Introduction to LaTeX

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Contents

List of Tables

List of Figures

Chapter 1

Introduction

The LaTeX document preparation system is a collection of TeX macros designed to make it easy for you to produce high-quality documents. TeX is a computer system for typesetting technical text, especially text containing a lot of mathematics; it is a system for producing beautiful text, comparable to the work of the finest printers.

Book quality text differ from ordinary typing in a number of simple but far from trivial ways. For example, typewritten text uses only two quotation marks: a double quote (`"`) and a single quote (`'`). The single quote also serves as an apostrophe. Book text, however, uses a left and a right version of each making four different symbols “, ‘, ’ and ”. Then there are distinctions among hyphens (-), dashes (–,—), and the minus sign ($-$) in books. There is only one size of dash on a typewriter. The TeX system pays a lot attention to these kinds of details.

Features of TeX include: 1) ligature replacement (for example, fi for fi), 2) kerning (different spacings between certain letter pairs, e.g., AV instead of AV), 3) automatic hyphenation, 4) line justification, 5) centering, 6) flushing right or left, 7) tabular aligning, 8) the formatting of complicated mathematical expressions, 9) section and page numbering, 10) the introduction of running heads, 11) the numbering and placing of footnotes, 12) the preparation of a table of contents and an index.

LaTeX is designed to make all these TeX facilities easy to use, yet still has the full power of TeX hidden under it. LaTeX can automatically number sections of a document, and produce table of contents, indexes and cross-references. It knows about different document styles. You can tell LaTeX what kind of document you are producing (article, report, or letter), and LaTeX will automatically set the margins, the heading styles and so on.

Only the most basic features of the LaTeX system will be discussed in this document. This document also describes how to use LaTeX in the VM/CMS environment at the Computing Service Branch. "LaTeX: A Document Preparation System" [1] by Leslie Lamport is the definitive reference. For advanced users "The TeXbook" [2] by Donald E. Knuth could be very useful.

Chapter 2

Getting Started

2.1 General Operation

To produce a well-formatted document using LaTeX, there are three steps to be followed:

1. Prepare an input file. The original text of your document is typed into an input file very much as it would be typed on a typewriter, except that this input file must now contain all of the instructions that are needed to describe the desired format for the printed output.
2. Process your input file with LaTeX. This will produce a `DVI` (device-independent) file as output.
3. Print the `DVI` file on a high quality printer.

If LaTeX complained that it didn't understand your input, or if the document didn't come out looking the way you wanted, you go back to edit the input file and do the steps over until everything is right.

2.2 Running a Sample File

Before preparing your own documents, you may want to get acquainted with LaTeX by running it on a sample input file. A copy of the file `SMALL TEX` is accessible to you. You can take a look at the file `SMALL TEX` by typing:

```
type small tex z
```

Next, run LaTeX on the file `SMALL TEX` by typing:

```
latex small
```

Now LaTeX processes the file and displays information at your terminal. You will see something like:

```
This is TeX, VM/CMS Version 2.93 (no format preloaded)
**
(small.tex.*
LaTeX Version 2.09 <26 Apr 1988>
(article.sty.*
Document Style ‘article’ <5 Feb 88>.
(art10.sty.*))
No file small.aux.
<1> (small.aux.*)
Output written on small.dvi (1 page, 1708 bytes).
Transcript written on small.texlog.
```

The first line (This is TeX ...) tells you which version of TeX is in use. In the next line you can see that "small tex" is being read. The next four lines describe the version of LaTeX being used, and the various files being read that comprise the `article` document style. (When TeX refers to a CMS file, it places periods between the filename, filetype and filemode.)

The message "No file small.aux" simply means that you haven't run this document through LaTeX before.

The appearance of a "1" in angle brackets indicates that page 1 has been processed.

The last two lines tell where the results are. The device-independent representation of your document is kept in a file called "small dvi", which contains one page of output and occupies 1708 bytes of disk space. A transcript of all this information is kept in a file called "small texlog" in case you want to look at it later. If you had received a number of error messages you might want to have this transcript around. (The 'texlog' file is not used for further processing and may be erased at any time. The 'aux' and other files may be required for multipass processing.)

When LaTeX has finished, it will have produced the file `SMALL DVI` on your A disk. You can print this file by typing the command:

```
texprint small
```

By default, the output will be produced on the CSB laser printer/plotter located in the M-60 mail room. Other destinations may be specified.

After it has been printed, you can delete the file `SMALL DVI` from your disk by typing:

```
erase small dvi
```

2.3 Preparing Your Own Input Files

The input file to LaTeX is a normal text file with some special notation inserted. Under VM/CMS, you can use the XEDIT editor to create such a file. You can name your input file with any filename filetype allowed by VM/CMS, but it is convenient to use the filetype TEX. TeX and LaTeX always assume the filetype to be TEX if it is not specified.

There are seven kinds of characters that can appear in your input file.

- The upper- and lowercase letters: `A...Z` and `a...z`
- The ten digits: `0...9`
- The 16 punctuation characters:

  ```
  . : ; , ? ! ‘ ’ ( ) [ ] - / * @
  ```

- The ten special characters:

  ```
  # $ % & ~ _ ^ \ { }
  ```

- The five mathematical characters: `+ = | < >`
- The character `"`
- The space character

These are the only characters that should appear in your input file. The characters ‘ and ’ may look like ` and ' respectively on your terminal. The character ^ may look like ¬. If you don't find some of the characters on your terminal, you can use some other characters which you do not need to replace them. For instance on a 3278-type terminal, there are no square brackets. You may use the ‘`set input`’ command to tell the operating system to translate the input characters ¢ to [, and | to].

```
set input ¢ ad
set input | bd
```

where ‘ad’ and ‘bd’ are hexadecimal codes for [and]. Subsequently entered ¢ and | will be replaced by the [and]. Don't forget to reset the translation before you need to input ¢ and | for other purposes.

```
set input
```

2.4 The Input

The input to LaTeX consists of normal text and instructions on how to format the text. The instructions are called LaTeX commands.

2.4.1 LaTeX Commands

The LaTeX command names can be of the three types:

- a special character like `~`
- a \ followed by a single nonletter (as in `\'`), called a *control symbol*
- a \ followed by a string of letters, called a *control word*

The case of letters in command names counts; so `\gamma` and `\Gamma` are different commands. A few commands have a `*`-form, a variant obtained by typing `*` after the command name. Spaces and single end-of-line following a control word are ignored.

Commands may have mandatory and/or optional arguments. A mandatory argument is enclosed by curly braces `{` and `}`, and optional arguments are enclosed by square brackets `[` and `]`, separated by commas. There should be no space between the arguments.

Many of LaTeX's control symbols are used to place accents on letters. For example, to generate "cet élève parle français" you type:

```
cet \'el\`eve parle fran\c cais.
```

Table B.1 on page 38 shows how to get a variety of accents.

