# LaTeX Workshop

SUMS @ UCSD

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# What is LaTeX?

/lɑːtɛx/

/leɪtɛks/

/liːt tɛk/

/fɪfti eɪt tɛn/

## References


[1] TheYolocast, "Galaxy brain." https://knowyourmeme.com/memes/galaxy-brain, January 2017. Accessed on 2021-11-29.

[2] Unknown/Traditional, "Expanding brain." https://imgflip.com/memegenerator/Expanding-Brain, April 2018. Accessed on 2021-11-29.

# What is LaTeX?

Typesetting language that makes you focus on **content**, not **form**.

## LaTeX Code and Output

```
\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
```

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

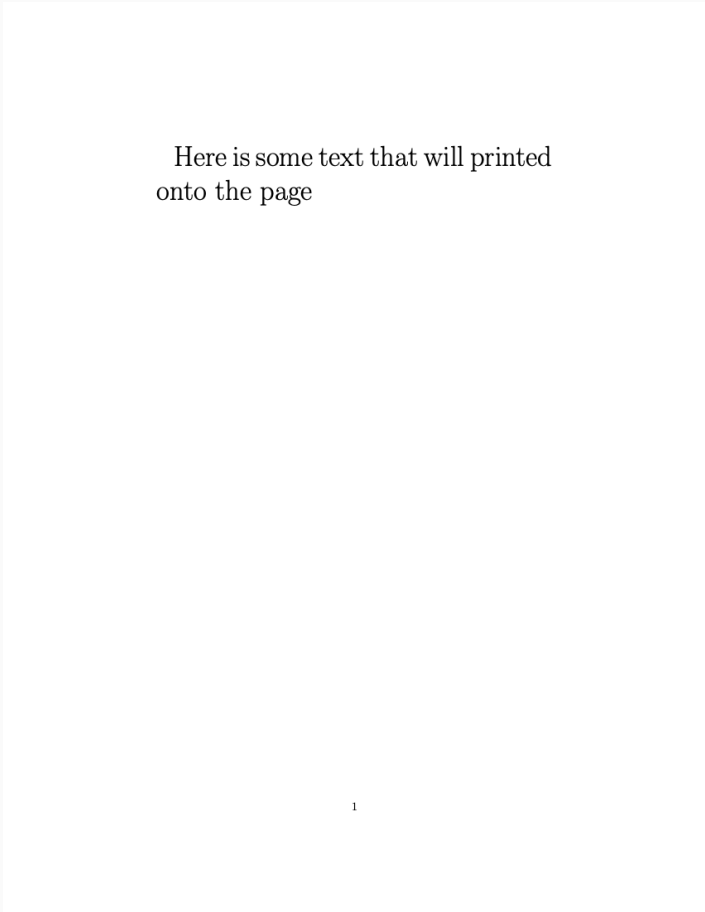
# Why not [INSERT TOOL HERE]?

LaTeX is just a tool; it has **pros** and **cons**.

| Tool | Pro | Con |
|---|---|---|
| Google Docs | Simple and fast | Limited equations |
| Paper | Write anything | Needs paper |
| Tablet | Paper with addons | Not easily searchable |
| Jupyter | Run code too | Formatting limited |
| LaTeX | Extremely customizable | High initial barrier |

# Document Structure

```
\documentclass{article} % Header
\usepackage{amsmath}
\begin{document}
    \Large
    Here is some text that will
    printed onto the page
\end{document}
```



# The LaTeX Building Blocks

LaTeX is *entirely* made up of **commands** and **environments**:

- Commands take the form `\cname[optional arg]{required arg}`
  Examples: `\frac{}{}` makes fractions, `\textbf{}` bolds text.

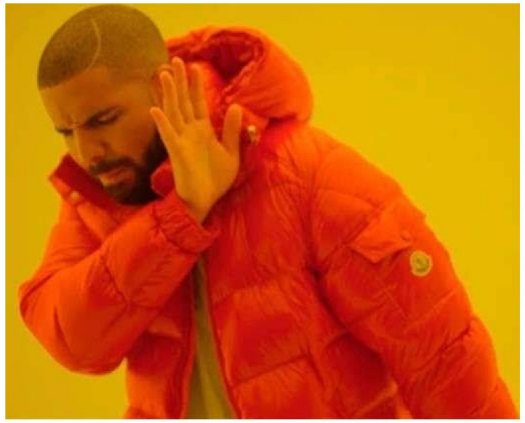
- Environments start with `\begin{env name}[opt arg]{req arg}` and end with `\end{env name}`
  Examples: `\begin{equation}` makes equations, `\begin{itemize}` makes a list like this one.

