRIPT font FooBar from the font family Foo:

```
.sty \n[.fp] Bar
.fam Foo
⇒ warning: can't find font 'FooR'
```

The default font position at start-up is 1; for the POSTSCRIPT device, this is associated with style 'R', so `gtroff` tries to open FooR.

A solution to this problem is to use a dummy font like the following:

```
.fp 0 dummy TR \" set up dummy font at position 0
.sty \n[.fp] Bar \" register style 'Bar'
.ft 0 \" switch to font at position 0
.fam Foo \" activate family 'Foo'
.ft Bar \" switch to font 'FooBar'
```

See [Section 5.18.3 \[Font Positions\]](#), page 98.

### 5.18.3 Font Positions

For the sake of old phototypesetters and compatibility with old versions of `troff`, `gtroff` has the concept of font *positions*, on which various fonts are mounted.

|                      |                                       |          |
|----------------------|---------------------------------------|----------|
| <code>.fp</code>     | <code>pos font [external-name]</code> | Request  |
| <code>\n[.f]</code>  |                                       | Register |
| <code>\n[.fp]</code> |                                       | Register |

Mount font *font* at position *pos* (which must be a non-negative integer). This numeric position can then be referred to with font changing commands. When `gtroff` starts it is using font position 1 (which must exist; position 0 is unused usually at start-up).

The current font in use, as a font position, is available in the read-only number register '`.f`'. This can be useful to remember the current font for later recall. It is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

```
.nr save-font \n[.f]
.ft B
... text text text ...
.ft \n[save-font]
```

The number of the next free font position is available in the read-only number register '`.fp`'. This is useful when mounting a new font, like so:

```
.fp \n[.fp] NEATOFONT
```

Fonts not listed in the 'DESC' file are automatically mounted on the next available font position when they are referenced. If a font is to be mounted explicitly with the `fp` request on an unused font position, it should be mounted on the first unused font position, which can be found in the `.fp`

register. Although `gtroff` does not enforce this strictly, it is not allowed to mount a font at a position whose number is much greater (approx. 1000 positions) than that of any currently used position.

The `fp` request has an optional third argument. This argument gives the external name of the font, which is used for finding the font description file. The second argument gives the internal name of the font which is used to refer to the font in `gtroff` after it has been mounted. If there is no third argument then the internal name is used as the external name. This feature makes it possible to use fonts with long names in compatibility mode.

Both the `ft` request and the `\f` escape have alternative syntax forms to access font positions.

|                      |         |
|----------------------|---------|
| <code>.ft nnn</code> | Request |
| <code>\fn</code>     | Escape  |
| <code>\f(nn</code>   | Escape  |
| <code>\f[nnn]</code> | Escape  |

Change the current font position to *nnn* (one-digit position *n*, two-digit position *nn*), which must be a non-negative integer.

If *nnn* is associated with a style (as set with the `sty` request or with the `styles` command in the ‘DESC’ file), use it within the current font family (as set with the `fam` request, the `\F` escape, or with the `family` command in the ‘DESC’ file).

```

this is font 1
.ft 2
this is font 2
.ft \" switch back to font 1
.ft 3
this is font 3
.ft
this is font 1 again

```

See [Section 5.18.1 \[Changing Fonts\]](#), page 95, for the standard syntax form.

### 5.18.4 Using Symbols

A *glyph* is a graphical representation of a *character*. While a character is an abstract entity containing semantic information, a glyph is something which can be actually seen on screen or paper. It is possible that a character has multiple glyph representation forms (for example, the character ‘A’ can be either written in a roman or an italic font, yielding two different glyphs); sometimes more than one character maps to a single glyph (this is a *ligature* – the most common is ‘fi’).

A *symbol* is simply a named glyph. Within **gtroff**, all glyph names of a particular font are defined in its font file. If the user requests a glyph not available in this font, **gtroff** looks up an ordered list of *special fonts*. By default, the POSTSCRIPT output device supports the two special fonts ‘SS’ (slanted symbols) and ‘S’ (symbols) (the former is looked up before the latter). Other output devices use different names for special fonts. Fonts mounted with the **fonts** keyword in the ‘DESC’ file are globally available. To install additional special fonts locally (i.e. for a particular font), use the **fspecial** request.

In summary, **gtroff** tries the following to find a given symbol:

- If the symbol has been defined with the **char** request, use it. This hides a symbol with the same name in the current font.
- Check the current font.
- If the symbol has been defined with the **fchar** request, use it.
- Check all fonts given with the **fspecial** request, in the order of appearance in **fspecial** calls.
- Check all fonts given with the **special** request, in the order of appearance in **special** calls (inclusively the special fonts defined in the ‘DESC’ file, which come first).
- As a last resort, consult all fonts loaded up to now (in the order they have been called the first time) for special fonts and check them.

See [Section 8.2 \[Font Files\]](#), page 180, and [Section 5.18.5 \[Special Fonts\]](#), page 103, for more details.

|                      |  |        |
|----------------------|--|--------|
| <code>\(nm</code>    |  | Escape |
| <code>\[name]</code> |  | Escape |

Insert a symbol *name* (two-character name *nm*). There is no special syntax for one-character names – the natural form ‘\n’ would collide with escapes.<sup>8</sup>

If *name* is undefined, a warning of type ‘char’ is generated, and the escape is ignored. See [Section 5.34 \[Debugging\]](#), page 154, for information about warnings.

The list of available symbols is device dependent; see the *groff.char(7)* man page for a complete list for the given output device. For example, say

```
man -Tdvi groff_char > groff_char.dvi
```

---

<sup>8</sup> Note that a one-character symbol is not the same as an input character, i.e., the character **a** is not the same as `\[a]`. By default, **groff** defines only a single one-character symbol, `\[-]`; it is usually accessed as `\-`. On the other hand, **gtroff** has the special feature that `\[charXXX]` is the same as the input character with character code *XXX*. For example, `\[char97]` is identical to the letter **a** if ASCII encoding is active.

for a list using the default DVI fonts (not all versions of the `man` program support the ‘-T’ option). If you want to use an additional macro package to change the used fonts, `groff` must be called directly:

```
groff -Tdvi -mec -man groff_char.7 > groff_char.dvi
```

`\C'xxx'` Escape

Typeset the glyph named `xxx`.<sup>9</sup> Normally it is more convenient to use `\[xxx]`, but `\C` has the advantage that it is compatible with newer versions of AT&T `troff` and is available in compatibility mode.

`\N'n'` Escape

Typeset the glyph with code `n` in the current font (`n` is **not** the input character code). The number `n` can be any non-negative decimal integer. Most devices only have glyphs with codes between 0 and 255; the Unicode output device uses codes in the range 0–65535. If the current font does not contain a glyph with that code, special fonts are *not* searched. The `\N` escape sequence can be conveniently used in conjunction with the `char` request:

```
.char \[phone] \f[ZD]\N'37'
```

The code of each glyph is given in the fourth column in the font description file after the `charset` command. It is possible to include unnamed glyphs in the font description file by using a name of ‘---’; the `\N` escape sequence is the only way to use these.

Some escape sequences directly map onto special glyphs.

`\'` Escape

This is a backslash followed by the apostrophe character, ASCII character 0x27 (EBCDIC character 0x7D). The same as `\[aa]`, the acute accent.

`\‘` Escape

This is a backslash followed by ASCII character 0x60 (EBCDIC character 0x79 usually). The same as `\[ga]`, the grave accent.

`\-` Escape

This is the same as `\[-]`, the minus sign in the current font.

`.cflags n c1 c2 ...` Request

Input characters and symbols have certain properties associated with it.<sup>10</sup> These properties can be modified with the `cflags` request. The first

<sup>9</sup> `\C` is actually a misnomer since it accesses an output glyph.

<sup>10</sup> Note that the output glyphs themselves don't have such properties. For `gtroff`, a glyph is a numbered box with a given width, depth, and height, nothing else. All manipulations with the `cflags` request work on the input level.



```

.tr XY
X
 ⇒ Y
.char X Z
X
 ⇒ Y
.tr XX
X
 ⇒ Z

```

The `fchar` request defines a fallback glyph: `gtroff` only checks for glyphs defined with `fchar` if it cannot find the glyph in the current font. `gtroff` carries out this test before checking special fonts.

```

.rchar c1 c2 ... Request

```

Remove the definitions of glyphs `c1`, `c2`, `...`. This undoes the effect of a `char` or `fchar` request.

It is possible to omit the whitespace between arguments.

See [Section 7.1 \[Special Characters\]](#), page 165.

### 5.18.5 Special Fonts

Special fonts are those that `gtroff` searches when it cannot find the requested glyph in the current font. The Symbol font is usually a special font.

`gtroff` provides the following two requests to add more special fonts. See [Section 5.18.4 \[Using Symbols\]](#), page 99, for a detailed description of the glyph searching mechanism in `gtroff`.

Usually, only non-TTY devices have special fonts.

```

.special s1 s2 ... Request
.fspecial f s1 s2 ... Request

```

Use the `special` request to define special fonts. They are appended to the list of global special fonts in the given order. The first entries in this list are the fonts defined with the `fonts` command in the ‘DESC’ file which are marked as special in the corresponding font description files.

Use the `fspecial` request to designate special fonts only when font `f` font is active. They are appended to the list of special fonts for `f` in the given order. Initially, this list is empty.

### 5.18.6 Artificial Fonts

There are a number of requests and escapes for artificially creating fonts. These are largely vestiges of the days when output devices did not have a wide variety of fonts, and when `nroff` and `troff` were separate programs.

Most of them are no longer necessary in GNU `troff`. Nevertheless, they are supported.

|                          |        |
|--------------------------|--------|
| <code>\H'height'</code>  | Escape |
| <code>\H'+height'</code> | Escape |
| <code>\H'-height'</code> | Escape |

Change (increment, decrement) the height of the current font, but not the width. If *height* is zero, restore the original height. Default scaling indicator is 'z'.

Currently, only the '-Tps' device supports this feature.

Note that `\H` doesn't produce an input token in `gtroff`. As a consequence, it can be used in requests like `mc` (which expects a single character as an argument) to change the font on the fly:

```
.mc \H'+5z'x\H'0'
```

In compatibility mode, `gtroff` behaves differently: If an increment or decrement is used, it is always taken relative to the current point size and not relative to the previously selected font height. Thus,

```
.cp 1
\H'+5'test \H'+5'test
```

prints the word 'test' twice with the same font height (five points larger than the current font size).

|                        |        |
|------------------------|--------|
| <code>\S'slant'</code> | Escape |
|------------------------|--------|

Slant the current font by *slant* degrees. Positive values slant to the right.

Currently, only the '-Tps' device supports this feature.

Note that `\S` doesn't produce an input token in `gtroff`. As a consequence, it can be used in requests like `mc` (which expects a single character as an argument) to change the font on the fly:

```
.mc \S'20'x\S'0'
```

This request is incorrectly documented in the original UNIX `troff` manual; the slant is always set to an absolute value.

|                          |         |
|--------------------------|---------|
| <code>.ul [lines]</code> | Request |
|--------------------------|---------|

The `ul` request normally underlines subsequent lines if a TTY output device is used. Otherwise, the lines are printed in italics (only the term 'underlined' is used in the following). The single argument is the number of input lines to be underlined; with no argument, the next line is underlined. If *lines* is zero or negative, stop the effects of `ul` (if it was active). Requests and empty lines do not count for computing the number of underlined input lines, even if they produce some output like `t1`. Lines inserted by macros (e.g. invoked by a trap) do count.

At the beginning of `ul`, the current font is stored and the underline font is activated. Within the span of a `ul` request, it is possible to change fonts, but after the last line affected by `ul` the saved font is restored.

This number of lines still to be underlined is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141). The underline font can be changed with the `uf` request.

The `u1` request does not underline spaces.

`.cu` [*lines*] Request  
 The `cu` request is similar to `u1` but underlines spaces as well (if a TTY output device is used).

`.uf` *font* Request  
 Set the underline font (globally) used by `u1` and `cu`. By default, this is the font at position 2. *font* can be either a non-negative font position or the name of a font.

`.bd` *font* [*offset*] Request

`.bd` *font1 font2* [*offset*] Request

`\n[.b]` Register

Artificially create a bold font by printing each glyph twice, slightly offset.

Two syntax forms are available.

- Imitate a bold font unconditionally. The first argument specifies the font to embolden, and the second is the number of basic units, minus one, by which the two glyphs are offset. If the second argument is missing, emboldening is turned off.

*font* can be either a non-negative font position or the name of a font.

*offset* is available in the `.b` read-only register if a special font is active; in the `bd` request, its default unit is ‘u’.

- Imitate a bold form conditionally. Embolden *font1* by *offset* only if font *font2* is the current font. This command can be issued repeatedly to set up different emboldening values for different current fonts. If the second argument is missing, emboldening is turned off for this particular current font.

This affects special fonts only (either set up with the `special` command in font files or with the `fspecial` request).

`.cs` *font* [*width* [*em-size*]] Request

Switch to and from *constant glyph space mode*. If activated, the width of every glyph is *width*/36 ems. The em size is given absolutely by *em-size*; if this argument is missing, the em value is taken from the current font size (as set with the `ps` request) when the font is effectively in use. Without second and third argument, constant glyph space mode is deactivated.

Default scaling indicator for *em-size* is ‘z’; *width* is an integer.

### 5.18.7 Ligatures and Kerning

Ligatures are groups of characters that are run together, i.e, producing a single glyph. For example, the letters ‘f’ and ‘i’ can form a ligature ‘fi’ as in the word ‘file’. This produces a cleaner look (albeit subtle) to the printed output. Usually, ligatures are not available in fonts for TTY output devices.

Most POSTSCRIPT fonts support the fi and fl ligatures. The C/A/T typesetter that was the target of AT&T `troff` also supported ‘ff’, ‘ffi’, and ‘fff’ ligatures. Advanced typesetters or ‘expert’ fonts may include ligatures for ‘ft’ and ‘ct’, although GNU `troff` does not support these (yet).

```
.lg [flag] Request
\n[.lg] Register
```

Switch the ligature mechanism on or off; if the parameter is non-zero or missing, ligatures are enabled, otherwise disabled. Default is on. The current ligature mode can be found in the read-only number register `.lg` (set to 1 or 2 if ligatures are enabled, 0 otherwise).

Setting the ligature mode to 2 enables the two-character ligatures (fi, fl, and ff) and disables the three-character ligatures (ffi and ffl).

*Pairwise kerning* is another subtle typesetting mechanism that modifies the distance between a glyph pair to improve readability. In most cases (but not always) the distance is decreased. For example, compare the combination of the letters ‘V’ and ‘A’. With kerning, ‘VA’ is printed. Without kerning it appears as ‘VA’. Typewriter-like fonts and fonts for terminals where all glyphs have the same width don’t use kerning.

```
.kern [flag] Request
\n[.kern] Register
```

Switch kerning on or off. If the parameter is non-zero or missing, enable pairwise kerning, otherwise disable it. The read-only number register `.kern` is set to 1 if pairwise kerning is enabled, 0 otherwise.

If the font description file contains pairwise kerning information, glyphs from that font are kerned. Kerning between two glyphs can be inhibited by placing `\&` between them: ‘V&A’.

See [Section 8.2.2 \[Font File Format\]](#), page 182.

*Track kerning* expands or reduces the space between glyphs. This can be handy, for example, if you need to squeeze a long word onto a single line or spread some text to fill a narrow column. It must be used with great care since it is usually considered bad typography if the reader notices the effect.

```
.tkf f s1 n1 s2 n2 Request
Enable track kerning for font f. If the current font is f the width of every glyph is increased by an amount between n1 and n2 (n1, n2 can be
```

negative); if the current point size is less than or equal to *s1* the width is increased by *n1*; if it is greater than or equal to *s2* the width is increased by *n2*; if the point size is greater than or equal to *s1* and less than or equal to *s2* the increase in width is a linear function of the point size.

The default scaling indicator is ‘z’ for *s1* and *s2*, ‘p’ for *n1* and *n2*.

Note that the track kerning amount is added even to the rightmost glyph in a line; for large values it is thus recommended to increase the line length by the same amount to compensate it.

Sometimes, when typesetting letters of different fonts, more or less space at such boundaries are needed. There are two escapes to help with this.

`\/` Escape

Increase the width of the preceding glyph so that the spacing between that glyph and the following glyph is correct if the following glyph is a roman glyph. For example, if an italic `f` is immediately followed by a roman right parenthesis, then in many fonts the top right portion of the `f` overlaps the top left of the right parenthesis. Use this escape sequence whenever an italic glyph is immediately followed by a roman glyph without any intervening space. This small amount of space is also called *italic correction*.

```
\f[I]f\f[R])
 ⇒ f)
\f[I]f\ \f[R])
 ⇒ f)
```

`\,` Escape

Modify the spacing of the following glyph so that the spacing between that glyph and the preceding glyph is correct if the preceding glyph is a roman glyph. Use this escape sequence whenever a roman glyph is immediately followed by an italic glyph without any intervening space. In analogy to above, this space could be called *left italic correction*, but this term isn’t used widely.

```
q\f[I]f
 ⇒ qf
q\,\f[I]f
 ⇒ qf
```

`\&` Escape

Insert a zero-width character, which is invisible. Its intended use is to stop interaction of a character with its surrounding.

