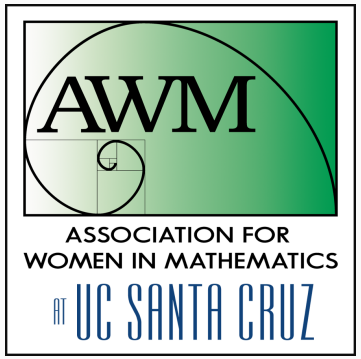
LaTeX *Workshop I*

UCSC Undergraduate Colloquium



by the Association for Women in Mathematics (AWM) Chapter
at UC Santa Cruz

Deewang Bhamidipati

15th April 2022

While you're waiting, please make an account at

`http://overleaf.com`

or open your offline TeX editor on your laptop.

What is LaTeX?

- LaTeX is a markup language like HTML, which when compiled produces beautifully formatted documents.

What is LaTeX?

- LaTeX is a markup language like HTML, which when compiled produces beautifully formatted documents.
- Overleaf is a cloud-based LaTeX editor that is useful for collaborations, and reduces headache about saving things.

What is LaTeX?

- LaTeX is a markup language like HTML, which when compiled produces beautifully formatted documents.
- Overleaf is a cloud-based LaTeX editor that is useful for collaborations, and reduces headache about saving things.
- If you want to use LaTeX locally on your computer, you need to install a compiler, MiKTeX, and an editor of your choice, I use Texmaker.

What is LaTeX?

(Input) `main.tex`

```
\documentclass{article}
\usepackage{amsmath,amsthm,amssymb,amsfonts}

\begin{document}

Euler's Identity, given below, is described as the most beautiful equation
\[e^{i\pi} + 1 = 0\]

\noindent
The quadratic formula is, when $a \neq 0$
\[x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\]

\end{document}
```

What is LaTeX?

When compiled!

What is LaTeX?

When compiled!

(Output) `main.pdf`

Euler's Identity, given below, is described as the most beautiful equation

$$e^{i\pi} + 1 = 0$$

The quadratic formula is, when $a \neq 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Structure of a LaTeX Document

```
\documentclass{article}

%the "preamble"
%
%packages and document configurations go here


\begin{document}

%actual content goes here

\end{document}
```

Structure of a LaTeX Document

```
%sets document type to "article"
%for example, for this presentation this is set to "beamer"
\documentclass{article}
```

Structure of a LaTeX Document

```
%sets document type to "article"
%for example, for this presentation this is set to "beamer"
\documentclass{article}

%controls margin lengths
\usepackage[top=0.75in, bottom=1.25in, left=1in, right=1in]{geometry}
```

Structure of a LaTeX Document

```
%sets document type to "article"
%for example, for this presentation this is set to "beamer"
\documentclass{article}

%controls margin lengths
\usepackage[top=0.75in, bottom=1.25in, left=1in, right=1in]{geometry}

%this is THE math package
\usepackage{amsmath,amsthm,amssymb}
```

Structure of a LaTeX Document

```
%sets document type to "article"
%for example, for this presentation this is set to "beamer"
\documentclass{article}

%controls margin lengths
\usepackage[top=0.75in, bottom=1.25in, left=1in, right=1in]{geometry}

%this is THE math package
\usepackage{amsmath,amsthm,amssymb}


\begin{document}

Euler's Identity, given below, is described as the most beautiful equation
\[e^{i\pi} + 1 = 0\]
where $i^2 = -1$.

\end{document}
```

Structure of a LaTeX Document

Your turn!

- Go to

  `https://bdeewang.com/activities/cs/undergrad-colloq/`

- Open `workshop_canvas.tex`.
- Copy everything to your Overleaf project, or a new .tex file on your local TeX editor.
- Make sure it compiles!
- Once you're done, look back at this presentation.

Writing Code

The Code

```
A series of consecutive lines is considered to be a paragraph.
This line is a part of the previous paragraph, for example.

Now this is a second paragraph.

        Whitespace within        a        line (including indentation!)

is ignored.
```

Output

A series of consecutive lines is considered to be a paragraph. This line is a part of the previous paragraph, for example.