# Introducing Packages

The "difficulty" of LaTeX comes from finding what command or environment to use, especially since there are so many packages:

| **Common AMS (American Mathematics Society) Packages** |
| --- |
| **amsmath**: For math environments and formatting |
| **amssymb**: Various math symbols |
| **amsfonts**: Necessary font utilities (loaded by amssymb) |
| **amsthm**: Environments for proofs, definitions, theorems, etc. |
| **tikz**: Used to draw images for math |

# Finding What You Need



```
\begin{tikzpicture}
 \draw (0,0) -- (1,1);
\end{tikzpicture}
```

```
\tikz{
 \draw (0,0) -- (1,1);
}
```

99% of what you need LaTeXfor can be boiled down to a few core commands and environments. Now, we introduce some common ones.

# Equations

## Ways to insert equations

```
% Inline methods
This sentence has $2+2$ words.
% Centered equations
\[ f(x) = ax^2+bx+c \] OR $$ f(x) = ax^2+bx+c $$
% Full block equations
\begin{equation} f(x) = ax^2 + bx + c \end{equation}
\begin{align} f(x) = ax^2 + bx + c \end{align}
```

## Two kinds of equation environments:

```
% This one numbers equations
\begin{align} f(x) = ax^2 + bx + c \end{align}
% This one DOESN'T number equations
\begin{align*} f(x) = ax^2 + bx + c \end{align*}
```

# Common Equation Lingo

The Blackboard Font to make $\mathbb{N} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R} \subset \mathbb{C} \subset \mathbb{H}$:

```
$\mathbb{N \subset Z \subset Q \subset R \subset C \subset H}$
```

Superscipts and subscripts like $x_i^2$:

```
$x_i^2$
```

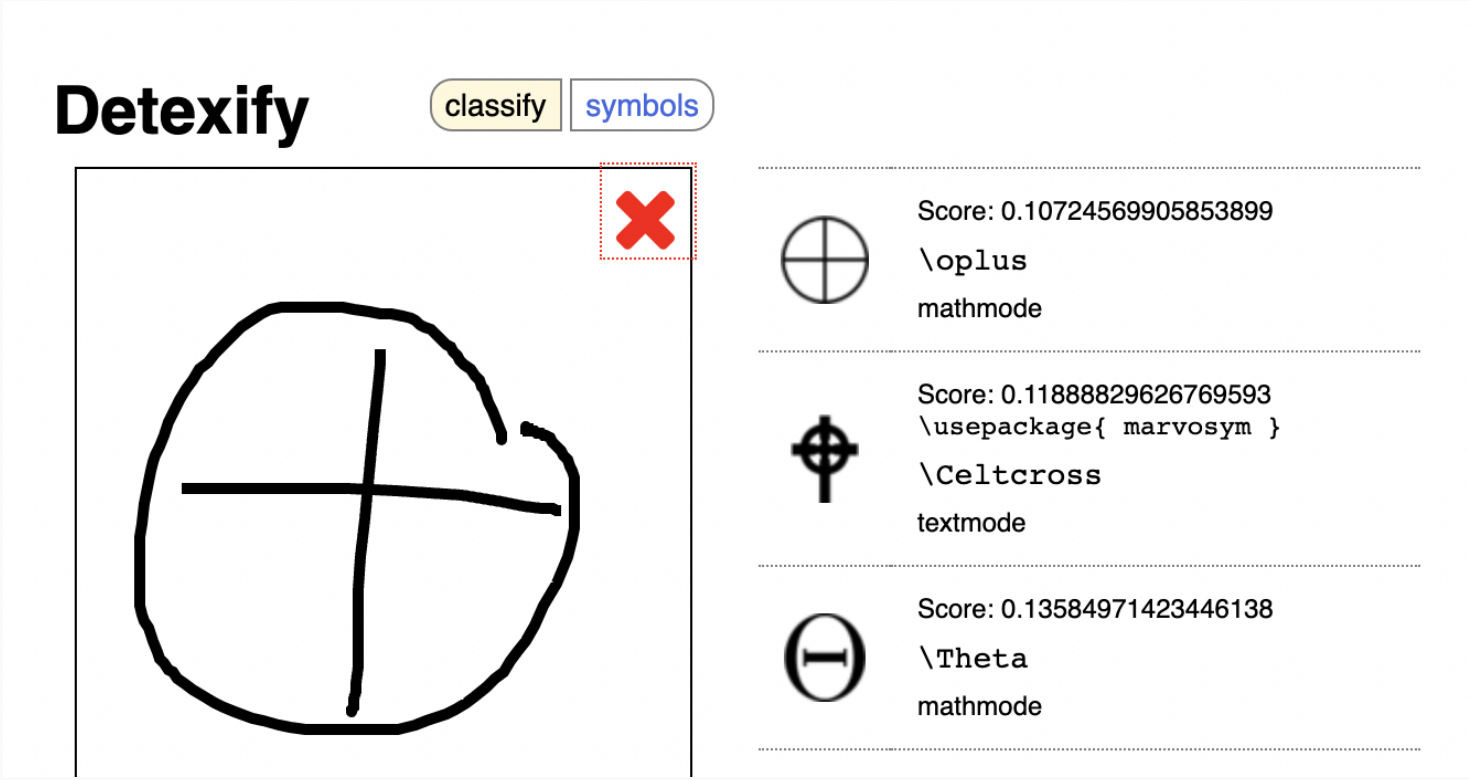
Expressions like $\sin, \epsilon > 0, \sum_{n=1}^{\infty}, \lim_{\alpha \to \infty}, \quad \square$:

```
$\sin, \cot, \sum_{n=1}^\infty, \lim_{n\to\infty}, \qed$
```