- It prevents the insertion of extra space after an end-of-sentence character.

```

Test.
Test.
 ⇒ Test. Test.
Test.\&
Test.
 ⇒ Test. Test.

```

- It prevents interpretation of a control character at the beginning of an input line.

```

.Test
 ⇒ warning: 'Test' not defined
\&.Test
 ⇒ .Test

```

- It prevents kerning between two glyphs.

```

VA
 ⇒ VA
V\&A
 ⇒ VA

```

- It is needed to map an arbitrary character to nothing in the `tr` request (see [Section 5.12 \[Character Translations\]](#), page 82).

\)

Escape

This escape is similar to `\&` except that it behaves like a character declared with the `cflags` request to be transparent for the purposes of an end-of-sentence character.

Its main usage is in macro definitions to protect against arguments starting with a control character.

```

.de xxx
\)\$1
..
.de yyy
\&\$1
..
This is a test.\c
.xxx '
This is a test.
 ⇒This is a test.' This is a test.
This is a test.\c
.yyy '
This is a test.
 ⇒This is a test.' This is a test.

```

## 5.19 Sizes

`gtroff` uses two dimensions with each line of text, type size and vertical spacing. The *type size* is approximately the height of the tallest glyph.<sup>12</sup> *Vertical spacing* is the amount of space `gtroff` allows for a line of text; normally, this is about 20% larger than the current type size. Ratios smaller than this can result in hard-to-read text; larger than this, it spreads the text out more vertically (useful for term papers). By default, `gtroff` uses 10 point type on 12 point spacing.

The difference between type size and vertical spacing is known, by typesetters, as *leading* (this is pronounced ‘leading’).

### 5.19.1 Changing Type Sizes

|                         |          |
|-------------------------|----------|
| <code>.ps [size]</code> | Request  |
| <code>.ps +size</code>  | Request  |
| <code>.ps -size</code>  | Request  |
| <code>\ssize</code>     | Escape   |
| <code>\n[.s]</code>     | Register |

Use the `ps` request or the `\s` escape to change (increase, decrease) the type size (in points). Specify *size* as either an absolute point size, or as a relative change from the current size. The size 0, or no argument, goes back to the previous size.

Default scaling indicator of *size* is ‘z’. If *size* is zero or negative, it is set to 1 u.

The read-only number register `.s` returns the point size in points as a decimal fraction. This is a string. To get the point size in scaled points, use the `.ps` register instead.

`.s` is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

```

snap, snap,
.ps +2
grin, grin,
.ps +2
wink, wink, \s+2nudge, nudge, \s+8 say no more!
.ps 10

```

The `\s` escape may be called in a variety of ways. Much like other escapes there must be a way to determine where the argument ends and the text begins. Any of the following forms are valid:

<sup>12</sup> This is usually the parenthesis. Note that in most cases the real dimensions of the glyphs in a font are *not* related to its type size! For example, the standard POSTSCRIPT font families ‘Times Roman’, ‘Helvetica’, and ‘Courier’ can’t be used together at 10pt; to get acceptable output, the size of ‘Helvetica’ has to be reduced by one point, and the size of ‘Courier’ must be increased by one point.

|                     |                                                                                      |
|---------------------|--------------------------------------------------------------------------------------|
| <code>\sn</code>    | Set the point size to $n$ points. $n$ must be either 0 or in the range 4 to 39.      |
| <code>\s+n</code>   | Increase or decrease the point size by $n$ points. $n$ must be exactly one digit.    |
| <code>\s-n</code>   |                                                                                      |
| <code>\s(nn</code>  | Set the point size to $nn$ points. $nn$ must be exactly two digits.                  |
| <code>\s+(nn</code> | Increase or decrease the point size by $nn$ points. $nn$ must be exactly two digits. |
| <code>\s-(nn</code> |                                                                                      |
| <code>\s(+nn</code> |                                                                                      |
| <code>\s(-nn</code> |                                                                                      |

Note that `\s` doesn't produce an input token in `gtroff`. As a consequence, it can be used in requests like `mc` (which expects a single character as an argument) to change the font on the fly:

```
.mc \s[20]x\s[0]
```

See [Section 5.19.2 \[Fractional Type Sizes\]](#), page 111, for yet another syntactical form of using the `\s` escape.

`.sizes s1 s2 ... sn [0]` Request

Some devices may only have certain permissible sizes, in which case `gtroff` rounds to the nearest permissible size. The 'DESC' file specifies which sizes are permissible for the device.

Use the `sizes` request to change the permissible sizes for the current output device. Arguments are in scaled points; the `sizescale` line in the 'DESC' file for the output device provides the scaling factor. For example, if the scaling factor is 1000, then the value 12000 is 12 points.

Each argument can be a single point size (such as '12000'), or a range of sizes (such as '4000-72000'). You can optionally end the list with a zero.

`.vs [space]` Request  
`.vs +space` Request  
`.vs -space` Request  
`\n[.v]` Register

Change (increase, decrease) the vertical spacing by *space*. The default scaling indicator is 'p'.

If `vs` is called without an argument, the vertical spacing is reset to the previous value before the last call to `vs`.

`gtroff` creates a warning of type 'range' if *space* is zero or negative; the vertical spacing is then set to the vertical resolution (as given in the `.V` register).

The read-only number register `.v` contains the current vertical spacing; it is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

The effective vertical line spacing consists of four components.

- The vertical line spacing as set with the `vs` request.
- The *post-vertical line spacing* as set with the `pvs` request. This is vertical space which will be added after a line has been output.
- The *extra pre-vertical line space* as set with the `\x` request, using a negative value. This is vertical space which will be added once before the current line has been output.
- The *extra post-vertical line space* as set with the `\x` request, using a positive value. This is vertical space which will be added once after the current line has been output.

It is usually better to use `vs` or `pvs` instead of `ls` to produce double-spaced documents: `vs` and `pvs` have a finer granularity for the inserted vertical space compared to `ls`; furthermore, certain preprocessors assume single-spacing.

See [Section 5.10 \[Manipulating Spacing\], page 76](#), for more details on the `\x` escape and the `ls` request.

|                           |          |
|---------------------------|----------|
| <code>.pvs [space]</code> | Request  |
| <code>.pvs +space</code>  | Request  |
| <code>.pvs -space</code>  | Request  |
| <code>\n[.pvs]</code>     | Register |

Change (increase, decrease) the post-vertical spacing by *space*. The default scaling indicator is ‘p’.

If `pvs` is called without an argument, the post-vertical spacing is reset to the previous value before the last call to `pvs`.

`gtroff` creates a warning of type ‘range’ if *space* is zero or negative; the vertical spacing is then set to zero.

The read-only number register `.pvs` contains the current post-vertical spacing; it is associated with the current environment (see [Section 5.27 \[Environments\], page 141](#)).

### 5.19.2 Fractional Type Sizes

A *scaled point* is equal to  $1/\text{sizescale}$  points, where *sizescale* is specified in the ‘DESC’ file (1 by default). There is a new scale indicator ‘z’ which has the effect of multiplying by *sizescale*. Requests and escape sequences in `gtroff` interpret arguments that represent a point size as being in units of scaled points, but they evaluate each such argument using a default scale indicator of ‘z’. Arguments treated in this way are the argument to the `ps` request, the third argument to the `cs` request, the second and fourth arguments to the `tkf` request, the argument to the `\H` escape sequence, and those variants of the `\s` escape sequence that take a numeric expression as their argument (see below).

For example, suppose *sizescale* is 1000; then a scaled point is equivalent to a millipoint; the request `.ps 10.25` is equivalent to `.ps 10.25z` and thus sets the point size to 10250 scaled points, which is equal to 10.25 points.

`gtroff` disallows the use of the ‘z’ scale indicator in instances where it would make no sense, such as a numeric expression whose default scale indicator was neither ‘u’ nor ‘z’. Similarly it would make no sense to use a scaling indicator other than ‘z’ or ‘u’ in a numeric expression whose default scale indicator was ‘z’, and so `gtroff` disallows this as well.

There is also new scale indicator ‘s’ which multiplies by the number of units in a scaled point. So, for example, `\n[.ps]s` is equal to ‘1m’. Be sure not to confuse the ‘s’ and ‘z’ scale indicators.

`\n[.ps]` Register  
 A read-only number register returning the point size in scaled points.  
`.ps` is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

`\n[.psr]` Register  
`\n[.sr]` Register  
 The last-requested point size in scaled points is contained in the `.psr` read-only number register. The last requested point size in points as a decimal fraction can be found in `.sr`. This is a string-valued read-only number register.

Note that the requested point sizes are device-independent, whereas the values returned by the `.ps` and `.s` registers are not. For example, if a point size of 11 pt is requested, and a `sizes` request (or a `sizescale` line in a ‘DESC’ file) specifies 10.95 pt instead, this value is actually used.

Both registers are associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

The `\s` escape has the following syntax for working with fractional type sizes:

`\s[n]`  
`\s'n'`      Set the point size to *n* scaled points; *n* is a numeric expression with a default scale indicator of ‘z’.

`\s[+n]`  
`\s[-n]`  
`\s+[n]`  
`\s-[n]`  
`\s'+n'`  
`\s'-n'`  
`\s+'n'`  
`\s-'n'`      Increase or or decrease the point size by *n* scaled points; *n* is a numeric expression with a default scale indicator of ‘z’.

See [Section 8.2 \[Font Files\]](#), page 180.

## 5.20 Strings

`gtroff` has string variables, which are entirely for user convenience (i.e. there are no built-in strings except `.T`, but even this is a read-write string variable).

|                                     |         |
|-------------------------------------|---------|
| <code>.ds name [string]</code>      | Request |
| <code>.ds1 name [string]</code>     | Request |
| <code>\*n</code>                    | Escape  |
| <code>\*(nm</code>                  | Escape  |
| <code>\*[name arg1 arg2 ...]</code> | Escape  |

Define and access a string variable *name* (one-character name *n*, two-character name *nm*). If *name* already exists, `ds` overwrites the previous definition. Only the syntax form using brackets can take arguments which are handled identically to macro arguments; the single exception is that a closing bracket as an argument must be enclosed in double quotes. See [Section 5.6.1.1 \[Request Arguments\]](#), page 57, and [Section 5.22.2 \[Parameters\]](#), page 123.

Example:

```
.ds foo a \\$1 test
.
This is *[foo nice].
⇒ This is a nice test.
```

The `\*` escape *interpolates* (expands in-place) a previously-defined string variable. To be more precise, the stored string is pushed onto the input stack which is then parsed by `gtroff`. Similar to number registers, it is possible to nest strings, i.e. string variables can be called within string variables.

If the string named by the `\*` escape does not exist, it is defined as empty, and a warning of type ‘`mac`’ is emitted (see [Section 5.34 \[Debugging\]](#), page 154, for more details).

**Caution:** Unlike other requests, the second argument to the `ds` request takes up the entire line including trailing spaces. This means that comments on a line with such a request can introduce unwanted space into a string.

```
.ds UX \s-1UNIX\s0\u\s-3tm\s0\d \" UNIX trademark
```

Instead the comment should be put on another line or have the comment escape adjacent with the end of the string.

```
.ds UX \s-1UNIX\s0\u\s-3tm\s0\d\" UNIX trademark
```

To produce leading space the string can be started with a double quote. No trailing quote is needed; in fact, any trailing quote is included in your string.

```
.ds sign " Yours in a white wine sauce,
```

Strings are not limited to a single line of text. A string can span several lines by escaping the newlines with a backslash. The resulting string is stored *without* the newlines.

```
.ds foo lots and lots \
of text are on these \
next several lines
```

It is not possible to have real newlines in a string. To put a single double quote character into a string, use two consecutive double quote characters.

The `ds1` request turns off compatibility mode while interpreting a string. To be more precise, a *compatibility save* input token is inserted at the beginning of the string, and a *compatibility restore* input token at the end.

```
.nr xxx 12345
.ds aa The value of xxx is \\n[xxx].
.ds1 bb The value of xxx ix \\n[xxx].
.
.cp 1
.
*(aa
 ⇒ warning: number register '[' not defined
 ⇒ The value of xxx is 0xxx].
*(bb
 ⇒ The value of xxx ix 12345.
```

Strings, macros, and diversions (and boxes) share the same name space. Internally, even the same mechanism is used to store them. This has some interesting consequences. For example, it is possible to call a macro with string syntax and vice versa.

```
.de xxx
a funny test.
..
This is *[xxx]
 ⇒ This is a funny test.

.ds yyy a funny test
This is
.yyy
 ⇒ This is a funny test.
```

Diversions and boxes can be also called with string syntax.

Another consequence is that you can copy one-line diversions or boxes to a string.

```
.di xxx
a \fItest\fR
.br
.di
.ds yyy This is *[xxx]\c
*[yyy].
⇒ This is a test.
```

As the previous example shows, it is possible to store formatted output in strings. The `\c` escape prevents the insertion of an additional blank line in the output.

Copying diversions longer than a single output line produces unexpected results.

```
.di xxx
a funny
.br
test
.br
.di
.ds yyy This is *[xxx]\c
*[yyy].
⇒ test This is a funny.
```

Usually, it is not predictable whether a diversion contains one or more output lines, so this mechanism should be avoided. With UNIX `troff`, this was the only solution to strip off a final newline from a diversion. Another disadvantage is that the spaces in the copied string are already formatted, making them unstretchable. This can cause ugly results.

A clean solution to this problem is available in GNU `troff`, using the requests `chop` to remove the final newline of a diversion, and `unformat` to make the horizontal spaces stretchable again.

```
.box xxx
a funny
.br
test
.br
.box
.chop xxx
.unformat xxx
This is *[xxx].
⇒ This is a funny test.
```

See [Section 5.33 \[Gtroff Internals\]](#), page 152, for more information.

`.as name [string]` Request  
`.as1 name [string]` Request

The `as` request is similar to `ds` but appends *string* to the string stored as *name* instead of redefining it. If *name* doesn't exist yet, it is created.

```
.as sign " with shallots, onions and garlic,
```

The `as1` request is similar to `as`, but compatibility mode is switched off while the appended string is interpreted. To be more precise, a *compatibility save* input token is inserted at the beginning of the appended string, and a *compatibility restore* input token at the end.

Rudimentary string manipulation routines are given with the next two requests.

`.substring str n1 [n2]` Request

Replace the string named *str* with the substring defined by the indices *n1* and *n2*. The first character in the string has index 0. If *n2* is omitted, it is taken to be equal to the string's length. If the index value *n1* or *n2* is negative, it is counted from the end of the string, going backwards: The last character has index  $-1$ , the character before the last character has index  $-2$ , etc.

```
.ds xxx abcdefgh
.substring xxx 1 -4
\[xxx]
⇒ bcde
```

`.length reg str` Request

Compute the number of characters of *str* and return it in the number register *reg*. If *reg* doesn't exist, it is created. `str` is read in copy mode.

```
.ds xxx abcd\h'3i'efgh
.length yyy \n[xxx]
\n[yyy]
⇒ 14
```

`.rn xx yy` Request

Rename the request, macro, diversion, or string *xx* to *yy*.

`.rm xx` Request

Remove the request, macro, diversion, or string *xx*. `gtroff` treats subsequent invocations as if the object had never been defined.

`.als new old` Request

Create an alias named *new* for the request, string, macro, or diversion object named *old*. The new name and the old name are exactly equivalent (it is similar to a hard rather than a soft link). If *old* is undefined, `gtroff` generates a warning of type 'mac' and ignores the request.

`.chop xx` Request  
 Remove (chop) the last character from the macro, string, or diversion named `xx`. This is useful for removing the newline from the end of diversions that are to be interpolated as strings. This command can be used repeatedly; see [Section 5.33 \[Gtroff Internals\]](#), page 152, for details on nodes inserted additionally by `gtroff`.

See [Section 5.5 \[Identifiers\]](#), page 54, and [Section 5.6.3.1 \[Comments\]](#), page 60.

## 5.21 Conditionals and Loops

### 5.21.1 Operators in Conditionals

In `if` and `while` requests, there are several more operators available:

`e` True if the current page is even or odd numbered (respectively).  
`o` True if the document is being processed in `nroff` mode (i.e., the `.nroff` command has been issued).  
`n` True if the document is being processed in `troff` mode (i.e., the `.troff` command has been issued).  
`t` True if the document is being processed in `troff` mode (i.e., the `.troff` command has been issued).  
`v` Always false. This condition is for compatibility with other `troff` versions only.

`'xxx'yyy'`

True if the string `xxx` is equal to the string `yyy`. Other characters can be used in place of the single quotes; the same set of delimiters as for the `\D` escape is used (see [Section 5.6.3 \[Escapes\]](#), page 58). `gtroff` formats the strings before being compared:

```
.ie "|"\fR|\fP" \
true
.el \
false
⇒ true
```

The resulting motions, glyph sizes, and fonts have to match,<sup>13</sup> and not the individual motion, size, and font requests. In the previous example, `'|'` and `'\fR|\fP'` both result in a roman `'|'` glyph with the same point size and at the same location on the page, so the strings are equal. If `.ft I` had been added before the `.ie`, the result would be “false” because (the first) `'|'` produces an italic `'|'` rather than a roman one.

