LaTeX Workshop

SUMS

October 24, 2023

UCSD

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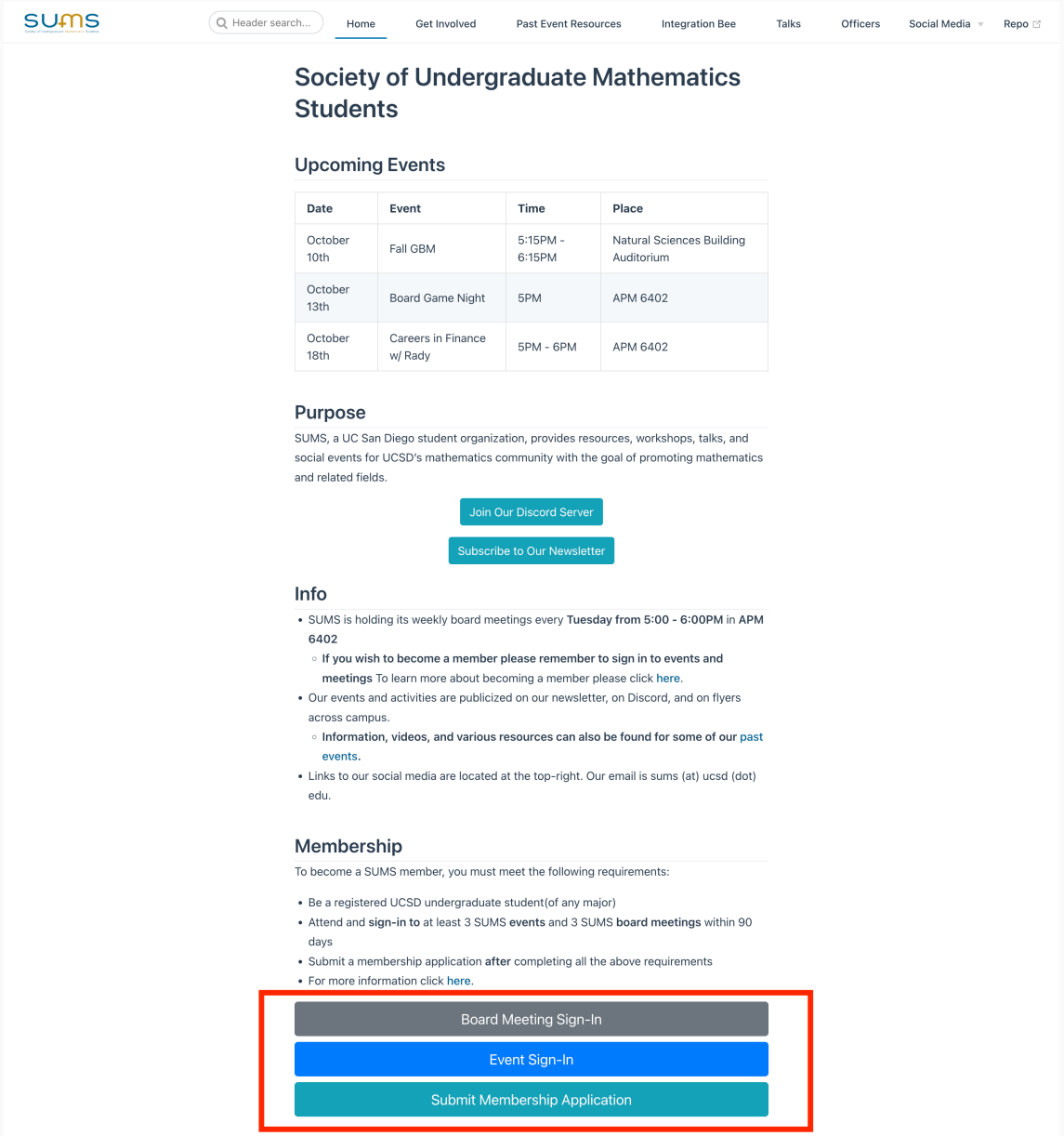

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What is LaTeX?

From the official website:

"LaTeXis a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeXis the de facto standard for the communication and publication of scientific documents."