2.4.2 Grouping

We can place text between curly braces to form a kind of scope of its own. Any changes that occur within the scope, such as changes in type style, are un-done when that scope finishes. The TeX or LaTeX declaration commands like `\bf` and `\em` that appear within a group, do not affect text outside the group. The braces in the input file must come in matching pairs. It can be difficult keeping track of matching braces that enclose a large amount of text. LaTeX provides a pair of commands `\begin` and `\end` that can define a block of text to be in a scope of its own called an *environment*. Typing

```
\begin{em}   ...   \end{em}
```

is equivalent to typing `{\em ... }`. In the next several chapters we will discuss some very important LaTeX environments.

The *scope* of a declaration begins with the declaration itself and ends with the first `}` or `\end` whose matching `{` or `\begin` occurs before the declaration. Consider the sentence, "The **bold** Roman marched home." You should type

```
The {\bf bold} Roman marched home.
```

not

```
The \bf{bold} Roman marched home.
```

2.4.3 Sentences and Paragraphs

A simple text document is just a series of words, sentences, and paragraphs. Words are separated by one or more spaces. Paragraphs are separated by one or more blank lines. The output is not affected by adding extra spaces or extra blank lines to the input file.

A period, question mark, or exclamation point is considered to end a sentence unless it follows an uppercase letter. If you get too much space after a mid-sentence period—abbreviations like etc. are the common culprits—then type a backslash followed by a space after the period (as `etc.\ `).

Text is emphasized with the `\em` declaration. *Emphasized* text is usually set in italic type. Underlining <u>emphasized</u> text is not recommended, but can be done by the `\underline{...}` command.

Double quotes are typed like this: ``` ``quoted text'' ```. Single quotes are typed like this: `` `single-quoted text' ``.

Long dashes are typed as three dash characters `---` like this.

Remember, don't type the 10 special characters (such as dollar sign and backslash) except as directed! The following seven are printed by typing a backslash in front of them: $ & # % _ { and }. The manual [1] tells how to make other symbols.

The `~` command produces an interword space at which TEX will not start a new line. You should type `Mr.~Drofnats` to prevent line breaking between Mr. and Drofnats.

The `\mbox` command prevents TEX from breaking its argument across lines.

In-line mathematical symbols or formulas are enclosed by `\(` ... `\)` or `$` ... `$`. We will discuss how to typeset mathematical formulas in Chapter 5.

2.4.4 Length and Spaces

A horizontal space is produced with the `\hspace` command. A vertical space is produced with the `\vspace` command. The command `\hspace{2cm}` produces a 2 cm horizontal space   like this.

The following dimensional units are recognized by TEX.

```
cm  Centimeters
em  One em is about the width of the letter M in the current
    font.
ex  One ex is about the height of the letter x in the current
    font.
in  Inches
pc  Picas(1pc=12pt)
pt  Points(1in=72.27pt)
mm  Millimeters
```

Horizontal or vertical spaces generated by `\hspace` or `\vspace` may disappear on the output if they fall at the beginning or end of a line or at the beginning or end of a page. The space produced by `\hspace*` or `\vspace*` will not disappear.

2.4.5 Footnotes

Footnotes are produced with a `\footnote` command having the text of the footnote as its argument. This footnote[1] was produced with the following input line:

```
This footnote\footnote{example of a footnote} was ...
```

2.4.6 Comments

When you want to add comments to the input file, you precede the comment with a percent (`%`) sign. Anything that follows the percent sign on a line is ignored by LaTeX.

[1] example of a footnote

Chapter 3

Putting It Together

3.1 The Document

The input for LaTeX usually begins with something like:

```
\documentstyle{article}
```

The word `article` on this line can be replaced by `report`, `book`, `letter`, or any other document style available to you. This tells LaTeX what sort of document you're producing, so LaTeX can set up the margins, heading style, and so on. **article** is a good document style for most simple documents.

The body of the document must be surrounded by two special commands.

```
\begin{document}
```

precedes the body of the document, and

```
\end{document}
```

ends the document. Thus, a kind of minimalist LaTeX input file might appear as follows:

```
\documentstyle{article}
\begin{document}
This is a one-line article.
\end{document}
```

The part of the input file preceding the `\begin{document}` command and after the `\documentstyle` command is called the *preamble*. The preamble contains only declarations. These declarations are used to change default settings of the document style.

For example, if you want to put more text on a page than the default, you could add:

```
\addlength{textheight}{1in}
```

or

```
\setlength{textheight}{8.9in}
```

in the preamble. There are other parameters you can modify in the same way, e.g., `textwidth`, `topmargin`, `oddsidemargin`, etc. See [1] page 163 for details.

3.1.1 The Document Style

The `\documentstyle` command has the following format:

`\documentstyle[`*options*`]{`*style*`}`

where *style* is the main document style and *options* is a list of one or more document style options, separated by commas—with no spaces in between.

The three main standard document styles in LaTeX are `article`, `report` and `book`. The `article` style is generally used for shorter documents than the `report` style, and the `book` style is meant for actual books. There is also a `letter` style to produce letters. The style options allow you to change the look of the document from the main style easily. For instance, if you like to have a larger type size than the standard ten-point size, you can specify:

```
\documentstyle[12pt]{article}
```

You can choose more than one option.

```
\documentstyle[11pt,twocolumn]{report}
```

The standard options are:

11pt Makes eleven-point type the normal (default) type size instead of ten-point type.

12pt Makes twelve-point type the normal (default) type size instead of ten-point type.

twoside Formats the output for printing on both sides of a page. (This is the default in the `book` style. The CSB laser printer/plotter is not capable of printing twosided documents.)

twocolumn Produces two-column pages.

titlepage For article style only; causes the `\maketitle` command and the `abstract` environment each to make a separate page. This is the default setting for `report` and `book` styles.

leqno Puts formula numbers on the left side in `equation` and `eqnarray` environments.

fleqn left-aligns displayed formulas.

You can also create your own style options. Have a TeXnician help you.

3.1.2 The Page Style

A page of output consists of three units: the head, the body and the foot. In this document, the page head is empty and the foot contains the page number. The *page style* determines what goes into the head and foot; it is specified with a `\pagestyle` command having the name of the page style as its argument. There are four standard page styles:

`plain` `empty` `headings` `myheadings`

See [1] page 83 for details.

The page number is usually Arabic. Use the `\pagenumbering` command to change the style of the page number. You can specify Roman page numbers with a `\pagenumbering{roman}` command. The `\pagenumbering` declaration resets the page number to one, starting with the current page.

3.1.3 The Title Page

A document usually has a title "page", one or more authors, and a date. For example:

```
\title{\bf Introduction to \LaTeX}
\author
{National Research Council \\ Finance and Information \\
Management Services}
\date{October 29, 1992}
\maketitle
```

produced the titlepage of this document.

The actual title "page" is generated by the `\maketitle` command. When using this command, you **must** provide a title and one or more authors. Use `\begin{titlepage}` ... `\end{titlepage}` if more control over the title page is desired. See [1] page 84 for more information.