<sup>13</sup> The created output nodes must be identical. See [Section 5.33 \[Gtroff Internals\]](#), page 152.

|                    |                                                                                                                                                                                                                                                                                    |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>r xxx</code> | True if there is a number register named <code>xxx</code> .                                                                                                                                                                                                                        |
| <code>d xxx</code> | True if there is a string, macro, diversion, or request named <code>xxx</code> .                                                                                                                                                                                                   |
| <code>m xxx</code> | True if there is a color named <code>xxx</code> .                                                                                                                                                                                                                                  |
| <code>c g</code>   | True if there is a glyph <code>g</code> available <sup>14</sup> ; <code>g</code> is either an ASCII character or a special character ( <code>\(gg</code> or <code>\[ggg]</code> ); the condition is also true if <code>g</code> has been defined by the <code>char</code> request. |

Note that these operators can't be combined with other operators like `':` or `'&'`; only a leading `'!` (without whitespace between the exclamation mark and the operator) can be used to negate the result.

```
.nr xxx 1
.ie !r xxx \
true
.el \
false
⇒ false
```

A whitespace after `'!` always evaluates to zero (this bizarre behaviour is due to compatibility with UNIX `troff`).

```
.nr xxx 1
.ie ! r xxx \
true
.el \
false
⇒ r xxx true
```

It is possible to omit the whitespace before the argument to the `'r'`, `'d'`, and `'c'` operators.

See [Section 5.4 \[Expressions\]](#), page 52.

### 5.21.2 if-else

`gtroff` has if-then-else constructs like other languages, although the formatting can be painful.

`.if expr anything` Request  
 Evaluate the expression *expr*, and executes *anything* (the remainder of the line) if *expr* evaluates to non-zero (true). *anything* is interpreted as though it was on a line by itself (except that leading spaces are swallowed). See [Section 5.4 \[Expressions\]](#), page 52, for more info.

---

<sup>14</sup> The name of this conditional operator is a misnomer since it tests names of output glyphs.

```
.nr xxx 1
.nr yyy 2
.if ((\n[xxx] == 1) & (\n[yyy] == 2)) true
 ⇒ true
```

`.nop anything` Request  
 Executes *anything*. This is similar to `.if 1`.

`.ie expr anything` Request

`.el anything` Request

Use the `ie` and `el` requests to write an if-then-else. The first request is the ‘if’ part and the latter is the ‘else’ part.

```
.ie n .ls 2 \" double-spacing in nroff
.el .ls 1 \" single-spacing in troff
```

`\{` Escape

`\}` Escape

In many cases, an if (or if-else) construct needs to execute more than one request. This can be done using the `\{` and `\}` escapes. The following example shows the possible ways to use these escapes (note the position of the opening and closing braces).

```
.ie t \{\
. ds lq ‘‘
. ds rq ’’
.\}
.el \
.\{\
. ds lq "
. ds rq "\}
```

See [Section 5.4 \[Expressions\]](#), page 52.

### 5.21.3 while

`gtroff` provides a looping construct using the `while` request, which is used much like the `if` (and related) requests.

`.while expr anything` Request

Evaluate the expression *expr*, and repeatedly execute *anything* (the remainder of the line) until *expr* evaluates to 0.

```
.nr a 0 1
.while (\na < 9) \{\
\n+a,
.\}
\n+a
⇒ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
```

Some remarks.

- The body of a `while` request is treated like the body of a `de` request: `gtroff` temporarily stores it in a macro which is deleted after the loop has been exited. It can considerably slow down a macro if the body of the `while` request (within the macro) is large. Each time the macro is executed, the `while` body is parsed and stored again as a temporary macro.

```
.de xxx
. nr num 10
. while (\\n[num] > 0) \{\
. \" many lines of code
. nr num -1
. \}
..
```

The traditional and often better solution (UNIX `troff` doesn't have the `while` request) is to use a recursive macro instead which is parsed only once during its definition.

```
.de yyy
. if (\\n[num] > 0) \{\
. \" many lines of code
. nr num -1
. yyy
. \}
..
.
.de xxx
. nr num 10
. yyy
..
```

Note that the number of available recursion levels is set to 1000 (this is a compile-time constant value of `gtroff`).

- The closing brace of a `while` body must end a line.

```
.if 1 \{\
. nr a 0 1
. while (\n[a] < 10) \{\
. nop \n+[a]
.\}\}
⇒ unbalanced \{ \}
```

### `.break`

Request

Break out of a `while` loop. Be sure not to confuse this with the `br` request (causing a line break).

`.continue` Request  
 Finish the current iteration of a `while` loop, immediately restarting the next iteration.

See [Section 5.4 \[Expressions\]](#), page 52.

## 5.22 Writing Macros

A *macro* is a collection of text and embedded commands which can be invoked multiple times. Use macros to define common operations.

`.de name [end]` Request  
`.de1 name [end]` Request  
`.dei name [end]` Request

Define a new macro named *name*. `gtroff` copies subsequent lines (starting with the next one) into an internal buffer until it encounters the line `..` (two dots). The optional second argument to `de` changes this to a macro to `‘.end’`.

There can be whitespace after the first dot in the line containing the ending token (either `‘.’` or macro `‘end’`).

Here a small example macro called `‘P’` which causes a break and inserts some vertical space. It could be used to separate paragraphs.

```
.de P
. br
. sp .8v
..
```

The following example defines a macro within another. Remember that expansion must be protected twice; once for reading the macro and once for executing.

```
\# a dummy macro to avoid a warning
.de end
..
.
.de foo
. de bar end
. nop \f[B]Hallo \\\$1!\f[]
. end
..
.
.foo
.bar Joe
⇒ Hallo Joe!
```

Since `\f` has no expansion, it isn't necessary to protect its backslash. Had we defined another macro within `bar` which takes a parameter, eight backslashes would be necessary before `'$1'`.

The `de1` request turns off compatibility mode while executing the macro. On entry, the current compatibility mode is saved and restored at exit.

```
.nr xxx 12345
.
.de aa
The value of xxx is \n[xxx].
..
.de1 bb
The value of xxx ix \n[xxx].
..
.
.cp 1
.
.aa
 ⇒ warning: number register ø' not defined
 ⇒ The value of xxx is 0xxx].
.bb
 ⇒ The value of xxx ix 12345.
```

The `dei` request defines a macro indirectly. That is, it expands strings whose names are *name* or *end* before performing the append.

This:

```
.ds xx aa
.ds yy bb
.dei xx yy
```

is equivalent to:

```
.de aa bb
```

Using `'trace.tmac'`, you can trace calls to `de` and `de1`.

Note that macro identifiers are shared with identifiers for strings and diversions.

|                         |         |
|-------------------------|---------|
| <code>.am xx</code>     | Request |
| <code>.am1 xx</code>    | Request |
| <code>.ami xx yy</code> | Request |

Works similarly to `de` except it appends onto the macro named `xx`. So, to make the previously defined `'P'` macro actually do indented instead of block paragraphs, add the necessary code to the existing macro like this:

```
.am P
.ti +5n
..
```

The `am1` request turns off compatibility mode while executing the appended macro piece. To be more precise, a *compatibility save* input token is inserted at the beginning of the appended code, and a *compatibility restore* input token at the end.

The `ami` request appends indirectly, meaning that `gtroff` expands strings whose names are `xx` or `yy` before performing the append.

Using `'trace.tmac'`, you can trace calls to `am` and `am1`.

See Section 5.20 [Strings], page 113, for the `als` request to rename a macro.

The `de`, `am`, `di`, `da`, `ds`, and `as` requests (together with its variants) only create a new object if the name of the macro, diversion or string diversion is currently undefined or if it is defined to be a request; normally they modify the value of an existing object.

### `.return`

Request

Exit a macro, immediately returning to the caller.

## 5.22.1 Copy-in Mode

When `gtroff` reads in the text for a macro, string, or diversion, it copies the text (including request lines, but excluding escapes) into an internal buffer. Escapes are converted into an internal form, except for `\n`, `\$`, `\*`, `\` and `\(RET)` which are evaluated and inserted into the text where the escape was located. This is known as *copy-in* mode or *copy* mode.

What this means is that you can specify when these escapes are to be evaluated (either at copy-in time or at the time of use) by insulating the escapes with an extra backslash. Compare this to the `\def` and `\edef` commands in `TEX`.

The following example prints the numbers 20 and 10:

```
.nr x 20
.de y
.nr x 10
\&\nx
\&\nx
..
.y
```

## 5.22.2 Parameters

The arguments to a macro or string can be examined using a variety of escapes.

### `\n[. $]`

Register

The number of arguments passed to a macro or string. This is a read-only number register.

Any individual argument can be retrieved with one of the following escapes:

|                       |        |
|-----------------------|--------|
| <code>\\$n</code>     | Escape |
| <code>\\$(nn)</code>  | Escape |
| <code>\\$[nnn]</code> | Escape |

Retrieve the *n*th, *nn*th or *nnn*th argument. As usual, the first form only accepts a single number (larger than zero), the second a two-digit number (larger or equal to 10), and the third any positive integer value (larger than zero). Macros and strings can have an unlimited number of arguments. Note that due to copy-in mode, use two backslashes on these in actual use to prevent interpolation until the macro is actually invoked.

|                         |         |
|-------------------------|---------|
| <code>.shift [n]</code> | Request |
|-------------------------|---------|

Shift the arguments 1 position, or as many positions as specified by its argument. After executing this request, argument *i* becomes argument *i* − *n*; arguments 1 to *n* are no longer available. Shifting by negative amounts is currently undefined.

|                   |        |
|-------------------|--------|
| <code>\\$*</code> | Escape |
| <code>\\$@</code> | Escape |

In some cases it is convenient to use all of the arguments at once (for example, to pass the arguments along to another macro). The `\$*` escape concatenates all the arguments separated by spaces. A similar escape is `\$@`, which concatenates all the arguments with each surrounded by double quotes, and separated by spaces. If not in compatibility mode, the input level of double quotes is preserved (see [Section 5.6.1.1 \[Request Arguments\]](#), page 57).

|                   |        |
|-------------------|--------|
| <code>\\$0</code> | Escape |
|-------------------|--------|

The name used to invoke the current macro. The `als` request can make a macro have more than one name.

```
.de generic-macro
. ...
. if \n[error] {\
. tm \$0: Houston, we have a problem.
. return
. }
..
.
.als foo generic-macro
.als bar generic-macro
```

See [Section 5.6.1.1 \[Request Arguments\]](#), page 57.

## 5.23 Page Motions

See [Section 5.10 \[Manipulating Spacing\]](#), page 76, for a discussion of the main request for vertical motion, `sp`.

|                                  |         |
|----------------------------------|---------|
| <code>.mk</code> [ <i>reg</i> ]  | Request |
| <code>.rt</code> [ <i>dist</i> ] | Request |

The request `mk` can be used to mark a location on a page, for movement to later. This request takes a register name as an argument in which to store the current page location. With no argument it stores the location in an internal register. The results of this can be used later by the `rt` or the `sp` request (or the `\v` escape).

The `rt` request returns *upwards* to the location marked with the last `mk` request. If used with an argument, return to a position which distance from the top of the page is *dist* (no previous call to `mk` is necessary in this case). Default scaling indicator is ‘v’.

Here a primitive solution for a two-column macro.

```
.nr column-length 1.5i
.nr column-gap 4m
.nr bottom-margin 1m
.
.de 2c
. br
. mk
. ll \n[column-length]u
. wh -\n[bottom-margin]u 2c-trap
. nr right-side 0
..
.
.de 2c-trap
. ie \n[right-side] \{\
. nr right-side 0
. po -(\n[column-length]u + \n[column-gap]u)
. \" remove trap
. wh -\n[bottom-margin]u
. \}
. el \{\
. \" switch to right side
. nr right-side 1
. po +(\n[column-length]u + \n[column-gap]u)
. rt
. \}
..
.
```

```
.pl 1.5i
.ll 4i
This is a small test which shows how the
rt request works in combination with mk.

.2c
Starting here, text is typeset in two columns.
Note that this implementation isn't robust
and thus not suited for a real two-column
macro.
```

Result:

```
This is a small test which shows how the
rt request works in combination with mk.

Starting here, isn't robust
text is typeset and thus not
in two columns. suited for a
Note that this real two-column
implementation macro.
```

The following escapes give fine control of movements about the page.

`\v'e'` Escape  
 Move vertically, usually from the current location on the page (if no absolute position operator '|' is used). The argument *e* specifies the distance to move; positive is downwards and negative upwards. The default scaling indicator for this escape is 'v'. Beware, however, that **gtroff** continues text processing at the point where the motion ends, so you should always balance motions to avoid interference with text processing.  
`\v` doesn't trigger a trap. This can be quite useful; for example, consider a page bottom trap macro which prints a marker in the margin to indicate continuation of a footnote or something similar.

There are some special-case escapes for vertical motion.

|                 |                    |        |
|-----------------|--------------------|--------|
| <code>\r</code> | Move upwards 1 v.  | Escape |
| <code>\u</code> | Move upwards .5 v. | Escape |
| <code>\d</code> | Move down .5 v.    | Escape |

`\h'e'` Escape  
 Move horizontally, usually from the current location (if no absolute position operator `'|'` is used). The expression *e* indicates how far to move: positive is rightwards and negative leftwards. The default scaling indicator for this escape is `'m'`.

There are a number of special-case escapes for horizontal motion.

`\(SP)` Escape  
 An unbreakable and unpaddable (i.e. not expanded during filling) space. (Note: This is a backslash followed by a space.)

`\~` Escape  
 An unbreakable space that stretches like a normal inter-word space when a line is adjusted.

`\|` Escape  
 A 1/6 th em space. Ignored for TTY output devices (rounded to zero).

`\^` Escape  
 A 1/12 th em space. Ignored for TTY output devices (rounded to zero).

`\0` Escape  
 A space the size of a digit.

The following string sets the  $\text{T}_\text{E}\text{X}$  logo:

```
.ds TeX T\h'- .1667m'\v'.224m'E\v'- .224m'\h'- .125m'X
```

|                       |          |
|-----------------------|----------|
| <code>\w'text'</code> | Escape   |
| <code>\n[st]</code>   | Register |
| <code>\n[sb]</code>   | Register |
| <code>\n[rst]</code>  | Register |
| <code>\n[rsb]</code>  | Register |
| <code>\n[ct]</code>   | Register |
| <code>\n[ssc]</code>  | Register |
| <code>\n[skw]</code>  | Register |

Return the width of the specified *text* in basic units. This allows horizontal movement based on the width of some arbitrary text (e.g. given as an argument to a macro).

The length of the string `'abc'` is `\w'abc'u`.

⇒ The length of the string `'abc'` is 72u.

Font changes may occur in *text* which don't affect current settings.

After use, `\w` sets several registers:

|                                  |                                                                                                                                                                                                                                                                                |                                                    |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| <b>st</b>                        |                                                                                                                                                                                                                                                                                |                                                    |
| <b>sb</b>                        | The highest and lowest point of the baseline, respectively, in <i>text</i> .                                                                                                                                                                                                   |                                                    |
| <b>rst</b>                       |                                                                                                                                                                                                                                                                                |                                                    |
| <b>rsb</b>                       | Like the <b>st</b> and <b>sb</b> registers, but takes account of the heights and depths of glyphs. With other words, this gives the highest and lowest point of <i>text</i> .                                                                                                  |                                                    |
| <b>ct</b>                        | Defines the kinds of glyphs occurring in <i>text</i> :                                                                                                                                                                                                                         |                                                    |
|                                  | 0                                                                                                                                                                                                                                                                              | only short glyphs, no descenders or tall glyphs.   |
|                                  | 1                                                                                                                                                                                                                                                                              | at least one descender.                            |
|                                  | 2                                                                                                                                                                                                                                                                              | at least one tall glyph.                           |
|                                  | 3                                                                                                                                                                                                                                                                              | at least one each of a descender and a tall glyph. |
| <b>ssc</b>                       | The amount of horizontal space (possibly negative) that should be added to the last glyph before a subscript.                                                                                                                                                                  |                                                    |
| <b>skw</b>                       | How far to right of the center of the last glyph in the <code>\w</code> argument, the center of an accent from a roman font should be placed over that glyph.                                                                                                                  |                                                    |
| <code>\kp</code>                 |                                                                                                                                                                                                                                                                                | Escape                                             |
| <code>\k(ps)</code>              |                                                                                                                                                                                                                                                                                | Escape                                             |
| <code>\k[<i>position</i>]</code> |                                                                                                                                                                                                                                                                                | Escape                                             |
|                                  | Store the current horizontal position in the <i>input</i> line in number register with name <i>position</i> (one-character name <i>p</i> , two-character name <i>ps</i> ). Use this, for example, to return to the beginning of a string for highlighting or other decoration. |                                                    |
| <code>\n[hp]</code>              |                                                                                                                                                                                                                                                                                | Register                                           |
|                                  | The current horizontal position at the input line.                                                                                                                                                                                                                             |                                                    |
| <code>\n[.k]</code>              |                                                                                                                                                                                                                                                                                | Register                                           |
|                                  | A read-only number register containing the current horizontal output position.                                                                                                                                                                                                 |                                                    |
| <code>\o'abc'</code>             |                                                                                                                                                                                                                                                                                | Escape                                             |
|                                  | Overstrike glyphs <i>a</i> , <i>b</i> , <i>c</i> , . . . ; the glyphs are centered, and the resulting spacing is the largest width of the affected glyphs.                                                                                                                     |                                                    |
| <code>\zg</code>                 |                                                                                                                                                                                                                                                                                | Escape                                             |
|                                  | Print glyph <i>g</i> with zero width, i.e., without spacing. Use this to overstrike glyphs left-aligned.                                                                                                                                                                       |                                                    |

`\Z'anything'` Escape

Print *anything*, then restore the horizontal and vertical position. The argument may not contain tabs or leaders.

