# LaTeX Workshop

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# Outline

# LaTeX Environment

# Overleaf

Create an account at `overleaf.com` New Project $\Longrightarrow$ Blank Project

# Overleaf

Make sure you have this instead

```
\documentclass{article}
\usepackage[margin=1.25in]{geometry} % Set margins

\title{\{LaTeX} Workshop}
\author{YOUR NAME}
\date{\today}

\begin{document}
\maketitle

\end{document}
```

# The Basics

# Basic Commands

LaTeX uses backslash \ for all of its commands, and everything is case sensitive

A command formats a small piece of text
Example: `\newpage` creates a new page and `\huge` increases font size

Some commands can accept arguments
Example: `\textit{hello}` italicize text and `\ul{goodbye}` underlines text

Commands can be combined and nested (starts inside and out)

Example: `\textit{hello \textbf{world}}`

# Basic Environments

An environment formats a large piece of text
Most environments have: `\begin{}` and `\end{}`

Example:
Create document

```
\begin{document}
...
\end{document}
```

Create lists

```
\begin{enumerate}
...
\end{enumerate}
```

# Spacing

Spacing is important

Use `\indent` to indent (may not always work)

Adding extra space to text does not create extra space

Creating new lines:
`\newline` or `\\`, which is equivalent to `Shift-Enter` in Word

# Spacing

Start a new paragraph:

`\par` or empty line between text, which is equivalent to `Enter` in Word

```
1 this line
2
3 new line
```

and

```
1 this line
2 \par new line
```

are the same

# Packages

LaTeX can extend its format capabilities by adding packages

To add a package use `\usepackage{}` before `\begin{document}`

Common packages include:

- `amsmath` or `mathtools` (extra math functions)
- `amssymb` (more math symbols)
- `graphicx` (display figures)

# Structure

Use `\section{}` to create a section

Append "sub" in front of section to create subsections
Add asterisk after section to remove section number
Example:

```
1 \section{This is a section}
2 \subsection{This is a subsection}
3 \subsubsection{This is a sub-subsection}
4 \section*{This is a section without a number}
```

# Lists

The `enumerate` environment creates a numbered list and `itemize` environment creates a bullet list

Use `\item` to make a new entry
List can be nested inside lists

Example:

```
1 \begin{enumerate}
2     \item Fruit
3     \begin{enumerate}
4         \item Apple
5         \item Banana
6     \end{enumerate}
7 \end{enumerate}
```

# Lists

1. Real Numbers ($\mathbb{R}$) (`\mathbb{R}`)
   - 1.1 Rationals ($\mathbb{Q}$)
   - 1.2 Natural Numbers ($\mathbb{N}$)
     - 1.2.1 1
     - 1.2.2 2
     - 1.2.3 3
     - 1.2.4 ...
   - 1.3 Integers ($\mathbb{Z}$)
2. Complex Numbers ($\mathbb{C}$)

# Lists

Replace some `enumerate` with `itemize`

- Real Numbers ($\mathbb{R}$)
  1. Rationals ($\mathbb{Q}$)
  2. Natural Numbers ($\mathbb{N}$)
     - 1
     - 2
     - 3
     - ...
  3. Integers ($\mathbb{Z}$)
- Complex Numbers ($\mathbb{C}$)

# Mathematics in LaTeX

# Different Math Modes

To write math, they have to be in math environments

Two types:
In-line $ ... $ or `\( ... \)` - within text

Display `\[ ... \]` - by itself
Also includes `equation` and `align` environment

Normal text can be inside math environments by using `\text{}`

# Math Mode Examples

Example:

```
1 The statement $|\mathcal{P}(S)| \leq |S|$ is false.
2
3 The following statement is false. \[ |\mathcal{P}(S)|
      \leq |S| \]
```

The statement $|\mathcal{P}(S)| \leq |S|$ is false.
The following statement is false.

$$|\mathcal{P}(S)| \leq |S|$$

# Math Symbols

Symbols can be on the keyboard or be a command

Keyboard Example:

$+ \quad - \quad ( \quad ) \quad > \quad < \quad =$

Command Example (requires `amssymb`):

`\geq` $\geq$ `\neq` $\neq$ `\{` and `\}`

To find more symbols use

`http://detexify.kirelabs.org/classify.html`

# Math Commands

Caret symbol (`Shift-6`) for superscripts: `^`
Underscore symbol (`Shift-dash`) for subscripts: `_`

For multiple characters, enclose in braces

Add spaces in math environment using (from smallest to greatest):

`\,` `\:` `\;` `\quad` `\qquad`

Example:

```
1 $ e^x \qquad e^{x^2} + y^2 \qquad e^{x^2 + y^2} $
```

$e^x \qquad e^{x^2} + y^2 \qquad e^{x^2+y^2}$

# Math Equations

The `equation` environment creates an equation along with a number

Example:

```
\begin{equation}
    a^2 + b^2 = c^2
\end{equation}
```

$$a^2 + b^2 = c^2 \tag{1}$$

To remove the number, add an asterisk at the end of `equation`

# Aligned Math

The `align*` environment creates several equations that are aligned together using the ampersand symbol (`Shift-7`)
Use double backslash `\\` to go to the next line

Example:

```
\begin{align*}
    \text{Let } a &= b \\
    a^2 &= ab \\
    a^2 - b^2 &= ab - b^2 \\
    (a - b)(a + b) &= b(a - b) \\
    a + b &= b \\
    b + b &= b \\
    2b &= b \\
    2 &= 1
\end{align*}
```

# Aligned Math

$$
\begin{aligned}
\text{Let } a &= b \\
a^2 &= ab \\
a^2 - b^2 &= ab - b^2 \\
(a-b)(a+b) &= b(a-b) && \text{distributive property} \\
a + b &= b \\
b + b &= b \\
2b &= b \\
2 &= 1
\end{aligned}
$$

# Fractions

The command is `\frac{}{}`, where the first braces is the numerator and the second braces is the denominator.

The display mode varies based on environment

Example:

```
A linear fractional transformation: $\frac{az + b}{cz + d}$
```

A linear fractional transformation: $\frac{az+b}{cz+d}$

```
\[ \text{A linear fractional transformation: } \frac{az + b}{cz + d} \]
```

A linear fractional transformation: $$\frac{az + b}{cz + d}$$

# Fractions

Force display or text fractions using `\dfrac` or `\tfrac` respectively

Example:

```
A linear fractional transformation: $\dfrac{az + b}{cz + d}$
```

A linear fractional transformation: $\dfrac{az + b}{cz + d}$

```
\[ \text{A linear fractional transformation: } \tfrac{az + b}{cz + d} \]
```

A linear fractional transformation: $\tfrac{az+b}{cz+d}$

# Calculus

Summation (varies between environments): `\sum_{k=1}^n k`

$$\sum_{k=1}^{n} k$$

$$\sum_{k=1}^{n} k$$

Integral: `\int_a^b x^2 \, dx`

$$\int_a^b x^2 \, dx$$

$$\int_a^b x^2 \, dx$$

# Calculus

Use fractions and add d or `\partial` in numerator and denominator

Example:

```
\[ \frac{d y}{d x} = 2x \]
\[ \frac{\partial f}{\partial x} = 2xy + z \]
```

$$\frac{dy}{dx} = 2x$$

$$\frac{\partial f}{\partial x} = 2xy + z$$

Add apostrophe to the function: `f'(x) \qquad f''(x)`

$$f'(x) \qquad f''(x)$$

# Questions?

Additional Resources:

- https://www.geneseo.edu/prism/latex
- Google!