3.2 Sectioning

The standard document styles have the following sectioning commands:

`\part`	`\subsection`	`\paragraph`
`\chapter`	`\subsubsection`	`\subparagraph`
`\section`		

Document-style parameters control which sectional units are numbered and which are listed in the table of contents. See [1] page 160 for ways to modify the default setting. The `article` document style does not contain the `\chapter` command. The `report` style assumes that there are chapters in the document.

If you use the `report` style for a document without chapters, all sections will be numbered assuming the chapter number is 0, e.g., Section 1 would be numbered 0.1.

This chapter began with the line:

```
\chapter{Putting It Together}
```

and this section began with the line

```
\section{Sectioning}
```

3.3 Appendices

An appendix in a document begins with an `\appendix` command. In `report` and `book` styles, appendix chapters are numbered as "A", "B", etc. In `article` style, appendix sections are numbered as "A", "B", etc.

3.4 Table of Contents

To generate a table of contents, just place the command `\tableofcontents` in your document where you want the table to appear.

LaTeX formats the Table of Contents based on the information saved from the *previous* run of the same document. You may need to run your document through LaTeX more than once in order to get the Table of Contents right.

3.5 Cross-References

LaTeX allows one to assign labels to various numbered entities (chapters, sections, pages, equations, tables and figures) and refer to those labels elsewhere in the document. The important thing is that these cross-references are made by name (referring to the label) rather than by number, and obviate the need for the author to know about the actual numbers.

As a specific example, Section 2.4.1 on page 6 discusses LaTeX commands. Shortly after the `\section` command that began that section, I included the line

```
\label{latexcmds}
```

This makes it possible to refer to that section elsewhere in the document by using the commands `\ref` and `\pageref`. For example, the sentence of this paragraph began,

```
As a specific example, Section~\ref{latexcmds}
on page~\pageref{latexcmds} discusses \LaTeX\ commands.
```

Note the use of tie character (`~`) to prevent line breaking between the word "Section" and the section number; and the word "page" and the page number.

3.6 Bibliography and Citation

A citation is a cross-reference to another publication, such as a journal article, called a *source*. With LaTeX, you can produce a list of sources yourself or else use a separate program called BibTeX to generate it. We will discuss how to generate a source list yourself.

The source list is created with a `thebibliography` environment. For example the last page of this document was produced by:

```
\begin{thebibliography}{99}
\bibitem{lam86} L.~Lamport, {\em{\LaTeX}: A Document
 Preparation System}, 1986, Addison-Wesley, Reading, Mass.
\bibitem{knu86} D.~Knuth, {\em The {\TeX}book}, 1986,
Addison-Wesley, Reading, Mass.
\bibitem{urb86} M.~Urban, {\em An Introduction to }\LaTeX,
TRW Software Productivity Project, February 17, 1986.
\end{thebibliography}
```

See [1] for more details.

The previous line was produced by

```
See \cite{lam86} for more details.
```

3.7 Running LaTeX

By now you should have an idea of how to create a simple LaTeX input file and you might be anxious to try LaTeX on your own. When you run your own input for the first time, things are unlikely to go as smoothly as they did for `SMALL TEX`. There will probably be a number of errors.

Suppose your file, say `MYDOC TEX` looks like this:

```
\documentstyle{article}
\begin{document}
Here is a word in {\Bf boldface} and here is one
in \it italics}. Here is a lower Greek \gamma
and a upper Greek \Gamma.
\end{document}
```

Let's try running `MYDOC TEX` through LaTeX by typing

```
latex mydoc
```

Here is what comes out at your terminal:

```
This is TeX, VM/CMS Version 2.93 (no format preloaded)
**
(mydoc.tex.*
LaTeX Version 2.09 <26 Apr 1988>
(article.sty.*
Document Style `article' <5 Feb 88>.
(art10.sty.*)) (mydoc.aux.*)
! Undefined control sequence.
l.3      Here is a word in {\Bf
                                boldface} and here is one
?
?
Type <return> to proceed, S to scroll future error messages,
R to run without stopping, Q to run quietly,
I to insert something, E to edit your file,
1 or ... or 9 to ignore the next 1 to 9 tokens of input,
H for help, X to quit.
?
h
The control sequence at the end of the top line
of your error message was never \def'ed. If you have
misspelled it (e.g., `\hobx'), type `I' and the correct
spelling (e.g., `I\hbox'). Otherwise just continue,
and I'll forget about whatever was undefined.

?
i\bf
?
! Too many }'s.
l.4      in \it italics}
                        . Here is a lower Greek \gamma
?

! Missing $ inserted.
<inserted text>
                $
<to be read again>
                  \gamma
l.4 ... \it italics}. Here is a lower greek \gamma

?
h
I've inserted a begin-math/end-math symbol since I think
you left one out. Proceed, with fingers crossed.
```

```
?
h
Sorry, I already gave what help I could...
Maybe you should try asking a human?
An error might have occurred before I noticed any problems.
``If all else fails, read the instructions.''

?
q
OK, entering \batchmode
```

The terminal output tells you that the first error is on line 3 of the file. The ? that ends the message indicates that LaTeX has stopped and is waiting for you to type something. You can type '?' to ask TeX what sort of response is expected. See [1] Chapter 6 for more information about LaTeX errors.

Chapter 4

Displayed Material

4.1 The quote Environment

The **quote** environment causes the text to be set somewhat narrower than normal. There is no paragraph indentation. For example:

```
Apply Knuth's advice to \LaTeX:
\begin{quote}
The best way to learn how to use \LaTeX\ is to use it.
Thus it's high time for you to sit down at a computer
terminal and interact with the \LaTeX\ system, trying
things out to see what happens.
\end{quote}
```

will produce:

Apply Knuth's advice to LaTeX:

> The best way to learn how to use LaTeX is to use it. Thus it's high time for you to sit down at a computer terminal and interact with the LaTeX system, trying things out to see what happens.

4.2 The quotation Environment

The `quotation` environment is just like the `quote` environment, except that paragraphs are indented:

Apply Knuth's advice to LaTeX:

> The best way to learn how to use LaTeX is to use it. Thus it's high time for you to sit down at a computer terminal and interact with the LaTeX system, trying things out to see what happens.

4.3 The `verse` Environment

The `verse` environment is used to display poetry. Basically, it is an environment with narrow output like `quote`, but lines that continue onto a second output line receive an extra indentation.

```
\begin{verse}
There is an environment for verse \\
Whose features some poets will curse.

For instead of making \\
Them do all line breaking \\
It allows them to put too many words on a line when
they'd rather be forced to be terse.
\end{verse}
```

would produce the following:

> There is an environment for verse
> Whose features some poets will curse.
>
> For instead of making
> Them do all line breaking
> It allows them to put too many words on a line when they'd rather
>   be forced to be terse.

4.4 The `verbatim` Environment

All text in this environment will appear exactly the way you typed it.

```
\begin{verbatim}
{\bf today's date is \today}
\end {verbatim}
```

produces

```
{\bf today's date is \today}
```

The `\verb` command simulates a short piece of typed text inside an ordinary paragraph. Its argument is not enclosed in braces, but by a pair of identical characters.

```
The \verb+%\ }{@&+ gnats are silly.
```

produces:

> The `%\ }{@&` gnats are silly.

