A Brief Overview of LaTeX

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What Is LaTeX?

LaTeX is a document preparation system designed by Leslie Lamport on top of Donald Knuth's TeX.

Useful Websites

There's a useful wikibook about LaTeX at
https://en.wikibooks.org/wiki/LaTeX

There's also a useful TeXFAQ at https://texfaq.org.

And Stack Exchange provides a useful question and answer site at
https://tex.stackexchange.com

The LaTeX Project has useful information at
https://www.latex-project.org/

The TeX Users Group (TUG) also has lots of useful information.

Get LaTeX for Free

The TeX Live (from TUG) has distributions for Unix, Windows and Mac OS X.

Get LaTeX for Free: Windows

MiKTeX is specifically for Windows (and is public domain).

proTeXt is an easy-to-install distribution based on MikTeX (and is also public domain).

Get LaTeX for Free: Mac OS X

MacTeX is a Mac-specific distribution, based on TeXLive.

LaTeX Editors

For Windows:

WinEdt: Available at http://www.winedt.com (shareware: US$40 student registration after a 30-day trial period). It can connect to pretty much any version of TeX, but is preconfigured for MiKTeX.

LEd: A free environment for rapid TeX and LaTeX document development. It is available at http://www.latexeditor.org/.

Cross-platform editors:

Texmaker: A free LaTeX editor that integrates many tools needed to develop documents with LaTeX in just one application. Texmaker runs on Unix, Mac OS X, and Windows systems and is available at http://www.xm1math.net/texmaker/.

TeXstudio: A cross-platform environment available at https://texstudio.org

LyX: Runs on many platforms (https://www.lyx.org/).

LaTeX Editors

Check the Mac OS X LaTeX website http://tug.org/mactex/ for **Mac editors.**

How Do I Use LaTeX?

Create a LaTeX source file (`filename.tex`) containing the content of the document plus LaTeX commands that describe the logical structure of the document.

Run LaTeX on the source file (either `latex filename.tex` or `pdflatex filename.tex`)

LaTeX formats the document using the formatting rules of the document class specified in the source, putting the output into either

- A device-independent file (`filename.dvi`) — if you used the `latex` command, or
- A PDF file (`filename.pdf`) — if you used the `pdflatex` command.

Device-Independent Output

If you used `latex filename.tex` to get `filename.dvi`: Then the formatted output can be

- Displayed on the screen using `xdvi`, or
- Translated into Postscript using `dvips` and then printed.

To use LaTeX 2e on the Department's Unix systems: You must use the command

```
source /usr/local/tex/setup.csh
```

(This command could go in one of the standard files such as your .login file.)

Typical session on our Unix systems:

```
pdflatex file.tex
bibtex file
pdflatex file.tex
pdflatex file.tex
```

Overview of LaTeX Source

```
\documentclass[options]{chosenDocumentClass}

   preamble

\begin{document}

   The content of your document goes here!

\end{document}
```

Document Classes

article: used for ordinary documents.
Some options: 11pt, 12pt, twoside, twocolumn

report: like article, only for longer documents.

book: for books.

letter: for letters.

seminar, slides or beamer: for slides.

The Title Page

Specify the title, author(s), and date (optional) in the preamble, and generate the title page with the `\maketitle` command.

```
\documentclass{article}
   \title{$P \not= \mathit{NP}$}
   \author{Helen Cameron}
\begin{document}
  \maketitle
   The rest of my article goes here.
\end{document}
```

Abstracts

If you want an abstract in your document: For example, a thesis proposal usually has an abstract — use the `abstract` environment and place it after the `\maketitle` command:

```
\begin{abstract}
  The negative side-effects of using lock-based
  synchronization mechanisms are well known.
\end{abstract}
```

Sectioning

To start a new section: `\section{section_title}`

Subsections and sub-subsections are also available:
`\subsection{subsection_title}` and
`\subsubsection{subsubsection_title}`.
To get unnumbered sections and subsections: Use
`\section*{section_title}` and
`\subsection*{subsection_title}`.

Example:

```
\section{Introduction}
Many theoretical computer scientists have
hypothesized --- correctly --- that
$P \not= \mathit{NP}$, but none were able to prove
it.  At last, that hypothesis is proved correct.

\subsection{The Class $P$}
The class $P$ consists of all decision problems
that can be solved in polynomial time.

\subsection{The Class $\mathit{NP}$}
The class $\mathit{NP}$ consist of all decision problems
that can be solved in nondeterministic polynomial time.
```

Text

Type in the text of your document mostly as you normally would.

LaTeX ignores whitespace (tabs, blanks, newlines) except ...

A blank line ends a paragraph.