Now this is a second paragraph.

Whitespace within a line (including indentation!) is ignored.

To Note

Some Quirks

The keystrokes, `\ $ _ ^ & ~ % { }` and `#` are not interpreted as text by TeX, but rather have special meaning. To get some of them as text, use `\backslash`, `\$`, `\&`, `\%`, `\{`, `\}`, `\#`.

To Note

Some Quirks

The keystrokes, `\ $ _ ^ & ~ % { }` and `#` are not interpreted as text by TeX, but rather have special meaning. To get some of them as text, use `\backslash`, `\$`, `\&`, `\%`, `\{`, `\}`, `\#`.

New lines.

```
Force newlines with\\
two double backslashes.

This is different from a paragraph break.
```

To Note

Some Quirks

The keystrokes, `\ $ _ ^ & ~ % { }` and `#` are not interpreted as text by TeX, but rather have special meaning. To get some of them as text, use `\backslash`, `\$`, `\&`, `\%`, `\{`, `\}`, `\#`.

New lines.

```
Force newlines with\\
two double backslashes.

This is different from a paragraph break.
```

Single and double quotes.

```
Use ``two backticks" for starting double quotes and a regular quotation
mark to end.

Use a `single backtick' for single quotes.
```

Math Mode. In-line and Display.

Code

```
Given a quadratic equation $ax^2 + bx + c = 0$ with $a \neq 0$, there are
two possible values of $x$:

    \[x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\]

This formula is known as the \textbf{quadratic formula}.
```

Math Mode. In-line and Display.

Code

```
Given a quadratic equation $ax^2 + bx + c = 0$ with $a \neq 0$, there are
two possible values of $x$:

    \[x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\]

This formula is known as the \textbf{quadratic formula}.
```

Output

Given a quadratic equation $ax^2 + bx + c = 0$ with $a \neq 0$, there are two possible values of x:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

This formula is known as the **quadratic formula**.

Text within Math Mode

Code

```
\[
\sin\theta = \frac{\text{opposite side}}{\text{hypotenuse}},
\qquad
\cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse}}
\]
```

Text within Math Mode

Code

```
\[
\sin\theta = \frac{\text{opposite side}}{\text{hypotenuse}},
\qquad
\cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse}}
\]
```

Output

$$\sin\theta = \frac{\text{opposite side}}{\text{hypotenuse}}, \qquad \cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse}}$$

Command Types

Command Types

A command with

- zero argument `\command`.

Command Types

Command Types

A command with

- zero argument `\command`.

  e.g. `$\pm\alpha\pi$` gives $\pm\alpha\pi$.

Command Types

Command Types

A command with

- zero argument `\command`.

  e.g. `$\pm\alpha\pi$` gives $\pm\alpha\pi$.

- single argument `\command{arg}`

Command Types

Command Types

A command with

- zero argument `\command`.

  e.g. `$\pm\alpha\pi$` gives $\pm\alpha\pi$.

- single argument `\command{arg}`

  e.g. `\emph{an example}` gives *an example*; `$\overline{z}$` gives $\overline{z}$.

Command Types

Command Types

A command with

- zero argument `\command`.

  e.g. `$\pm\alpha\pi$` gives $\pm\alpha\pi$.

- single argument `\command{arg}`

  e.g. `\emph{an example}` gives *an example*; `$\overline{z}$` gives $\overline{z}$.

- multiple arguments `\command{arg1}{arg2}{arg3}`

Command Types

Command Types

A command with

- zero argument `\command`.

  e.g. `$\pm\alpha\pi$` gives $\pm\alpha\pi$.

- single argument `\command{arg}`

  e.g. `\emph{an example}` gives *an example*; `$\overline{z}$` gives $\overline{z}$.

- multiple arguments `\command{arg1}{arg2}{arg3}`

  e.g. `$\dfrac{4}{5}$` gives $\dfrac{4}{5}$.

Command Types

A command with

- zero argument `\command`.

  e.g. `$\pm\alpha\pi$` gives $\pm\alpha\pi$.

- single argument `\command{arg}`

  e.g. `\emph{an example}` gives *an example*; `$\overline{z}$` gives $\overline{z}$.

