A Brief Introduction to LaTeX

Created for 15-251: Great Theoretical Ideas in Computer Science

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LaTeX?

What is it?

- A system to produce beautiful typeset documents
- Converts a plain text file to postscript

Why should I use it?

- Easiest and best way to typeset equations (*much* faster than MS equation editor)
- By far, the most commonly used document system in computer science research
- It's pretty
- Cross-platform
- Extensible
- Number figures, equations, etc. automatically

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A Few Things You Should Know

- There are two version of LaTeX around: 2.09 and 2ϵ
- I'll be teaching you 2ϵ (which is the newer of the 2)
- LaTeX is based on another program called TeX, which is a much more low-level formatting language

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How do I use LaTeX?

(This is the process for andrew UNIX systems)

1. Create a latex document with your favorite text editor. (Use a `.tex` extension)
2. Convert your `.tex` to a `.dvi` file with the command `'latex soup.tex'` This will create a `soup.dvi` file. (note that in CS, you have to use `latex2e`)
3. Preview the dvi file by using the command `'xdvi soup.dvi'`
4. When it's all done, convert the dvi to postscript with the command `'dvips -o soup.ps soup.dvi'`
5. Print out the `soup.ps` file using `print` or `lpr`
6. (or just Print from the dvi with `'dvips -Pprintername soup.dvi'`)

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What does it look like?

- Plain text file
- `\command` used for commands
- `\command{arg}` for commands with arguments
- `\begin{name}` and `\end{name}` pairs
- `$x=y$` is used for math mode (more on this later)
- blank lines for paragraphs
- all whitespace is the same (except for blank lines)

An Example Document

```
\documentclass{article}
\usepackage{fullpage}
\input macros.tex
% This is a comment
% load other packages as necessary
\usepackage{amssymb}
\usepackage{proof}

\title{CS 15-814 Type Systems for PL}
\author{Patrick Riley}
\date{September 23, 1999}

%%%%%%%%%%%%%%%%%%%
\begin{document}
%%%%%%%%%%%%%%%%%%%
\maketitle

\section{$T_n$ Inductive Definition}
```

```latex
We will prove that
$\mathcal{T}_n \subseteq \mathcal{T}_{n+1}$ by
induction on $n$.

\begin{enumerate}
  \item Base Case $n=0$:
     $\mathcal{T}_0 = \emptyset$
  \item Inductive Step:
\end{enumerate}

\end{document}
```

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An Example Run of LaTeX

```
gs231:~/latex-test % latex hw1.tex
This is TeX, Version 3.1415 (C version 6.1)
(hw1.tex
LaTeX2e <1995/12/01> patch level 2
(/usr/local/lib/texmf/tex/latex2e/base/article.cls
Document Class: article 1995/12/20 v1.3q Standard LaTeX document class
(/usr/local/lib/texmf/tex/latex2e/base/size10.clo))
(/usr/local/lib/texmf/tex/contrib/fullpage.sty
Style Option FULLPAGE Version 2 as of 15 Dec 1988
) (/usr/local/lib/texmf/tex/latex2e/base/latexsym.sty)
(/afs/cs.cmu.edu/user/pfr/tex/macros.tex) (/afs/cs.cmu.edu/user/pfr/tex/pl.tex
(/usr/local/lib/texmf/tex/latex2e/amslatex/inputs/amsmath.sty
(/usr/local/lib/texmf/tex/latex2e/amslatex/inputs/amstext.sty
(/usr/local/lib/texmf/tex/latex2e/amslatex/inputs/amsgen.sty))
(/usr/local/lib/texmf/tex/latex2e/amslatex/inputs/amsbsy.sty)
(/usr/local/lib/texmf/tex/latex2e/amslatex/inputs/amsopn.sty)))
(/afs/cs.cmu.edu/project/prodigy-1/pstone/tex/amssymb.sty
(/afs/cs.cmu.edu/project/prodigy-1/pstone/tex/amsfonts.sty))
(/afs/cs.cmu.edu/user/pfr/tex/proof.sty)
No file hw1.aux.
(/usr/local/lib/texmf/tex/latex2e/base/Ulasy.fd)
(/usr/local/lib/texmf/tex/latex2e/base/Umsa.fd)
(/usr/local/lib/texmf/tex/latex2e/base/Umsb.fd) [1] (hw1.aux) )
Output written on hw1.dvi (1 page, 860 bytes).
Transcript written on hw1.log.
```

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An Example Output

CS 15-814 Type Systems for PL

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September 23, 1999

1 T_n Inductive Definition

We will prove that $\mathcal{T}_n \subseteq \mathcal{T}_{n+1}$ by induction on n.