4.5 The `center` Environment

The `center` environment is used to produce one or more lines of centered text, a \\ command starting a new line.

```
\begin{center}
\bf Introduction to \LaTeX \\
Document Preparation System
\end{center}
```

would produce the following:

Introduction to LaTeX
Document Preparation System

4.6 The `flushleft` and `flushright` Environments

The `flushleft` and `flushright` are similar to the `center` environment, but instead of centering lines, lines are moved to the left or right margin.

```
\begin{flushright}
Robert Klein \\
University of Calgary \\
2500 University Drive N.W. \\
Calgary, ALBERTA \\
T2N 1N4
\end{flushright}
```

would produce the following:

Robert Klein
University of Calgary
2500 University Drive N.W.
Calgary, ALBERTA
T2N 1N4

4.7 List-Making Environments

LaTeX provides three list-making environments: `itemize`, `enumerate`, and `description`. Each new list item must begin with an `\item` command.

4.7.1 Itemized Lists

The `itemize` environment is used to itemized lists. For example:

```
\begin{itemize}
\item itemized lists
\item enumerated list, in which each item is numbered
      consecutively
\item description list, in which each item has a text
      label instead of a bullet or a number.
\end{itemize}
```

would produce the following:

- itemized lists
- enumerated list, in which each item is numbered consecutively
- description list, in which each item has a text label instead of a bullet or a number.

4.7.2 Enumerated Lists

The `enumerate` environment automatically numbers each item in the list.

```
\begin{enumerate}
\item itemized lists
\item enumerated list, in which each item is numbered
      consecutively
\item description list, in which each item has a text
      label instead of a bullet or a number.
\end{enumerate}
```

would produce the following:

1. itemized lists
2. enumerated list, in which each item is numbered consecutively
3. description list, in which each item has a text label instead of a bullet or a number.

4.7.3 Description Lists

In the `description` environment, you specify the item labels as the argument to the `\item` command, enclosed in square brackets

```
There are four standard {\em page styles}:
\begin{description}
\item[plain] The head is empty, the foot only a page number;
it is the default page style.
```

```
\item[empty] The head and foot are both empty.
\item[headings] The head contains information determined by
the document style (usually a sectional-unit heading) and
the page number; the foot is empty.
\item[myheadings] Same as {\tt headings}, except the head
information is specified by the user.
\end{description}
```

will produce:

There are four standard *page styles*:

plain The head is empty, the foot only a page number; it is the default page style.

empty The head and foot are both empty.

headings The head contains information determined by the document style (usually a sectional-unit heading) and the page number; the foot is empty.

myheadings Same as `headings`, except the head information is specified by the user.

4.7.4 Nesting Lists

```
\begin{itemize}
  \item Each list item is marked with a {\em label}.  The labels
    in this itemized list are bullets.
  \item Lists can be nested within one another.
    \begin{enumerate}
      \item The item labels in an enumerated list are numerals
            or letters.
      \item A list should have at least two items.
    \end{enumerate}
    \LaTeX\ permits at least four levels of nested lists, which is
    more than enough.

  \item Blank lines before an item have no effect.
\end{itemize}
```

produces:

- Each list item is marked with a *label*. The labels in this itemized list are bullets.
- Lists can be nested within one another.

1. The item labels in an enumerated list are numerals or letters.
2. A list should have at least two items.

LaTeX permits at least four levels of nested lists, which is more than enough.

- Blank lines before an item have no effect.

4.8 The `tabbing` Environment

In the `tabbing` environment, you align text in columns by setting tab stops and tabbing to them, like you would do with an ordinary typewriter. Tab stops are set with the `\=` command, and `\>` moves to the next tab stop. For example:

```
\begin{tabbing}
 \hspace{1.0in} \= \hspace{1.5in} \=
 \hspace{1.0in} \= \hspace{1.5in} \kill
 Year \> Hours worked \> Hours lost \> No. of workers \\
   \>       \>      \>     \\
83 \> 21678 \> 466 \> 24 \\
84 \> 22343 \> 687 \> 28 \\
85 \> 24565 \> 521 \> 27 \\
86 \> 21232 \> 344 \> 27 \\
   \>       \>      \>     \\
\end{tabbing}
```

will produce:

Year	Hours worked	Hours lost	No. of workers
83	21678	466	24
84	22343	687	28
85	24565	521	27
86	21232	344	27

4.9 The `tabular` Environment

```
\begin{center}
\begin{tabular}{|r|c|r|} \hline
\multicolumn{3}{|c|}{AT\&T Common Stock} \\
\hline
```

```
Year & Price & Dividend \\ \hline
1971 & 41--54 &\$2.60 \\ \hline
   2 & 41--54 &  2.70 \\ \hline
   3 & 46--55 &  2.87 \\ \hline
   4 & 40--53 &  3.24 \\ \hline
   5 & 45--52 &  3.40 \\ \hline
   6 & 51--59 &   .95 \\ \hline
\end{tabular}
\end{center}
```

will produce:

AT&T Common Stock		
Year	Price	Dividend
1971	41–54	$2.60
2	41–54	2.70
3	46–55	2.87
4	40–53	3.24
5	45–52	3.40
6	51–59	.95

Chapter 5

Mathematical Formulas

There are four environments which put TeX in math mode:

math environment produces an in-text formula: $\sum_{n=1}^{m} x_i$

- `$` *formula* `$`
- `\(` *formula* `\)`
- `\begin{math}` *formula* `\end{math}`

displaymath environment produces an unnumbered displayed formula:

$$\sin 2\theta = 2\sin\theta\cos\theta$$

- `$$` *formula* `$$` (TeX notation)
- `\[` *formula* `\]`
- `\begin{displaymath}` *formula* `\end{displaymath}`

equation environment produces a numbered displayed formula:

$$\int_{-\infty}^{+\infty} e^{-x^2}\,dx = \sqrt{\pi} \tag{5.1}$$

- `\begin{equation}` *formula* `\end{equation}`

eqnarray environment produces numbered multiline displayed formulas:

$$ax^2 + bx + c = 0 \tag{5.2}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{5.3}$$

- `\begin{eqnarray}` *equations* `\end{eqnarray}`

eqnarray* environment produces unnumbered multiline displayed formulas:

$$\begin{eqnarray*}
ax^2 + bx + c & = & 0 \\
x & = & \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
\end{eqnarray*}$$

- `\begin{eqnarray*}` *equations* `\end{eqnarray*}`

5.1 Some Common Structures

Subscripts and Superscripts

Subscripts and superscripts are made with the `_{`*subscript*`}` and `^{`*superscript*`}`. For example:

`x^{2y}`	x^{2y}
`x_{2y}`	x_{2y}

Fractions

Fractions denoted by the / are made in the obvious way. The large fractions in displayed formulas are done with the `\frac{`*numerator*`}{`*denominator*`}` command.

```
\begin{displaymath}
x = \frac{y+z/2}{y+1}
\end{displaymath}
```

$$x = \frac{y + z/2}{y + 1}$$

Roots

The `\sqrt[`*n*`]{`*argument*`}` command produces the *n*th root of its *argument*.

