Introduction to LaTeX

Writing papers the right way

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LATEX is. . .

. . . a sophisticated document preparation sytem.

LATEX has. . .

- Stylistic uniformity
- Bibliography support
- Sophisticated structuring abilities
- Reference tracking
- Highly extendible capabilities

LaTeX is not. . .

. . . a word processor.

LaTeX does not. . .

- Spell-check your documents[1]
- Give you complete control over formatting
- Provide a graphical interface for editing

"You take care of writing, and we'll take care of presentation."

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[1]You can use the program ispell to spell check your LaTeX

A Brief History

It all started with Donald Knuth and *The Art of Computer Programming*. . .

- T$_E$X - a computer language used for typesetting math and other technical material.
  - Created in the late 1970s by Donald Knuth
- L^{A}T$_E$X - a higher-level method of accessing the power of T$_E$X
  - Created in the early 1980s by Leslie Lamport

L^{A}T$_E$X is pronounced lah-tech or lay-tech.

Why LaTeX?

Presentation shouldn't get in the way of content.

For example. . .

- With a word processor, you spend valuable time agonizing over what font size to make the section headings.

  With LaTeX, you just tell it to start a new section.

- With a word processor, changing the formatting means you have to change each instance individually.

  With LaTeX, you just redefine the relevant commands.

- With a word processor, you have to carefully match any provided templates.

  With LaTeX, you can be sure you've fit the template, and switch templates easily.

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"Hello LATEX!"

Creating a LATEX Document

- Write a `.tex` file using any text editor and save it in the `MiniPaper` folder

```
% this is hello.tex
\documentclass{article}
\begin{document}
    Hello, \LaTeX!

\end{document}
```

- Compile using the RSI Makefile

```
$ cd ~/RSI/MiniPaper/

$ make hello.pdf
```

- Preview the results

```
$ evince hello.pdf &
```

documentclass

LaTeX has several templates, selected using `\documentclass`

Classes:

- book
- report
- article
- letter
- beamer

Etc.

You'll be using the 'article' class for your paper

Declarations and Environments

Declarations. . .

- Are stated once
- Take effect until further notice
- Can optionally be constrained

Ex. `\documentclass`, `\small`

Environments. . .

- Have matching `begin` and `end` declarations
- Must be constrained

Ex. `\begin{document}` `...\end{document}`

Arguments

Required arguments. . .

- Are contained in curly braces
- Must be included

Ex. `\documentclass{`<u>article</u>`}`

Optional arguments. . .

- Are contained in square brackets
- Can be left out
- Give you more control over the commands

Ex. `\documentclass[`<u>12pt</u>`]{article}`

Special Characters

- Another type of command
- Don't define any formatting or structure
- Print non-standard characters or characters which usually mean something else

Ex. \LaTeX, \textbackslash, \%

Note: % is a reserved character because it is for comments (After a %, the rest of the line is ignored by the compiler)

Packages

Packages allow you to further customize LaTeX.

The command:

> \usepackage{$name$}

Some packages:

graphicx, epsfig, geometry, fancyhdr, setspace, amsmath, listings, xcolor, url. . .

Most of the packages you'll need are already included in the template

Font Types

Font face:

`\emph{`*Text*`}, \textbf{`**Text**`}, \texttt{Text}, \textrm{`Text`},`
`\textsf{Text}, \textsc{`Text`}`

Font size:

`{\tiny Text}, {\scriptsize Text}, {\footnotesize Text}, {\small`
`Text}, {\normalsize Text}, {\large Text}, {\Large Text}, {\LARGE`
`Text}, {\huge Text}, {\Huge Text}`

Alignment:

`\begin{center/flushright/flushleft}`

`...`

`\end{center/flushright/flushleft}`

Spacing

Margins

The default: between 1.5 inches and 1.875 inches

Setting margins: `\usepackage[margin=0.5in]{geometry}`

Paragraphs and other breaks

Paragraphs are separated by a blank line.