1. Base Case $n = 0$: $\mathcal{T}_0 = \emptyset$
2. Inductive Step:

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Basic Nuts and Bolts (and stuff you need to know)

- Line breaks can be anywhere (LaTeX makes it look nice anyway)
- A blank line makes a new paragraph
- Several kinds of quotation marks

Type this	to get this
’	’
‘	‘
’ ’	”
‘ ‘	“

- There are ten “special characters” that are not handled as basic characters:
  `# $ % & _ { } ~ ^ \`
- The first seven you can get by using `\#`, `\$`, etc.
- The ‘%’ character makes the rest of the line a comment

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Basic Stuff Example- The Source

```
Line breaks
do
not matter

Blank lines

do.

``Quote'' `quote'

The next part will be gone
because %it's a comment

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

Basic Stuff Example- The Result

Line breaks do not matter

Blank lines

do.

“Quote” ‘quote’

The next part will be gone because

$ % & _ { }

Bigger and More Exciting Bolts and Nuts

- Text markup commands
  - `\emph{test}`: *test*
  - `\textbf{test}`: **test**
  - `\textit{test}`: *test*
- use `$x=y$` to write math stuff in text ($x = y$ instead of x=y) (*much* more math stuff to follow)
- `\section{Name}` can be used to start a new section. Automatic numbering and such makes this a good thing.
- '~' is the same as a space, except that it will never become a line break. Useful for `Dr.~Smith` or `Figure~7`

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More Bolts and Nuts Example - The Source

```
Make \emph{text}look \textbf{different}
in a \texttt{sentence}.

Don't use n, when you mean $n$.
$x>y$ looks better than x>y.

\section{I am a title}

Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table
6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6
Table 6 Table 6 Table 6 Table 6 Table 6

is not as good as

Table~9 Table~9 Table~9 Table~9 Table~9 Table~9 Table~9
Table~9 Table~9 Table~9 Table~9 Table~9 Table~9 Table~9
Table~9 Table~9 Table~9 Table~9 Table~9 Table~9 Table~9
Table~9 Table~9 Table~9
```

More Bolts and Nuts Example - The Output

Make *text* look **different** in a `sentence`.

Don't use n, when you mean n. $x > y$ looks better than x¿y.

1 I am a title

Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6 Table 6

is not as good as

Table 9 Table 9 Table 9 Table 9 Table 9 Table 9
Table 9 Table 9 Table 9 Table 9 Table 9 Table 9
Table 9 Table 9 Table 9 Table 9 Table 9 Table 9
Table 9 Table 9 Table 9 Table 9 Table 9 Table 9

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More stuff

- `\begin{itemize}\end{itemize}`to create bulleted lists (`\item`) creates the bullet.
  - You have seen
  - lots of these
- `\begin{enumerate}\end{enumerate}`to create numbered lists (`\item`) creates the number.
  1. When you need
  2. numbers, you just
  3. *need* numbers!
- `\begin{verbatim}\end{verbatim}`looks like typed text and ignores LaTeX commands:

```
One way to get $#%&~$ special characters!
\begin{itemize}
 \item I would have a bullet there
\end{itemize}
```

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Everybody loves math!

For some of this, you need to put `\usepackage{amsmath}` in the preamble.

- Symbols: There are lots of them, like `\Theta\infty\in\oplus`: $\Theta\infty \in \oplus$.
- Sub- and Superscript: Use `_` for subscript and `^` for superscript (use `{}` for multiple characters)

  `z^2` $\Rightarrow z^2$ `x_{14}` $\Rightarrow x_{14}$ `w_n^{12}` $\Rightarrow w_n^{12}$
- Sum and Products

  `\sum_{i=0}^n i` `\prod_1^\infty x^2 y_3`

$$\sum_{i=0}^{n} i \qquad \prod_{1}^{\infty} x^2 y_3$$

- Fractions are made with `\frac{num}{dem}`

  `\frac{abc}{d^2}` $\Rightarrow \frac{abc}{d^2}$

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- Square Root.
  - You can use `\sqrt{x}` to get this: $\sqrt{x}$
  - `\sqrt` also takes an optional argument
  - optional arguments are in square brackets *before* the regular arguments
  - `\sqrt[3]{x}` produces $\sqrt[3]{x}$

Equations

- $$ is useful for math stuff in text, but what if you need a full separate line?
- The equation environment