A square root `$\sqrt{x+y}$`	$\sqrt{x+y}$
An *n*th root `$\sqrt[n]{2}$`	$\sqrt[n]{2}$

Greek Letters

The command to produce a lowercase Greek letter is obtained by adding a \ to the name of the letter. For an upper case Greek letter, just capitalize the first letter of the command name.

```
Making Greek letters is as easy as $\pi$ (or $\Pi$).
```

produces:

Making Greek letters is as easy as π (or Π).

See Table B.3 for a complete list of commands for making Greek letters.

Common Mathematical Functions

The names of algebraic variables are usually italic or Greek letters, but common mathematical functions like 'sin' are always set in roman type. The command to produce such a function is obtained by adding a \ to the name of the function. For example, to produce 'sin' type `\sin`. Other commands like `\sin` for generating function names are listed in Table B.11.

Examples

The equation 5.1 was produced by:

```
\begin{equation}
\int_{-\infty}^{+\infty} e^{-x^2}dx = \sqrt{\pi}
\end{equation}
```

The equations 5.2 and 5.3 were produced by:

```
\begin{eqnarray}
ax^2+bx+c  & = & 0 \\
x & = & \frac{-b\pm\sqrt{b^2-4ac}}{2a}
\end{eqnarray}
```

5.2 Basic Rules

1. All spaces are ignored. The following four commands could be used to add extra space into your formulas:

`\,`	thin space	`\!`	negative thin space
`\:`	medium space	`\;`	thick space

2. Alphabetic characters are in math italic style unless otherwise specified.
3. Many control sequences only work in mathematics mode and produce errors at other times.
4. Blank lines are not allowed in math mode.

Example of use of thin space:

`\int_{-3}^{-1}x\,dx` produces $\int_{-3}^{-1} x\, dx$

Example of math italic and roman fonts:

`x_{\rm max} - x_{\rm min}` produces $x_{\rm max} - x_{\rm min}$

5.3 The `array` Environment

The `array` environment has a single argument that specifies the number of columns and the alignment of items within the columns. For each column in the array, there is a single letter in the argument that specifies how items in the column should be positioned: c for centered, l for flush left, or r for flush right. Each row is separated by a \\ command and items within the rows are separated by an & character. For example:

```
\begin{displaymath}
\begin{array}{cclrr}
a1 & a2 & a3 & a4 & 11 \\
b+2 & c+4 & x_2y^{x+1} & z & 1,000 \\
a+b+c & c & xyz & c - b  & 34,500
\end{array}
\end{displaymath}
```

$$\begin{array}{cclrr}
a1 & a2 & a3 & a4 & 11 \\
b+2 & c+4 & x_2y^{x+1} & z & 1,000 \\
a+b+c & c & xyz & c - b & 34,500
\end{array}$$

Another example:

```
\begin{displaymath}
\begin{array}{c}
\begin{array}{cc}
x_{11} & x_{12} \\
x_{21} & x_{22}
\end{array}\\
y \\ z
\end{array}
\end{displaymath}
```

$$\begin{array}{c}
\begin{array}{cc}
x_{11} & x_{12} \\
x_{21} & x_{22}
\end{array}\\
y \\ z
\end{array}$$

Matrices often appear in the form of a generic pattern that use ellipses to indicate rows or columns that are left out. For example:

```
\begin{displaymath}
A = \left(\begin{array}{cccc}
          a_{11} & a_{12} & \ldots & a_{1n} \\
          a_{21} & a_{22} & \ldots & a_{2n} \\
          \vdots & \vdots & \ddots & \vdots  \\
          a_{m1} & a_{m2} & \ldots & a_{mn}
          \end{array}\right)
\end{displaymath}
```

will produce:

$$A = \left(\begin{array}{cccc} a_{11} & a_{12} & \ldots & a_{1n} \\ a_{21} & a_{22} & \ldots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \ldots & a_{mn} \end{array}\right)$$

5.4 The eqnarray Environment

The `eqnarray` environment produces a sequence of displayed formulas aligned in three columns. The items are flushed right, centered and flushed left for the first, second and third column respectively.

```
\begin{eqnarray}
x & = & 4y + 3z \\
z & > & a + b + ... + j + \nonumber \\
  &   & k + l + m
\end{eqnarray}
```

will produce

$$\begin{array}{rcll} x & = & 4y + 3z & (5.4) \\ z & > & a + b + ... + j + & \\ & & k + l + m & (5.5) \end{array}$$

Chapter 6

Floating Bodies

LaTeX breaks paragraphs and sentences across pages to avoid partially filled pages. Some things like pictures and tables, cannot be split; they must be "floated" to convenient places, such as the top of the following page, to prevent half-empty pages. `table` and `figure` are two of the environments provided by LaTeX that produce floating objects.

6.1 The `table` and `figure` Environments

The `table` environment is generally used for tabular information and the `figure` environment is generally used for pictures. There is really no difference between the two environments except how they are captioned.

Figures and tables may be placed where the environment appears, above the text at the top of a page, below the text at the bottom of a page, or on a separate page containing nothing but tables and figures. There is an optional argument *loc* for the `\begin{table}` and `\begin{figure}` commands. The *loc* argument is a sequence of zero to four letters, each one specifying a location where the figure or table may be placed. See Table 6.1 for the possible locations, which was produced by:

```
\begin{table}[htbp]
\begin{center}
\begin{tabular}{||c|l||}
\hline option & meaning \\
\hline
h & here on the page \\
b & bottom of a page  \\
t & top of a page \\
p & floating page \\
\hline
\end{tabular}
\end{center}
\caption{Table/Figure Destinations}
\label{tb:loc}
\end{table}
```

option	meaning
h	here on the page
b	bottom of a page
t	top of a page
p	floating page

Table 6.1: Table/Figure Destinations

The caption on a table or figure is made with a `\caption` command having the caption's text as its argument. More than one `\caption` command can appear in the same figure or table environment.

The `\label` command is used to label a table or figure in order that it can be referred to somewhere else. The `\listoftables` command produces a "List of Tables" at the place where the command was specified. The command `\listoffigures` similarly produces a "List of Figures".

6.2 Merging Graphics

Graphics can be embedded within a TEX or LATEX document for output on the CSB laser printer/plotter. The plots can be created with any of the available graphics packages on VM/CMS— DISSPLA, TELLAGRAF, etc.

The plot file created by one of the graphics packages must be processed by the VM/CMS PLOTTEX command before it can be embedded in the document. The `\plot` macro written by CSB is used.

(5.5in,4.25in,shuttle)

Figure 6.1: Example of embedded graphics

```
\begin{figure}
\begin{center}
\plot(5.5in,4.25in,shuttle)
\caption{Example of embedded graphics}
\label{fg:shuttle}
\end{center}
\end{figure}
```

will produce Figure 6.1 on page 30.

