LaTeX Workshop — Society of Physics Students

Presenter: Damien Koon

Computer use recommended

Headstart: https://overleaf.com

Guess The Equation!

Universal Law of Gravitation

$$\frac{d^2\vec{x}}{dt^2} = -G\frac{M_1}{r^2}\hat{r}$$

Relativistic Energy

$$E^2 = (pc)^2 + (mc^2)^2$$

Ideal Gas Law

$$\frac{P}{T} = \frac{nR}{V}$$

Riemann Hypothesis

$$\zeta(\tfrac{1}{2} + bi) = 0$$

Schrödinger Equation

$$\frac{-\hbar^2}{2m}\nabla^2\psi + V\psi = E\psi$$

Schwarzschild radius

$$r_s = \frac{2GM}{c^2}$$

LaTeX?

- Created by Leslie Lamport (1980s),
  - built on Donald Knuth's TeX (1978)
  - **(τέχνη) - Techne**

LaTeX

What is LaTeX?

- Markup language
- Easy way to write math
- Excellent formatting

$$T^2 = 4I + [A_0, A_1] \otimes [B_0, B_1]$$

$$H|0\rangle = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix} = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ 1 \end{bmatrix} = \frac{1}{\sqrt{2}} (|0\rangle + |1\rangle)$$

$$|+\rangle = \frac{1}{\sqrt{2}}(|0\rangle + e^{i2\pi} |1\rangle) \qquad |-\rangle = \frac{1}{\sqrt{2}}(|0\rangle + e^{i\pi} |1\rangle)$$

$$|+i\rangle = \frac{1}{\sqrt{2}}(|0\rangle + e^{i\frac{\pi}{2}} |1\rangle) \qquad |-i\rangle = \frac{1}{\sqrt{2}}(|0\rangle + e^{i\frac{3\pi}{2}} |1\rangle)$$

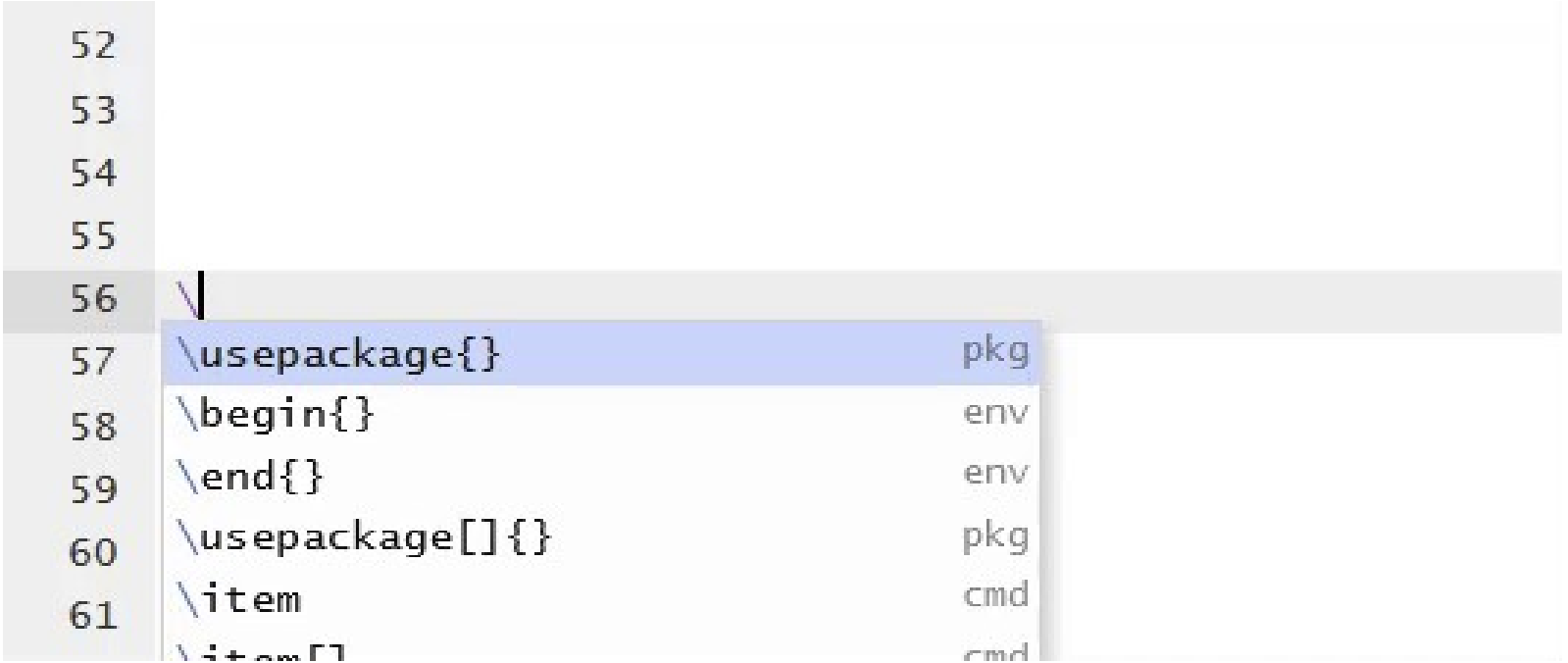
How do you use LaTeX?