```
This equation gets:
\begin{equation}
  \sum_i=1^n i = \frac{n(n+1)}{2}
  \label{eq:gauss}
\end{equation}
it's own line
```

This equation gets:

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

it's own line

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Automatic Numbering

What was that `\label` stuff?

- LaTeX will automatically number equations (and other things) for you
- `\label{name}` gives those numbers a name
- `\ref{name}` allows you to retrieve that number
- Instead of saying `equation~7`, you should say `equation~\ref{eq:gauss}`
- That way, you can add or reorder equations and everything is still okay
- LaTeX numbers many other things (like section and figures) that you can label and ref.

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Other equation environments

There are lots of other equation-like environments. Here are two useful ones:

- gather environment puts multiple equations together, but on different lines. (Use \\ to start a new line)

```
\begin{gather}
  x+y+z  \geq 1 \\
  0      = x^2 - y^3 + z^{111}
\end{gather}
```

$$x + y + z \geq 1 \tag{2}$$

$$0 = x^2 - y^3 + z^{111} \tag{3}$$

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- align environment is like `gather`, but allows you to align the different lines with `&`

```
\begin{align}
  x+y+z & \geq 1 \\
  0     & = x^2 - y^3 + z^{111}
\end{align}
```

$$
\begin{align}
x+y+z & \geq 1 \tag{4} \\
0 & = x^2 - y^3 + z^{111} \tag{5}
\end{align}
$$

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Math stuff for you to discover

I don't have time to explain everything. Here are some more interesting mathematical things that LaTeX can do.

- Array and matrix environments
- Delimiters (parentheses, braces, etc.)
- Over and under lines and braces
- Many other equation environments

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What else can LaTeX do?

I'm not going to describe these here, but just to tempt you...

- Pictures (from `.eps` files or natively)
- Tables (with `\begin{tabular}`) You might need this, but it's a little complicated to explain. Look in the books.
- Bibliography stuff
- Indexing
- Table of contents
- We just scratched the surface of the mathematics support
- Postscript tricks

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Editors and Helpful Stuff for UNIX

I personally use

- XEmacs
- AUXTEX: a special emacs mode that helps you write LATEX quickly and easily
- It should already be installed in the clusters
- Try this for some pointers to more info: `http://sunsite.auc.dk/auctex/`

If you must have a WYSIWYG, try LyX.

- (Warning, I've never used it, but I've heard)
- You can't do everything that you can with regular LATEX
- It the end, you'll be better off really knowing LATEX

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Editors and Helpful Stuff for Windows

I've never used this, but many people do.

- There are latex distributions for Windows
- However, I would recommend using the unix clusters latex stuff because it's already installed with lots of packages.
- WinEdt is an editor that provides some GUI support to help you along `www.winedt.com`
- (Cory has used it a bit)

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Editors and Helpful Stuff for Macintosh

- (I've never done this)
- but I heard that there is a free port called OzTeX

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On-Line Resources

- The LaTeXproject homepage
  `http://www.latex-project.org/`
- CTAN Catalogue (all the packages you could ever need) `ftp://ftp.duke.edu/tex-archive/help/Catalogue/catalogue.html`
- for AuCTeX: `http://sunsite.auc.dk/auctex/`
- for WinEdt: `www.winedt.com`
- (See our web page for more useful stuff)

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Books

This is a good introductory book (it's how I learned):

- Lamport, Leslie. *LaTeX: A Document Preparation System (2nd Ed.)*. Addison-Wesley Publishing Corp, 1994.

This is essential if you really start using LaTeX(it describes some of the most useful of the millions of packages available)

- Goossens, Michel and Frank Mittelbach and Alexander Samarin. *The LaTeX Companion*. Addison-Wesley Publishing Corp, 1994.