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Slides at <https://hckr.cc/ht2425s1-w4-slides>

# Where are we?

Introduction

Syntax

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Conclusion

# NUS Hackers



`http://nushackers.org`

**hackerschool**

Friday **Hacks**

**Hack** & Roll

**Hacker** Tools

# About Me

Hi! I'm Jotham Wong. My GitHub is

<https://github.com/JothamWong>

Year 4 CS and an aspiring graduate student/professor.

I also enjoy games (League, Civ, Godot), walking and teaching.

# Required Software

These are preferable, but otherwise you should be to follow along using Overleaf<sup>1</sup>

- A T<sub>E</sub>X distribution (instructions in our publicity channels)
- VS Code with LaTeX Workshop

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<sup>1</sup><https://www.overleaf.com/>

# What is $\text{\LaTeX}$ ?

- A markup language for document preparation<sup>2</sup>
- Uses plain text<sup>3</sup> in contrast to most WYSIWYG editors
- Started as a writing tool for mathematicians and computer scientists.
- Built on top of  $\text{\TeX}$  by Leslie Lamport<sup>4</sup> in 1983

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<sup>2</sup>Just like HTML (Hyper-Text Markup Language) is a markup language

<sup>3</sup>thus versionable using a VCS like `git`

<sup>4</sup>Winner of the Turing Award in 2013 for his work in distributed and concurrent systems

# What is T<sub>E</sub>X?

- A typesetting system designed and mostly written by Donald Knuth<sup>5</sup> in 1978
- Because Knuth was disappointed with the typesetting of the 2nd edition of TAOCP.
- 2 Goals:
  - Allow anybody to produce high-quality books with minimal effort
  - Provide a system that would give exactly the same results on all computers, at any point in time

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<sup>5</sup>Winner of the Turing Award in 1974 for analysis of algorithms and the design of programming languages

# Trivia

Version number of T<sub>E</sub>X approaches  $\pi$ :

3.0  $\rightarrow$  3.1  $\rightarrow$  3.14  $\rightarrow$  3.141  $\rightarrow$  ...  $\rightarrow$  3.14159265 (current)

Version number of Metafont<sup>6</sup> approaches  $e$ :

2.0  $\rightarrow$  2.7  $\rightarrow$  2.71  $\rightarrow$  ...  $\rightarrow$  2.7182818 (current)

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<sup>6</sup>Companion to T<sub>E</sub>X written by Knuth, used to describe fonts using geometrical equations



# What can I use $\text{\LaTeX}$ for?

- Reports
- Books
- Cheatsheets
- Presentation<sup>7</sup>
- And so much more!

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<sup>7</sup>This presentation is written in  $\text{\LaTeX}$  using Beamer! <https://github.com/JothamWong/latex-teaching/blob/main/latex.pdf>

# Basic $\text{\LaTeX}$ Syntax

- A  $\text{\LaTeX}$  document consists of commands and environments<sup>8</sup>

- The command syntax:

```
\command[option1,option2,...]{arg1}{arg2}...
```

- The environment syntax:

```
\begin{environment}  
    % Some children content  
\end{environment}
```

- Comments are whatever comes after %

---

<sup>8</sup>HTML terms: tags = commands, tags with children = environments

# Basic L<sup>A</sup>T<sub>E</sub>X Document

We will explain the commands and environment used here later on.

```
\documentclass{article}
```

```
\begin{document}
```

```
Hello world!
```

```
\end{document}
```

# Spaces

- All whitespace characters are treated as space.
- Several consecutive spaces are treated as one space.
- Leading/trailing spaces are ignored.
- A single line break is treated as a space.
- Two or more line breaks define the end of a paragraph.

# Let's try out spaces

```
\begin{document}
```

It does not matter whether you  
enter one or several spaces  
after a word.

An empty line starts a new  
paragraph.

```
\end{document}
```

# Reserved Characters

Reserved characters either have a special meaning or are unavailable in all the fonts <sup>9</sup>.

# \$ % ^ & \_ { } ~ \

Instead, use

`\# \ $ \% \^{} \& \_ \{ \} \~{} \textbackslash`

Note the empty argument to caret and tilde, because otherwise they are used to create diacritics.

We use `\textbackslash` because `\\` is line breaking.

