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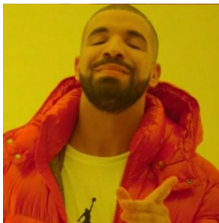
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Figure 1: Using LaTeX to write more efficiently.


Figure 2: Using LaTeX to feel superior to Word users.

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Lab 10: LaTeX
CS 2112 Fall 2024

November 11/13, 2024

What is LaTeX

- ▶ Turing-complete typesetting language; extension of TeX
- ▶ Focus on content; formatting can be swapped later
- ▶ Used to produce professional looking documents (like this one!) with formulas and diagrams
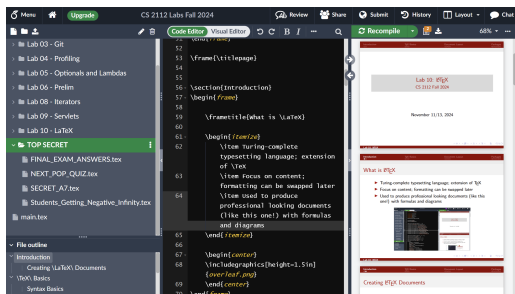
Creating LaTeX Documents

You can install command-line utilities to parse .tex files and compile them down to .pdf.

Many students find it easier to use a web-based LaTeX compiler. The course staff recommends Overleaf.

There is also great emacs integration with a package called auctex.

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Syntax Basics

- ▶ TeX works with a series of tags or commands
- ▶ Each is preceded by a backslash '\' character
- ▶ Arguments are grouped using curly bracelets { } if more than one character long
- ▶ Example: The fraction $\frac{1}{2}$ is declared with the code \frac{1}{2}

Preamble

▶ Each document starts with a preamble, which is the stuff before the \begin{document}

▶ The document class defines what type of document you're making; you'll typically use article, but others exist (these presentations use beamer, for example)

▶ You'll also declare any packages you use (more on that later)

▶ Finally, declare any information that goes in the title block

```
1  \documentclass{article}
2  \usepackage[utf8]{inputenc}
3
4  \title{First Document}
5  \author{Andrew Myers}
6  \date{November 2024}
```

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Document Body

- ▶ After the preamble, the contents of your document go between the \begin{document} and the \end{document}
- ▶ Add the \maketitle command to generate a header block based on the information from your preamble

```
1  \documentclass{article}
2  \usepackage[utf8]{inputenc}
3  \title{First Document}
4  \author{Andrew Myers}
5  \date{November 2024}
6
7  \begin{document}
8  \maketitle
9  Stuff goes here
10 \end{document}
```

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Basic Layout

▶ Press enter **twice** to start a new paragraph

▶ Use \\ to create a newline

▶ Use \textbf{bold} to create bold, \textit{italics}, or \underline{underlined} text

▶ Use the \section{Title} and \subsection{Title} commands to create sections and subsections

▶ Use the \begin{itemize} and \end{itemize} commands to create bulleted lists, or swap itemize with enumerate to create numbered lists. Add items with \item.

Math

- ▶ You'll need to import the amsmath package; add the line `\usepackage{amsmath}` to your preamble.
- ▶ Create an inline equation by wrapping your equation in dollar signs or `\(` and `\)`, so `$1+1$` compiles down to $1 + 1$
- ▶ Break the equation onto its own block by using two dollar signs or `\[` and `\]`, as in `$$1+1$$` or `\[1+1\]`
- ▶ There are countless math formatting commands
  - ▶ `$\frac{n}{d}$` $\frac{n}{d}$
  - ▶ `$x^{p}_{b}$` x^p_b
  - ▶ `$\lim_{x\to0}$` $\lim_{x\to0}$
  - ▶ `$\alpha\beta\infty$` $\alpha\beta\infty$
  - ▶ `$\sum_{i=0}^n$` $\sum_{i=0}^n$
  - ▶ `$\int_0^5x\,dx$` $\int_0^5 x\,dx$
- ▶ Many more available; Google what you need
- ▶ Detexify is a useful tool for looking up symbols

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More Math

You can make matrices and vectors in math mode like so:

```
1  \begin{bmatrix}
2      a & b\\
3      c & d
4  \end{bmatrix}
```

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

Swap out the bmatrix for pmatrix for rounded parentheses around the matrix, or just matrix for no brackets at all.

