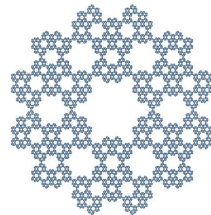


# L<sup>A</sup>T<sub>E</sub>X Workshop

Mathematics Undergraduate Student Association

9 February 2023



Mathematics  
Undergraduate  
Student  
Association

# What is it?

LaTeX is a document preparation/typesetting system, used by students, professors, and professionals across the mathematical community.

It's pronounced *LAY-tek* or *LAH-tek*!

LaTeX is used for:

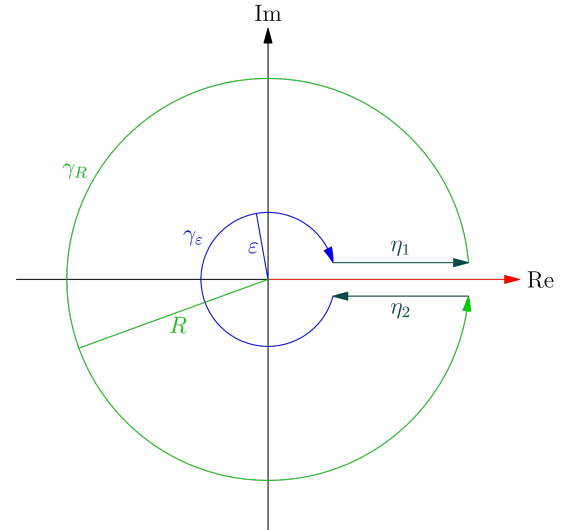
- Research Papers
- Homework and Problem Sets
- Resumes and CVs
- Posters and Presentations

$$\int_0^{\infty} \frac{\sqrt{x}}{x^2 + 1} dx = \frac{\pi}{\sqrt{2}}$$

# Why learn how to use it?

- Looks super fancy and professional
- Makes your math prettier than Microsoft Word
- Your grader can read your homework
- Easy to learn, handles formatting for you
- Tons of packages let you make any mathematical drawing or diagram you want

$$\begin{array}{ccccc}
 \widehat{H}^i(G, F(\text{Hom}_{\mathbb{Z}}(I_G, A))) & \xrightarrow{(c\cup-)_{\mathcal{U}}} & & \xrightarrow{f} & \widehat{H}^{i+1}(G, FA) \\
 \downarrow x\cup- & \searrow (c\cup-)_{\mathcal{A}} & & & \downarrow \Phi_A^{(i+1)} \\
 & & \widehat{H}^{i+1}(G, F(I_G \otimes_{\mathbb{Z}} \text{Hom}_{\mathbb{Z}}(I_G, A))) & & \\
 & & \downarrow \Phi_{I_G \otimes_{\mathbb{Z}} \text{Hom}_{\mathbb{Z}}(I_G, A)}^{(i+1)} & & \\
 \widehat{H}^{r+i}(G, F'(\text{Hom}_{\mathbb{Z}}(I_G, A))) & \xrightarrow{(c\cup-)_{\mathcal{U}'}} & & \xrightarrow{f} & \widehat{H}^{r+i+1}(G, F'A) \\
 \downarrow & \searrow (c\cup-)_{\mathcal{A}'} & & & \downarrow \\
 & & \widehat{H}^{r+i+1}(G, F'(I_G \otimes_{\mathbb{Z}} \text{Hom}_{\mathbb{Z}}(I_G, A))) & & 
 \end{array}$$



# Getting Started

You can write LaTeX in a lot of different environments!

Today, we'll get set up with a free online editor called Overleaf.

## Steps to get going:

1. Head to **overleaf.com** and make an account.
  - a. If you use your Berkeley email, you'll get the professional version for free!  
This comes with some nice benefits like version tracking and integrations.
2. Once you've done that, click New Project > Blank Project.
3. You'll come up with a new project with some stuff in it.



