An introduction to LaTeX for students

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Pros and Cons of LaTeX

Why use LaTeX?

- Ideal for typesetting mathematics.
- Automatic numbering and citations!
- Gives the user control of page formatting.
- Separates the writing of content from the formatting.
- Free to use; support of the open source community.
- The output is a pdf; readable by all.
- It's standard.
- It's pretty.

When NOT to use LaTeX:

- Creating flyers.
- When you have only text. (No figs, tables, eqns, references)
- If you don't want to be in charge of the formatting.

Typesetting Mathematics

$$\int_1^9 \frac{\partial}{\partial y}\left(yx^5 + e^{xy}\right) dx$$

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi}{6}$$

$$\sqrt{a^2 + b^2}$$

$$\alpha\beta\gamma\delta \cdots \omega \quad \mathbb{ABC} \cdots \mathbb{Z} \quad \mathcal{ABC} \cdots \mathcal{Z}$$

$$(A \cap B) \cup C = (A \cup C) \cap (B \cup C)$$

$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \begin{pmatrix} -1 & 0 \\ 3 & 1 \end{pmatrix} = \begin{pmatrix} 5 & 2 \\ 9 & 4 \end{pmatrix}$$

Automatic numbering

I am able to reference theorems, figures, and equations even if their numbers change.

Theorem 1.
I am a theorem.

Proof.
Some pretty, distracting equations:

$$|z| = \begin{cases} z & \text{if } z \geq 0 \\ -z & \text{if } z < 0 \end{cases}$$

$$z = 14x - 7y \tag{1}$$

$$10x = 17y \tag{2}$$

By Equations (1) and (2), we have proved Theorem 1. □

Structure of a .tex file

```
\documentclass[11pt]{amsart}


\usepackage{geometry}                % See geometry.pdf to learn the
layout options. There are lots.
\geometry{letterpaper}                   % ... or a4paper or a5paper
or ...

\usepackage{url}    % Need this package to display URLs properly.
\usepackage{color}  % Use this package to use colored text.
\usepackage{epsfig} % Use this package to insert figures created
externally.

\newcommand{\bi}{\bigskip}  % You can define your own commands to save
yourself writing.

\title{An introduction to \LaTeX~for students}
\author{Christopher Hanusa}
\date{\today}


%%%%%%%%%%%%%%%%%%%%%%%%%
\begin{document}
%%%%%%%%%%%%%%%%%%%%%%%%%
\maketitle
\thispagestyle{empty} % Remove page numbers.


%%%%%%%%%%%%%%%%%%%%%%%%%
\section{Introduction}

Here is some text.  We now discuss the background in Section~
\ref{sec:background}.  Then we will discuss my favorite equations in
Section~\ref{sec:eqns}.

%%%%%%%%%%%%%%%%%%%%%%%%%
\subsection{Background}
\label{sec:background}

Here is the necessary background information.  Blah blah blah.  Blah blah
blah.  Blah blah blah.

%%%%%%%%%%%%%%%%%%%%%%%%%
\subsection{My Favorite Equations}
\label{sec:eqns}

\begin{equation}
\int_{1}^{9} \frac{\partial}{\partial y}\Big(yx^5+e^{xy}\Big)\, dx
\label{eqn:int}
\end{equation}

\begin{equation}
\sum_{n=1}^{\infty} \frac{1}{n^2} =\frac{\pi}{6}
\label{eqn:sum}
\end{equation}

\begin{equation}
\sqrt{a^{2} + b^{2}}
\label{eqn:sqrt}
\end{equation}
```

Always begins with \documentclass

Next, import necessary packages.

Insert user-created commands.

File content starts with \begin{document}

To break into sections, use \section and \subsection

Use % to write comments or to help with the visual structure.

File content ends with \end{document}

Typing text and using fonts

To type text, type normally; extra whitespace does not matter. To go to a new paragraph, skip a line. Use a pair of left quotes to open a quote; "use a pair of right quotes to close."

The following characters are reserved: # $ % & ~ _ ^ { } > < \

- \ is what tells LaTeX that you are entering a command.
- % is for entering comments.
- $ is for writing in math mode.

For fonts, surround the text you wish with braces and insert **bf** (bold), *em* (emphasized), \rm (roman), \`tt` (fixed width), as in `{\bf Hello}` to produce **Hello**.

Including equations

LaTeX excels at integrating the writing of mathematics into text. To include math symbols or equations "inline", use `$` to begin and to end; for example, type `$a_1^2 + b_1^2$` to get $a_1^2 + b_1^2$.