You can force a new line using `\\`

To force a new page, use `\newpage` or `\clearpage`

Other spacing

Force a space using $\sim$

Add space using `\hspace{1in}` or `\vspace{1in}`

Fill space using `\hfill` or `\vfill`

Lists

There are two main types. . .

Bulleted lists:

```
\begin{itemize}
    \item Text
    \item Text
\end{itemize}
```

- Text
- Text

Numbered lists:

```
\begin{enumerate}
    \item Text
    \item Text
\end{enumerate}
```

1. Text
2. Text

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The RSI File Structure

In your `MiniPaper` or `Paper` directory, you'll notice several files...

- `main.tex` brings everything together, don't edit it
- `preamble.tex` contains any additional packages or macros
- `cover.tex` contains the cover information (title, author, etc.)
- `abstract.tex` and `summary.tex` contain the text of your scientific abstract and executive summary, respectively
- `paper.tex` contains the main body of your paper, including any and all figures, tables, etc.
- `biblio.bib` is a BibTeX file containing your references
- `appa.tex` contains the text of any appendices you may have

Compile using `make main.pdf`

The Title Page

`cover.tex` is where you define the content of your title page

- It includes declarations of the `title`, `author`, and `date`
- You should replace the title and author as needed, but leave the date alone

```
\title{Length-enhanced superlative verbiage}
\author{Joe Everystudent
    \vspace{0.5in}\\
    under the direction of\\
    Dr.  Famous Person\\
    Massachusetts Institute of Technology
    \vspace{1in}}
```

- The title page is created automatically using the `maketitle` command in `main.tex`

Abstract and Summary

- The minipaper only has an abstract
- Your final paper will have both a **technical** abstract and a **non-technical** summary
- All you need to do is fill in the text, and the template takes care of the rest

Behind the Scenes

```
\begin{abstract}
  \input{abstract}
  \vspace{1in}
  \begin{center}\textbf{Summary}\end{center}
  \input{summary}
\end{abstract}
```

Bibliography

`biblio.bib` acts as a database of references, and only includes in the bibliography those references you cite in your paper

BibTEX

```
@article{nameofentry,
    author = {D. Deutsch and A. Barenco and Artur Ekert},
    title = {Universality in Quantum Computation},
    journal = {Proceedings:  Math and Physical Sciences},
    volume = 449,
    year = 1995,
    number = 1937,
    pages = {669--677}
}
```

A more complete list of examples can be found at
`web.mit.edu/rsi/www/pdfs/bibtex-format.pdf`

Referencing

References

> \section{Results}\label{res}
>
> ...
>
> As seen in Section \ref{res} ...

Footnotes

> ...telephony\footnote{Phony telephones}

Citations

> Redundancy \cite{nameofentry}
>
> For multiple citations:
>
> ...methodology \cite{nameofentry, nameofotherentry}

The Paper

LATEX is built off of the idea of *structure* over *formatting*

        \section{Introduction}

Layers of sectioning

 section
   subsection
     subsubsection
       paragraph
         subparagraph

These commands should be used as needed in both `paper.tex` and `appa.tex`

Typesetting Math

LATEX allows you to typeset any sort of equations.

LATEX math support

$$\int_a^b \frac{d\theta}{1+\theta^2} = \tan^{-1} b - \tan^{-1} a$$

Using math mode

Inline math mode: `$...$`

$$\int_1^\infty e^{-x} dx \qquad \sum_{n=0}^\infty n!$$

Display math mode: `$$...$$`
Numbered equations: `\begin{equation}...\end{equation}`

Some Commands

974	`$974$`
$4 + 2$	`$4+2$`
$\sqrt[3]{5}$	`$\sqrt[3]{5}$`
$\frac{x}{y}$	`$\frac{x}{y}$`
A^x_y	`$A^{x}_{y}$`
$\sum_{k=1}^n k$	`$\sum_{k=1}^n k$`
$2 \ne 4$	`$2 \ne 4$`
$\phi \in \Psi$	`$\phi \in \Psi$`
$\hat{\imath} \times \hat{\jmath} = \hat{k}$	`$\hat{\i} \times \hat{\j} = \hat{k}$`
$f''(\xi)$	`$f''(\xi)$`
CH$_3$COOH	`CH$_3$COOH`
$180°$C	`180$^{\circ}$C`
Coca Cola$^{\text{TM}}$	`Coca Cola$^{\text{TM}}$`

...runs in $\Theta(\log n)$ time...