Modifiers like $\vec{x}, i \neq j, \bar{x}, \boxed{\pi \notin \mathbb{Q}}$:

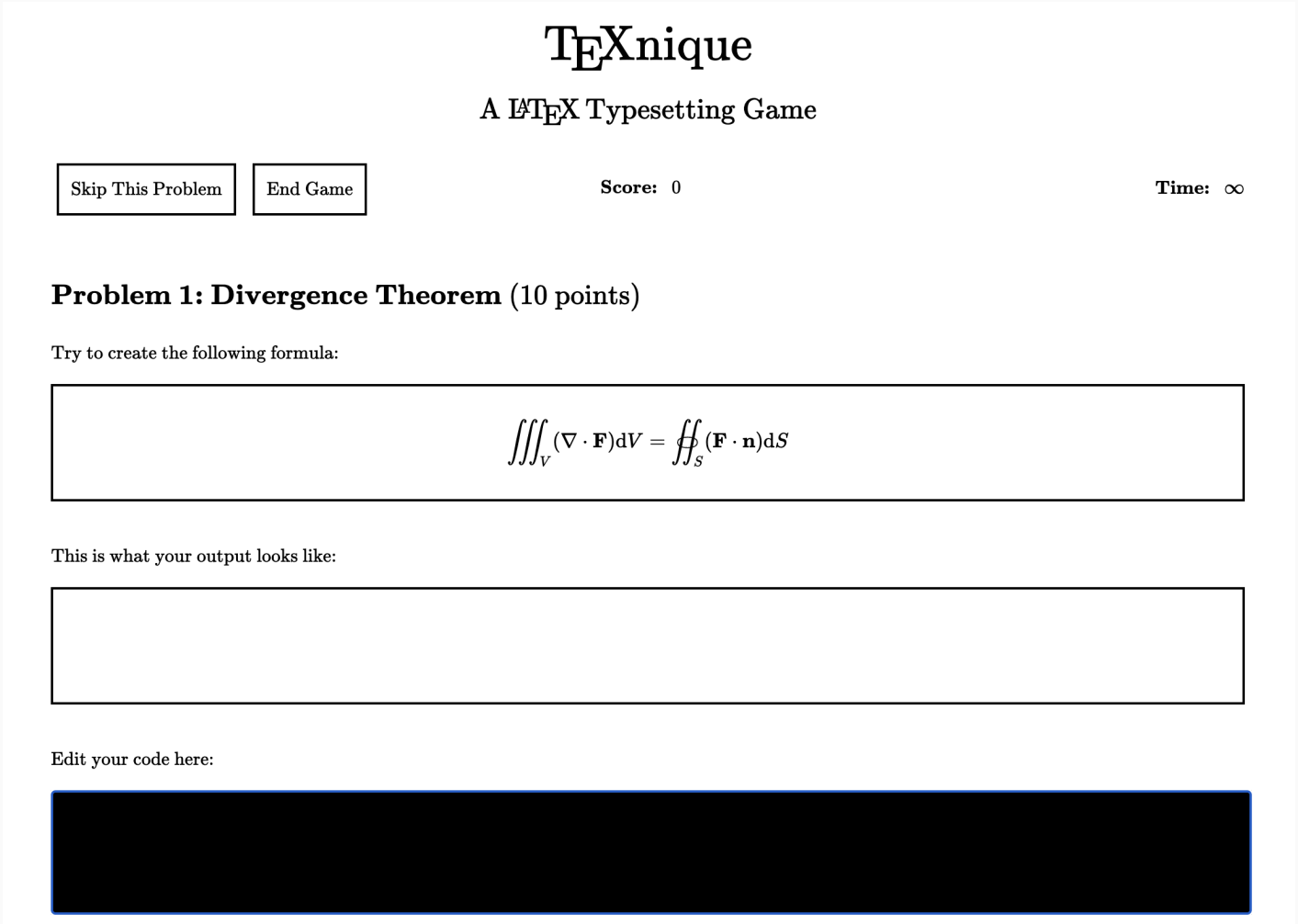
```
$\vec{x}, i\not=j, \bar{x}, \boxed{\pi \not\in \mathbb{Q}}$
```