Certain symbols everyone uses:

$\sqrt{10}$	`$\sqrt{10}$`
$\int_1^{10}$	`$\int_{1}^{10}$`
$\sum_{n=1}^{\infty}$	`$\sum_{n=1}^\infty$`
$\frac{1}{n^2}$	`$\frac{1}{n^2}$`
α	`$\alpha$`
$\ldots$	`$\hdots$`; also useful `$\cdots$` and `$\vdots$`

Each mathematician has their own symbol needs; either peruse tables of symbols or use Detexify (`detexify.kirelabs.org`)

Referencing equations, figures, theorems

Alternatively, create equations on their own lines using \begin{equation} and \end{equation}, as in

\begin{equation} \frac{a}{b}+1=\frac{a+b}{b} \end{equation}

$$\frac{a}{b} + 1 = \frac{a + b}{b} \tag{3}$$

Include a \label{*name*} to reference it later with \ref{*name*}.

Same goes with defining figures and theorems:

```
\begin{figure}
    (figure here)
    \label{fig:name1}
\end{figure}
```

```
\begin{theorem}
    (theorem here)
    \label{thm:name2}
\end{theorem}
```

. . . Figure \ref{*fig:name1*} exhibits Theorem \ref{*thm:name2*} . . .

Lists and Tables

Lists are pretty simple; use itemize (bullets) or enumerate (numerals).

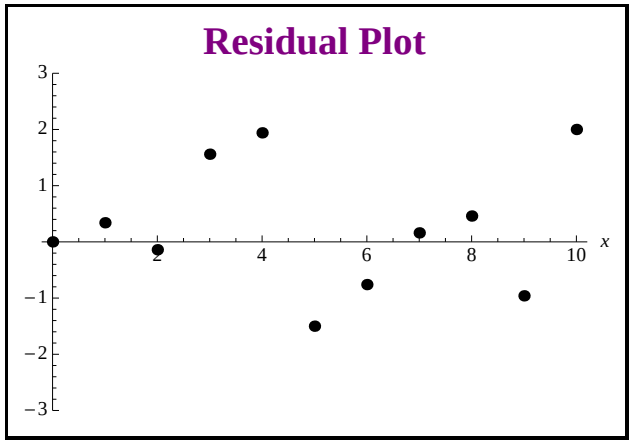
1. Item 1.
2. Item 2.
   - Item 2a.
   - Item 2b.

```
\begin{enumerate}
    \item Item 1.
    \item Item 2.
    \begin{itemize}
        \item Item 2a.
        \item Item 2b.
    \end{itemize}
\end{enumerate}
```

Tables are pretty complicated; use tabular.

Miscellaneous

- To include graphics, use the package `epsfig` or `graphicx`.
  `\epsfig{figure=residual4.eps,height=1in}`



- To use color, use the package `xcolor`.
  For example, {\color{red} xcolor}.

- To organize citations, use BibTEX
- To create slide shows, use Beamer
- LaTeX integrates with the editor `emacs`.

Installation

So you're hooked! How to get LaTeX for yourself?

- On a Mac
  - Distribution: MacTeX (`tug.org/mactex/`)
  - Viewer: TeXShop (`texshop.org`)
- On a PC
  - Distribution: MiKTeX (`miktex.org`)
  - Viewer: TeXnicCenter (`texniccenter.org`)
- On Linux
  - Like everything else, it's possible.

Tips and help

This is one academic exercise where I say: PLAGIARIZE!
Read other people's files to see what they do; then copy.

Search the web! Example: "latex tabular"

Helpful reference sheets (condensed):

- Typing Math: Short Math Guide for LaTeX
  `ftp://ftp.ams.org/pub/tex/doc/amsmath/short-math-guide.pdf`
- Find symbols: `detexify.kirelabs.org` or search.

Helpful for getting started (some reading):

- `http://www.tug.org/begin.html`
- `www.ctan.org/tex-archive/info/mil/mil.pdf`

Let's get hands on!

1. Download Empty.tex and NotEmpty.tex from my website.
2. Open each using TeXShop on your computer.
3. Start typing.
4. When you want to see the output, click on the "Typeset" button or click Cmd-S (save) Cmd-T (typeset).
5. This will pop up a small window which runs the "latex" command, and (if you have no errors), will pop up a window with the output in pdf format.
6. If you have errors, you need to decode them, fix them, and typeset again. (often: mismatched $\{$ $\}$ or misspelled command)