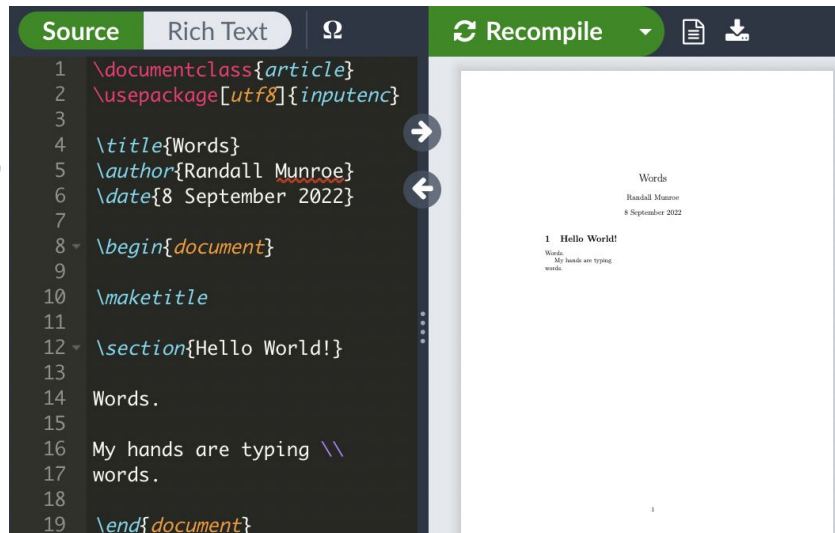
# Writing Text

Stuff between the lines “`\begin{document}`” and “`\end{document}`” is shown as text!

Write down a sentence after the “`\section{Introduction}`” line.

Hit “Recompile” or Ctrl + Enter for it to show up on the right.

Notice that LaTeX doesn't care about extra spaces, and to go to a new line you can either put `\\` at the end of the line, or press enter/return twice.



The screenshot shows a LaTeX editor interface. On the left, the source code is displayed in a dark theme with line numbers 1 through 19. The code includes document class and package declarations, title and author information, and a section command. On the right, a preview window shows the compiled PDF output, which includes the title, author, date, and the content of the section.

```
1 \documentclass{article}
2 \usepackage[utf8]{inputenc}
3
4 \title{Words}
5 \author{Randall Munroe}
6 \date{8 September 2022}
7
8 \begin{document}
9
10 \maketitle
11
12 \section{Hello World!}
13
14 Words.
15
16 My hands are typing \\
17 words.
18
19 \end{document}
```

```
\section{Whitespace}
```

Notice that LaTeX  
doesn't care about `whitespace`.  
Unless I have a double backslash!

Or press enter twice for a new paragraph.

## 1 Whitespace

Notice that LaTeX doesn't care about whitespace.  
Unless I have a double backslash!

Or press enter twice for a new paragraph.

# Writing Math

To write math in LaTeX, all you need to do is surround your equation!

To format equations, do `$$insert math here$$` or `\[insert math here\]`.

→ Try typing `\[x^2 + y^2 = 1\]`

For mathematical expressions within your writing, do `$insert math here$`.

→ Try typing `The circle $x^2 + y^2 = 1$ has radius $1$.`

This is enough to do a lot, but some math symbols require special commands.

Try it out and see the difference!

# More Math Symbols

Commands in LaTeX start with `\` and tell LaTeX to write something different.

If you want to make a math symbol, the command `\symbolname` will work a lot of the time. Sometimes the command has a different name.

Try some of the following. Remember to put them in mathmode! (`\[ \]` or `$ $`)

`\lim`    `\sum`    `\int`    `\pi`    `\Psi`    `\infty`    `\to`    `\rightarrow`

`\in`    `\cdot`    `\subseteq`    `\emptyset`    `\ge`    `\le`    `\ne`

Now, search “Detexify” on Google and go to the first link.

Draw any math symbol and see what command you should use for it!

# Subscripts, Superscripts, Braces

If you want to make a subscript or a superscript, use `_` or `^`.

→ Try typing `$f_1 \colon A \to B$` by `$f_1(n) = \int_0^1 x^n dx$`

If you want to put more than one symbol in a subscript or a superscript, you can group things with curly braces `{ }`. These are also used for commands!

→ Try typing `$x^{217} \ne x^{\{217\}}$`

→ Try typing `$$\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}$$`



# More Nice Commands

We saw `\sqrt{}`. More commands: `\frac{}{}`, `\overline{}`, and `\pmod{}`.

→ Try them! Put a symbol or expression inside each curly brace spot.

There are other useful commands like `\sin`, `\cos`, `\log`, `\pm`.

Don't just type the words in without the `\` or they'll show up in italics!