LaTeX ignores the formatting you used when you type in your text and formats it according to the document class you specified.

Lists

LaTeX provides three types of lists:

enumerated list: items are numbered

itemized list: unnumbered items

descriptive lists: items are named

Example: Enumerated List

In the source:

```
\begin{enumerate}
\item Prove that $P \not= \mathit{NP}$.
   \begin{enumerate}
     \item Give an overview of your proof.
     \item Now provide the details.
   \end{enumerate}
\end{enumerate}
```

In the output:

1. Prove that $P \neq NP$.
   1. Give an overview of your proof.
   2. Now provide the details.

Example: Itemized List

In the source:

```
\begin{itemize}
  \item I can describe my ideas in point form.
  \item Students like point form.
  \item English professors do not.
\end{itemize}
```

In the output:

- I can describe my ideas in point form.
- Students like point form.
- English professors do not.

Example: Descriptive List

In the source:

```
\begin{description}
  \item[Chocolate:] Necessary to my existence.
    Don't get between me and my chocolate!
  \item[Baby carrots:] Nice crunch and healthy, too.
\end{description}
```

In the output:

Chocolate: Necessary to my existence. Don't get between me and my chocolate!

Baby carrots: Nice crunch and healthy, too.

In-line Lists

To produce a list that is in-line in a sentence: Investigate the `paralist` package.

Put `\usepackage{paralist}` in the preamble, and then you can write in-line lists that (a) can be used within paragraphs, (b) takes care of enumeration and (c) has items that can be referenced, using the following source code:

```
\begin{inparaenum}[(a)]
  \item can be used within paragraphs,
  \item takes care of enumeration and
  \item has items that can be referenced. \label{pl2}
\end{inparaenum}
```

Mathematics

In-line equation $\log_2 32 = \log_2 2^5 = 5$ is created with
`$\log_{2} 32 = \log_{2} 2^{5} = 5$`.

Unnumbered displayed equation

$$\frac{x^2+x}{x} = x + 1$$

is created by

```
\[
\frac{x^{2}+x}{x} = x + 1
\]
```

Numbered displayed equation

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2} \tag{1}$$

is created by

```
\begin{equation}
\sum_{i=1}^{n} i = \frac{n(n+1)}{2}  \label{mysum}
\end{equation}
```

and can be referred to anywhere in the text as Equation 1 using `Equation~\ref{mysum}`.

Be Careful with Fractions

Do not use `\frac{numerator}{denominator}` in an in-line formula.

Instead, either use a displayed equation

```
\[
\frac{numerator}{denominator}
\]
```

or use `(numerator)/(denominator)` in an in-line formula.

Be Careful with Fractions

Consider `$\frac{1}{2}$`, which produces $\frac{1}{2}$. The digits are too small, and the result is too tall and will make the inter-line spacing look funny.

The result is more readable if you use `$1/2$`, which produces $1/2$.

The result is of `\frac{}{}` is readable only in a displayed formula:

```
\[
\frac{1}{2}
\]
```

produces

$$\frac{1}{2}.$$

Many Useful Symbols and Math Commands

Don't type words directly in mathematical expressions.

For example, if you type `$log n$`, you get *logn*. LaTeX thinks you are multiplying four variables named *l* *o*, *g* and *n*, and does not typeset "log" as a word.

LaTeX provides many useful commands for commonly-used mathematical words: `\log`, `\ln`, `\lim`, `\sin`, and so on.

In the above example, you should type `$\log n$` to get $\log n$.

Many Useful Symbols and Math Commands

http://tug.ctan.org/info/symbols/comprehensive/symbols-a4.pdf contains a comprehensive list of symbols you can use in mathematical expressions and elsewhere.

Detexify (at http://detexify.kirelabs.org/classify.html) allows you to draw the symbol you want and then describes the symbols that LaTeX provides that are like your drawing.

Typing Words in Math Mode

If you want to use a word in math mode, then use `\mathit{}` as the following example shows.

```
$\mathit{force} = \mathit{mass} \cdot
                  \mathit{acceleration}$
```

produces $\mathit{force} = \mathit{mass} \cdot \mathit{acceleration}$.

Numbering

LaTeX can figure out the numbering for you, if you tell it to remember a number with `\label{yourlabelname}`, just as we saw in numbered displayed equations.

Example: Because I typed

```
\begin{frame}
\frametitle{Numbering}
  \label{num}
  \ldots
\end{frame}
```

I can refer to this section as Slide 32 *anywhere* in this document using `Slide~\ref{num}` and LaTeX automagically fills in the number for me.