# Detexify




https://detexify.kirelabs.org/classify.html

# TeXnique




https://texnique.xyz/

# Equation Exercises

Copy the following: *Hint.* Use Detexify, Google, or an LLM.

1) $\mathcal{C} \to \mathcal{S}$

2) $\Phi(x) = \dfrac{1}{1 - x - x^2} = \displaystyle\sum_{n=0}^{\infty} F_n x^n$

Challenge Problem:

3) $\mathbf{1}_{\mathbb{Q}}(x) = \begin{cases} 1 & x \in \mathbb{Q} \\ 0 & x \notin \mathbb{Q} \end{cases}$

# Matrices

```
\begin{matrix}
1 & 0 \\ 0 & 1
\end{matrix}
```

$$\begin{matrix}
1 & 0 \\ 0 & 1
\end{matrix}$$

```
\begin{pmatrix}
1 & 2 \\ 3 & 4
\end{pmatrix}
```

$$\begin{pmatrix}
1 & 2 \\ 3 & 4
\end{pmatrix}$$

```
\begin{bmatrix}
1 & 2 \\ 3 & 4
\end{bmatrix}
```

$$\begin{bmatrix}
1 & 2 \\ 3 & 4
\end{bmatrix}$$

```
\begin{Bmatrix}
1 & 0 \\ 0 & 1
\end{Bmatrix}
```

$$\begin{Bmatrix}
1 & 0 \\ 0 & 1
\end{Bmatrix}$$

```
\begin{vmatrix}
1 & 2 \\ 3 & 4
\end{vmatrix}
```

$$\begin{vmatrix}
1 & 2 \\ 3 & 4
\end{vmatrix}$$

```
\begin{Vmatrix}
1 & 2 \\ 3 & 4
\end{Vmatrix}
```

$$\begin{Vmatrix}
1 & 2 \\ 3 & 4
\end{Vmatrix}$$

# Tables

```
\begin{center}
\begin{tabular}{c | c r l}
    ~ & R & P & S \\
    \hline
    R & 0,0 & -1,1 & 1,-1 \\
    P & 1,-1 & 0,0 & -1,1 \\
    S & -1,1 & 1,-1 & 0,0
\end{tabular}
\end{center}
```

| | R | P | S |
|---|---|---|---|
| R | 0,0 | -1,1 | 1,-1 |
| P | 1,-1 | 0,0 | -1,1 |
| S | -1,1 | 1,-1 | 0,0 |

# Common Spacing Problems

**New Lines:**

Moving to the next line: `\\`

Moving 2 new lines down: `\\[2*\baselineskip]` or `\bigskip`

Starting a new page: `\newpage`

**Indents:**

Removing one paragraph indent: `\noindent`

Removing entire document's indent: `\setlength{\parindent}{0cm}`

**Errors:**

Overfull/underfull hbox/vbox errors: Either something is too big like

$$1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+1$$

or you did `\\\\` or other repeated spacing commands.

# Case Study: Enumerate Package

**Note:** `enumerate` and `enumitem` are two different, conflicting packages!

```
\begin{enumerate}[(a)]
    \item Hello
    \item[1.] Hi
    \item[i)] Hey
    \item One
    \setcounter{enumi}{5}
    \item Hmm
\end{enumerate}
```

(a) Hello
1. Hi
i) Hey
(b) One
(f) Hmm

# Extensions

See example pdfs for more advanced features.