→ For example:

```
\[ \sin \frac{\theta}{2} = \pm \sqrt{ \frac{1 - \cos \theta}{2} } \]
```

→ Overleaf helps you to find when you're missing a curly brace in your code!

More handy things:

- `align*`
- Linear algebra

```
Source Rich Text Ω
1 \documentclass{article}
2 \usepackage[utf8]{inputenc}
3 \usepackage{amsmath}
4
5 \title{Homework 1}
6 \author{Anonymous Student}
7 \date{8 September 2022}
8
9 \begin{document}
10
11 \maketitle
12
13 \section{Problem 1}
14 We show that  $713$  is composite by factoring.
15 Indeed,
16 \begin{align*}
17 713 &= 729 - 16 \\
18 &= 27^2 - 4^2 \\
19 &= 27^2 - 27 \cdot 4 + 27 \cdot 4 - 4^2 \\
20 &= (27-4)(27+4) \\
21 &= 23 \cdot 31.
22 \end{align*}
23
24 \section{Problem 2}
25 We show that the matrix
26 \[A=\begin{bmatrix}
27 0 & 1 \\
28 0 & 0
29 \end{bmatrix}\]
30 is nilpotent. For this, we compute
31 \[A^2=\begin{bmatrix}
32 0 & 1 \\
33 0 & 0
34 \end{bmatrix}\]
35 \begin{bmatrix}
36 0 & 1 \\
37 0 & 0
38 \end{bmatrix}=\begin{bmatrix}
39 0 & 0 \\
40 0 & 0
41 \end{bmatrix}.
42
43 \end{document}
```

Recompile

Homework 1

Anonymous Student

8 September 2022

**1 Problem 1**

We show that 713 is composite by factoring. Indeed,

$$\begin{aligned} 713 &= 729 - 16 \\ &= 27^2 - 4^2 \\ &= 27^2 - 27 \cdot 4 + 27 \cdot 4 - 4^2 \\ &= (27 - 4)(27 + 4) \\ &= 23 \cdot 31. \end{aligned}$$

**2 Problem 2**

We show that the matrix

$$A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$$

is nilpotent. For this, we compute

$$A^2 = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}.$$

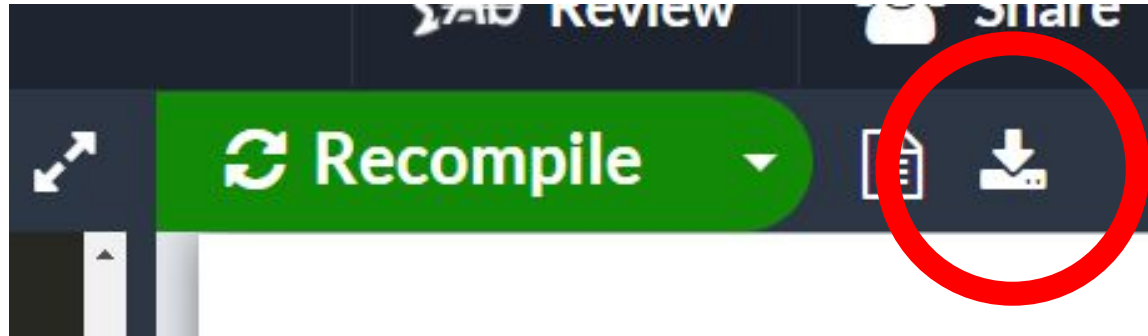
1

# Downloading from Overleaf

Press the little “Download PDF” button above the document to download!

You can submit your PDF to Gradescope or bCourses or email it.

It will look really great!



# Other Resources

- Detexify: We tried this, find symbols by drawing them.
- MathPix: Turn pictures into LaTeX.
- MathQuill: Turn your typing into LaTeX.
- TeX Stack Exchange: Lots of very smart people with strange/good opinions.
- texnique.xyz: Fun LaTeX typing game. Give it a go!
- Super useful packages:
  - **amsmath**, **amsthm**, and **amssymb**: Very nice and important extra commands.
  - **graphicx**: Put images into your file.
  - **tikz** and **asymptote**: Make cool diagrams.
  - **enumitem**: Automates writing lists.

# Delimiters

( ) and [ ] work in mathmode. What if you want curly braces { }?

Trying  $\{ z : z^k = 1 \}$  makes the braces disappear. Use  $\left\{$  and  $\right\}$  instead.

Unfortunately, delimiters can act a little weird when you have big expressions.