The format of the `\plot` macro is:

```
\plot (<width>,<height>,<plot file>
      (,<plot number>)(,<flip>)(,<thick pen>))
```

For a complete description of the `\plot` macro, type:

```
help tex graphics
```

The plot file specified in a `\plot` macro is not referenced until the TEXPRINT command is issued with the PLOTS option specified. The plot is scaled up or down to fit within the area specified by *width* and *height*.

If the processing of a plot file fails when TEXPRINT is issued, or the PLOTS option has not been specified, a box will be drawn around the area specified by the *width* and *height*; i.e., the TeX/LaTeX document can be printed without including the plot(s).

Chapter 7

More LaTeX

7.1 Changing the Type Size

LaTeX's default type style is "roman" and its default type size is ten-point type, but you can change the default type size as an option in the document style declaration as we mentioned in Section 3.1.1 on page 10. LaTeX also provides declaration commands for changing the type size.

Gnu	`\tiny`	Gnu	`\scriptsize`	Gnu	`\footnotesize`
Gnu	`\small`	Gnu	`\normalsize`	Gnu	`\large`
Gnu	`\Large`	Gnu	`\LARGE`	Gnu	`\huge`
Gnu	`\Huge`				

7.2 Changing the Type Style

In Section 2.4.3 we talked about the `\em` command which is used for emphasizing text. The `\em` declaration actually tells LaTeX to start using an *italic* type style—unless it already is using italics, in which case it chooses roman style.

LaTeX provides the following seven type styles:

This is roman type style	`{\rm This is roman type style}`
This is italic type style	`{\it This is italic type style}`
This is bold type style	`{\bf This is bold type style}`
This is slanted type style	`{\sl This is slanted type style}`
This is sans serif type style	`{\sf This is sans serif type style}`
THIS IS SMALL CAPS STYLE	`{\sc This is Small Caps style}`
`This is typewriter type style`	`{\tt This is typewriter type style}`

7.3 Loading Fonts

There are a number of fonts available on the CSB laser printer/plotter that LaTeX doesn't know about. By using the `\newfont` command, LaTeX will load the font for you. For example, if you want to use the font "steit20", you type the following lines:

```
\newfont{\swit}{steit20}
{\swit This is a Swiss italic 20 point font.}
```

which produces:

If you want to load the font "cmssdc10" at magnification 2074 for producing slides, you type:

```
\newfont{\bigsf}{cmssdc10 scaled 2074}
{\bigsf A big font for slides}
```

A big font for slides

The first argument of the `\newfont` command defines the command name for the font. The second argument identifies the font. A list of available TeX fonts and magnifications for the CSB laser printer/plotters can be obtained from CSB.

7.4 Letters

The **letter** document style is for producing letters.

- The return address is declared by using the `\address` command, with multiple output lines.
- The `\signature` command declares your name as it appears at the end of the letter.
- The name and address of the recipient is specified as the argument of the `\begin{letter}` command.
- Use the `\opening` and `\closing` commands for opening and closing notes.
- The `\cc` command can be used after the closing to list names of people to whom you are sending copies.

For Example:

```
\documentstyle{letter}
\begin{document}
\address{R.J. Drofnats\\Professor Farm Ecology\\
The University of St. Anford\\
P. O. Box 1009\\Haga Alto CA 94321}
\signature{R.J. Drofnats\\Professor}
\begin{letter}{Prof.\ Brian Reid\\
Dept.\ of Electrical Engineering\\
Stanford University\\
Stanford, CA 94305}

\opening{Dear Prof.\ Reid:}

I understand that you are having difficulties with Alka-Seltzer
tablets. Since there are 25 pills per bottle, while the
manufacturer's directions recommended ``plop,~plop''
my colleagues tell me that you have accumulated a substantial
number of bottles in which there is one tablet left.

At present I am engaged on the potential applications of isolated
analgesics. If you would be so kind
as to donate your Alka-Selzter collection to our project, I would
be more than happy to send you preprints of any progress reports
that we may publish concerning this critical problem.

\closing{Sincerely,}
\cc {The \TeX book}
\ps {P.S. If you like, I will check into the possibility that
your donation and the meals that you have been eating might be
tax deductible, in connection with our research.}
\end{letter}
\end{document}
```

R.J. Drofnats
Professor Farm Ecology
The University of St. Anford
P. O. Box 1009
Haga Alto, CA 94321

February 25, 1998

Prof. Brian Reid
Dept. of Electrical Engineering
Stanford University
Stanford, CA 94305

Dear Prof. Reid:

I understand that you are having difficulties with Alka-Seltzer tablets. Since there are 25 pills per bottle, while the manufacturer's directions recommended "plop, plop" my colleagues tell me that you have accumulated a substantial number of bottles in which there is one tablet left.

At present I am engaged on the potential applications of isolated analgesics. If you would be so kind as to donate your Alka-Selzter collection to our project, I would be more than happy to send you preprints of any progress reports that we may publish concerning this critical problem.

Sincerely,

R.J. Drofnats
Professor

cc: The TEXbook

P.S. If you like, I will check into the possibility that your donation and the meals that you have been eating might be tax deductible, in connection with our research.

Appendix A

Related CMS Commands

A.1 The LATEX command

LATEX	fn (ft) (fm) (options) options: VIEW (TEXPRINT options) PRINT defaults: no VIEW nor PRINT

Type HELP LATEX for more information.

A.2 The TEXPRINT command

$$\text{TEXPRINT} \left\{ \begin{array}{l} \text{fn (ft) (fm) (device) ((options()))} \\ \text{QUery} \left[\begin{array}{l} \text{device} \\ \text{spoolid} \end{array} \right] \\ \text{PUrge} \left\{ \begin{array}{l} \text{spoolid} \\ \text{CLass c} \\ \text{FORM form} \\ \text{ALL} \end{array} \right\} \end{array} \right\}$$

options:

$$\left[\begin{array}{l} \text{preVIEW} \\ \text{DVIVIEW} \end{array} \right] \text{(QUIET)} \left[\begin{array}{l} \text{default} \\ \text{CENTER} \\ \text{NOCENTER} \end{array} \right] \left[\begin{array}{l} \text{PORTRAIT} \\ \text{LANDSCAPE} \end{array} \right]$$

$$\text{(PAGES list)} \quad \text{(PLOTS)} \quad \left[\text{FORM} \left\{ \begin{array}{l} \text{PAPER11} \\ \text{PAPER14} \end{array} \right\} \right]$$

$$\left[\text{CLASS} \left\{ \begin{array}{c} \text{X} \\ \text{A} \\ \text{D} \\ \text{S} \end{array} \right\} \right] \text{(COPY nn) (MAG m.nnn)} \left[\begin{array}{l} \text{TRAIL} \\ \text{NOTRAIL} \end{array} \right]$$

$$\left[\text{DIST} \left\{ \begin{array}{l} \text{distcode} \\ \text{PICKUP} \end{array} \right\} \right] \text{(TAG tagtext)}$$

default options:

- output to LASER device at M-60 (no PREVIEW or DVIVIEW)
- default TeX page positioning (1.0 inch margins)
- PORTRAIT all PAGES no PLOTS MAG 1.000
- FORM PAPER11 CLASS A COPY 1
- TRAILer page output on central CSB devices; NOTRAILer page for most others
- current user DIST and TAG

Type HELP TEXPRINT for information.