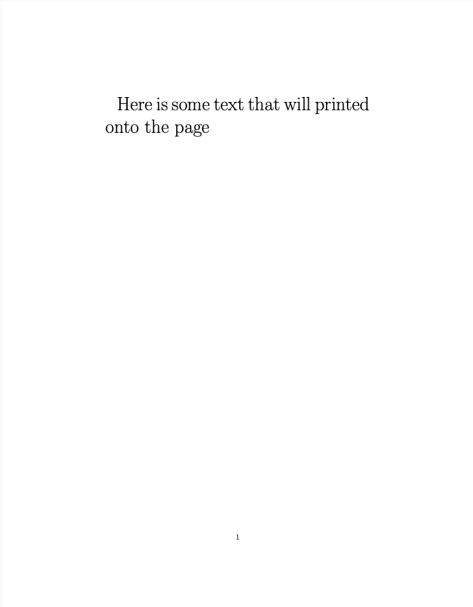
Notably for us, it can be used to convert a special programming-like language, called LaTeX, into a PDF.

LaTeX IDEs

TeXstudio is an offline libre software (La)TeX suite. Overleaf (Student) is an online proprietary LaTeX suite. pdfTeX is an offline libre software command line tool for converting (La)TeX into PDFs.

Document Structure

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



Commands and Environments

- Regular text
- Lists are a type of **environment**:
  - Items (Unordered) using `\begin{itemize}` .
  - Enumeration (Ordered) using `\begin{enumerate}`.
- You can pass two types of **arguments** to a **command**.
  - Required arguments in {}.
  - Optional arguments in [].
- Commands that generate complex output:
  - Title, author, table of contents, bibliography, etc.

Essential Math Packages

AMS (American Mathematics Society)

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

Other Fields

physics: Utilities for derivatives, vectors, etc.

siunitx: Allows expressing quantities in SI units

braket: Use for Bra-ket and set notation

graphicx: Allows inserting images into the document

Equations

Ways to insert equations

```
% Inline methods
This sentence has $2+2$ words.
% Centered equations
\[ f(x) = ax^2+bx+c \] and $$ f(x) = ax^2+bx+c $$
% Full 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*}
```