Use  $\left$  and  $\right$  with your delimiters and they'll resize appropriately.

→ Unsized delimiters:  $\left[ 3 \times \left( \frac{1}{2} + 5 \right) \right]$

→ Resized delimiters:  $\left[ 3 \times \left( \frac{1}{2} + 5 \right) \right]$

→ With  $\left\{ \right\}$ :  $\left\{ z \in [0,1] : z \geq \frac{\sqrt{3}}{2} \right\}$

# Typing Your Homeworks: Lists

Let's talk about lists. We can either make bulleted lists or numbered lists.

These commands DO NOT go in mathmode! They go *outside* the  $\[ \]$  and  $\$ \$$ .

Bullets:

```
\begin{itemize}
  \item First bullet.
  \item Second bullet.
\end{itemize}
```

Numbers:

```
\begin{enumerate}
  \item First item.
  \item Second item.
\end{enumerate}
```

# Typing Your Homeworks: Unusual Numbering

Each item in a list can have as many lines after it as you like, and can have both inline math and formatted equations. So you can use lists to number your problems!

```
\begin{enumerate}
  \item[1-1]  $4 + 4 = 8$ .
  \item[1-2] Maybe  $\pi + e$ ?
\end{enumerate}
```

```
\begin{enumerate}
  \setcounter{enumi}{1}
  \item Item 2.
  \setcounter{enumi}{-1}
  \item Item 0.
\end{enumerate}
```

# Typing Your Homeworks: The Preamble

The preamble is everything that comes before `\begin{document}`.

First line: `\documentclass{article}`

- Tells LaTeX how to format your document.
- We usually use `article`, but there are others like `book`, `slides`, `letter`, etc.

After that: `\usepackage{somepackagename}`

- Tells LaTeX what extra collections of commands you want to use.
- Under the current `\usepackage`, add another: `\usepackage{amssymb}`



# Typing Your Homeworks: Customizing Page Setup

You might have noticed that your document has huge margins right now. That's the default for the article document class, but we can customize it (like almost anything in LaTeX)!

→ `\usepackage[left=2cm, right=2cm, top=3cm]{geometry}` to change margins

You can also change the alignment of your text (default is left-aligned, obviously):

→ `\begin{flushleft}` on the left `\end{flushleft}`

→ `\begin{flushright}` on the right `\end{flushright}`

→ `\begin{center}` in the center `\end{center}`

# Typing Your Homeworks: Definitions

Now that we've added the `amssymb` package, we can do blackboard letters!

→ Between the begin/end document line, try  `$\mathbb{Q} \subset \mathbb{R}$` .

This is annoying to type if you're using the real numbers a lot!

Let's make our own nickname command for `\mathbb{R}`.