A.3 The PLOTTEX command

Use the PLOTTEX command to produce a TEX or LATEX compatible plot file from a regular plot file generated by one of the graphics packages.

The format of the PLOTTEX command is:

```
PLOTTEX fn
```

where `fn` is the filename of a file containing the plot data. The filetype of the file must be PLOTFILE. The TEX/LATEX compatible file is generated with the filename fn and filetype PLOTTEX. Type HELP PLOTTEX for more information.

Appendix B

Special Characters and Symbols

`\`{a}`	grave	à
`\'{a}`	acute	á
`\^{a}`	circumflex	â
`\"{a}`	umlaut	ä
`\c{c}`	cedilla	ç
`\~{a}`	tilde	ã
`\={a}`	macron/bar	ā
`\.{a}`	dot	ȧ
`\u{a}`	breve	ă
`\v{a}`	haček	ǎ
`\H{a}`	Hungarian umlaut	a̋
`\t{aa}`	tie-after	a͡a
`\d{a}`	dot-under	ạ
`\b{a}`	bar-under	a̲
`$\vec{a}$`	vector	$\vec{a}$

Table B.1: Accents

\oe	œ	(French ligature)
\OE	Œ	(French ligature)
\ae	æ	(Latin and Scandinavian ligature)
\AE	Æ	(Latin and Scandinavian ligature)
\aa	å	(Scandinavian A with circle)
\AA	Å	(Scandinavian A with circle)
\o	ø	(Scandinavian O with slash)
\O	Ø	(Scandinavian O with slash)
\l	ł	(Polish suppressed-L)
\L	Ł	(Polish suppressed-L)
\ss	ß	(German sharp S)
\i	ı	(dotless "i")
\j	ȷ	(dotless "j")
>	¿	(Spanish question mark)
<	¡	(Spanish exclamation mark)
\dag	†	
\ddag	‡	
\S	§	
\P	¶	
\pounds	£	
\copyright	©	

Table B.2: Foreign Symbols

α	`\alpha`	ι	`\iota`	ϱ	`\varrho`
β	`\beta`	κ	`\kappa`	σ	`\sigma`
γ	`\gamma`	λ	`\lambda`	ς	`\varsigma`
δ	`\delta`	μ	`\mu`	τ	`\tau`
ϵ	`\epsilon`	ν	`\nu`	υ	`\upsilon`
ε	`\varepsilon`	ξ	`\xi`	ϕ	`\phi`
ζ	`\zeta`	o	`o`	φ	`\varphi`
η	`\eta`	π	`\pi`	χ	`\chi`
θ	`\theta`	ϖ	`\varpi`	ψ	`\psi`
ϑ	`\vartheta`	ρ	`\rho`	ω	`\omega`
Γ	`\Gamma`	Ξ	`\Xi`	Φ	`\Phi`
Δ	`\Delta`	Π	`\Pi`	Ψ	`\Psi`
Θ	`\Theta`	Σ	`\Sigma`	Ω	`\Omega`
Λ	`\Lambda`	Υ	`\Upsilon`		

Table B.3: Greek Letters (math mode)

<table>
<tr><td>$\aleph$</td><td><code>\aleph</code></td><td>$\prime$</td><td><code>\prime</code></td><td>$\forall$</td><td><code>\forall</code></td></tr>
<tr><td>$\hbar$</td><td><code>\hbar</code></td><td>$\emptyset$</td><td><code>\emptyset</code></td><td>$\exists$</td><td><code>\exists</code></td></tr>
<tr><td>$\imath$</td><td><code>\imath</code></td><td>∇</td><td><code>\nabla</code></td><td>$\neg$</td><td><code>\neg</code></td></tr>
<tr><td>$\jmath$</td><td><code>\jmath</code></td><td>$\surd$</td><td><code>\surd</code></td><td>$\flat$</td><td><code>\flat</code></td></tr>
<tr><td>ℓ</td><td><code>\ell</code></td><td>$\top$</td><td><code>\top</code></td><td>$\natural$</td><td><code>\natural</code></td></tr>
<tr><td>$\wp$</td><td><code>\wp</code></td><td>$\bot$</td><td><code>\bot</code></td><td>$\sharp$</td><td><code>\sharp</code></td></tr>
<tr><td>$\Re$</td><td><code>\Re</code></td><td>$\|$</td><td><code>\|</code></td><td>$\clubsuit$</td><td><code>\clubsuit</code></td></tr>
<tr><td>$\Im$</td><td><code>\Im</code></td><td>$\angle$</td><td><code>\angle</code></td><td>$\diamondsuit$</td><td><code>\diamondsuit</code></td></tr>
<tr><td>∂</td><td><code>\partial</code></td><td>$\triangle$</td><td><code>\triangle</code></td><td>$\heartsuit$</td><td><code>\heartsuit</code></td></tr>
<tr><td>∞</td><td><code>\infty</code></td><td>$\backslash$</td><td><code>\backslash</code></td><td>$\spadesuit$</td><td><code>\spadesuit</code></td></tr>
</table>

Table B.4: Miscellaneous Special Symbols (math mode)

$\sum$	`\sum`	$\bigcap$	`\bigcap`	$\bigodot$	`\bigodot`
$\prod$	`\prod`	$\bigcup$	`\bigcup`	$\bigotimes$	`\bigotimes`
$\coprod$	`\coprod`	$\bigsqcup$	`\bigsqcup`	$\bigoplus$	`\bigoplus`
$\int$	`\int`	$\bigvee$	`\bigvee`	$\biguplus$	`\biguplus`
$\oint$	`\oint`	$\bigwedge$	`\bigwedge`		

Table B.5: Large Operators (math mode)

$\pm$	`\pm`	$\cap$	`\cap`	$\vee$	`\vee`
$\mp$	`\mp`	$\cup$	`\cup`	$\wedge$	`\wedge`
$\setminus$	`\setminus`	$\uplus$	`\uplus`	$\oplus$	`\oplus`
$\cdot$	`\cdot`	$\sqcap$	`\sqcap`	$\ominus$	`\ominus`
$\times$	`\times`	$\sqcup$	`\sqcup`	$\otimes$	`\otimes`
$\ast$	`\ast`	$\triangleleft$	`\triangleleft`	$\oslash$	`\oslash`
$\star$	`\star`	$\triangleright$	`\triangleright`	$\odot$	`\odot`
$\diamond$	`\diamond`	$\wr$	`\wr`	$\dagger$	`\dagger`
$\circ$	`\circ`	$\bigcirc$	`\bigcirc`	$\ddagger$	`\ddagger`
$\bullet$	`\bullet`	$\bigtriangleup$	`\bigtriangleup`	$\amalg$	`\amalg`
$\div$	`\div`	$\bigtriangledown$	`\bigtriangledown`		