- Step 1: Don’t install it, use Overleaf!
  - https://www.overleaf.com
  - Installing LaTeX locally is a pain
    - Not recommended for beginners



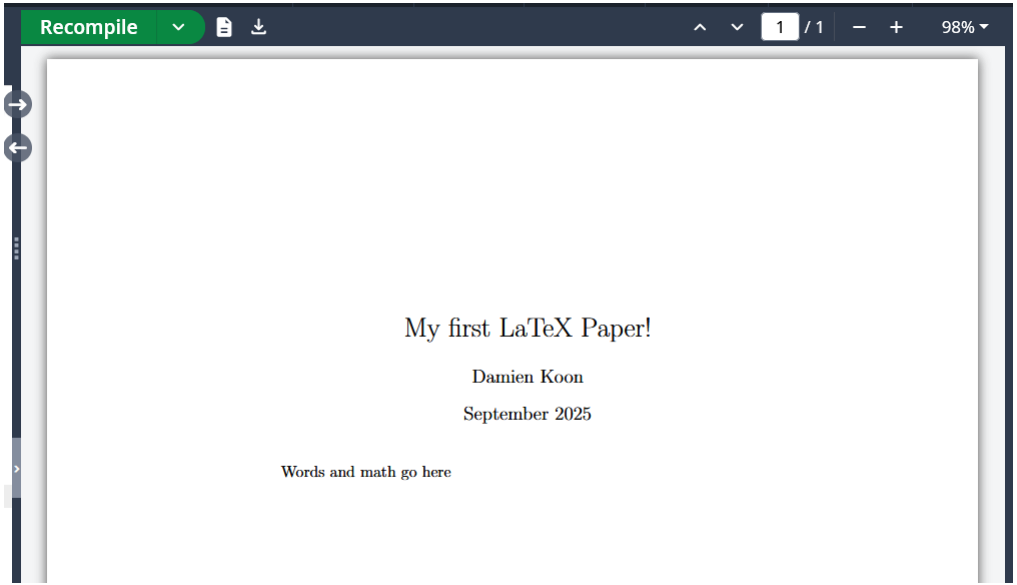
- Step 2: Make an account (**Now**…?)
  - Click new project in the top left

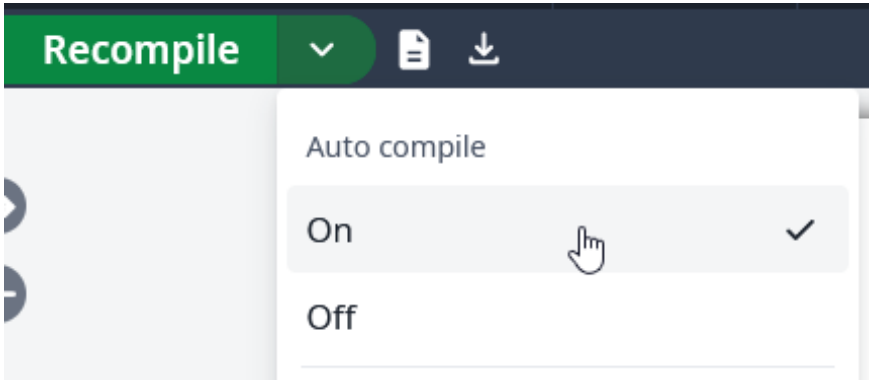
What does using LaTeX look like?