The following is an example of a strike-through macro:

```
.de ST
.nr ww \w'\$1'
\Z@\v'-.25m'\l'\n[ww]u'@\$1
..
.
This is
.ST "a test"
an actual emergency!
```

## 5.24 Drawing Requests

`gtroff` provides a number of ways to draw lines and other figures on the page. Used in combination with the page motion commands (see [Section 5.23 \[Page Motions\]](#), page 125, for more info), a wide variety of figures can be drawn. However, for complex drawings these operations can be quite cumbersome, and it may be wise to use graphic preprocessors like `gpic` or `ggrn`. See [Section 6.3 \[gpic\]](#), page 163, and [Section 6.4 \[ggrn\]](#), page 163, for more information.

All drawing is done via escapes.

`\l'l'` Escape

`\l'lg'` Escape

Draw a line horizontally. *l* is the length of the line to be drawn. If it is positive, start the line at the current location and draw to the right; its end point is the new current location. Negative values are handled differently: The line starts at the current location and draws to the left, but the current location doesn't move.

*l* can also be specified absolutely (i.e. with a leading '|') which draws back to the beginning of the input line. Default scaling indicator is 'm'.

The optional second parameter *g* is a glyph to draw the line with. If this second argument is not specified, `gtroff` uses the underscore glyph, `\[ru]`.

To separate the two arguments (to prevent `gtroff` from interpreting a drawing glyph as a scaling indicator if the glyph is represented by a single character) use `\&`.

Here a small useful example:

```
.de box
\[br]\$*\[br]\l'|0\[rn]'\l'|0\[ul]'
..
```

Note that this works by outputting a box rule (a vertical line), then the text given as an argument and then another box rule. Finally, the line drawing escapes both draw from the current location to the beginning of the *input* line – this works because the line length is negative, not moving the current point.

`\L'l'` Escape  
`\L'lg'` Escape

Draw vertical lines. Its parameters are similar to the `\l` escape, except that the default scaling indicator is 'v'. The movement is downwards for positive values, and upwards for negative values. The default glyph is the box rule glyph, `\[br]`. As with the vertical motion escapes, text processing blindly continues where the line ends.

This is a `\L'3v'test`.

Here the result, produced with `grotty`.

```
This is a
 |
 |
 |test.
```

`\D'command arg ...'` Escape

The `\D` escape provides a variety of drawing functions. Note that on character devices, only vertical and horizontal lines are supported within `grotty`; other devices may only support a subset of the available drawing functions.

The default scaling indicator for all subcommands of `\D` is 'm' for horizontal distances and 'v' for vertical ones. Exceptions are `\D'f ...'` and `\D't ...'` which use u as the default.

`\D'l dx dy'`

Draw a line from the current location to the relative point specified by  $(dx,dy)$ .

The following example is a macro for creating a box around a text string; for simplicity, the box margin is taken as a fixed value, 0.2 m.

```

.de BOX
. nr @wd \w'\\$1'
\h'.2m'\
\h'-.2m'\v'(.2m - \n[rsb]u)'\
\D'1 0 -(\n[rst]u - \n[rsb]u + .4m)'\
\D'1 (\n[@wd]u + .4m) 0'\
\D'1 0 (\n[rst]u - \n[rsb]u + .4m)'\
\D'1 -(\n[@wd]u + .4m) 0'\
\h'.2m'\v'-.2m - \n[rsb]u)'\
\\$1\
\h'.2m'
..

```

First, the width of the string is stored in register `@wd`. Then, four lines are drawn to form a box, properly offset by the box margin. The registers `rst` and `rsb` are set by the `\w` escape, containing the largest height and depth of the whole string.

- `\D'c d'` Draw a circle with a diameter of  $d$  with the leftmost point at the current position.
- `\D'C d'` Draw a solid circle with the same parameters as an outlined circle. No outline is drawn.
- `\D'e x y'` Draw an ellipse with a horizontal diameter of  $x$  and a vertical diameter of  $y$  with the leftmost point at the current position.
- `\D'E x y'` Draw a solid ellipse with the same parameters as an outlined ellipse. No outline is drawn.
- `\D'a dx1 dy1 dx2 dy2'`  
Draw an arc clockwise from the current location through the two specified relative locations  $(dx1,dy1)$  and  $(dx2,dy2)$ . The coordinates of the first point are relative to the current position, and the coordinates of the second point are relative to the first point.
- `\D'~ dx1 dy1 dx2 dy2 ...'`  
Draw a spline from the current location to the relative point  $(dx1,dy1)$  and then to  $(dx2,dy2)$ , and so on.
- `\D'f n'` Set the shade of gray to be used for filling solid objects to  $n$ ;  $n$  must be an integer between 0 and 1000, where 0 corresponds solid white and 1000 to solid black, and values in between correspond to intermediate shades of gray. This applies only to solid circles, solid ellipses, and solid polygons. By default, a level of 1000 is used.
- `\D'p dx1 dy1 dx2 dy2 ...'`  
Draw a polygon from the current location to the relative position  $(dx1,dy1)$  and then to  $(dx2,dy2)$  and so on. When the

specified data points are exhausted, a line is drawn back to the starting point.

`\D'P dx1 dy1 dx2 dy2 ...'`

Draw a solid polygon with the same parameters as an outlined polygon. No outline is drawn.

Here a better variant of the box macro to fill the box with some color. Note that the box must be drawn before the text since colors in `gtroff` are not transparent; the filled polygon would hide the text completely.

```
.de BOX
. nr @wd \w'\$$1'
\h'.2m'\
\h'-.2m'\v'(.2m - \n[rsb]u)'\
\M[lightcyan]\
\D'P 0 -(\n[rst]u - \n[rsb]u + .4m) \
 (\n[@wd]u + .4m) 0 \
 0 (\n[rst]u - \n[rsb]u + .4m) \
 -(\n[@wd]u + .4m) 0'\
\h'.2m'\v'-(.2m - \n[rsb]u)'\
\M[]\
\$$1\
\h'.2m'
..
```

`\D't n'` Set the current line thickness to  $n$  machine units. A value of zero selects the smallest available line thickness. A negative value makes the line thickness proportional to the current point size (this is the default behaviour of AT&T `troff`).

See Section 8.1.2.3 [Graphics Commands], page 172.

`\b'string'`

Escape

Pile a sequence of glyphs vertically, and center it vertically on the current line. Use it to build large brackets and braces.

Here an example how to create a large opening brace:

```
\b'\[1t]\[bv]\[1k]\[bv]\[1b]'
```

The first glyph is on the top, the last glyph in *string* is at the bottom. Note that `gtroff` separates the glyphs vertically by 1m, and the whole object is centered 0.5m above the current baseline; the largest glyph width is used as the width for the whole object. This rather inflexible positioning algorithm doesn't work with `'-Tdvi'` since the bracket pieces vary in height for this device. Instead, use the `eqn` preprocessor.

See Section 5.10 [Manipulating Spacing], page 76, how to adjust the vertical spacing with the `\x` escape.

## 5.25 Traps

*Traps* are locations, which, when reached, call a specified macro. These traps can occur at a given location on the page, at a given location in the current diversion, at a blank line, after a certain number of input lines, or at the end of input.

Setting a trap is also called *planting*. It is also said that a trap is *sprung* if the associated macro is executed.

### 5.25.1 Page Location Traps

*Page location traps* perform an action when `gtroff` reaches or passes a certain vertical location on the page. Page location traps have a variety of purposes, including:

- setting headers and footers
- setting body text in multiple columns
- setting footnotes

`.vpt` *flag* Request  
`\n[.vpt]` Register

Enable vertical position traps if *flag* is non-zero, or disables them otherwise. Vertical position traps are traps set by the `wh` or `dt` requests. Traps set by the `it` request are not vertical position traps. The parameter that controls whether vertical position traps are enabled is global. Initially vertical position traps are enabled. The current setting of this is available in the `.vpt` read-only number register.

`.wh` *dist* [*macro*] Request

Set a page location trap. Positive values for *dist* set the trap relative to the top of the page; negative values set the trap relative to the bottom of the page. Default scaling indicator is ‘v’.

*macro* is the name of the macro to execute when the trap is sprung. If *macro* is missing, remove the first trap (if any) at *dist*.

The following is a simple example of how many macro packages set headers and footers.

```

.de hd \" Page header
' sp .5i
. tl 'Title''date'
' sp .3i
..
.
.de fo \" Page footer
' sp 1v
. tl ''%'
' bp
..
.
.wh 0 hd \" trap at top of the page
.wh -1i fo \" trap one inch from bottom

```

A trap at or below the bottom of the page is ignored; it can be made active by either moving it up or increasing the page length so that the trap is on the page.

It is possible to have more than one trap at the same location; to do so, the traps must be defined at different locations, then moved together with the `ch` request; otherwise the second trap would replace the first one. Earlier defined traps hide later defined traps if moved to the same position (the many empty lines caused by the `bp` request are omitted):

```

.de a
. nop a
..
.de b
. nop b
..
.de c
. nop c
..
.
.wh 1i a
.wh 2i b
.wh 3i c
.bp
⇒ a b c

.ch b 1i
.ch c 1i
.bp
⇒ a

```

```
.ch a 0.5i
.bp
⇒ a b
```

`\n[.t]` Register

A read-only number register holding the distance to the next trap.

If there are no traps between the current position and the bottom of the page, it contains the distance to the page bottom. In a diversion, the distance to the page bottom is infinite (the returned value is the biggest integer which can be represented in `groff`) if there are no diversion traps.

`.ch macro dist` Request

Change the location of a trap. The first argument is the name of the macro to be invoked at the trap, and the second argument is the new location for the trap (note that the parameters are specified the opposite of the `.wh` request). This is useful for building up footnotes in a diversion to allow more space at the bottom of the page for them.

Default scaling indicator for `dist` is ‘v’. If `dist` is missing, the trap is removed.

`\n[.ne]` Register

The read-only number register `.ne` contains the amount of space that was needed in the last `ne` request that caused a trap to be sprung. Useful in conjunction with the `.trunc` register. See [Section 5.17 \[Page Control\]](#), [page 93](#), for more information.

`\n[.trunc]` Register

A read-only register containing the amount of vertical space truncated by the most recently sprung vertical position trap, or, if the trap was sprung by an `ne` request, minus the amount of vertical motion produced by the `ne` request. In other words, at the point a trap is sprung, it represents the difference of what the vertical position would have been but for the trap, and what the vertical position actually is.

## 5.25.2 Diversion Traps

`.dt dist macro` Request

Set a trap *within* a diversion. `dist` is the location of the trap (identical to the `.wh` request; default scaling indicator is ‘v’) and `macro` is the name of the macro to be invoked. The number register `.t` still works within diversions. See [Section 5.26 \[Diversions\]](#), [page 137](#), for more information.

### 5.25.3 Input Line Traps

`.it n macro` Request  
`.itc n macro` Request

Set an input line trap. *n* is the number of lines of input which may be read before springing the trap, *macro* is the macro to be invoked. Request lines are not counted as input lines.

For example, one possible use is to have a macro which prints the next *n* lines in a bold font.

```
.de B
. it \\$1 B-end
. ft B
..
.
.de B-end
. ft R
..
```

The `itc` request is identical, except that a line interrupted with `\c` counts as one input line.

Both requests are associated with the current environment (see [Section 5.27 \[Environments\], page 141](#)); switching to another environment disables the current input trap, and going back reactivates it, restoring the number of already processed lines.

### 5.25.4 Blank Line Traps

`.blm macro` Request  
 Set a blank line trap. `gtroff` executes *macro* when it encounters a blank line in the input file.

### 5.25.5 End-of-input Traps

`.em macro` Request  
 Set a trap at the end of input. *macro* is executed after the last line of the input file has been processed.

For example, if the document had to have a section at the bottom of the last page for someone to approve it, the `em` request could be used.

```

.de approval
. ne 5v
. sp |(\n[.t] - 6v)
. in +4i
. lc _
. br
Approved:\t\a
. sp
Date:\t\t\a
..
.
.em approval

```

## 5.26 Diversions

In `gtroff` it is possible to *divert* text into a named storage area. Due to the similarity to defining macros it is sometimes said to be stored in a macro. This is used for saving text for output at a later time, which is useful for keeping blocks of text on the same page, footnotes, tables of contents, and indices.

For orthogonality it is said that `gtroff` is in the *top-level diversion* if no diversion is active (i.e., the data is diverted to the output device).

|                        |         |
|------------------------|---------|
| <code>.di macro</code> | Request |
| <code>.da macro</code> | Request |

Begin a diversion. Like the `de` request, it takes an argument of a macro name to divert subsequent text into. The `da` macro appends to an existing diversion.

`di` or `da` without an argument ends the diversion.

|                          |         |
|--------------------------|---------|
| <code>.box macro</code>  | Request |
| <code>.boxa macro</code> | Request |

Begin (or appends to) a diversion like the `di` and `da` requests. The difference is that `box` and `boxa` do not include a partially-filled line in the diversion.

Compare this:

```

Before the box.
.box xxx
In the box.
.br
.box
After the box.
.br
 ⇒ Before the box. After the box.
.xxx
 ⇒ In the box.

```

with this:

```

Before the diversion.
.di yyy
In the diversion.
.br
.di
After the diversion.
.br
 ⇒ After the diversion.
.yyy
 ⇒ Before the diversion. In the diversion.

```

box or boxa without an argument ends the diversion.

`\n[.z]` Register  
`\n[.d]` Register

Diversions may be nested. The read-only number register `.z` contains the name of the current diversion (this is a string-valued register). The read-only number register `.d` contains the current vertical place in the diversion. If not in a diversion it is the same as the register `nl`.

`\n[.h]` Register

The *high-water mark* on the current page. It corresponds to the text baseline of the lowest line on the page. This is a read-only register.

```

.tm .h==\n[.h], nl==\n[nl]
 ⇒ .h==0, nl==-1

```

This is a test.

```

.br
.sp 2
.tm .h==\n[.h], nl==\n[nl]
 ⇒ .h==40, nl==120

```

As can be seen in the previous example, empty lines are not considered in the return value of the `.h` register.

`\n[dn]` Register  
`\n[d1]` Register

After completing a diversion, the read-write number registers `dn` and `d1` contain the vertical and horizontal size of the diversion.

```

.\" Center text both horizontally & vertically
.
.\" Enclose macro definitions in .eo and .ec
.\" to avoid the doubling of the backslash
.eo
.\" macro .(c starts centering mode
.de (c
. br
. ev (c
. evc 0
. in 0
. nf
. di @c
..
.\" macro .)c terminates centering mode
.de)c
. br
. ev
. di
. nr @s (((\n[.t]u - \n[dn]u) / 2u) - 1v)
. sp \n[@s]u
. ce 1000
. @c
. ce 0
. sp \n[@s]u
. br
. fi
. rr @s
. rm @s
. rm @c
..
.\" End of macro definitions, restore escape mechanism
.ec

```

`\!` Escape  
`\?anything\?` Escape

Prevent requests, macros, and escapes from being interpreted when read into a diversion. This takes the given text and *transparently* embeds it into the diversion. This is useful for macros which shouldn't be invoked until the diverted text is actually output.



**.asciify** *div*

Request

*Unformat* the diversion specified by *div* in such a way that ASCII characters, characters translated with the `trin` request, space characters, and some escape sequences that were formatted and diverted are treated like ordinary input characters when the diversion is reread. It can be also used for gross hacks; for example, the following sets register `n` to 1.

```
.tr @.
.di x
@nr n 1
.br
.di
.tr @@
.asciify x
.x
```

See [Section 5.22.1 \[Copy-in Mode\]](#), page 123.

**.unformat** *div*

Request

Like `asciify`, `unformat` the specified diversion. However, `unformat` only unformats spaces and tabs between words. Unformatted tabs are treated as input tokens, and spaces are stretchable again.

The vertical size of lines is not preserved; glyph information (font, font size, space width, etc.) is retained.

## 5.27 Environments

It happens frequently that some text should be printed in a certain format regardless of what may be in effect at the time, for example, in a trap invoked macro to print headers and footers. To solve this `gtroff` processes text in *environments*. An environment contains most of the parameters that control text processing. It is possible to switch amongst these environments; by default `gtroff` processes text in environment 0. The following is the information kept in an environment.

- font parameters (size, family, style, glyph height and slant, space and sentence space size)
- page parameters (line length, title length, vertical spacing, line spacing, indentation, line numbering, centering, right-justifying, underlining, hyphenation data)
- fill and adjust mode
- tab stops, tab and leader characters, escape character, no-break and hyphen indicators, margin character data
- partially collected lines
- input traps
- drawing and fill colours

These environments may be given arbitrary names (see [Section 5.5 \[Identifiers\]](#), page 54, for more info). Old versions of `troff` only had environments named ‘0’, ‘1’, and ‘2’.