In the preamble, we use `\newcommand {\yourcommandname} { some stuff }`

→ Under the `\usepackage` lines, add `\newcommand {\RR} {\mathbb{R}}`

→ Try using your new `\RR` command later in your document.

```

% Various black-board things
\renewcommand{\AA}{\mathbb A}
\newcommand{\RR}{\mathbb R}
\newcommand{\ZZ}{\mathbb Z}
\newcommand{\NN}{\mathbb N}
\newcommand{\QQ}{\mathbb Q}
\newcommand{\CC}{\mathbb C}
\newcommand{\FF}{\mathbb F}
\newcommand{\OO}{\mathcal O}
\newcommand{\PP}{\mathbb P}
\newcommand{\CP}{\mathbb{CP}}

\newcommand{\e}{\varepsilon}
\newcommand{\ball}[2]{(#1-#2,\,#1+#2)}

\newcommand{\lfloor}[1]{\left\lfloor#1\right\rfloor}
\newcommand{\ceil}[1]{\left\lceil#1\right\rceil}
\newcommand{\norm}[1]{\left\|#1\right\|}
\newcommand{\diff}{\operatorname{diff}}
\newcommand{\disc}{\operatorname{disc}}
\newcommand{\ord}{\operatorname{ord}}
\newcommand{\lcm}{\operatorname{lcm}}
\newcommand{\del}{\partial}
\newcommand{\emp}{\varnothing}
\newcommand{\divides}{\mid}
\newcommand{\op}[1]{\operatorname{#1}}
\newcommand{\mf}[1]{\mathfrak{#1}}
\newcommand{\mc}[1]{\mathcal{#1}}

\newcommand{\bb}[1]{\left\llbracket#1\right\rrbracket}

% Algebra
\newcommand{\coker}{\operatorname{coker}} % why isn't this a thing?!
\newcommand{\codim}{\operatorname{codim}}
\newcommand{\id}{\operatorname{id}}
\newcommand{\tr}{\operatorname{tr}}
\newcommand{\im}{\operatorname{im}}

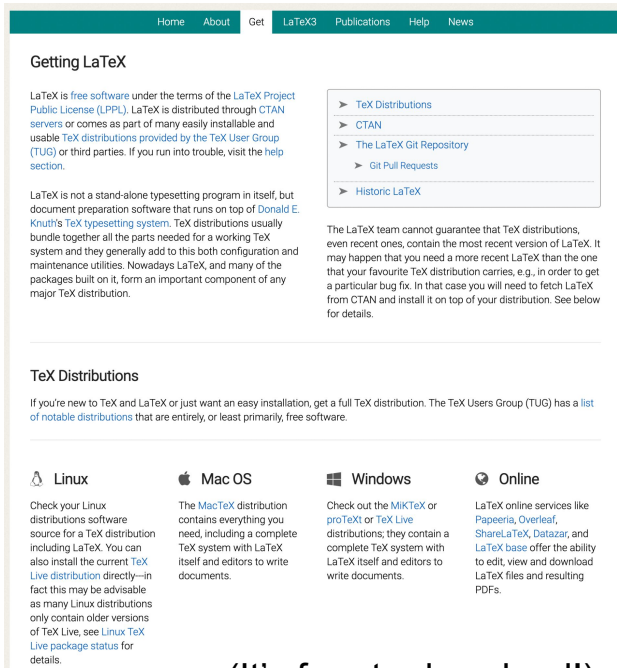
```

# I'm Lazy

Sorry to literally anyone who  
ever has to read my LaTeX code

# TeXing Locally

<https://www.latex-project.org/get/>

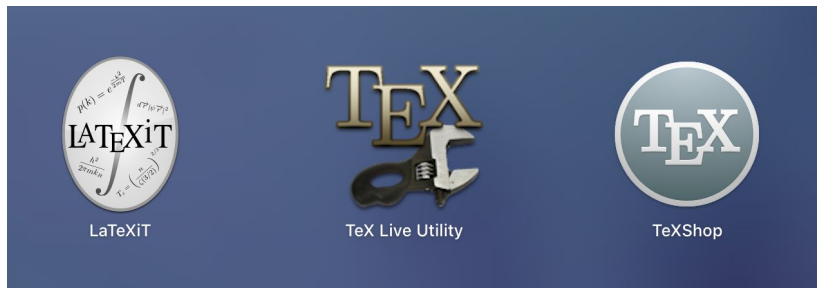


The screenshot shows the 'Getting LaTeX' page from the LaTeX Project website. The page has a teal header with navigation links: Home, About, Get, LaTeX3, Publications, Help, News. The main content is titled 'Getting LaTeX' and includes a paragraph about the LaTeX Project Public License (LPPL) and CTAN servers. Below this is a list of links: TeX Distributions, CTAN, The LaTeX Git Repository, Git Pull Requests, and Historic LaTeX. A second paragraph explains that LaTeX is not a stand-alone typesetting program but a document preparation software that runs on top of Donald E. Knuth's TeX typesetting system. A note states that the LaTeX team cannot guarantee that TeX distributions, even recent ones, contain the most recent version of LaTeX. Below this is a section for 'TeX Distributions' with a sub-heading 'TeX Distributions' and a paragraph stating that if you're new to TeX and LaTeX, you should get a full TeX distribution. At the bottom, there are four columns for different operating systems: Linux, Mac OS, Windows, and Online. Each column has a small icon and a brief description of the distribution options available for that platform.

(It's free to download!)