Writing Equations

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

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

Superscipts, subscripts, left and right to make x_i^2:

```
$x_i^2$
```

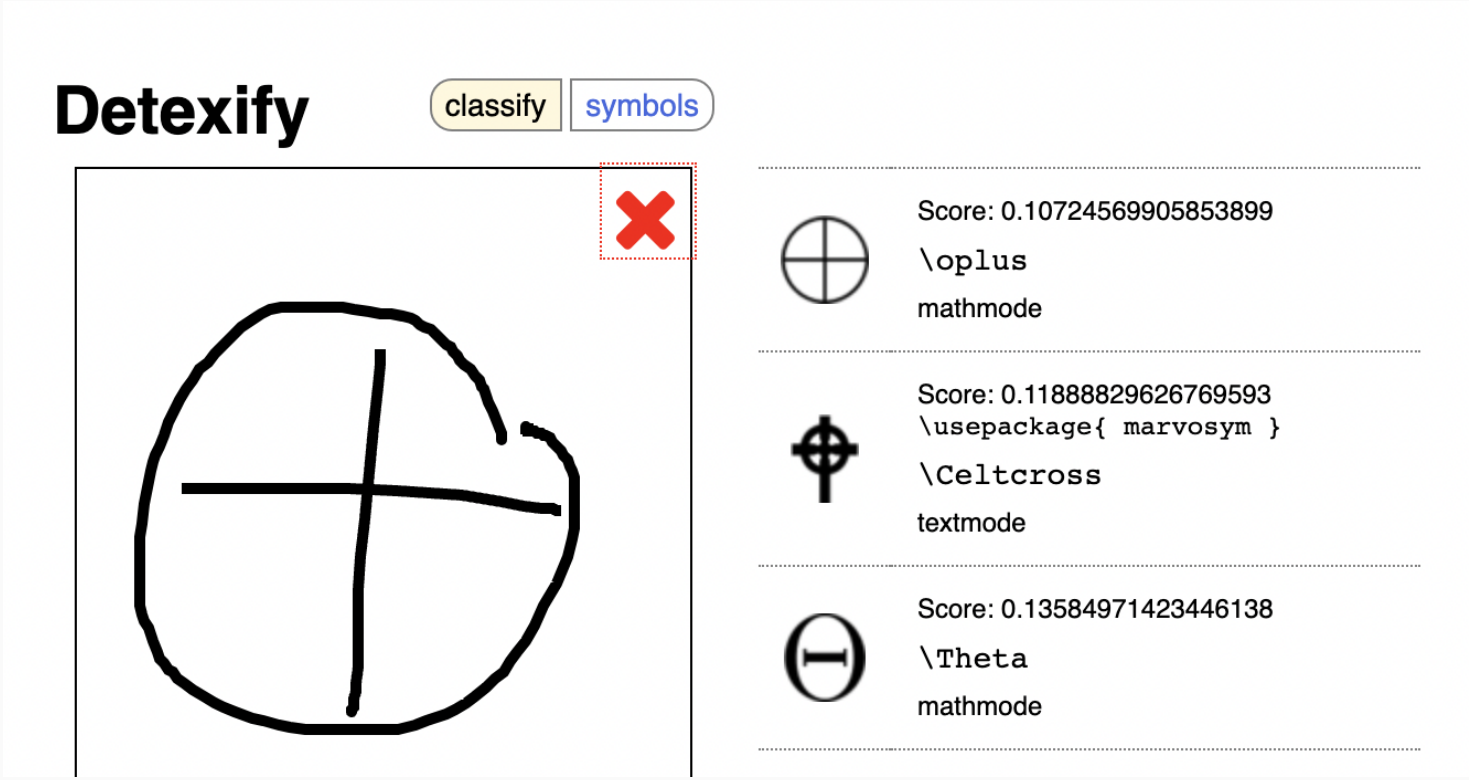
Common conmands like $\sin, \epsilon > 0, \sum_{n=1}^{\infty}, \lim_{\alpha\to\infty}, \quad \square$:

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

Common small environments $\vec{x}, i \neq j, \bar{x}, \boxed{\pi \notin \mathbb{Q}}$:

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

Detexify



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

Equation Exercises

Copy the following: *Hint:* Look things up and ask!

1) $$-\frac{\hbar^2}{2m}\nabla^2\psi + V(\mathbf{x})\psi = E\psi$$

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

3) $$^{k}a \equiv \underbrace{a^{a^{\cdot^{\cdot^{a}}}}}_{k \text{ times}}$$

Challenge Problem:

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

Matrices

Types of Wrappers

matrix: Default wrapper

pmatrix: Parenthesis wrapper

bmatrix: Brackets wrapper

vmatrix: Used for determinants

Vmatrix: Used for matrix norms

Use & for aligning elements and \\ for switching lines, and use the "\begin" and "\end" clause to start the matrix environment.

Matrices

$$\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix} \qquad \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \qquad \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

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

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

Matrix and Table Exercises

Copy the following: *Hint:* Look things up and ask!

1) $I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

2) $x^T = \begin{pmatrix} 1 & 2 & \dots & n \end{pmatrix}$

3)

Number	Factors
12	1, 2, 3, 4, 6, 12
60	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60

Challenge Problem:

4)

My Tic-Tac-Toe		
X		
X	O	

Tips and Tricks

Parameters and new commands:

```
\\[2*\baselineskip]
\newcommand{\sline}{\\[0.5\baselineskip]}
```

The no-break-space character:

```
\LaTeX~'s best friend is \TeX
\\~\\
```

Better differentials with **esdiff**:

```
\diff[2]{y}{x}
```

Better inline fractions with **nicefrac**:

```
Put in paragraph $\nicefrac{abc}{xyz}$.
```

Dummy text with **lipsum**:

```
\lipsum[1][1] and \lipsum[1-3]
```

Enumerate

```
\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

References

1. Overleaf LaTeX Documentation https://www.overleaf.com/learn