- multiple arguments `\command{arg1}{arg2}{arg3}`

  e.g. `$\dfrac{4}{5}$` gives $\dfrac{4}{5}$.

- optional (with some mandatory) arguments `\command[opt1,opt2]{arg1}{arg2}` or `\command{arg}[opt]`

Command Types

A command with

- zero argument `\command`.

  e.g. `$\pm\alpha\pi$` gives $\pm\alpha\pi$.

- single argument `\command{arg}`

  e.g. `\emph{an example}` gives *an example*; `$\overline{z}$` gives $\overline{z}$.

- multiple arguments `\command{arg1}{arg2}{arg3}`

  e.g. `$\dfrac{4}{5}$` gives $\dfrac{4}{5}$.

- optional (with some mandatory) arguments `\command[opt1,opt2]{arg1}{arg2}` or `\command{arg}[opt]`

  e.g. `\documentclass[11pt]{article}` and `\begin{theorem}[Quadratic Formula]`.

Commands

Your turn!

- Open the `workshop_canvas.tex` file.
- Solve the given simple algebra question, and typeset your answer.
- Try and use math mode, in-line and display, while experimenting with some commands.
- Make sure your file compiles without an error.
- If finished early, try typesetting random equations.
- Head to `https://detexify.kirelabs.org/classify.html` and find commands for various math symbols that you know.

Environments

Environments help in streamlining your document.

Environments

Environments help in streamlining your document.

Environment

- a normal environment

```
\begin{environment}
%content here
\end{environment}
```

Environments

Environments help in streamlining your document.

Environment

- a normal environment

```
\begin{environment}
%content here
\end{environment}
```

- an environment with options

```
\begin{environment}[options]
%content here
\end{environment}
```

Formatting and Nested Lists

add `\usepackage{enumitem}` to your preamble.

Formatting and Nested Lists

add `\usepackage{enumitem}` to your preamble.

Code

```
\begin{itemize}[itemsep=2em,leftmargin=5em]

   \item[$\rhd$] This is a list where I can control if the list is

   \item[(1)] numbered, or

   \item[$\bullet$] bulleted, or

   \item[(c)] lettered. But also nested lists
    \begin{itemize}
       \item[(i)] a nest
    \end{itemize}

\end{itemize}
```

Formatting and Nested Lists

Output

- ▷ This is a list where I can control if the list is

(1) numbered, or

- bulleted, or

(c) lettered. But also nested lists

    (i) a nest

Tables

Code

```
\begin{tabular}{cr|l}
   No. & Country & River \\
   \hline
   1. & India & Kaveri\\
   2. & USA & Mississippi river\\
   3. & Egypt & Nile
\end{tabular}
```

Tables

Code

```
\begin{tabular}{cr|l}
   No. & Country & River \\
   \hline
   1. & India & Kaveri\\
   2. & USA & Mississippi river\\
   3. & Egypt & Nile
\end{tabular}
```

Output

No.	Country	River
1.	India	Kaveri
2.	USA	Mississippi river
3.	Egypt	Nile

Sections, Theorems, Lemmas, Proofs, Definitions etc.

Add to Preamble

```
\newtheorem{theorem}{Theorem}[section]
\newtheorem{lemma}[theorem]{Lemma}

\theoremstyle{definition}
\newtheorem{definition}[theorem]{Definition}

\newtheorem{problem}{Problem}[section]
```

Sections, Theorems, Lemmas, Proofs, Definitions etc.

Add to Preamble

```
\newtheorem{theorem}{Theorem}[section]
\newtheorem{lemma}[theorem]{Lemma}

\theoremstyle{definition}
\newtheorem{definition}[theorem]{Definition}

\newtheorem{problem}{Problem}[section]
```

Code

```
\section{Section}

\begin{theorem}
This is a theorem.
\end{theorem}
\begin{proof}
A proof of the theorem.
\end{proof}

\begin{lemma}[Euler, 1847]
A lemma by Euler.
\end{lemma}

\begin{definition}
A definition.
\end{definition}

\begin{problem}
What is $2^2$?
\end{problem}
\begin{proof}[Solution]
$2^2 = 2\cdot 2 = 4$.
\end{proof}
```

Sections, Theorems, Lemmas, Proofs, Definitions etc.