Hint

Any number that LaTeX generates (page numbers, item numbers, section or subsection numbers, figure numbers, equation numbers and so on) can be "captured" using the `\label` command and used elsewhere in your text with the `\ref` command.

Never type the numbers that LaTeX generated for you. For example, never type "As Figure 1 shows, ...". Always use `\label` and `\ref`. Make LaTeX do the work, instead!

Figures

LaTeX can do figures:

```
\begin{figure}
  Content of the figure goes here.
  \caption{Caption of the figure.}
  \label{figurelabel}
\end{figure}
```

The contents could be text, diagrams created with the pgf/tikz package or LaTeX's own picture environment, a table or anything else that LaTeX is capable of handling, such as included JPEG, PNG, PDF or GIF.
Note: Tables, included JPEG, PNG, PDF, or GIF and picture diagrams can all go anywhere in a document, not just in figures.

Including JPEG, PNG, PDF or GIF

To include a JPEG, PNG, PDF or GIF picture, you must include the graphicx package, that handles pictures. (Other formats should be converted to PDF.)

You include the graphicx package, for example, using the `\usepackage{graphicx}` command in the preamble.

Using the graphicx package, you can include a picture using `\includegraphics{fileName.jpg}`.

You can shrink or expand a picture by specifying a height and/or a width or a scaling factor:

```
\includegraphics[width=0.5\textwidth]{boy.png}
\includegraphics[height=60mm]{cats.jpg}
\includegraphics[scale=0.5]{myGraphic.png}
```

Example:

```
\usepackage{graphicx} % In the preamble

\begin{center}        % In the body of the document
  \includegraphics[scale=0.9]{tinyPicture.jpg}
\end{center}
```

Double-Spaced Document

To double-space your document (for your thesis proposal or any assignment in this course, for example), use

```
\usepackage{setspace}
\doublespacing
```

in the preamble.

A Period That Does Not End a Sentence

A period is used to mark the end of sentence in LaTeX source. (Exception: a period following an uppercase letter does not end a sentence in LaTeX source.)

LaTeX puts a larger amount of space between the end of sentence and the start of the next one than it puts between two words within a sentence.

A Period That Does Not End a Sentence

Example: in "Cameron et al.", the period does not end a sentence.

To tell LaTeX that a period does not end a sentence, place a backslash followed by a blank immediately after the period.

Example: `Cameron et al.\`

If you want a period after an uppercase letter to end a sentence, type `\@` immediately after the period.

For example:

```
DO NOT REMOVE YOUR LAPTOP CASE.\@
It would void your warranty.
```

Periods That Don't End Sentences: Examples

Look for common abbreviations. Here are some examples:

et al.: Using "et al." without a `~\cite{}` command immediately after it:
`Cameron et al.\ speculate that` ...

Titles of people: Dr. or Mr. or Mrs. or other abbreviated titles. Type `Dr.\ Peter Graham`, for example.

etc.: Note that you should avoid "etc." as much as possible and certainly not end a sentence with "etc."

Special case: "i.e." and "e.g." should each be followed immediately by a comma — i.e., and e.g., — so you don't need to type "`\ `" after them.

Correct Quotation Marks

Here is what correct quotation marks look like:

> *“Be careful how you type in your quotes,” she said.*

In elementary school, we referred to them as 66 and 99.

To get correct quotes:

Opening double quotes: Type two single back quotes with no space between: ‘‘

Closing double quotes: Type two single forward (ordinary) quotes with no space between them ’’

Quoting Someone Else's Words

Remember that you must:

- indent the copied text,
- put quotation marks around the copied text,
- provide a reference to the original document (the one that you copied the text from) immediately before the copied text, and
- provide a complete bibliographic entry for the original document in a "References" section at the end of your document.

Direct Quotations in LaTeX

```
Gunawi et al.~\cite{gun} conclude that
\begin{quote}
  ``Adding reliability through the
  I/O shepherd was simple in some
  ways and challenging in others.''
\end{quote}
```

Gunawi et al. [1] conclude that

> *"Adding reliability through the I/O shepherd was simple in some ways and challenging in others."*

Advice

Learn to let LaTeX do the formatting.

- Microsoft Word makes you do the formatting.
- LaTeX is expert at formatting.

There's Lots More!

- You can do a table of contents and an index.
- You can split your LaTeX source into multiple files.
- And there's lots of other things LaTeX can do!

Haryadi S. Gunawi, Vijayan Prabhakaran, Swetha Krishnan, Andrea C. Arpaci-Dusseau, and Remzi H. Arpaci-Dusseau. Improving file system reliability with I/O shepherding. *ACM SIGOPS Operating Systems Review*, 41(6):293–306, December 2007.