Figures and Tables

Both are environments:

Figures

```
\begin{figure}
   ...
\end{figure}
```

Tables

```
\begin{table}
   ...
\end{table}
```

Positioning can be defined as an optional argument:

```
\begin{figure}[htbp]
```

includegraphics

The Commands

```
\subsection{Hardware Configuration}

\begin{figure}[ht]
   \centering
   \includegraphics[height=3in]{figure0.png}
\end{figure}

\begin{figure}[ht]
   \centering
   \includegraphics[width=\textwidth]{figure1.png}
\end{figure}
```

Formatting Tables

The `table` environment defines the figure style. The `tabular` environment defines the table itself.

```
      \section{Related Work}

\begin{table}[ht]
   \centering
   \begin{tabular}{|r||c|c|} \hline
      Trial & $n$ & $t$ \\ \hline
      1 & 23 & 2 \\ \hline
      2 & 15 & 10 \\ \hline
      3 & 100 & 20 \\ \hline
   \end{tabular}
\end{table}
```

Trial	n	t
1	23	2
2	15	10
3	100	20

Captions and Labels

Captioning

```
\end{tabular}
\caption{The data.}
\end{table}
```

Labeling

```
\caption{The data.}
\label{nameoftable}
\end{table}
```

Referencing

```
...in Table \ref{nameoftable}
```

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Getting Started

Beamer allows all the same commands as a normal LaTeX document, plus some.

Adding a Slide

```
\begin{frame}{Title}
   ...
\end{frame}
```

Special slides

Title slide:
```
\titlepage
```
Table of contents:
```
\tableofcontents[currentsection]
```

Beamer at RSI

We have a template for this too! It's in the file `slides.tex`

Title Slide

Be sure to fill in the title, subtitle (if necessary) and author

```
\title{Witty catch-phrase}
\subtitle{Length-enhanced superlative verbiage}
\author[Joe Everystudent]{Joe Everystudent\\
   Research Science Institute\\
   Under the Direction of Dr.  Famous Person\\
   Massachusetts Institute of Technology}
```

The template already includes a title slide!

Formatting

Some special environments can be useful for presentations

Blocks

```
\begin{block}
    ...
\end{block}
```

Columns

```
\begin{columns}
  \column{0.5\textwidth}
     Column 1
  \column{0.5\textwidth}
     Column 2
\end{columns}
```

Animation

You can also do some basic animation in beamer.

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- \pause puts a pause before revealing the rest of the slide

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- *command*<*num*−*num*> makes the command apply only for some number of the "frames"

Animation

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- `\pause` puts a pause before revealing the rest of the slide
- *command*`<num-num>` makes the command apply only for some number of the "frames"
- The previous bullet is defined by `\item<3-4>`

Animation

You can also do some basic animation in beamer.

- \pause puts a pause before revealing the rest of the slide

- The previous bullet is defined by \item<3-4>
- The bullet disappears after the fourth "frame"

Themes

You can also choose different themes for beamer.

Design

$\backslash$usetheme$\{$*theme*$\}$

Antibes, Berkeley, Berlin, Goettingen, Malmoe, Szeged, Warsaw...

Color

$\backslash$usecolortheme$\{$*theme*$\}$

beaver, crane, lily, rose, seahorse, whale...