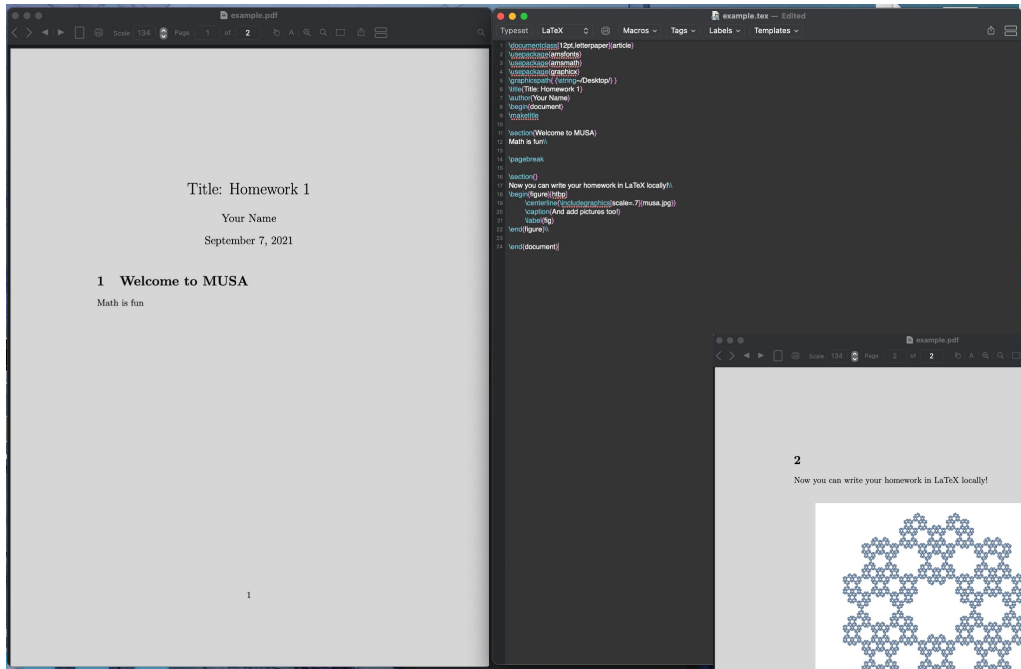
The first two minutes of [this video](#) explains pretty well how to download TeXShop onto a Mac or PC. The download will take ~10-15 min.

These items will show up on your apps, but you're only going to use TeXShop!



# General Set-Up:

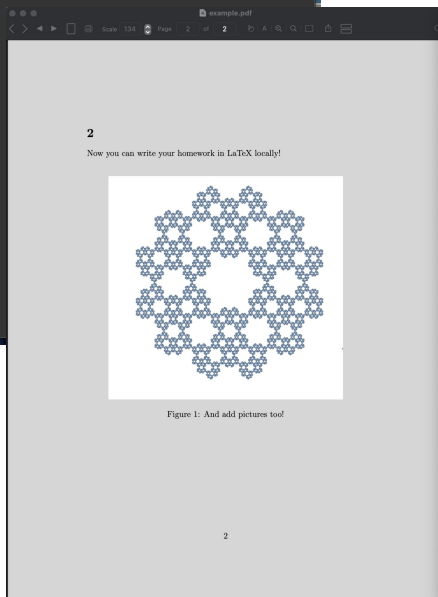
Press the Typeset button to see your work in pdf form



```
Typeaset LaTeX Macros Tags Labels Templates
1 \documentclass[12pt,letterpaper]{article}
2 \usepackage{amsfonts}
3 \usepackage{amsmath}
4 \usepackage{graphicx}
5 \graphicspath{ {\string~/Desktop/} }
6 \title{Title: Homework 1}
7 \author{Your Name}
8 \begin{document}
9 \maketitle
10
11 \section{Welcome to MUSA}
12 Math is fun\\
13
14 \pagebreak
15
16 \section{}
17 Now you can write your homework in LaTeX locally!\\
18 \begin{figure}[htbp]
19 \centerline{\includegraphics[scale=.7]{musa.jpg}}
20 \caption{And add pictures too!}
21 \label{fig}
22 \end{figure}\\
23
24 \end{document}
```

Save the picture as a .jpg on your Desktop

[This video](#) helped me learn this general set up and understand how packages work



# Symbols and Packages

[Here](#) is my favorite site for finding common symbols

What if you find a command for a symbol you're looking for, but it fails when you run it? Most likely, you will need to add a package.

For example...