Output

1 Section

Theorem 1.1. *This is a theorem.*
Proof. A proof of the theorem. □

Lemma 1.2 (Euler, 1847). *A lemma by Euler.*

Definition 1.3. A definition.

Problem 1.1. What is 2^2?
Solution. $2^2 = 2 \cdot 2 = 4$. □

Environments

Your turn!

- Open the `workshop_canvas.tex` file back again.
- Initiate the problem environment with label "Test", and create a list with two simple problems.
- Write solutions using the proof environment.
- Make sure you compile without any errors.

Title

We haven't discussed how to add a title to your document. The `workshop_canvas` file already has one.

Title

We haven't discussed how to add a title to your document. The `workshop_canvas` file already has one.

You should add the following code immediately after `\begin{document}`.

Title

We haven't discussed how to add a title to your document. The `workshop_canvas` file already has one.

You should add the following code immediately after `\begin{document}`.

Code

```
\title{Workshop Canvas}
\author{You}
\date{\today}
%use \date{} and \date{10th April 1994} for no date and custom date resp.
\maketitle                  %creates the title
```

Title

We haven't discussed how to add a title to your document. The `workshop_canvas` file already has one.

You should add the following code immediately after `\begin{document}`.

Code

```
\title{Workshop Canvas}
\author{You}
\date{\today}
%use \date{} and \date{10th April 1994} for no date and custom date resp.
\maketitle                    %creates the title
```

Output

Workshop Canvas

You

April 15, 2022

Adding Images

Suppose you have image files *thunder.jpg* and *lightning.png* in the **same folder** as your LaTeX code.

Add to Preamble

```
\usepackage{graphicx}  %lets you embed graphics
```

Adding Images

Suppose you have image files *thunder.jpg* and *lightning.png* in the **same folder** as your LaTeX code.

Add to Preamble

```
\usepackage{graphicx}  %lets you embed graphics
```

Code

```
\includegraphics[width=5cm]{thunder}
%scales image so that it's 5cm wide

\includegraphics[width=\textwidth]{lightning}
%scales image so that it's as wide as the entire page
```

Aligning Math

How do we get the following? Display math mode doesn't seem enough.

Aligned Math Example

$$ax^2 + bx + c = 0 \qquad \text{given}$$

$$x^2 + \frac{b}{a}x + \frac{c}{a} = 0 \qquad \text{divide by } a\text{, since } a \neq 0$$

$$x^2 + \frac{b}{a}x = -\frac{c}{a} \qquad \text{subtract } \frac{c}{a}$$

$$x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 = -\frac{c}{a} + \left(\frac{b}{2a}\right)^2 \qquad \text{add } \left(\frac{b}{a}\right)^2$$

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2} \qquad \text{complete the square and simplify}$$

$$x + \frac{b}{2a} = \pm\frac{\sqrt{b^2 - 4ac}}{2a} \qquad \text{take square roots}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad \text{subtract } \frac{b}{2a} \text{ and simplify}$$

Aligning Math

Code

```
\begin{align*}
 x^2 - 11x + 28
     &= x^2 - 7x - 4x + 28   && \text{write $-11 = -7 - 4$}\\[0.5em]
     &= x(x - 7) - 4(x - 7)  && \text{take $x$ and $-4$ common}\\[0.5em]
     &= (x - 4)(x - 7)       && \text{take $x - 7$ common}
\end{align*}
```

Aligning Math

Code

```
\begin{align*}
 x^2 - 11x + 28
     &= x^2 - 7x - 4x + 28   && \text{write $-11 = -7 - 4$}\\[0.5em]
     &= x(x - 7) - 4(x - 7)  && \text{take $x$ and $-4$ common}\\[0.5em]
     &= (x - 4)(x - 7)       && \text{take $x - 7$ common}
\end{align*}
```

Output

$$
\begin{aligned}
x^2 - 11x + 28 &= x^2 - 7x - 4x + 28 && \text{write } -11 = -7 - 4 \\
&= x(x - 7) - 4(x - 7) && \text{take } x \text{ and } -4 \text{ common} \\
&= (x - 4)(x - 7) && \text{take } x - 7 \text{ common}
\end{aligned}
$$

Aligning Math

Your turn!