You can align equations using the align* environment, like so:

```
1  \begin{align*}
2      2x - 5y &=  8 \\
3      9y &=  -12
4  \end{align*}
```

$$2x - 5y = 8$$
$$9y = -12$$

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Commands

You can define your own commands using
\newcommand{\R}{\mathbb{R}}. The first argument (in this case \R) is
the command you're defining; the second is what the command
should turn into (in this case \mathbb{R}).

Specify the number of parameters in square brackets and use them
like #1 for the first parameter, etc.

```
1  \newcommand {\ plusbinomial }[3]{(#2 + #3)^#1}
2  \plusbinomial {3}{x}{y}
```

$(x + y)^3$

Redefine previous commands using \renewcommand{\S}{\mathbb{S}}

Importing Packages

► As stated earlier, import packages using
   \usepackage{package_name} in the preamble

► Countless useful packages; we'll show just a sampling here

► Nice-to-knows:
   ► geometry   Page orientation and margins
   ► amsmath   Powerful math tools
   ► amssymb   Extended range of math symbols
   ► listings   Include syntax-highlighted code
   ► graphicx   Import pictures
   ► tikz   Create diagrams

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Page Margins

Using the geometry package, you can customize the size, margins, and orientation of your page.
For example, including the following in your preamble will make the page landscape with 2-inch margins.

```
1  \usepackage[letterpaper, landscape, margin=2in]{geometry}
```

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Sample Graphics

The following is will import a picture, as long as the graphicx
package is included. This TEX code is taken from the first slide of
this presentation

```
1  \includegraphics[height=3in]{meme.png}
```

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Sample Code Block

The following will render out a code block, as long as the listings package is included. Use the \lstset command to customize language, syntax highlighting, line numbers, and more.

```
1  \begin{lstlisting}
2      public static void main(String[] args) {
3          System.out.println("Hello World");
4      }
5  \end{lstlisting}
```
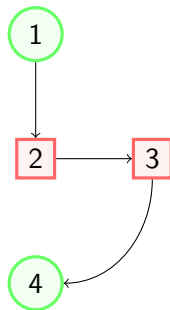
Sample Diagram

The following will render out a diagram with the `tikz` package. Tikz is a very complex with tons of options beyond the scope of this lab, but hopefully this gives you a taste of what is possible.

```
 1  \begin{tikzpicture}[
 2  roundnode/.style=
 3      {circle, draw=green!60, fill=green!5, very thick, minimum size=7mm},
 4  squarednode/.style=
 5      {rectangle, draw=red!60, fill=red!5, very thick, minimum size=5mm},
 6  ]
 7    %Nodes
 8    \node[squarednode]      (maintopic)                            {2};
 9    \node[roundnode]        (uppercircle)   [above=of maintopic] {1};
10    \node[squarednode]      (rightsquare)   [right=of maintopic] {3};
11    \node[roundnode]        (lowercircle)   [below=of maintopic] {4};
12
13    %Lines
14    \draw[->] (uppercircle.south) -- (maintopic.north);
15    \draw[->] (maintopic.east) -- (rightsquare.west);
16    \draw[->] (rightsquare.south) .. controls +(down:7mm) and +(right:7mm) ..
17        (lowercircle.east);
18  \end{tikzpicture}
```

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Sample Diagram

This is what the diagram on the previous page renders out to:

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Exercise

On the course website, under today's lab, there's a link labeled
"Exercise" that leads to a pdf document created with LATEX.
Please try to recreate it.