TABLE 69: halloweenmath Halloween-Themed Math Operators

☺	<code>\bigpumpkin†</code>	👻	<code>\mathleftghost</code>	☁	<code>\reversemathcloud</code>
☠	<code>\bigskull</code>	👹	<code>\mathrightbat</code>	👹	<code>\reversemathwitch†</code>
👹	<code>\mathbat</code>	👻	<code>\mathrightghost</code>	👹	<code>\reversemathwitch*†</code>
☁	<code>\mathcloud</code>	👹	<code>\mathwitch*†</code>	☠	<code>\skull</code>
👻	<code>\mathghost</code>	👹	<code>\mathwitch†</code>		
👹	<code>\mathleftbat</code>	☺	<code>\pumpkin</code>		

† These symbols accept limits. For example, `\mathwitch*_{i=0}^{\infty} f(x)` produces “ $\overset{\infty}{\underset{i=0}{\mathwitch*}} f(x)$ ” in text mode and

$$\overset{\infty}{\underset{i=0}{\mathwitch*}} f(x)$$

in display mode.

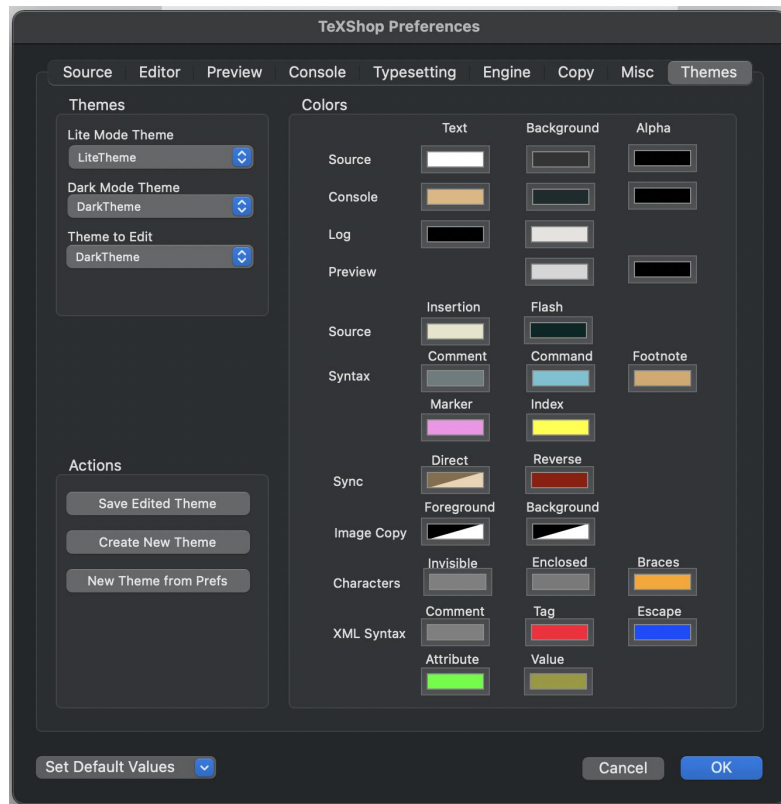
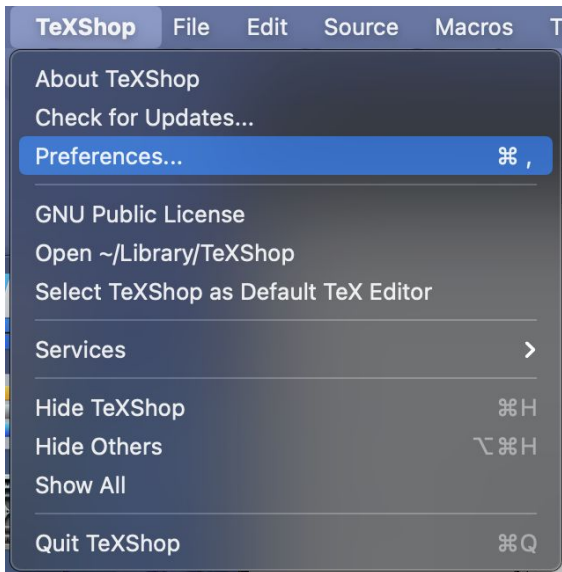
‡ `\greatpumpkin` is a synonym for `\bigpumpkin`.

```
Typeset LaTeX Mac
1 \documentclass[12pt,letterpaper]{article}
2 \usepackage{amsfonts}
3 \usepackage{amsmath}
4 \usepackage{graphicx}
5 \usepackage{halloweenmath}
6 \graphicspath{ {string~/Desktop/} }
7 \title{Title: Homework 1}
8 \author{Your Name}
9 \begin{document}
10 \maketitle
11
```

Now instead of left and right arrows to prove if and only if statements, you can use left and right BATS or GHOSTS!