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The Structure of an Error
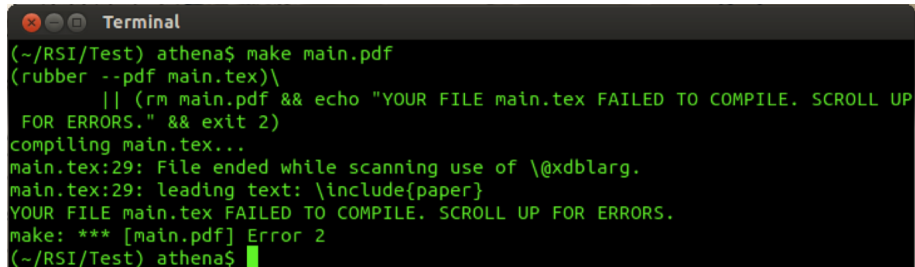
Missing Closing Braces

The Code

`\includegraphics{picture.png`

The Error Message


```
(~/RSI/Test) athena$ make main.pdf
(rubber --pdf main.tex)\
        || (rm main.pdf && echo "YOUR FILE main.tex FAILED TO COMPILE. SCROLL UP
 FOR ERRORS." && exit 2)
compiling main.tex...
main.tex:29: File ended while scanning use of \@xdblarg.
main.tex:29: leading text: \include{paper}
YOUR FILE main.tex FAILED TO COMPILE. SCROLL UP FOR ERRORS.
make: *** [main.pdf] Error 2
(~/RSI/Test) athena$
```

Missing Environment End

The Code

```
\begin{itemize}
\item Text.
```

The Error Message
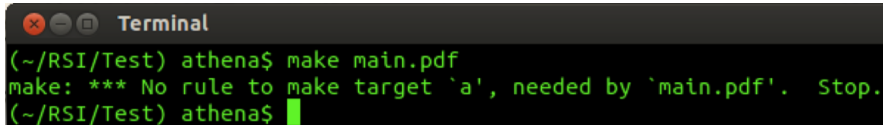
```
Terminal
(~/RSI/Test) athena$ make main.pdf
/mit/rsi/scripts/maketexdmake.pl paper.tex paper.tex.d
/mit/rsi/scripts/maketexdmake.pl main.tex main.tex.d
(rubber --pdf main.tex)\
    || (rm main.pdf && echo "YOUR FILE main.tex FAILED TO COMPILE. SCROLL UP
 FOR ERRORS." && exit 2)
compiling main.tex...
main.tex:38: \begin{itemize} on input line 22 ended by \end{document}.
main.tex:38: leading text: \end{document}
YOUR FILE main.tex FAILED TO COMPILE. SCROLL UP FOR ERRORS.
make: *** [main.pdf] Error 2
(~/RSI/Test) athena$
```

Spaces in Filenames

The Code

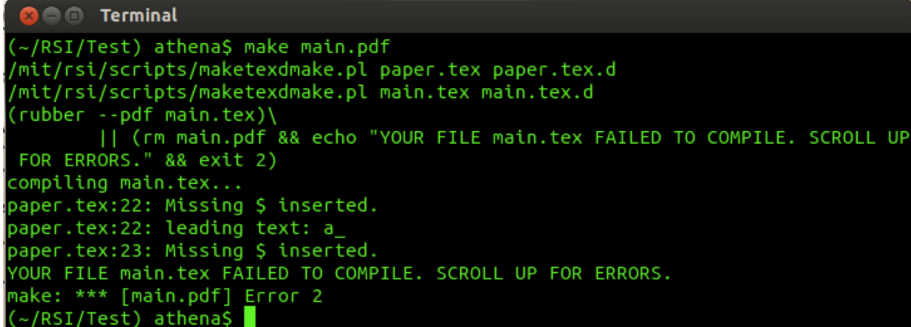`\includegraphics{a picture.png}`

The Error Message


```
(~/RSI/Test) athena$ make main.pdf
make: *** No rule to make target `a', needed by `main.pdf'.  Stop.
(~/RSI/Test) athena$
```