<sup>9</sup>This might feel weird, but remember that T<sub>E</sub>X and L<sup>A</sup>T<sub>E</sub>X are such old systems from the 1970s and 1980s

# Other tricky characters

- `<` and `>` symbols usually do not get rendered correctly.
- Instead, use `\textless` and `\textgreater`
- In some circumstances, square brackets are reserved (for options)
- Thus, `\command [text]` fails, instead do `\command{}`  
`[text]`

# Packages

- Just like other programming languages,  $\text{\LaTeX}$  has packages as well
- $\text{\LaTeX}$  also has its own package manager, called CTAN
- Use the command `\usepackage {packagename}` to “import” and use a package.
- We will go through some useful packages in the upcoming subsections.



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Document Class

Document environment

Fonts

Text and Paragraph Formatting

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# Back to Our Example

```
\documentclass{article}
```

```
\begin{document}
```

```
Hello world!
```

```
\end{document}
```

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# Document Class

```
\documentclass{article}
```

- Use the `article` document class.
- Document class file defines the formatting standard to follow, which in this case is the generic article format.
- Other document classes, e.g. `acmart` for ACM<sup>10</sup> publications, `beamer` for presentations<sup>11</sup>
- Another option is `extarticle` as it offers extra font sizes (good for cheatsheets)

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<sup>10</sup>Association for Computing Machinery

<sup>11</sup>Like this presentation!

# Document Class options

- 10pt, 11pt, 12pt – size of main font (default: 10pt)
- a4paper, letterpaper, ... - size of paper
- landscape – Landscape mode layout
- titlepage, notitlepage – whether a new page should be started after the document title

Find out more at [https://en.wikibooks.org/wiki/LaTeX/Document\\_Structure#Document\\_classes](https://en.wikibooks.org/wiki/LaTeX/Document_Structure#Document_classes)

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# Document Environment

```
\begin{document}
```

- The beginning of the document environment.
- Tells  $\text{\LaTeX}$  that the content of document starts here.
- Anything before this line is called **the preamble**

```
\end{document}
```

- The end of the document environment
- Tells  $\text{\LaTeX}$  that the document is complete.
- Anything after this line is ignored.

# Top Matter

Top Matter: information about the document itself

- Provide information using the title, author, date
- Typeset the title using `\maketitle`

```
\documentclass{article}
```

```
\title{How to Basic: \LaTeX{}}
```

```
\author{Jotham Wong Yi Shuen}
```

```
\date{3 September 2024}
```

```
\begin{document}
```

```
\maketitle
```

```
\end{document}
```



# Sectioning Commands

```
\section{Some Section Title}
```

```
\subsection{Some Subsection Title}
```

```
\subsubsection{Some Subsubsection Title}
```

To get an unnumbered sections, add an asterisk to the end of the command name, e.g. `\section*{Look Ma, no numbers!}`

Typeset a table of contents using `\tableofcontents`

Note: unnumbered section will not be included in the TOC unless explicitly included:

```
\addcontentsline{toc}{subsection}{Look Ma, no  
↪ numbers!}
```

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# Emphasising text

- Use the `\emph{text}` command
- Typically done by italicising the text.
- Note that the command is dynamic: emphasising a word in an already emphasised sentence will revert the word to upright font.

# Font styles

```
\textnormal{document font family}  
\emph{Emphasised text}  
\texttt{teletype font family (monospaced)}  
\textbf{bold fontface}  
\textsc{Small Capitals}  
\uppercase{uppercase}
```

# Font size

Changes the size in scope

```
{\tiny test}
```

```
{\scriptsize test}
```

```
{\footnotesize test}
```

```
{\small test}
```

```
{\normalsize test}
```

```
{\large test}
```

```
{\Large test}
```

```
{\LARGE test}
```

```
{\huge test}
```

```
{\Huge test}
```

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# Non-breaking Space

Use tilde ( $\sim$ ) to tell  $\text{\LaTeX}$  not to change space into line break.

# Line spacing

- For controlling line spacing, I usually use the `setspace` package.
- Import it in the preamble: `\usepackage{setspace}`
- Useful commands: `\singlespacing`, `\onehalfspacing`, `\doublespacing`
- Useful environments: `singlespace`, `onehalfspace`, `doublespace`, `spacing`

```
\begin{spacing}{2.5}
```

This paragraph has `\\` huge gaps `\\` between lines.

```
\end{spacing}
```



# Quote-marks

In  $\text{\LaTeX}$ , quote-marks can go the wrong way if you're not careful!

