

Figure 1: Using L^AT_EX to write more efficiently.



Figure 2: Using L^AT_EX to feel superior to Word users.

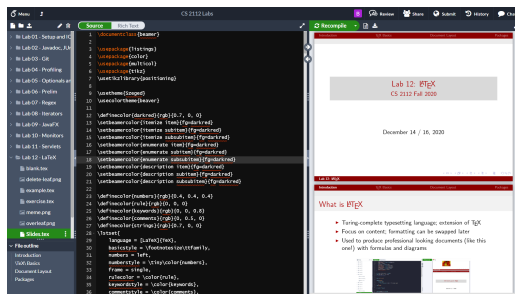
Lab 12: L^AT_EX

CS 2112 Fall 2021

December 6, 2021

What is L^AT_EX

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



Creating L^AT_EX 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 L^AT_EX compiler. The course staff recommends Overleaf.

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

Syntax Basics

- ▶ T_EX 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{December 2019}
```

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{December 2020}
6
7 \begin{document}
8 \maketitle
9 Stuff goes here
10 \end{document}
```

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_b^p
 - ▶ `$$\lim_{x\to 0}$$` $\lim_{x \rightarrow 0}$
 - ▶ `$$\alpha\beta\infty$` $\alpha\beta\infty$
 - ▶ `$$\sum_{i=0}^n$` $\sum_{i=0}^n$
 - ▶ `$$\int_0^5 x\,dx$` $\int_0^5 x \, dx$
- ▶ Many more available; Google what you need
- ▶ Detexify is a useful tool for looking up symbols

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*}
```

$$\begin{aligned} 2x - 5y &= 8 \\ 9y &= -12 \end{aligned}$$

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

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}
```

Sample Graphics

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

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

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.

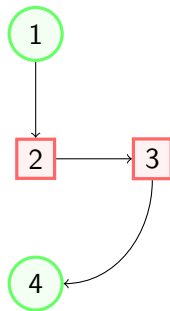
```

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}

```


Sample Diagram

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



Exercise

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

The End + Thank You

It has been a pleasure working with all of you this semester. Best of luck on all your future endeavors, and thanks for coming to lab.

Omkar Bhalerao, Vivian Ding, Shirley Huang, Quest McQuilkin, Charles Sherk, William Wang, Jerry Xu