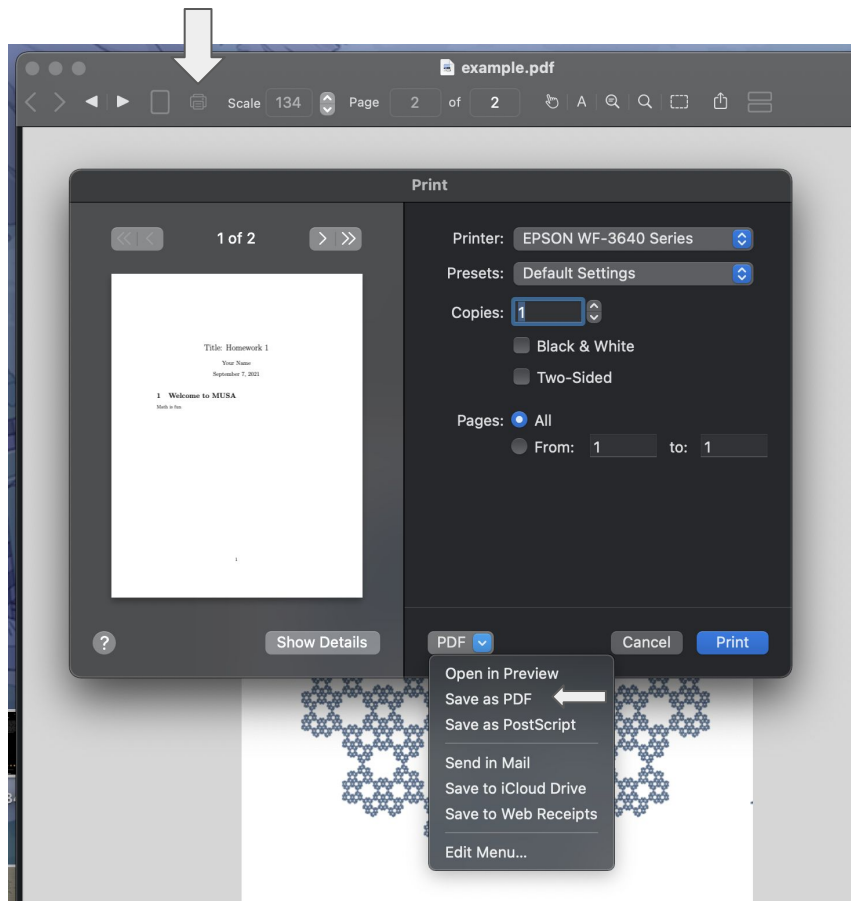
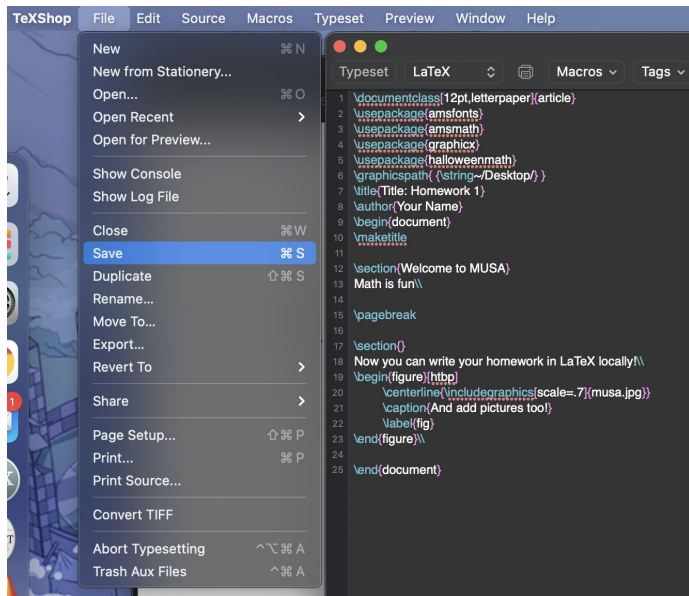
# Why not just use Overleaf?

You can change the colors!!!!



# Once you're done....

You need to save your work both as a TeX file so you can edit it in the future (below) and as a pdf (right)







<https://tinyurl.com/LaTeXMUSA>