To ``quote'` in  $\text{\LaTeX}$

To ```quote''` in  $\text{\LaTeX}$

# Paragraph Alignment

Alignment	Environment	Command
Left justified	<code>flushleft</code>	<code>\raggedright</code>
Right justified	<code>flushright</code>	<code>\raggedleft</code>
Center	<code>center</code>	<code>\centering</code>

# Paragraph Indentation

- By default, first paragraph after a heading is not indented, subsequent paragraphs are indented by `\parindent`
- This follows typical Anglo-American publishing convention.
- To set this length, in preamble:  
`\setlength{\parindent}{1cm} % Default 15pt`
- You can use the `indentfirst` package to indent the beginning of every section
- To force indent a non-indented paragraph, use `\indent` at the beginning of the paragraph.
- To force non-indent an indented paragraph, use `\noindent`

# Adding paragraph skips

- To make paragraphs boundary clear using zero indentation, vertical space between paragraphs is needed.
- Use the `parskip` package

# Verbatim Environment

Introduce text that will not be interpreted by the compiler in a monospaced font

```
\begin{verbatim}
```

The verbatim environment

simply reproduces every

character you input,

including all s p a c e s!

```
\end{verbatim}
```

# Code Blocks

We can also use the `minted` package to introduce code blocks with syntax highlighting!

`https://ctan.org/pkg/minted?lang=en`

# Typesetting URLs

Use the `hyperref` package, with the

`\url{https://www.nushackers.org/}` command

If you want coloured hyperlink instead of box, set option `colorlinks` when using the `hyperref` package:

`\usepackage[colorlinks]{hyperref}`

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# Mathematics

Knuth's motivation to develop  $\text{T}_{\text{E}}\text{X}$  among others was to allow simple construction of mathematical formulae that looks professional when printed.

Typesetting Mathematics is one of  $\text{\LaTeX}$ 's greatest strengths

# Getting started

I usually use the `mathtools` package to provide more powerful and flexible commands than plain  $\text{\LaTeX}$

```
\usepackage{mathtools}
```

# Environments

$\text{\LaTeX}$  provides displayed equation environment (`displaymath`), where the formulae are on a line by themselves.

Short hand<sup>12</sup>: `\[e^{i \pi} + 1 = 5\]`

To get automatically numbered equations, use the `equation` environment:

```
\begin{equation}
e^{i \pi} + 1 = 0
\end{equation}
```

---

<sup>12</sup>DO NOT use `$$...$$`, it is an older  $\text{\TeX}$  syntax that causes problems and is not officially supported by  $\text{\LaTeX}$

# Inline vs Displayed Equations

However, if you want to get an inline formula, use the `math` environment or the shorthand<sup>13</sup>:

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

These work on some flavours of Markdown too, e.g.

<https://hackmd.io>

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<sup>13</sup>There also exists the  $\text{\LaTeX}$  shorthand `\(...\)`

# Maths Symbols

A pretty good list at [https://en.wikibooks.org/wiki/LaTeX/Mathematics#List\\_of\\_mathematical\\_symbols](https://en.wikibooks.org/wiki/LaTeX/Mathematics#List_of_mathematical_symbols)

You can also use detexify:

<http://detexify.kirelabs.org/>

Or even cooler: <https://mathpix.com/>

# Powers and indices

Use the caret (^) to raise something, and underscore (\_) to lower.

If more than one expression is raised or lowered, group them using curly braces

Exercise: typeset this

$$k_{n+1} = n^2 + k_n^2 - k_{n-1}$$

# Fractions and Binomials

`$\frac{x^2}{y^3}$`

`$\binom{n}{r}$`

$$\frac{x^2}{y^3}$$

$$\binom{n}{r}$$

# Roots

`\sqrt[n]{1 + x + x^2 + x^3 + \dots + x^n}`

$$\sqrt[n]{1 + x + x^2 + x^3 + \dots + x^n}$$



# Sums and Integrals

Use the `\sum` and `\int` for sum and integral respectively, with the limits specified using caret and underscore.