Table B.6: Binary Operators (math mode)

$\leq$	`\leq`	$\geq$	`\geq`	$\equiv$	`\equiv`
$\prec$	`\prec`	$\succ$	`\succ`	$\sim$	`\sim`
$\preceq$	`\preceq`	$\succeq$	`\succeq`	$\simeq$	`\simeq`
$\ll$	`\ll`	$\gg$	`\gg`	$\asymp$	`\asymp`
$\subset$	`\subset`	$\supset$	`\supset`	$\approx$	`\approx`
$\subseteq$	`\subseteq`	$\supseteq$	`\supseteq`	$\cong$	`\cong`
$\sqsubseteq$	`\sqsubseteq`	$\sqsupseteq$	`\sqsupseteq`	$\bowtie$	`\bowtie`
$\in$	`\in`	$\ni$	`\ni`	$\propto$	`\propto`
$\vdash$	`\vdash`	$\dashv$	`\dashv`	$\models$	`\models`
$\smile$	`\smile`	$\mid$	`\mid`	$\doteq$	`\doteq`
$\frown$	`\frown`	$\parallel$	`\parallel`	$\perp$	`\perp`

Table B.7: Relation Symbols (math mode)

$\not<$	`\not<`	$\not>$	`\not>`	$\not=$	`\not=`
$\not\leq$	`\not\leq`	$\not\geq$	`\not\geq`	$\not\equiv$	`\not\equiv`
$\not\prec$	`\not\prec`	$\not\succ$	`\not\succ`	$\not\sim$	`\not\sim`
$\not\preceq$	`\not\preceq`	$\not\succeq$	`\not\succeq`	$\not\simeq$	`\not\simeq`
$\not\subset$	`\not\subset`	$\not\supset$	`\not\supset`	$\not\approx$	`\not\approx`
$\not\subseteq$	`\not\subseteq`	$\not\supseteq$	`\not\supseteq`	$\not\cong$	`\not\cong`
$\not\sqsubseteq$	`\not\sqsubseteq`	$\not\sqsupseteq$	`\not\sqsupseteq`	$\not\asymp$	`\not\asymp`

Table B.8: Negated Relation Symbols (math mode)

$\leftarrow$	\leftarrow	$\longleftarrow$	\longleftarrow	$\uparrow$	\uparrow
$\Leftarrow$	\Leftarrow	$\Longleftarrow$	\Longleftarrow	$\Uparrow$	\Uparrow
$\rightarrow$	\rightarrow	$\longrightarrow$	\longrightarrow	$\downarrow$	\downarrow
$\Rightarrow$	\Rightarrow	$\Longrightarrow$	\Longrightarrow	$\Downarrow$	\Downarrow
$\leftrightarrow$	\leftrightarrow	$\longleftrightarrow$	\longleftrightarrow	$\updownarrow$	\updownarrow
$\Leftrightarrow$	\Leftrightarrow	$\Longleftrightarrow$	\Longleftrightarrow	$\Updownarrow$	\Updownarrow
$\mapsto$	\mapsto	$\longmapsto$	\longmapsto	$\nearrow$	\nearrow
$\hookleftarrow$	\hookleftarrow	$\hookrightarrow$	\hookrightarrow	$\searrow$	\searrow
$\leftharpoonup$	\leftharpoonup	$\rightharpoonup$	\rightharpoonup	$\swarrow$	\swarrow
$\leftharpoondown$	\leftharpoondown	$\rightharpoondown$	\rightharpoondown	$\nwarrow$	\nwarrow
$\rightleftharpoons$	\rightleftharpoons				

Table B.9: Arrows (math mode)

<table>
<tr><td>$($</td><td>(</td><td>$)$</td><td>)</td><td>$\uparrow$</td><td>\uparrow</td></tr>
<tr><td>$[$</td><td>[</td><td>$]$</td><td>]</td><td>$\downarrow$</td><td>\downarrow</td></tr>
<tr><td>$\{$</td><td>\{</td><td>$\}$</td><td>\}</td><td>$\updownarrow$</td><td>\updownarrow</td></tr>
<tr><td>$\lfloor$</td><td>\lfloor</td><td>$\rfloor$</td><td>\rfloor</td><td>$\Uparrow$</td><td>\Uparrow</td></tr>
<tr><td>$\lceil$</td><td>\lceil</td><td>$\rceil$</td><td>\rceil</td><td>$\Downarrow$</td><td>\Downarrow</td></tr>
<tr><td>$\langle$</td><td>\langle</td><td>$\rangle$</td><td>\rangle</td><td>$\Updownarrow$</td><td>\Updownarrow</td></tr>
<tr><td>$/$</td><td>/</td><td>$\backslash$</td><td>\backslash</td><td></td><td></td></tr>
<tr><td>$\vert$</td><td>|</td><td>$\Vert$</td><td>\|</td><td></td><td></td></tr>
</table>

Table B.10: Delimiters (math mode)

\arccos	\csc	\ker	\min
\arcsin	\deg	\lg	\Pr
\arctan	\det	\lim	\sec
\arg	\dim	\liminf	\sin
\cos	\exp	\limsup	\sinh
\cosh	\gcd	\ln	\sup
\cot	\hom	\log	\tan
\coth	\inf	\max	\tanh

Table B.11: Common Mathematical Functions

Appendix C

LaTeX on UNIX systems

LaTeX on UNIX systems is used in the same way it is used on most other systems:

`latex` *filename*

will process the `.tex` file through the formatter, producing a file of the same name, but ending in `.dvi`. The `.dvi` file can be previewed on X based terminals by issuing

`xdvi` *filename*

Note that for the previewer to work, the `DISPLAY` environment variable must be set to be the name of the workstation/X terminal where the document is to be displayed. For example, if the system used to display the document is `nrccsb3.di.nrc.ca`, the environment variable is set using:

```
setenv DISPLAY nrccsb3.di.nrc.ca:0
```
(for C and T shell users)

```
DISPLAY="nrccsb3.di.nrc.ca:0"; export DISPLAY
```
(for Bourne and Korn shell users)

The document can be printed on a variety of printers, the most popular one being PostScript-based. The `.dvi` file first needs to be translated into PostScript, using the `dvips` command, as

`dvips` [options] *filename*

The result will be a file ending in `.ps`, which can then be sent to the PostScript printer of your choice, using

`lp` *filename*

for System V based systems (most Silicon Graphics, IBMs, HPs), or

`lpr` *filename*

for BSD type systems (such as Suns, some Silicon Graphics, DECs).

At any time during the compilation of LaTeX, if a font error happens, please contact your systems administrator. That person can easily rebuild the needed fonts.

Many UNIX systems include other tools to be used with LaTeX documents. Some of those tools allow a rough previewing of `.dvi` files on an ASCII based screen (`dvitype`), or produce output to use on overhead projectors (`slitex`) or use a speller on the document (`texspell`). Contact your system administrator to find out which TeX/LaTeX utilities reside on your system.

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[3] M. Urban, *An Introduction to LaTeX*, TRW Software Productivity Project, February 17, 1986.