Viewing Your Document

- LaTeX uses a compiler to show you your document





Why do I use LaTeX?

- Professional-quality papers, equations, and reports
- **Standard** in physics, astronomy, and math (And many more fields)
- Required for many journal submissions, theses, and ***some lab reports***
- Widely used in research and collaborations

Why not use Microsoft Word?

- Some symbols doesn’t exist in Word (or are clunky to use)
  - Examples: div-grad-curl, astronomical symbols, vector, tensors, bra-ket, set theory, lines and hats on symbols, logic symbols
- Word’s Equation Editor
  - Lacking customization
  - Imprecise formatting
  - Awkward

Document Preamble

- All documents start a little like this

- To write your document, you will need to “code”

```
1  \documentclass{article}
2
3  \title{Introduction to LaTeX}
4  \author{Damien Koon}
5  \date{September 2025}
6
7  \begin{document}
```

Bibliography

```
\bibitem{Reference_tag}
Author, \textit{Title}.
Publisher, Date.
```

```
\cite{Reference_tag}
```

Bibliography

References

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[2] Bell, J. S. "On the Einstein Podolsky Rosen Paradox." *Physics Physique Fizika*, vol. 1, pp. 195–200, 1964. https://cds.cern.ch/record/111654/files/vol1p195-200_001.pdf

[3] Clauser, J. F., Horne, M. A., Shimony, A., & Holt, R. A. "Proposed Experiment to Test Local Hidden-Variable Theories." *Physical Review Letters*, vol. 23, no. 15, pp. 880–884, 1969. https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.23.880

[4] Toheeb Olaide/Class Notes, "logic-gates-symbol-csc-classnotesng.jpg," classnotes.ng, Date, https://classnotes.ng/lesson/logic-gate

[5] Wyrd Smythe/Logos Con Carne, "bloch-hdr.png," logosconcarne.com, March 15, 2021, https://logosconcarne.com/2021/03/15/qm-101-bloch-sphere/

[6] Liam Cope, Logic Circuit: Definition, Examples, Types and FAQs, January 2025, , https://engineerfix.com/electrical/plc/logic-circuit/

[7] Tsirelson, B. S. "Quantum Generalizations of Bell's Inequality." *Letters in Mathematical Physics*, vol. 4, pp. 93–100, 1980.

[8] IBM, *Qiskit: An Open-Source Framework for Quantum Computing*, 2025, 2.0, https://qiskit.org

[9] IBM, *IBM Quantum Computing*, 2025, https://quantum-computing.ibm.com

Equations and Mathematical Typeset

Inline: **$ ... $**

Centered standalone line: **\[... \]**

Centered standalone line: $$ ... $$
(This is old, don’t use it.)

My first LaTeX Paper!

Damien Koon

September 2025

Using $ ... $ for inline math:
This integral, $\int_{-\infty}^{\infty} x^2 e^{-x^2} dx$, is a fun one!

Using \[... \] for ceneterd math:

$$\int_{-\infty}^{\infty} x^2 e^{-x^2} dx$$

$$ ... $$ is the old way, don’t use it.

$$\int_{-\infty}^{\infty} x^2 e^{-x^2} dx$$

Packages

- If you can’t do it in LaTeX, someone else probably found a way to do it.

- Examples: (You should use some of these!)

```
\usepackage[letter, margin=1in]{geometry}          % Changing the margins
\usepackage{amsmath, mathrsfs, amssymb, physics}   % Multiple packages, all new symbols
\usepackage{graphicx}                              % For inserting pictures
\usepackage{titlesec}                              % Better titles
\usepackage{titling}                               % Makes my title look a little better
\usepackage{xcolor, listings}                      % Python/Programming Syntax Highlighting
\usepackage{parskip}                               % Better paragraph formatting
\usepackage{multirow}                              % New way to format tables
\usepackage{array}                                 % More ways to format tables
\usepackage[braket, qm]{qcircuit}                  % For making quantum circuit diagrams
```