`.ev [env]` Request  
`\n[.ev]` Register

Switch to another environment. The argument *env* is the name of the environment to switch to. With no argument, `gtroff` switches back to the previous environment. There is no limit on the number of named environments; they are created the first time that they are referenced. The `.ev` read-only register contains the name or number of the current environment. This is a string-valued register.

Note that a call to `ev` (with argument) pushes the previously active environment onto a stack. If, say, environments ‘foo’, ‘bar’, and ‘zap’ are called (in that order), the first `ev` request without parameter switches back to environment ‘bar’ (which is popped off the stack), and a second call switches back to environment ‘foo’.

Here is an example:

```
.ev footnote-env
.fam N
.ps 6
.vs 8
.ll -.5i
.ev

...

.ev footnote-env
\dg Note the large, friendly letters.
.ev
```

`.evc env` Request

Copy the environment *env* into the current environment.

The following environment data is not copied:

- Partially filled lines.
- The status whether the previous line was interrupted.
- The number of lines still to center, or to right-justify, or to underline (with or without underlined spaces); they are set to zero.
- The status whether a temporary indent is active.
- Input traps and its associated data.
- Line numbering mode is disabled; it can be reactivated with ‘.nm +0’.
- The number of consecutive hyphenated lines (set to zero).

|                       |          |
|-----------------------|----------|
| <code>\n[.cht]</code> | Register |
| <code>\n[.cdp]</code> | Register |
| <code>\n[.csk]</code> | Register |

The `\n[.cht]` register contains the maximum extent (above the baseline) of the last glyph added to the current environment.

The `\n[.cdp]` register contains the maximum extent (below the baseline) of the last glyph added to the current environment.

The `\n[.csk]` register contains the *skew* (how far to the right of the glyph's center that `gtroff` should place an accent) of the last glyph added to the current environment.

## 5.28 Suppressing output

|                    |        |
|--------------------|--------|
| <code>\0num</code> | Escape |
|--------------------|--------|

Disable or enable output depending on the value of *num*:

`\00` Disable any glyphs from being emitted to the device driver, provided that the escape occurs at the outer level (see `\0[3]` and `\0[4]`). Motion is not suppressed so effectively `\0[0]` means *pen up*.

`\01` Enable output of glyphs, provided that the escape occurs at the outer level.

`\00` and `\01` also reset the four registers `'opminx'`, `'opminy'`, `'opmaxx'`, and `'opmaxy'` to `-1`. See E [Register Index], page 205. These four registers mark the top left and bottom right hand corners of a box which encompasses all written glyphs.

For example the input text:

```
Hello \0[0]world \0[1]this is a test.
```

produces the following output:

```
Hello this is a test.
```

`\02` Provided that the escape occurs at the outer level, enable output of glyphs and also write out to `stderr` the page number and four registers encompassing the glyphs previously written since the last call to `\0`.

`\03` Begin a nesting level. At start-up, `gtroff` is at outer level.

`\04` End a nesting level.

`\0[5Pfilename]`

This escape is `grohtml` specific. Provided that this escape occurs at the outer nesting level write the *filename* to `stderr`. The position of the image, *P*, must be specified and must be one of `l`, `r`, `c`, or `i` (left, right, centered, inline). *filename* will be associated with the production of the next inline image.

## 5.29 Colors

`.color [n]` Request  
`\n[.color]` Register

If *n* is missing or non-zero, activate colors (this is the default); otherwise, turn it off.

The read-only number register `.color` is 1 if colors are active, 0 otherwise.

Internally, `color` sets a global flag; it does not produce a token. Similar to the `cp` request, you should use it at the beginning of your document to control color output.

Colors can be also turned off with the ‘-c’ command line option.

`.defcolor ident scheme color_components` Request

Define color with name *ident*. *scheme* can be one of the following values: `rgb` (three components), `cym` (three components), `cmk` (four components), and `gray` or `grey` (one component).

Color components can be given either as a hexadecimal string or as positive decimal integers in the range 0–65535. A hexadecimal string contains all color components concatenated. It must start with either `#` or `##`; the former specifies hex values in the range 0–255 (which are internally multiplied by 257), the latter in the range 0–65535. Examples: `#FFC0CB` (pink), `##ffff0000ffff` (magenta). The default color name value is device-specific (usually black). It is possible that the default color for `\m` and `\M` is not identical.

A new scaling indicator `f` has been introduced which multiplies its value by 65536; this makes it convenient to specify color components as fractions in the range 0 to 1 (1f equals 65536u). Example:

```
.defcolor darkgreen rgb 0.1f 0.5f 0.2f
```

Note that `f` is the default scaling indicator for the `defcolor` request, thus the above statement is equivalent to

```
.defcolor darkgreen rgb 0.1 0.5 0.2
```

`\mc` Escape  
`\m(co` Escape  
`\m[color]` Escape

Set drawing color. The following example shows how to turn the next four words red.

```
\m[red]these are in red\m[] and these words are in black.
```

The escape `\m[]` returns to the previous color.

The drawing color is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

Note that `\m` doesn't produce an input token in `gtroff`. As a consequence, it can be used in requests like `mc` (which expects a single character as an argument) to change the color on the fly:

```
.mc \m[red]x\m[]
```

|                               |        |
|-------------------------------|--------|
| <code>\Mc</code>              | Escape |
| <code>\M(co</code>            | Escape |
| <code>\M[<i>color</i>]</code> | Escape |

Set background color for filled objects drawn with the `\D'...'` commands.

A red ellipse can be created with the following code:

```
\M[red]\h'0.5i'\D'E 2i 1i'\M[]
```

The escape `\M[]` returns to the previous fill color.

The fill color is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

Note that `\M` doesn't produce an input token in `gtroff`.

### 5.30 I/O

`gtroff` has several requests for including files:

|                              |         |
|------------------------------|---------|
| <code>.so <i>file</i></code> | Request |
|------------------------------|---------|

Read in the specified *file* and includes it in place of the `so` request. This is quite useful for large documents, e.g. keeping each chapter in a separate file. See [Section 6.7 \[gsoelim\]](#), page 163, for more information.

Since `gtroff` replaces the `so` request with the contents of *file*, it makes a difference whether the data is terminated with a newline or not: Assuming that file `'xxx'` contains the word `'foo'` without a final newline, this

```
This is
.so xxx
bar
```

yields `'This is foobar'`.

|                                  |         |
|----------------------------------|---------|
| <code>.pso <i>command</i></code> | Request |
|----------------------------------|---------|

Read the standard output from the specified *command* and includes it in place of the `pso` request.

This request causes an error if used in safer mode (which is the default). Use `groff's` or `troff's` `'-U'` option to activate unsafe mode.

The comment regarding a final newline for the `so` request is valid for `pso` also.

|                               |         |
|-------------------------------|---------|
| <code>.mso <i>file</i></code> | Request |
|-------------------------------|---------|

Identical to the `so` request except that `gtroff` searches for the specified *file* in the same directories as macro files for the the `'-m'` command line

option. If the file name to be included has the form ‘*name.tmac*’ and it isn’t found, *mso* tries to include ‘*tmac.name*’ and vice versa.

**.trf *file*** Request  
**.cf *file*** Request

Transparently output the contents of *file*. Each line is output as if it were preceded by \!; however, the lines are not subject to copy mode interpretation. If the file does not end with a newline, then a newline is added (*trf* only). For example, to define a macro *x* containing the contents of file ‘*f*’, use

```
.di x
.trf f
.di
```

Both *trf* and *cf*, when used in a diversion, embeds an object in the diversion which, when reread, causes the contents of *file* to be transparently copied through to the output. In UNIX *troff*, the contents of *file* is immediately copied through to the output regardless of whether there is a current diversion; this behaviour is so anomalous that it must be considered a bug.

While *cf* copies the contents of *file* completely unprocessed, *trf* disallows characters such as NUL that are not valid *gtroff* input characters (see [Section 5.5 \[Identifiers\], page 54](#)).

Both requests cause a line break.

**.nx [*file*]** Request  
 Force *gtroff* to continue processing of the file specified as an argument. If no argument is given, immediately jump to the end of file.

**.rd [*prompt* [*arg1 arg2 ...*]]** Request  
 Read from standard input, and include what is read as though it were part of the input file. Text is read until a blank line is encountered. If standard input is a TTY input device (keyboard), write *prompt* to standard error, followed by a colon (or send BEL for a beep if no argument is given).

Arguments after *prompt* are available for the input. For example, the line

```
.rd data foo bar
```

with the input ‘This is \\$.’ prints

```
This is bar.
```

Using the *nx* and *rd* requests, it is easy to set up form letters. The form letter template is constructed like this, putting the following lines into a file called ‘*repeat.let*’:

```
.ce
*(td
.sp 2
.nf
.rd
.sp
.rd
.fi
Body of letter.
.bp
.nx repeat.let
```

When this is run, a file containing the following lines should be redirected in. Note that requests included in this file are executed as though they were part of the form letter. The last block of input is the `ex` request which tells `groff` to stop processing. If this was not there, `groff` would not know when to stop.

```
Trent A. Fisher
708 NW 19th Av., #202
Portland, OR 97209
```

```
Dear Trent,
```

```
Len Adollar
4315 Sierra Vista
San Diego, CA 92103
```

```
Dear Mr. Adollar,
```

```
.ex
```

`.pi pipe` Request

Pipe the output of `gtroff` to the shell command(s) specified by *pipe*. This request must occur before `gtroff` has a chance to print anything.

`pi` causes an error if used in safer mode (which is the default). Use `groff`'s or `troff`'s `'-U'` option to activate unsafe mode.

Multiple calls to `pi` are allowed, acting as a chain. For example,

```
.pi foo
.pi bar
...
```

is the same as `'pi foo | bar'`.

Note that the intermediate output format of `gtroff` is piped to the specified commands. Consequently, calling `groff` without the `'-Z'` option normally causes a fatal error.

`.sy cmds` Request  
`\n[systat]` Register

Execute the shell command(s) specified by *cmds*. The output is not saved anywhere, so it is up to the user to do so.

This request causes an error if used in safer mode (which is the default). Use `groff`'s or `troff`'s `-U` option to activate unsafe mode.

For example, the following code fragment introduces the current time into a document:

```
.sy perl -e 'printf ".nr H %d\n.nr M %d\n.nr S %d\n",\
 (localtime(time))[2,1,0]' > /tmp/x\n[$$]
.so /tmp/x\n[$$]
.sy rm /tmp/x\n[$$]
\nH:\nM:\nS
```

Note that this works by having the `perl` script (run by `sy`) print out the `nr` requests which set the number registers `H`, `M`, and `S`, and then reads those commands in with the `so` request.

For most practical purposes, the number registers `seconds`, `minutes`, and `hours` which are initialized at start-up of `gtroff` should be sufficient. Use the `af` request to get a formatted output:

```
.af hours 00
.af minutes 00
.af seconds 00
\n[hours]:\n[minutes]:\n[seconds]
```

The `systat` read-write number register contains the return value of the `system()` function executed by the last `sy` request.

`.open stream file` Request  
`.opena stream file` Request

Open the specified *file* for writing and associates the specified *stream* with it.

The `opena` request is like `open`, but if the file exists, append to it instead of truncating it.

Both `open` and `opena` cause an error if used in safer mode (which is the default). Use `groff`'s or `troff`'s `-U` option to activate unsafe mode.

`.write stream data` Request  
`.writec stream data` Request

Write to the file associated with the specified *stream*. The stream must previously have been the subject of an open request. The remainder of the line is interpreted as the `ds` request reads its second argument: A leading `"` is stripped, and it is read in copy-in mode.

The `writetc` request is like `write`, but only `write` appends a newline to the data.

`.writem stream xx` Request  
 Write the contents of the macro or string `xx` to the file associated with the specified `stream`.  
`xx` is read in copy mode, i.e., already formatted elements are ignored. Consequently, diversions must be unformatted with the `asciify` request before calling `writem`. Usually, this means a loss of information.

`.close stream` Request  
 Close the specified `stream`; the stream is no longer an acceptable argument to the `write` request.  
 Here a simple macro to write an index entry.

```
.open idx test.idx
.
.de IX
. write idx \\n[%] \\$*
..
.
.IX test entry
.
.close idx
```

`\Ve` Escape  
`\V(ev` Escape  
`\V[env]` Escape  
 Interpolate the contents of the specified environment variable `env` (one-character name `e`, two-character name `ev`) as returned by the function `getenv`. `\V` is interpreted in copy-in mode.

### 5.31 Postprocessor Access

There are two escapes which give information directly to the postprocessor. This is particularly useful for embedding `POSTSCRIPT` into the final document.

`\X'xxx'` Escape  
 Embeds its argument into the `gtroff` output preceded with `'x X'`.  
 The escapes `&`, `\)`, `\%`, and `\:` are ignored within `\X`, `\'` and `\~` are converted to single space characters. All other escapes (except `\\` which produces a backslash) cause an error.  
 If the `'use_charnames_in_special'` keyword is set in the `'DESC'` file, special characters no longer cause an error; the name `xx` is represented as `\'(xx)'` in the `'x X'` output command. Additionally, the backslash is represented as `\\`.  
`'use_charnames_in_special'` is currently used by `grohtml` only.

|                       |        |
|-----------------------|--------|
| <code>\Yn</code>      | Escape |
| <code>\Y(nm</code>    | Escape |
| <code>\Y[name]</code> | Escape |

This is approximately equivalent to ‘`\X’\*[name]’`’ (one-character name *n*, two-character name *nm*). However, the contents of the string or macro *name* are not interpreted; also it is permitted for *name* to have been defined as a macro and thus contain newlines (it is not permitted for the argument to `\X` to contain newlines). The inclusion of newlines requires an extension to the UNIX `troff` output format, and confuses drivers that do not know about this extension (see [Section 8.1.2.4 \[Device Control Commands\]](#), page 175).

See [Chapter 7 \[Output Devices\]](#), page 165.

## 5.32 Miscellaneous

This section documents parts of `gtroff` which cannot (yet) be categorized elsewhere in this manual.

`.nm [start [inc [space [indent]]]]` Request

Print line numbers. *start* is the line number of the *next* output line. *inc* indicates which line numbers are printed. For example, the value 5 means to emit only line numbers which are multiples of 5; this defaults to 1. *space* is the space to be left between the number and the text; this defaults to one digit space. The fourth argument is the indentation of the line numbers, defaulting to zero. Both *space* and *indent* are given as multiples of digit spaces; they can be negative also. Without any arguments, line numbers are turned off.

`gtroff` reserves three digit spaces for the line number (which is printed right-justified) plus the amount given by *indent*; the output lines are concatenated to the line numbers, separated by *space*, and *without* reducing the line length. Depending on the value of the horizontal page offset (as set with the `po` request), line numbers which are longer than the reserved space stick out to the left, or the whole line is moved to the right.

Parameters corresponding to missing arguments are not changed; any non-digit argument (to be more precise, any argument starting with a character valid as a delimiter for identifiers) is also treated as missing.

If line numbering has been disabled with a call to `nm` without an argument, it can be reactivated with ‘`.nm +0`’, using the previously active line numbering parameters.

The parameters of `nm` are associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141). The current output line number is available in the number register `ln`.

```
.po 1m
.ll 2i
This test shows how line numbering works with groff.
.nm 999
This test shows how line numbering works with groff.
.br
.nm xxx 3 2
.ll -\w'0'u
This test shows how line numbering works with groff.
.nn 2
This test shows how line numbering works with groff.
```

And here the result:

```
This test shows how
line numbering works
999 with groff. This
1000 test shows how line
1001 numbering works with
1002 groff.
 This test shows how
 line numbering
works with groff.
This test shows how
1005 line numbering
works with groff.
```

`.nn` [*skip*] Request  
Temporarily turn off line numbering. The argument is the number of lines not to be numbered; this defaults to 1.

`.mc` *glyph* [*dist*] Request  
Print a *margin character* to the right of the text.<sup>15</sup> The first argument is the glyph to be printed. The second argument is the distance away from the right margin. If missing, the previously set value is used; default is 10pt). For text lines that are too long (that is, longer than the text length plus *dist*), the margin character is directly appended to the lines. With no arguments the margin character is turned off. If this occurs before a break, no margin character is printed.  
For empty lines and lines produced by the `tl` request no margin character is emitted.

The margin character is associated with the current environment (see [Section 5.27 \[Environments\]](#), page 141).

---

<sup>15</sup> *Margin character* is a misnomer since it is an output glyph.

This is quite useful for indicating text that has changed, and, in fact, there are programs available for doing this (they are called `nrcbar` and `changebar` and can be found in any ‘`comp.sources.unix`’ archive.

```
.ll 3i
.mc |
This paragraph is highlighted with a margin
character.
.sp
Note that vertical space isn't marked.
.br
\&
.br
But we can fake it with '\&'.
```

Result:

```
This paragraph is highlighted |
with a margin character. |

Note that vertical space isn't |
marked. |

But we can fake it with '\&' |
```

|                             |          |
|-----------------------------|----------|
| <code>.psbb filename</code> | Request  |
| <code>\n[llx]</code>        | Register |
| <code>\n[lly]</code>        | Register |
| <code>\n[urx]</code>        | Register |
| <code>\n[ury]</code>        | Register |

Retrieve the bounding box of the PostScript image found in *filename*. The file must conform to Adobe’s *Document Structuring Conventions* (DSC); the command searches for a `%%BoundingBox` comment and extracts the bounding box values into the number registers `llx`, `lly`, `urx`, and `ury`. If an error occurs (for example, `psbb` cannot find the `%%BoundingBox` comment), it sets the four number registers to zero.