Use `\limits` if you want the limits specified above and below the symbol in inline mode, or use displayed equation mode.

$$\text{\$}\text{\textcolor{blue}{\code{\sum}}}_{\text{\textcolor{green}{i=1}}}^{\text{\textcolor{green}{10}}} \text{\textcolor{green}{t}}_{\text{\textcolor{blue}{i}}}\text{\$}$$

$$\sum_{i=1}^{10} t_i$$

$$\text{\$}\text{\textcolor{blue}{\code{\sum}}}\text{\textcolor{blue}{\code{\limits}}}_{\text{\textcolor{green}{i=1}}}^{\text{\textcolor{green}{10}}} \text{\textcolor{green}{t}}_{\text{\textcolor{blue}{i}}}\text{\$}$$

$$\sum_{i=1}^{10} t_i$$

Use `\,` for a small space

$$\text{\$}\text{\textcolor{blue}{\code{\int}}}_0^{\text{\textcolor{blue}{\code{\infty}}}} \text{\textcolor{green}{e}}^{\text{\textcolor{green}{-x}}}\text{\textcolor{blue}{\code{\,}}}\text{\textcolor{blue}{\code{d}}}\text{\textcolor{blue}{x}}\text{\$}$$

$$\int_0^{\infty} e^{-x} dx$$

$$\text{\$}\text{\textcolor{blue}{\code{\int}}}\text{\textcolor{blue}{\code{\limits}}}_0^{\text{\textcolor{blue}{\code{\infty}}}} \text{\textcolor{green}{e}}^{\text{\textcolor{green}{-x}}}\text{\textcolor{blue}{\code{\,}}}\text{\textcolor{blue}{\code{d}}}\text{\textcolor{blue}{x}}\text{\$}$$

$$\int_0^{\infty} e^{-x} dx$$

# Other big commands

Note that this also applies to other “big” commands like

`$\prod$` ,  `$\bigcup$` ,  `$\bigcap$` , etc.

# Brackets, braces, delimiters

```
 $( a ), [ b ], \{ c \}, | d |, \| e \|, \langle f \rangle$   
↪  $\lceil g \rceil, \lfloor g \rfloor, \lceil h \rceil, \lfloor h \rfloor,$   
↪  $\ulcorner i \urcorner$ 
```

$(a), [b], \{c\}, |d|, \|e\|, \langle f \rangle, \lfloor g \rfloor, \lceil h \rceil, \ulcorner i \urcorner$

# Automatic sizing

`$P\left(A=2\middle|\frac{A^2}{B}>4\right)$`

`$P(A=2|\frac{A^2}{B}>4)$`

$$P\left(A = 2 \middle| \frac{A^2}{B} > 4\right)$$

$$P(A = 2 | \frac{A^2}{B} > 4)$$

# Exercises

$$\binom{n}{r} = {}_nC_r = \frac{n!}{r!(n-r)!}, {}_nC_r \times r! = {}_nP_r$$

$$\lim_{n \rightarrow \infty} \left| \frac{a_{n+1}}{a_n} \right| = \rho$$

$$\frac{d^2y}{dx^2} + p(x)\frac{dy}{dx} + q(x)y = F(x)$$

$$\{x \mid x \in \mathbb{R}^+, -1 \leq x \leq 1\}$$

# Bibliography

One of  $\text{\LaTeX}$ 's greatest power is automated bibliography and references. Especially useful for writing a formal paper.

We will be using Bib $\text{\TeX}$

# Bib File

First, create a '.bib' file in your project. Here is what a sample '.bib' file might look like.

```
@book{texbook,  
  author = {Donald E. Knuth},  
  year = {1986},  
  title = {The {\TeX} Book},  
  publisher = {Addison-Wesley Professional}  
}
```

The bib file serves as your project's bibliography database.

# Citing the document

Inside your document, include these 2 commands.

```
\bibliographystyle{plain}  
\bibliography{refs}
```

Inside a paragraph, where you wish to cite

```
\LaTeX is a set of macros built upon \TeX  
↪ \cite{texbook}
```



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# Resources

Wikibooks provide some good resources:

<https://en.wikibooks.org/wiki/LaTeX>

So does overleaf:

[https://www.overleaf.com/learn/latex/Main\\_Page](https://www.overleaf.com/learn/latex/Main_Page)

# Get started writing $\text{\LaTeX}$

Overleaf is a good option for collaborative  $\text{\LaTeX}$  document writing. Used by virtually all academic researchers.

Learn good  $\text{\LaTeX}$  code on GitHub!

Make your own cheatsheets and make them open source!

Refer to Jovyn's cheatsheets:

<https://github.com/jovyntls/cheatsheets>

# Acknowledgements

Julius Putra (ex NusHackers Core Team) for the base set of slides and Beamer template

<https://github.com/indocomsoft>

# Talk to us!



- **Feedback form:**

<https://hckr.cc/ht2425s1-w4-feedback>

- **Telegram Group Chat:**

[@nushackers\\_chat](https://t.me/nushackers_chat)

- **Telegram Channel:**

[@nushackers](https://t.me/nushackers)