Forgetting to Escape
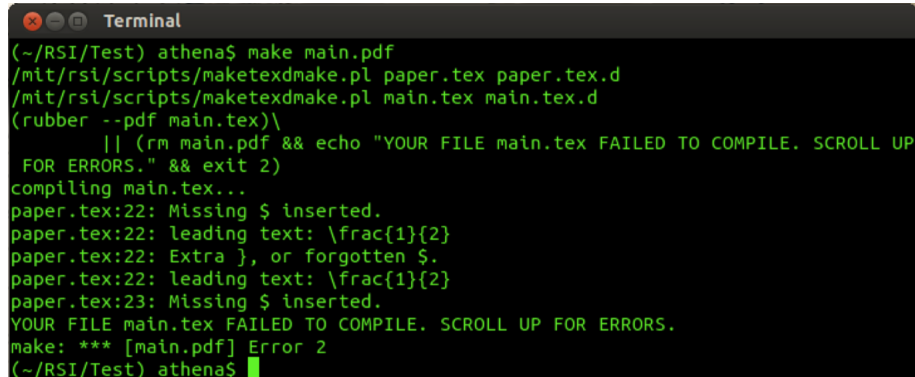
The Code

a_b

The Error Message

```
Terminal
(~/RSI/Test) athena$ make main.pdf
/mit/rsi/scripts/maketexdmake.pl paper.tex paper.tex.d
/mit/rsi/scripts/maketexdmake.pl main.tex main.tex.d
(rubber --pdf main.tex)\
        || (rm main.pdf && echo "YOUR FILE main.tex FAILED TO COMPILE. SCROLL UP
 FOR ERRORS." && exit 2)
compiling main.tex...
paper.tex:22: Missing $ inserted.
paper.tex:22: leading text: a_
paper.tex:23: Missing $ inserted.
YOUR FILE main.tex FAILED TO COMPILE. SCROLL UP FOR ERRORS.
make: *** [main.pdf] Error 2
(~/RSI/Test) athena$
```

Forgetting to Use Math Mode

The Code

```
\frac{1}{2}
```

The Error Message


```
Terminal
(~/RSI/Test) athena$ make main.pdf
/mit/rsi/scripts/maketexdmake.pl paper.tex paper.tex.d
/mit/rsi/scripts/maketexdmake.pl main.tex main.tex.d
(rubber --pdf main.tex)\
        || (rm main.pdf && echo "YOUR FILE main.tex FAILED TO COMPILE. SCROLL UP
 FOR ERRORS." && exit 2)
compiling main.tex...
paper.tex:22: Missing $ inserted.
paper.tex:22: leading text: \frac{1}{2}
paper.tex:22: Extra }, or forgotten $.
paper.tex:22: leading text: \frac{1}{2}
paper.tex:23: Missing $ inserted.
YOUR FILE main.tex FAILED TO COMPILE. SCROLL UP FOR ERRORS.
make: *** [main.pdf] Error 2
(~/RSI/Test) athena$
```

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So, why LaTeX?

- LaTeX allows you to worry about the content and the structure, rather than the presentation.
- LaTeX has one of the most advanced math typesetting systems around.
- LaTeX is incredibly extendible.
- LaTeX keeps track of references so you don't have to.
- LaTeX allows you to make more consistent, and more easily changeable, documents.

Getting Help and Learning More

- LaTeX Wikibooks:
  `en.wikibooks.org/wiki/LaTeX`
- *The Not So Short Introduction to LaTeX 2_ε*:
  `www.ctan.org/tex-archive/info/lshort/english/lshort.pdf`
- *A Short Math Guide for LaTeX*:
  `ftp://ftp.ams.org/pub/tex/doc/amsmath/short-math-guide.pdf`
- *The Beamer Theme Matrix*:
  `www.hartwork.org/beamer-theme-matrix/`

Google is still your best friend!