### 5.33 gtroff Internals

`gtroff` processes input in three steps. One or more input characters are converted to an *input token*.<sup>16</sup> Then, one or more input tokens are converted to an *output node*. Finally, output nodes are converted to the intermediate output language understood by all output devices.

Actually, before step one happens, `gtroff` converts certain escape sequences into reserved input characters (not accessible by the user); such

<sup>16</sup> Except the escapes `\f`, `\F`, `\H`, `\m`, `\M`, `\R`, `\s`, and `\S` which are processed immediately if not in copy-in mode.

reserved characters are used for other internal processing also – this is the very reason why not all characters are valid input. See [Section 5.5 \[Identifiers\]](#), page 54, for more on this topic.

For example, the input string `'fi\[[:u]'` is converted into a character token `'f'`, a character token `'i'`, and a special token `':u'` (representing u umlaut). Later on, the character tokens `'f'` and `'i'` are merged to a single output node representing the ligature glyph `'fi'` (provided the current font has a glyph for this ligature); the same happens with `':u'`. All output glyph nodes are `'processed'` which means that they are invariably associated with a given font, font size, advance width, etc. During the formatting process, `gtroff` itself adds various nodes to control the data flow.

Macros, diversions, and strings collect elements in two chained lists: a list of input tokens which have been passed unprocessed, and a list of output nodes. Consider the following the diversion.

```
.di xxx
a
\!b
c
.br
.di
```

It contains these elements.

| node list                 | token list      | element number |
|---------------------------|-----------------|----------------|
| <i>line start node</i>    | —               | 1              |
| <i>glyph node a</i>       | —               | 2              |
| <i>word space node</i>    | —               | 3              |
| —                         | <code>b</code>  | 4              |
| —                         | <code>\n</code> | 5              |
| <i>glyph node c</i>       | —               | 6              |
| <i>vertical size node</i> | —               | 7              |
| <i>vertical size node</i> | —               | 8              |
| —                         | <code>\n</code> | 9              |

Elements 1, 7, and 8 are inserted by `gtroff`; the latter two (which are always present) specify the vertical extent of the last line, possibly modified by `\x`. The `br` request finishes the current partial line, inserting a newline input token which is subsequently converted to a space when the diversion is reread. Note that the word space node has a fixed width which isn't stretchable anymore. To convert horizontal space nodes back to input tokens, use the `unformat` request.

Macros only contain elements in the token list (and the node list is empty); diversions and strings can contain elements in both lists.

Note that the `chop` request simply reduces the number of elements in a macro, string, or diversion by one. Exceptions are *compatibility save* and *compatibility ignore* input tokens which are ignored. The `substring` request also ignores those input tokens.

Some requests like `tr` or `cflags` work on glyph identifiers only; this means that the associated glyph can be changed without destroying this association. This can be very helpful for substituting glyphs. In the following example, we assume that glyph ‘foo’ isn’t available by default, so we provide a substitution using the `fchar` request and map it to input character ‘x’.

```
.fchar \[foo] foo
.tr x \[foo]
```

Now let us assume that we install an additional special font ‘bar’ which has glyph ‘foo’.

```
.special bar
.rchar \[foo]
```

Since glyphs defined with `fchar` are searched before glyphs in special fonts, we must call `rchar` to remove the definition of the fallback glyph. Anyway, the translation is still active; ‘x’ now maps to the real glyph ‘foo’.

## 5.34 Debugging

`gtroff` is not easy to debug, but there are some useful features and strategies for debugging.

`.lf line filename` Request

Change the line number and the file name `gtroff` shall use for error and warning messages. *line* is the input line number of the *next* line.

Without argument, the request is ignored.

This is a debugging aid for documents which are split into many files, then put together with `soelim` and other preprocessors. Usually, it isn’t invoked manually.

`.tm string` Request

`.tm1 string` Request

`.tmc string` Request

Send *string* to the standard error output; this is very useful for printing debugging messages among other things.

*string* is read in copy mode.

The `tm` request ignores leading spaces of *string*; `tm1` handles its argument similar to the `ds` request: a leading double quote in *string* is stripped to allow initial blanks.

The `tmc` request is similar to `tm1` but does not append a newline (as is done in `tm` and `tm1`).

`.ab [string]` Request

Similar to the `tm` request, except that it causes `gtroff` to stop processing.

With no argument it prints ‘User Abort.’ to standard error.

`.ex` Request  
 The `ex` request also causes `gtroff` to stop processing; see also [Section 5.30 \[I/O\]](#), page 145.

When doing something involved it is useful to leave the debugging statements in the code and have them turned on by a command line flag.

```
.if \n(DB .tm debugging output
```

To activate these statements say

```
groff -rDB=1 file
```

If it is known in advance that there will be many errors and no useful output, `gtroff` can be forced to suppress formatted output with the `-z` flag.

`.pm` Request  
 Print the entire symbol table on `stderr`. Names of all defined macros, strings, and diversions are print together with their size in bytes. Since `gtroff` sometimes adds nodes by itself, the returned size can be larger than expected.

This request differs from UNIX `troff`: `gtroff` reports the sizes of diversions, ignores an additional argument to print only the total of the sizes, and the size isn't returned in blocks of 128 characters.

`.pnr` Request  
 Print the names and contents of all currently defined number registers on `stderr`.

`.ptr` Request  
 Print the names and positions of all traps (not including input line traps and diversion traps) on `stderr`. Empty slots in the page trap list are printed as well, because they can affect the priority of subsequently planted traps.

`.fl` Request  
 Instruct `gtroff` to flush its output immediately. The intent is for interactive use, but this behaviour is currently not implemented in `gtroff`. Contrary to UNIX `troff`, TTY output is sent to a device driver also (`grotty`), making it non-trivial to communicate interactively.  
 This request causes a line break.

`.backtrace` Request  
 Print a backtrace of the input stack to the standard error stream.  
 Consider the following in file `'test'`:

```
.de xxx
. backtrace
..
.de yyy
. xxx
..
.
.yyy
```

On execution, `gtroff` prints the following:

```
test:2: backtrace: macro 'xxx'
test:5: backtrace: macro 'yyy'
test:8: backtrace: file 'test'
```

The option `-b` of `gtroff` internally calls a variant of this request on each error and warning.

`\n[slimit]` Register  
 Use the `slimit` number register to set the maximum number of objects on the input stack. If `slimit` is less than or equal to 0, there is no limit set. With no limit, a buggy recursive macro can exhaust virtual memory. The default value is 1000; this is a compile-time constant.

`.warnscale si` Request  
 Set the scaling indicator used in warnings to *si*. Valid values for *si* are `'u'`, `'i'`, `'c'`, `'p'`, and `'P'`. At startup, it is set to `'i'`.

`.spreadwarn [limit]` Request  
 Make `gtroff` emit a warning if the additional space inserted for each space between words in an output line is larger or equal to *limit*. A negative value is changed to zero; no argument toggles the warning on and off without changing *limit*. The default scaling indicator is `'m'`. At startup, `spreadwarn` is deactivated, and *limit* is set to 3 m.

For example,

```
.spreadwarn 0.2m
```

will cause a warning if `gtroff` must add 0.2 m or more for each interword space in a line.

This request is active only if text is justified to both margins (using `.ad b`).

`gtroff` has command line options for printing out more warnings (`-w`) and for printing backtraces (`-b`) when a warning or an error occurs. The most verbose level of warnings is `-ww`.

`.warn` [*flags*] Request  
`\n[.warn]` Register

Control the level of warnings checked for. The *flags* are the sum of the numbers associated with each warning that is to be enabled; all other warnings are disabled. The number associated with each warning is listed below. For example, `.warn 0` disables all warnings, and `.warn 1` disables all warnings except that about missing glyphs. If no argument is given, all warnings are enabled.

The read-only number register `.warn` contains the current warning level.

### 5.34.1 Warnings

The warnings that can be given to `gtroff` are divided into the following categories. The name associated with each warning is used by the `-w` and `-W` options; the number is used by the `warn` request and by the `.warn` register.

|                       |                                                                                                                                       |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <code>'char'</code>   |                                                                                                                                       |
| <code>'1'</code>      | Non-existent glyphs. <sup>17</sup> This is enabled by default.                                                                        |
| <code>'number'</code> |                                                                                                                                       |
| <code>'2'</code>      | Invalid numeric expressions. This is enabled by default. See <a href="#">Section 5.4 [Expressions]</a> , page 52.                     |
| <code>'break'</code>  |                                                                                                                                       |
| <code>'4'</code>      | In fill mode, lines which could not be broken so that their length was less than the line length. This is enabled by default.         |
| <code>'delim'</code>  |                                                                                                                                       |
| <code>'8'</code>      | Missing or mismatched closing delimiters.                                                                                             |
| <code>'el'</code>     |                                                                                                                                       |
| <code>'16'</code>     | Use of the <code>el</code> request with no matching <code>ie</code> request. See <a href="#">Section 5.21.2 [if-else]</a> , page 118. |
| <code>'scale'</code>  |                                                                                                                                       |
| <code>'32'</code>     | Meaningless scaling indicators.                                                                                                       |
| <code>'range'</code>  |                                                                                                                                       |
| <code>'64'</code>     | Out of range arguments.                                                                                                               |
| <code>'syntax'</code> |                                                                                                                                       |
| <code>'128'</code>    | Dubious syntax in numeric expressions.                                                                                                |
| <code>'di'</code>     |                                                                                                                                       |
| <code>'256'</code>    | Use of <code>di</code> or <code>da</code> without an argument when there is no current diversion.                                     |

---

<sup>17</sup> `char` is a misnomer since it reports missing glyphs – there aren't missing input characters, only invalid ones.

- ‘**mac**’  
‘512’      Use of undefined strings, macros and diversions. When an undefined string, macro, or diversion is used, that string is automatically defined as empty. So, in most cases, at most one warning is given for each name.
- ‘**reg**’  
‘1024’      Use of undefined number registers. When an undefined number register is used, that register is automatically defined to have a value of 0. So, in most cases, at most one warning is given for use of a particular name.
- ‘**tab**’  
‘2048’      Use of a tab character where a number was expected.
- ‘**right-brace**’  
‘4096’      Use of `\}` where a number was expected.
- ‘**missing**’  
‘8192’      Requests that are missing non-optional arguments.
- ‘**input**’  
‘16384’      Invalid input characters.
- ‘**escape**’  
‘32768’      Unrecognized escape sequences. When an unrecognized escape sequence `\X` is encountered, the escape character is ignored, and `X` is printed.
- ‘**space**’  
‘65536’      Missing space between a request or macro and its argument. This warning is given when an undefined name longer than two characters is encountered, and the first two characters of the name make a defined name. The request or macro is not invoked. When this warning is given, no macro is automatically defined. This is enabled by default. This warning never occurs in compatibility mode.
- ‘**font**’  
‘131072’      Non-existent fonts. This is enabled by default.
- ‘**ig**’  
‘262144’      Invalid escapes in text ignored with the `ig` request. These are conditions that are errors when they do not occur in ignored text.
- ‘**color**’  
‘524288’      Color related warnings.
- ‘**all**’      All warnings except ‘`di`’, ‘`mac`’ and ‘`reg`’. It is intended that this covers all warnings that are useful with traditional macro packages.

‘w’ All warnings.

## 5.35 Implementation Differences

GNU `troff` has a number of features which cause incompatibilities with documents written with old versions of `troff`.

Long names cause some incompatibilities. UNIX `troff` interprets

```
.dsabcd
```

as defining a string ‘ab’ with contents ‘cd’. Normally, GNU `troff` interprets this as a call of a macro named `dsabcd`. Also UNIX `troff` interprets `\*[` or `\n[` as references to a string or number register called ‘[’. In GNU `troff`, however, this is normally interpreted as the start of a long name. In compatibility mode GNU `troff` interprets long names in the traditional way (which means that they are not recognized as names).

|                      |          |
|----------------------|----------|
| <code>.cp [n]</code> | Request  |
| <code>.do cmd</code> | Request  |
| <code>\n[.C]</code>  | Register |

If `n` is missing or non-zero, turn on compatibility mode; otherwise, turn it off.

The read-only number register `.C` is 1 if compatibility mode is on, 0 otherwise.

Compatibility mode can be also turned on with the ‘-C’ command line option.

The `do` request turns off compatibility mode while executing its arguments as a `gtroff` command.

```
.do fam T
```

executes the `fam` request when compatibility mode is enabled.

`gtroff` restores the previous compatibility setting before interpreting any files sourced by the `cmd`.

Two other features are controlled by ‘-C’. If not in compatibility mode, GNU `troff` preserves the input level in delimited arguments:

```
.ds xx '
 \w'abc*(xxdef'
```

In compatibility mode, the string ‘72def’ is returned; without ‘-C’ the resulting string is ‘168’ (assuming a TTY output device).

Finally, the escapes `\f`, `\H`, `\m`, `\M`, `\R`, `\s`, and `\S` are transparent for recognizing the beginning of a line only in compatibility mode (this is a rather obscure feature). For example, the code

```
.de xx
Hallo!
..
\fB.xx\fP
```

prints ‘Hallo!’ in bold face if in compatibility mode, and ‘.xx’ in bold face otherwise.

GNU **troff** does not allow the use of the escape sequences `\|`, `\^`, `\&`, `\{`, `\}`, `\SP`, `\'`, `\'`, `\-`, `\_`, `\!`, `\%`, and `\c` in names of strings, macros, diversions, number registers, fonts or environments; UNIX **troff** does. The `\A` escape sequence (see [Section 5.5 \[Identifiers\]](#), page 54) may be helpful in avoiding use of these escape sequences in names.

Fractional point sizes cause one noteworthy incompatibility. In UNIX **troff** the `ps` request ignores scale indicators and thus

```
.ps 10u
```

sets the point size to 10 points, whereas in GNU **troff** it sets the point size to 10 scaled points. See [Section 5.19.2 \[Fractional Type Sizes\]](#), page 111, for more information.

In GNU **troff** there is a fundamental difference between (unformatted) input characters and (formatted) output glyphs. Everything that affects how a glyph is output is stored with the glyph node; once a glyph node has been constructed it is unaffected by any subsequent requests that are executed, including `bd`, `cs`, `tkf`, `tr`, or `fp` requests. Normally glyphs are constructed from input characters at the moment immediately before the glyph is added to the current output line. Macros, diversions and strings are all, in fact, the same type of object; they contain lists of input characters and glyph nodes in any combination. A glyph node does not behave like an input character for the purposes of macro processing; it does not inherit any of the special properties that the input character from which it was constructed might have had. For example,

```
.di x
\\ \\
.br
.di
.x
```

prints ‘\\’ in GNU **troff**; each pair of input backslashes is turned into one output backslash and the resulting output backslashes are not interpreted as escape characters when they are reread. UNIX **troff** would interpret them as escape characters when they were reread and would end up printing one ‘\’. The correct way to obtain a printable backslash is to use the `\e` escape sequence: This always prints a single instance of the current escape character, regardless of whether or not it is used in a diversion; it also

works in both GNU `troff` and UNIX `troff`.<sup>18</sup> To store, for some reason, an escape sequence in a diversion that will be interpreted when the diversion is reread, either use the traditional `\!` transparent output facility, or, if this is unsuitable, the new `\?` escape sequence.

See [Section 5.26 \[Diversion\]](#), page 137, and [Section 5.33 \[Gtroff Internals\]](#), page 152, for more information.

---

<sup>18</sup> To be completely independent of the current escape character, use `\(rs` which represents a reverse solidus (backslash) glyph.



## 6 Preprocessors

This chapter describes all preprocessors that come with `groff` or which are freely available.

### 6.1 `geqn`

#### 6.1.1 Invoking `geqn`

### 6.2 `gtbl`

#### 6.2.1 Invoking `gtbl`

### 6.3 `gpic`

#### 6.3.1 Invoking `gpic`

### 6.4 `ggrn`

#### 6.4.1 Invoking `ggrn`

### 6.5 `grap`

A free implementation of `grap`, written by Ted Faber, is available as an extra package from the following address:

<http://www.lunabase.org/~faber/Vault/software/grap/>

### 6.6 `grefer`

#### 6.6.1 Invoking `grefer`

### 6.7 `gsoelim`

#### 6.7.1 Invoking `gsoelim`



## 7 Output Devices

### 7.1 Special Characters

See [Section 8.2 \[Font Files\]](#), page 180.

### 7.2 grotty

#### 7.2.1 Invoking grotty

### 7.3 grops

#### 7.3.1 Invoking grops

#### 7.3.2 Embedding POSTSCRIPT

### 7.4 grodvi

#### 7.4.1 Invoking grodvi

### 7.5 grolj4

#### 7.5.1 Invoking grolj4

### 7.6 grolbp

#### 7.6.1 Invoking grolbp

### 7.7 grohtml

#### 7.7.1 Invoking grohtml

## 7.7.2 grohtml specific registers and strings

|                                     |          |
|-------------------------------------|----------|
| <code>\n[ps4html]</code>            | Register |
| <code>\*[www-image-template]</code> | String   |

The registers `ps4html` and `www-image-template` are defined by the `pre-grohtml` preprocessor. `pre-grohtml` reads in the `troff` input, marks up the inline equations and passes the result firstly to

```
troff -Tps -rps4html=1 -dwww-image-template=template
```

and secondly to

```
troff -Thtml
```

The PostScript device is used to create all the image files, and the register `ps4html` enables the macro sets to ignore floating keeps, footers, and headings.