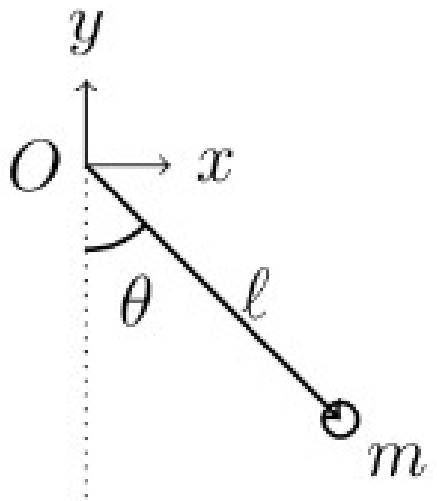
Figures

- Make your own figures and import them
  - graphicx package
  - **\includegraphics[scale=0.75]{Picture.png}**
  - **\caption{My first LaTeX picture!}**

- \usepackage{Tikz}
  - Avoid this

30-60 Minutes of Trial and Error

```
\begin{center}
\begin{tikzpicture}
    % Draw axes
    \draw[->] (0,0) -- (0,0.5) node[above] {$y$};
    \draw[->] (0,0) -- (0.5,0) node[right] {$x$};

    % Draw vector
    \draw[->,thick] (0,0) -- (1.5,-1.5) node[below right] {$m$};

    % Draw length, l
    \node at (1, -0.75) {$b$};

    % Draw dotted line
    \draw[dotted] (0,0) -- (0, -2)
    \node at (-0.3, 0) {$O$};

    % Draw angle theta
    \draw[thick] (0,-0.5) arc[start angle=-90, end angle=-45, radius=0.5];
    \node at (0.3,-0.8) {$\theta$};

    % Draw circle at the end of vector
    \draw[thick] (1.5,-1.5) circle (0.1);
\end{tikzpicture}
\end{center}
```



Making Tables in LaTeX is easy…?

```
966
967 \begin{center}
968 \begin{tabular}{
969   |>{\centering\arraybackslash}p{1.5cm}  % Centered column
970   |>{\centering\arraybackslash}p{1.5cm}
971   |>{\centering\arraybackslash}p{1.5cm}
972   |>{\centering\arraybackslash}p{1.5cm}
973   |>{\centering\arraybackslash}p{1.5cm}|
974 }
975  \hline
976  \multicolumn{5}{|c|}{All possible permutations} \\
977  \hline
978  \(B_0\) & \(B_1\) & \(B_0 - B_1\) & \(B_0 + B_1\) & \(S(\lambda)\) \\
979  \hline
980  \(+1\)   &  \(+1\)    & \(0\) &  \(+2\) & \(+2A_1\) \\
981  \(+1\)   &  \(-1\)    & \(+2\)&  \(0\) & \(+2A_0\) \\
982  \(-1\)   &  \(+1\)    & \(-2\)&  \(0\) & \(-2A_0\) \\
983  \(-1\)   &  \(-1\)    & \(0\) &  \(-2\) & \(-2A_1\) \\
984  \hline
985 \end{tabular}
986 \end{center}
```

All possible permutations				
B_0	B_1	$B_0 - B_1$	$B_0 + B_1$	$S(\lambda)$
$+1$	$+1$	0	$+2$	$+2A_1$
$+1$	-1	$+2$	0	$+2A_0$
-1	$+1$	-2	0	$-2A_0$
-1	-1	0	-2	$-2A_1$

You'll get the hang of it.

Reference examples!

What I don’t like about LaTeX

- Steep learning curve
- Error messages
- Not fully WYSIWYG

- Even with these issues, LaTeX is unmatched and remains the standard.

Links

- Overleaf community resources (quick guides, cheat sheets, etc)
  - https://www.overleaf.com/for/community/resources
- Learn LaTeX in 30 Minutes
  - https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes
- Trefor Bazett's LaTeX Tutorials Playlist
  - https://www.youtube.com/playlist?list=PLHXZ9OQGMqxcWWkx2DMnQmj5os2X5ZR73

Optional Homework

- Type up ***your*** next homework assignment in LaTeX!
  - This is easier at the start of the semester
  - You could upload your homeworks on Github (Ask your professor first!)
  - Just start editing a document and get the feel for it as you go

I use LaTeX at least once a week, usually more, and I wish I learned it earlier

You will be slow at first, and it requires a lot of Googling, but you will get faster.

Thank You for Attending! - Questions?

- You now know:
  - What LaTeX is
  - How to make a basic document
  - How to teach yourself how to use LaTeX

Want one-on-one help learning LaTeX?

Need help fixing your document?

Contact Info: **DKoon2024@my.fit.edu**