- Open the `workshop_canvas.tex` file back again.
- Initiate a proof environment with label "Solution to Workshop Problem".
- Use the `align*` environment and add

$$1 + \frac{2}{3} + \frac{4}{5}$$

  in as many steps as possible.

  What is you use the `align` environment?

- Make sure you compile without any errors.

Macros: Custom Commands

Add to Preamble

```
%if something is too long, abbreviate it
\newcommand{\RR}{\mathbb R}
\newcommand{\qq}{\mathbf Q}

%define commands that don't exist
\newcommand{\id}{\operatorname{id}}

%the first command takes one argument and the second two
\newcommand{\set}[1]{\left\{#1\right\}}
\newcommand{\setp}[2]{\left\{#1\ :\ #2\right\}}

%don't like the way a command looks, redefine it
\renewcommand{\Re}{\operatorname{Re}}
\renewcommand{\emptyset}{\varnothing}
```

Macros: Custom Commands

Code

```
The set $\set{1,2,3} \subseteq \qq$, while

   \[\setp{x \in \RR}{x^2 + 1 = 0} = \emptyset\]

The identity map $\id:\qq \to \qq$ is defined as $\id(r) = r$.
```

Macros: Custom Commands

Code

```
The set $\set{1,2,3} \subseteq \qq$, while

   \[\setp{x \in \RR}{x^2 + 1 = 0} = \emptyset\]

The identity map $\id:\qq \to \qq$ is defined as $\id(r) = r$.
```

Output

The set $\{1,2,3\} \subseteq \mathbf{Q}$, while

$$\left\{x \in \mathbb{R} \,:\, x^2 + 1 = 0\right\} = \varnothing$$

The identity map $\mathrm{id} : \mathbf{Q} \to \mathbf{Q}$ is defined as $\mathrm{id}(r) = r$.

Debugging Tips

Core idea: compile frequently and often.

- Try googling error messages. Not always a good strategy, LaTeX notoriously gives terrible error messages.
- Not sure which line is causing an error? Steadily comment out more and more of your document to isolate the problem.

  Hotkey for toggling commenting in Overleaf is `ctrl + /`, and in Texmaker use `ctrl + T` to comment and `ctrl + U` to uncomment.
- Using a new package? Skimming through the manual can be helpful.

Resources

- Figuring out names of symbols:
  `https://detexify.kirelabs.org/classify.html`

Resources

- Figuring out names of symbols:
  `https://detexify.kirelabs.org/classify.html`
- Very comprehensive tutorial:
  `https://www.overleaf.com/learn`

Resources

- Figuring out names of symbols:
  `https://detexify.kirelabs.org/classify.html`
- Very comprehensive tutorial:
  `https://www.overleaf.com/learn`
- For general questions:
  `https://tex.stackexchange.com/`

Resources

- Figuring out names of symbols:
  `https://detexify.kirelabs.org/classify.html`
- Very comprehensive tutorial:
  `https://www.overleaf.com/learn`
- For general questions:
  `https://tex.stackexchange.com/`
- Ask Google!
  (Liberally copying LaTeX examples you find is totally fine)

Resources

- Figuring out names of symbols:
  `https://detexify.kirelabs.org/classify.html`
- Very comprehensive tutorial:
  `https://www.overleaf.com/learn`
- For general questions:
  `https://tex.stackexchange.com/`
- Ask Google!
  (Liberally copying LaTeX examples you find is totally fine)
- Some instructors share templates.

Maybe Next Time

- Making slides with `beamer`.
- Drawing figures using `tikz`.
- Drawing commutative diagrams using `tikz-cd`
- Manage a bibliography using `bibtex`.

References

[1] LaTeX Workshop. CSE 311 — Foundations of Computing I (Spring 2017). University of Washington. https://courses.cs.washington.edu/courses/cse311/17sp/latex/slides.pdf.