The register `www-image-template` is set to the user specified template name or the default name.

## 7.8 gxditview

### 7.8.1 Invoking gxditview

## 8 File formats

All files read and written by `gtroff` are text files. The following two sections describe their format.

### 8.1 `gtroff` Output

This section describes the intermediate output format of GNU `troff`. This output is produced by a run of `gtroff` before it is fed into a device postprocessor program.

As `groff` is a wrapper program around `gtroff` that automatically calls a postprocessor, this output does not show up normally. This is why it is called *intermediate*. `groff` provides the option ‘-Z’ to inhibit postprocessing, such that the produced intermediate output is sent to standard output just like calling `gtroff` manually.

Here, the term *troff output* describes what is output by `gtroff`, while *intermediate output* refers to the language that is accepted by the parser that prepares this output for the postprocessors. This parser is smarter on whitespace and implements obsolete elements for compatibility, otherwise both formats are the same.<sup>1</sup>

The main purpose of the intermediate output concept is to facilitate the development of postprocessors by providing a common programming interface for all devices. It has a language of its own that is completely different from the `gtroff` language. While the `gtroff` language is a high-level programming language for text processing, the intermediate output language is a kind of low-level assembler language by specifying all positions on the page for writing and drawing.

The intermediate output produced by `gtroff` is fairly readable, while output from AT&T `troff` is rather hard to understand because of strange habits that are still supported, but not used any longer by `gtroff`.

#### 8.1.1 Language Concepts

During the run of `gtroff`, the input data is cracked down to the information on what has to be printed at what position on the intended device. So the language of the intermediate output format can be quite small. Its only elements are commands with and without arguments. In this section, the term *command* always refers to the intermediate output language, and never to the `gtroff` language used for document formatting. There are commands for positioning and text writing, for drawing, and for device controlling.

---

<sup>1</sup> The parser and postprocessor for intermediate output can be found in the file ‘`groff-source-dir/src/libs/libdriver/input.cc`’.

### 8.1.1.1 Separation

AT&T troff output has strange requirements on whitespace. The `gtroff` output parser, however, is smart about whitespace by making it maximally optional. The whitespace characters, i.e., the tab, space, and newline characters, always have a syntactical meaning. They are never printable because spacing within the output is always done by positioning commands.

Any sequence of space or tab characters is treated as a single *syntactical space*. It separates commands and arguments, but is only required when there would occur a clashing between the command code and the arguments without the space. Most often, this happens when variable-length command names, arguments, argument lists, or command clusters meet. Commands and arguments with a known, fixed length need not be separated by syntactical space.

A line break is a syntactical element, too. Every command argument can be followed by whitespace, a comment, or a newline character. Thus a *syntactical line break* is defined to consist of optional syntactical space that is optionally followed by a comment, and a newline character.

The normal commands, those for positioning and text, consist of a single letter taking a fixed number of arguments. For historical reasons, the parser allows to stack such commands on the same line, but fortunately, in `gtroff`'s intermediate output, every command with at least one argument is followed by a line break, thus providing excellent readability.

The other commands – those for drawing and device controlling – have a more complicated structure; some recognize long command names, and some take a variable number of arguments. So all ‘D’ and ‘x’ commands were designed to request a syntactical line break after their last argument. Only one command, ‘x X’, has an argument that can stretch over several lines; all other commands must have all of their arguments on the same line as the command, i.e., the arguments may not be splitted by a line break.

Empty lines (these are lines containing only space and/or a comment), can occur everywhere. They are just ignored.

### 8.1.1.2 Argument Units

Some commands take integer arguments that are assumed to represent values in a measurement unit, but the letter for the corresponding scale indicator is not written with the output command arguments. Most commands assume the scale indicator ‘u’, the basic unit of the device, some use ‘z’, the scaled point unit of the device, while others, such as the color commands, expect plain integers.

Note that single characters can have the eighth bit set, as can the names of fonts and special characters. The names of characters and fonts can be of arbitrary length. A character that is to be printed will always be in the current font.

A string argument is always terminated by the next whitespace character (space, tab, or newline); an embedded ‘#’ character is regarded as part of the argument, not as the beginning of a comment command. An integer argument is already terminated by the next non-digit character, which then is regarded as the first character of the next argument or command.

### 8.1.1.3 Document Parts

A correct intermediate output document consists of two parts, the *prologue* and the *body*.

The task of the prologue is to set the general device parameters using three exactly specified commands. `gtroff`’s prologue is guaranteed to consist of the following three lines (in that order):

```
x T device
x res n h v
x init
```

with the arguments set as outlined in [Section 8.1.2.4 \[Device Control Commands\], page 175](#). Note that the parser for the intermediate output format is able to swallow additional whitespace and comments as well even in the prologue.

The body is the main section for processing the document data. Syntactically, it is a sequence of any commands different from the ones used in the prologue. Processing is terminated as soon as the first ‘`x stop`’ command is encountered; the last line of any `gtroff` intermediate output always contains such a command.

Semantically, the body is page oriented. A new page is started by a ‘`p`’ command. Positioning, writing, and drawing commands are always done within the current page, so they cannot occur before the first ‘`p`’ command. Absolute positioning (by the ‘`H`’ and ‘`V`’ commands) is done relative to the current page; all other positioning is done relative to the current location within this page.

## 8.1.2 Command Reference

This section describes all intermediate output commands, both from AT&T `troff` as well as the `gtroff` extensions.

### 8.1.2.1 Comment Command

`#anything<end of line>`

A comment. Ignore any characters from the ‘#’ character up to the next newline character.

This command is the only possibility for commenting in the intermediate output. Each comment can be preceded by arbitrary

syntactical space; every command can be terminated by a comment.

### 8.1.2.2 Simple Commands

The commands in this subsection have a command code consisting of a single character, taking a fixed number of arguments. Most of them are commands for positioning and text writing. These commands are smart about whitespace. Optionally, syntactical space can be inserted before, after, and between the command letter and its arguments. All of these commands are stackable, i.e., they can be preceded by other simple commands or followed by arbitrary other commands on the same line. A separating syntactical space is only necessary when two integer arguments would clash or if the preceding argument ends with a string argument.

**C** *xxx*<whitespace>

Print a special character named *xxx*. The trailing syntactical space or line break is necessary to allow glyph names of arbitrary length. The glyph is printed at the current print position; the glyph's size is read from the font file. The print position is not changed.

**c** *g* Print glyph *g* at the current print position;<sup>2</sup> the glyph's size is read from the font file. The print position is not changed.

**f** *n* Set font to font number *n* (a non-negative integer).

**H** *n* Move right to the absolute vertical position *n* (a non-negative integer) in basic units 'u' relative to left edge of current page.

**h** *n* Move *n* (a non-negative integer) basic units 'u' horizontally to the right. The original UNIX troff manual allows negative values for *n* also, but **gtroff** doesn't use this.

**m** *color-scheme* [*component* ...]

Set the color for text (glyphs), line drawing, and the outline of graphic objects using different color schemes; the analogous command for the filling color of graphic objects is 'DF'. The color components are specified as integer arguments between 0 and 65536. The number of color components and their meaning vary for the different color schemes. These commands are generated by **gtroff**'s escape sequence `\m`. No position changing. These commands are a **gtroff** extension.

**mc** *cyan magenta yellow*

Set color using the CMY color scheme, having the 3 color components *cyan*, *magenta*, and *yellow*.

---

<sup>2</sup> 'c' is actually a misnomer since it outputs a glyph.

- md** Set color to the default color value (black in most cases). No component arguments.
- mg gray** Set color to the shade of gray given by the argument, an integer between 0 (black) and 65536 (white).
- mk cyan magenta yellow black**  
Set color using the CMYK color scheme, having the 4 color components *cyan*, *magenta*, *yellow*, and *black*.
- mr red green blue**  
Set color using the RGB color scheme, having the 3 color components *red*, *green*, and *blue*.
- N n** Print glyph with index *n* (a non-negative integer) of the current font. This command is a **gtroff** extension.
- n b a** Inform the device about a line break, but no positioning is done by this command. In AT&T **troff**, the integer arguments *b* and *a* informed about the space before and after the current line to make the intermediate output more human readable without performing any action. In **groff**, they are just ignored, but they must be provided for compatibility reasons.
- p n** Begin a new page in the outprint. The page number is set to *n*. This page is completely independent of pages formerly processed even if those have the same page number. The vertical position on the outprint is automatically set to 0. All positioning, writing, and drawing is always done relative to a page, so a ‘p’ command must be issued before any of these commands.
- s n** Set point size to *n* scaled points (this is unit ‘z’). AT&T **troff** used the unit points (‘p’) instead. See [Section 8.1.4 \[Output Language Compatibility\]](#), page 180.
- t xxx<whitespace>**  
**t xxx dummy-arg<whitespace>**  
Print a word, i.e., a sequence of characters *xxx* representing output glyphs which names are single characters, terminated by a space character or a line break; an optional second integer argument is ignored (this allows the formatter to generate an even number of arguments). The first glyph should be printed at the current position, the current horizontal position should then be increased by the width of the first glyph, and so on for each glyph. The widths of the glyphs are read from the font file, scaled for the current point size, and rounded to a multiple of the horizontal resolution. Special characters cannot be printed using this command (use the ‘C’ command for special characters). This command is a **gtroff** extension; it is only used

for devices whose ‘DESC’ file contains the `tcommand` keyword (see [Section 8.2.1 \[DESC File Format\], page 181](#)).

`u n xxx<whitespace>`

Print word with track kerning. This is the same as the ‘t’ command except that after printing each glyph, the current horizontal position is increased by the sum of the width of that glyph and  $n$  (an integer in basic units ‘u’). This command is a `gtroff` extension; it is only used for devices whose ‘DESC’ file contains the `tcommand` keyword (see [Section 8.2.1 \[DESC File Format\], page 181](#)).

`V n`

Move down to the absolute vertical position  $n$  (a non-negative integer in basic units ‘u’) relative to upper edge of current page.

`v n`

Move  $n$  basic units ‘u’ down ( $n$  is a non-negative integer). The original UNIX troff manual allows negative values for  $n$  also, but `gtroff` doesn’t use this.

`w`

Informs about a paddable white space to increase readability. The spacing itself must be performed explicitly by a move command.

### 8.1.2.3 Graphics Commands

Each graphics or drawing command in the intermediate output starts with the letter ‘D’, followed by one or two characters that specify a subcommand; this is followed by a fixed or variable number of integer arguments that are separated by a single space character. A ‘D’ command may not be followed by another command on the same line (apart from a comment), so each ‘D’ command is terminated by a syntactical line break.

`gtroff` output follows the classical spacing rules (no space between command and subcommand, all arguments are preceded by a single space character), but the parser allows optional space between the command letters and makes the space before the first argument optional. As usual, each space can be any sequence of tab and space characters.

Some graphics commands can take a variable number of arguments. In this case, they are integers representing a size measured in basic units ‘u’. The arguments called  $h1$ ,  $h2$ , . . . ,  $hn$  stand for horizontal distances where positive means right, negative left. The arguments called  $v1$ ,  $v2$ , . . . ,  $vn$  stand for vertical distances where positive means down, negative up. All these distances are offsets relative to the current location.

Unless indicated otherwise, each graphics command directly corresponds to a similar `gtroff \D` escape sequence. See [Section 5.24 \[Drawing Requests\], page 129](#).

Unknown ‘D’ commands are assumed to be device-specific. Its arguments are parsed as strings; the whole information is then sent to the postprocessor.

In the following command reference, the syntax element `<line break>` means a syntactical line break as defined above.

`D~ h1 v1 h2 v2 ... hn vn<line break>`

Draw B-spline from current position to offset  $(h1,v1)$ , then to offset  $(h2,v2)$ , if given, etc. up to  $(hn,vn)$ . This command takes a variable number of argument pairs; the current position is moved to the terminal point of the drawn curve.

`Da h1 v1 h2 v2<line break>`

Draw arc from current position to  $(h1,v1)+(h2,v2)$  with center at  $(h1,v1)$ ; then move the current position to the final point of the arc.

`DC d<line break>`

`DC d dummy-arg<line break>`

Draw a solid circle using the current fill color with diameter  $d$  (integer in basic units ‘u’) with leftmost point at the current position; then move the current position to the rightmost point of the circle. An optional second integer argument is ignored (this allows the formatter to generate an even number of arguments). This command is a `gtroff` extension.

`Dc d<line break>`

Draw circle line with diameter  $d$  (integer in basic units ‘u’) with leftmost point at the current position; then move the current position to the rightmost point of the circle.

`DE h v<line break>`

Draw a solid ellipse in the current fill color with a horizontal diameter of  $h$  and a vertical diameter of  $v$  (both integers in basic units ‘u’) with the leftmost point at the current position; then move to the rightmost point of the ellipse. This command is a `gtroff` extension.

`De h v<line break>`

Draw an outlined ellipse with a horizontal diameter of  $h$  and a vertical diameter of  $v$  (both integers in basic units ‘u’) with the leftmost point at current position; then move to the rightmost point of the ellipse.

`DF color-scheme [component ...]<line break>`

Set fill color for solid drawing objects using different color schemes; the analogous command for setting the color of text, line graphics, and the outline of graphic objects is ‘m’. The color components are specified as integer arguments between 0 and 65536. The number of color components and their meaning vary for the different color schemes. These commands are generated by `gtroff`’s escape sequences `\D’F ...` and `\M` (with no other

corresponding graphics commands). No position changing. This command is a **gtroff** extension.

**DFc** *cyan magenta yellow*<line break>

Set fill color for solid drawing objects using the CMY color scheme, having the 3 color components *cyan*, *magenta*, and *yellow*.

**DFd**<line break>

Set fill color for solid drawing objects to the default fill color value (black in most cases). No component arguments.

**DFg** *gray*<line break>

Set fill color for solid drawing objects to the shade of gray given by the argument, an integer between 0 (black) and 65536 (white).

**DFk** *cyan magenta yellow black*<line break>

Set fill color for solid drawing objects using the CMYK color scheme, having the 4 color components *cyan*, *magenta*, *yellow*, and *black*.

**DFr** *red green blue*<line break>

Set fill color for solid drawing objects using the RGB color scheme, having the 3 color components *red*, *green*, and *blue*.

**Df** *n*<line break>

The argument *n* must be an integer in the range  $-32767$  to  $32767$ .

$0 \leq n \leq 1000$

Set the color for filling solid drawing objects to a shade of gray, where 0 corresponds to solid white, 1000 (the default) to solid black, and values in between to intermediate shades of gray; this is obsoleted by command ‘**DFg**’.

$n < 0$  or  $n < 1000$

Set the filling color to the color that is currently being used for the text and the outline, see command ‘**m**’. For example, the command sequence

```
mg 0 0 65536
Df -1
```

sets all colors to blue.

No position changing. This command is a **gtroff** extension.

**Dl** *h v*<line break>

Draw line from current position to offset (*h,v*) (integers in basic units ‘**u**’); then set current position to the end of the drawn line.

**Dp** *h1 v1 h2 v2 ... hn vn***<line break>**

Draw a polygon line from current position to offset (*h1,v1*), from there to offset (*h2,v2*), etc. up to offset (*hn,vn*), and from there back to the starting position. For historical reasons, the position is changed by adding the sum of all arguments with odd index to the actual horizontal position and the even ones to the vertical position. Although this doesn't make sense it is kept for compatibility. This command is a **gtroff** extension.

**Dp** *h1 v1 h2 v2 ... hn vn***<line break>**

Draw a solid polygon in the current fill color rather than an outlined polygon, using the same arguments and positioning as the corresponding 'Dp' command. This command is a **gtroff** extension.

**Dt** *n***<line break>**

Set the current line thickness to *n* (an integer in basic units 'u') if *n* > 0; if *n* = 0 select the smallest available line thickness; if *n* < 0 set the line thickness proportional to the point size (this is the default before the first 'Dt' command was specified). For historical reasons, the horizontal position is changed by adding the argument to the actual horizontal position, while the vertical position is not changed. Although this doesn't make sense it is kept for compatibility. This command is a **gtroff** extension.

### 8.1.2.4 Device Control Commands

Each device control command starts with the letter 'x', followed by a space character (optional or arbitrary space or tab in **gtroff**) and a subcommand letter or word; each argument (if any) must be preceded by a syntactical space. All 'x' commands are terminated by a syntactical line break; no device control command can be followed by another command on the same line (except a comment).

The subcommand is basically a single letter, but to increase readability, it can be written as a word, i.e., an arbitrary sequence of characters terminated by the next tab, space, or newline character. All characters of the subcommand word but the first are simply ignored. For example, **gtroff** outputs the initialization command 'x i' as 'x init' and the resolution command 'x r' as 'x res'.

In the following, the syntax element **<line break>** means a syntactical line break (see [Section 8.1.1.1 \[Separation\]](#), page 168).

**xF** *name***<line break>**

The 'F' stands for *Filename*.

Use *name* as the intended name for the current file in error reports. This is useful for remembering the original file name when **gtroff** uses an internal piping mechanism. The input file

is not changed by this command. This command is a `gtroff` extension.

`xf n s<line break>`

The ‘f’ stands for *font*.

Mount font position *n* (a non-negative integer) with font named *s* (a text word). See [Section 5.18.3 \[Font Positions\]](#), page 98.

`xH n<line break>`

The ‘H’ stands for *Height*.

Set glyph height to *n* (a positive integer in scaled points ‘z’). AT&T `troff` uses the unit points (‘p’) instead. See [Section 8.1.4 \[Output Language Compatibility\]](#), page 180.

`xi<line break>`

The ‘i’ stands for *init*.

Initialize device. This is the third command of the prologue.

`xp<line break>`

The ‘p’ stands for *pause*.

Parsed but ignored. The original UNIX `troff` manual writes  
pause device, can be restarted

`xr n h v<line break>`

The ‘r’ stands for *resolution*.

Resolution is *n*, while *h* is the minimal horizontal motion, and *v* the minimal vertical motion possible with this device; all arguments are positive integers in basic units ‘u’ per inch. This is the second command of the prologue.

`xS n<line break>`

The ‘S’ stands for *Slant*.

Set slant to *n* (an integer in basic units ‘u’).

`xs<line break>`

The ‘s’ stands for *stop*.

Terminates the processing of the current file; issued as the last command of any intermediate `troff` output.

`xt<line break>`

The ‘t’ stands for *trailer*.

Generate trailer information, if any. In `gtroff`, this is actually just ignored.

`xT xxx<line break>`

The ‘T’ stands for *Typesetter*.

Set name of device to word *xxx*, a sequence of characters ended by the next white space character. The possible device names

coincide with those from the `groff` ‘-T’ option. This is the first command of the prologue.

`xu n<line break>`

The ‘u’ stands for *underline*.

Configure underlining of spaces. If *n* is 1, start underlining of spaces; if *n* is 0, stop underlining of spaces. This is needed for the `cu` request in `nroff` mode and is ignored otherwise. This command is a `groff` extension.

`xX anything<line break>`

The ‘x’ stands for *X-escape*.

Send string *anything* uninterpreted to the device. If the line following this command starts with a ‘+’ character this line is interpreted as a continuation line in the following sense. The ‘+’ is ignored, but a newline character is sent instead to the device, the rest of the line is sent uninterpreted. The same applies to all following lines until the first character of a line is not a ‘+’ character. This command is generated by the `groff` escape sequence `\X`. The line-continuing feature is a `groff` extension.

### 8.1.2.5 Obsolete Command

In AT&T `troff` output, the writing of a single glyph is mostly done by a very strange command that combines a horizontal move and a single character giving the glyph name. It doesn’t have a command code, but is represented by a 3-character argument consisting of exactly 2 digits and a character.

`ddg`

Move right *dd* (exactly two decimal digits) basic units ‘u’, then print glyph *g* (represented as a single character).

In `groff`, arbitrary syntactical space around and within this command is allowed to be added. Only when a preceding command on the same line ends with an argument of variable length a separating space is obligatory. In AT&T `troff`, large clusters of these and other commands are used, mostly without spaces; this made such output almost unreadable.

For modern high-resolution devices, this command does not make sense because the width of the glyphs can become much larger than two decimal digits. In `groff`, this is only used for the devices `X75`, `X75-12`, `X100`, and `X100-12`. For other devices, the commands ‘t’ and ‘u’ provide a better functionality.

### 8.1.3 Intermediate Output Examples

This section presents the intermediate output generated from the same input for three different devices. The input is the sentence 'hell world' fed into `gtroff` on the command line.

High-resolution device `ps`

This is the standard output of `gtroff` if no '-T' option is given.

```
shell> echo "hell world" | groff -Z -T ps
```

```
x T ps
x res 72000 1 1
x init
p1
x font 5 TR
f5
s10000
V12000
H72000
thell
wh2500
tw
H96620
torld
n12000 0
x trailer
V792000
x stop
```

This output can be fed into `grops` to get its representation as a PostScript file.

Low-resolution device `latin1`

This is similar to the high-resolution device except that the positioning is done at a minor scale. Some comments (lines starting with '#') were added for clarification; they were not generated by the formatter.

```
shell> echo "hell world" | groff -Z -T latin1
```

```
prologue
x T latin1
x res 240 24 40
x init
begin a new page
p1
font setup
```

```

x font 1 R
f1
s10
initial positioning on the page
V40
H0
write text 'hell'
thell
inform about space, and issue a horizontal jump
wh24
write text 'world'
tworld
announce line break, but do nothing because ...
n40 0
... the end of the document has been reached
x trailer
V2640
x stop

```

This output can be fed into `grotty` to get a formatted text document.

#### AT&T troff output

Since a computer monitor has a very low resolution compared to modern printers the intermediate output for the X Window devices can use the jump-and-write command with its 2-digit displacements.

```

shell> echo "hell world" | groff -Z -T X100

x T X100
x res 100 1 1
x init
p1
x font 5 TR
f5
s10
V16
H100
write text with jump-and-write commands
ch07e071031w06w11o07r05103dh7
n16 0
x trailer
V1100
x stop

```

This output can be fed into `xditview` or `gxditview` for displaying in X.

Due to the obsolete jump-and-write command, the text clusters in the AT&T `troff` output are almost unreadable.

### 8.1.4 Output Language Compatibility

The intermediate output language of AT&T `troff` was first documented in the UNIX `troff` manual, with later additions documented in *A Typesetter-independent TROFF*, written by Brian Kernighan.

The `gtruff` intermediate output format is compatible with this specification except for the following features.

- The classical quasi device independence is not yet implemented.
- The old hardware was very different from what we use today. So the `groff` devices are also fundamentally different from the ones in AT&T `troff`. For example, the AT&T PostScript device is called `post` and has a resolution of only 720 units per inch, suitable for printers 20 years ago, while `groff`'s `ps` device has a resolution of 72000 units per inch. Maybe, by implementing some rescaling mechanism similar to the classical quasi device independence, `groff` could emulate AT&T's `post` device.
- The B-spline command `'D~'` is correctly handled by the intermediate output parser, but the drawing routines aren't implemented in some of the postprocessor programs.
- The argument of the commands `'s'` and `'x H'` has the implicit unit scaled point `'z'` in `gtruff`, while AT&T `troff` has point `('p')`. This isn't an incompatibility but a compatible extension, for both units coincide for all devices without a `sizescale` parameter in the `'DESC'` file, including all postprocessors from AT&T and `groff`'s text devices. The few `groff` devices with a `sizescale` parameter either do not exist for AT&T `troff`, have a different name, or seem to have a different resolution. So conflicts are very unlikely.
- The position changing after the commands `'Dp'`, `'DP'`, and `'Dt'` is illogical, but as old versions of `gtruff` used this feature it is kept for compatibility reasons.

## 8.2 Font Files

The `gtruff` font format is roughly a superset of the `ditroff` font format (as used in later versions of AT&T `troff` and its descendants). Unlike the `ditroff` font format, there is no associated binary format; all files are text files.<sup>3</sup> The font files for device *name* are stored in a directory `'devname'`. There are two types of file: a device description file called `'DESC'` and for each font *f* a font file called `'f'`.

<sup>3</sup> Plan 9 `troff` has also abandoned the binary format.

### 8.2.1 ‘DESC’ File Format

The ‘DESC’ file can contain the following types of line. Except for the `charset` keyword which must come last (if at all), the order of the lines is not important.

- `res n`        There are  $n$  machine units per inch.
- `hor n`        The horizontal resolution is  $n$  machine units.
- `vert n`        The vertical resolution is  $n$  machine units.
- `sizescale n`  
                 The scale factor for point sizes. By default this has a value of 1. One scaled point is equal to one point/ $n$ . The arguments to the `unitwidth` and `sizes` commands are given in scaled points. See [Section 5.19.2 \[Fractional Type Sizes\]](#), page 111, for more information.
- `unitwidth n`  
                 Quantities in the font files are given in machine units for fonts whose point size is  $n$  scaled points.
- `prepro program`  
                 Call *program* as a preprocessor. Currently, this keyword is used by `groff` with option ‘`-Thtml`’ only.
- `postpro program`  
                 Call *program* as a postprocessor. For example, the line  
                     `postpro grodvi`  
                 in the file ‘`devdvi/DESC`’ makes `groff` call `grodvi` if option ‘`-Tdvi`’ is given (and ‘`-Z`’ isn’t used).
- `tcommand`      This means that the postprocessor can handle the ‘`t`’ and ‘`u`’ intermediate output commands.
- `sizes s1 s2 ... sn 0`  
                 This means that the device has fonts at  $s1$ ,  $s2$ , ...  $sn$  scaled points. The list of sizes must be terminated by 0 (this is digit zero). Each  $si$  can also be a range of sizes  $m-n$ . The list can extend over more than one line.
- `styles S1 S2 ... Sm`  
                 The first  $m$  font positions are associated with styles  $S1$  ...  $Sm$ .
- `fonts n F1 F2 F3 ... Fn`  
                 Fonts  $F1$  ...  $Fn$  are mounted in the font positions  $m+1$ , ...,  $m+n$  where  $m$  is the number of styles. This command may extend over more than one line. A font name of 0 means no font is mounted on the corresponding font position.
- `family fam`  
                 The default font family is *fam*.

**use\_charnames\_in\_special**

This command indicates that **gtroff** should encode special characters inside special commands. Currently, this is only used by the HTML output device. See [Section 5.31 \[Postprocessor Access\]](#), page 149.

**papersize** *string* ...

Select a paper size. Valid values for *string* are the ISO paper types A0-A7, B0-B7, C0-C7, D0-D7, DL, and the US paper types **letter**, **legal**, **tabloid**, **ledger**, **statement**, **executive**, **com10**, and **monarch**. Case is not significant for *string* if it holds predefined paper types. Alternatively, *string* can be a file name (e.g. `/etc/papersize`); if the file can be opened, **groff** reads the first line and tests for the above paper sizes. Finally, *string* can be a custom paper size in the format *length,width* (no spaces before and after the comma). Both *length* and *width* must have a unit appended; valid values are ‘i’ for inches, ‘C’ for centimeters, ‘p’ for points, and ‘P’ for picas. Example: `12c,235p`. An argument which starts with a digit is always treated as a custom paper format. **papersize** sets both the vertical and horizontal dimension of the output medium.

More than one argument can be specified; **groff** scans from left to right and uses the first valid paper specification.

**pass\_filenames**

Tell **gtroff** to emit the name of the source file currently being processed. This is achieved by the intermediate output command ‘F’. Currently, this is only used by the HTML output device.

**print program**

Use *program* as a spooler program for printing. If omitted, the ‘-l’ and ‘-L’ options of **groff** are ignored.

**charset** This line and everything following in the file are ignored. It is allowed for the sake of backwards compatibility.

The **res**, **unitwidth**, **fonts**, and **sizes** lines are mandatory. Other commands are ignored by **gtroff** but may be used by postprocessors to store arbitrary information about the device in the ‘DESC’ file.

Here a list of obsolete keywords which are recognized by **groff** but completely ignored: **spare1**, **spare2**, **biggestfont**.

## 8.2.2 Font File Format

A *font file*, also (and probably better) called a *font description file*, has two sections. The first section is a sequence of lines each containing a sequence of blank delimited words; the first word in the line is a key, and subsequent words give a value for that key.

- name** *f*      The name of the font is *f*.
- spacewidth** *n*  
                   The normal width of a space is *n*.
- slant** *n*      The glyphs of the font have a slant of *n* degrees. (Positive means forward.)
- ligatures** *lig1 lig2 ... lign* [0]  
                   Glyphs *lig1*, *lig2*, ..., *lign* are ligatures; possible ligatures are ‘ff’, ‘fi’, ‘fl’, ‘ffi’ and ‘ffl’. For backwards compatibility, the list of ligatures may be terminated with a 0. The list of ligatures may not extend over more than one line.
- special**      The font is *special*; this means that when a glyph is requested that is not present in the current font, it is searched for in any special fonts that are mounted.

Other commands are ignored by **gtruff** but may be used by postprocessors to store arbitrary information about the font in the font file.

The first section can contain comments which start with the ‘#’ character and extend to the end of a line.

The second section contains one or two subsections. It must contain a **charset** subsection and it may also contain a **kernpairs** subsection. These subsections can appear in any order. Each subsection starts with a word on a line by itself.

The word **charset** starts the character set subsection.<sup>4</sup> The **charset** line is followed by a sequence of lines. Each line gives information for one glyph. A line comprises a number of fields separated by blanks or tabs. The format is

*name metrics type code* [*entity-name*] [-- *comment*]

*name* identifies the glyph name<sup>5</sup>: If *name* is a single character *c* then it corresponds to the **gtruff** input character *c*; if it is of the form ‘\c’ where *c* is a single character, then it corresponds to the special character ‘\[c]’; otherwise it corresponds to the special character ‘\[name]’. If it is exactly two characters *xx* it can be entered as ‘\(\xx’. Note that single-letter special characters can’t be accessed as ‘\c’; the only exception is ‘\-’ which is identical to ‘\[ -]’.

**gtruff** supports 8-bit input characters; however some utilities have difficulties with eight-bit characters. For this reason, there is a convention that the entity name ‘**charn**’ is equivalent to the single input character whose code is *n*. For example, ‘**char163**’ would be equivalent to the character with code 163 which is the pounds sterling sign in the ISO Latin-1 character set.

<sup>4</sup> This keyword is misnamed since it starts a list of ordered glyphs, not characters.

<sup>5</sup> The distinction between input, characters, and output, glyphs, is not clearly separated in the terminology of **gtruff**; for example, the **char** request should be called **glyph** since it defines an output entity.

You shouldn't use 'charn' entities in font description files since they are related to input, not output. Otherwise, you get hard-coded connections between input and output encoding which prevents use of different (input) character sets.

The name '---' is special and indicates that the glyph is unnamed; such glyphs can only be used by means of the \N escape sequence in `gtroff`.

The *type* field gives the glyph type:

- 1 the glyph has a descender, for example, 'p';
- 2 the glyph has an ascender, for example, 'b';
- 3 the glyph has both an ascender and a descender, for example, 'C'.

The *code* field gives the code which the postprocessor uses to print the glyph. The glyph can also be input to `gtroff` using this code by means of the \N escape sequence. *code* can be any integer. If it starts with '0' it is interpreted as octal; if it starts with '0x' or '0X' it is interpreted as hexadecimal. Note, however, that the \N escape sequence only accepts a decimal integer.

The *entity-name* field gives an ASCII string identifying the glyph which the postprocessor uses to print the `gtroff` glyph *name*. This field is optional and has been introduced so that the HTML device driver can encode its character set. For example, the glyph '\[Po]' is represented as '&pound;' in HTML 4.0.

Anything on the line after the *entity-name* field resp. after '--' will be ignored.

The *metrics* field has the form:

```
width[,height[,depth[,italic-correction
[,left-italic-correction[,subscript-correction]]]]]
```

There must not be any spaces between these subfields (it has been split here into two lines for better legibility only). Missing subfields are assumed to be 0. The subfields are all decimal integers. Since there is no associated binary format, these values are not required to fit into a variable of type 'char' as they are in `ditroff`. The *width* subfield gives the width of the glyph. The *height* subfield gives the height of the glyph (upwards is positive); if a glyph does not extend above the baseline, it should be given a zero height, rather than a negative height. The *depth* subfield gives the depth of the glyph, that is, the distance from the baseline to the lowest point below the baseline to which the glyph extends (downwards is positive); if a glyph does not extend below the baseline, it should be given a zero depth, rather than a negative depth. The *italic-correction* subfield gives the amount of space that should be added after the glyph when it is immediately to be followed by a glyph from a roman font. The *left-italic-correction* subfield gives the amount of space that should be added before the glyph when it is immediately to be preceded by a glyph from a roman font. The *subscript-*

*correction* gives the amount of space that should be added after a glyph before adding a subscript. This should be less than the italic correction.

A line in the **charset** section can also have the format

*name* "

This indicates that *name* is just another name for the glyph mentioned in the preceding line.

The word **kernpairs** starts the kernpairs section. This contains a sequence of lines of the form:

*c1 c2 n*

This means that when glyph *c1* appears next to glyph *c2* the space between them should be increased by *n*. Most entries in the kernpairs section have a negative value for *n*.



## **9 Installation**



# A Copying This Manual

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Version 1.1, March 2000

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## E Register Index

The macro package or program a specific register belongs to is appended in brackets.

A register name `x` consisting of exactly one character can be accessed as `\nx`. A register name `xx` consisting of exactly two characters can be accessed as `\n(xx)`. Register names `xxx` of any length can be accessed as `\n[xxx]`.

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## G String Index

The macro package or program a specific string belongs to is appended in brackets.

A string name `x` consisting of exactly one character can be accessed as `\*x`. A string name `xx` consisting of exactly two characters can be accessed as `\*(xx)`. String names `xxx` of any length can be accessed as `\*[xxx]`.

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## H Glyph Name Index

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