(6CCS3∪7CCSM)(PRJ∪EEP): Individual Project

A Quick Guide to LaTeX

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What is LaTeX

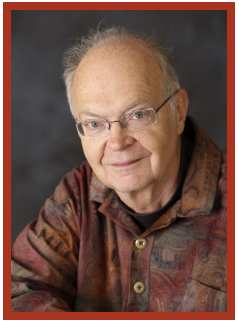
- **LaTeX (LaTeX: pronounced "La(y)-Tek")** is a document preparation / typesetting system with its own mark-up language in which you specify the content and the layout (style) of your document

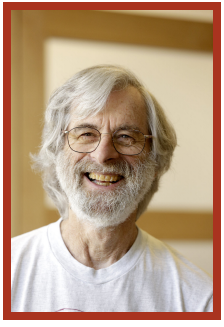
- **Why use LaTeX?**
  - **Many Powerful features:** Mathematical symbols, Referencing, Cross-referencing, Paper-size, Headers, Footers, Page Numbering, (these slides!), etc. ...
  - Available on **many platforms**, (inc. several cloud-based platforms)

- **Limitations:**
  - Not **WYSIWYG** (what-you-see-is-what-you-get),
  - Higher **learning threshold** than typical word-processors,
  - Some things are a bit of a **tricky / tedious** (*e.g.* Tables)

What is LaTeX

- TeX was originally created and developed by **Donald Knuth**
- LaTeX is a 'dialect' of TeX created by **Leslie Lamport**,
  - Facilitates **automatic numbering** of chapters, sections, equations, cross-referencing, etc.
  - More suitable for **beginners**





Installing LaTeX

- **Windows**
  - **MikTex** (comes with **TeXworks** editor)

    `https://miktex.org/`
  - **Texmaker** (editor)

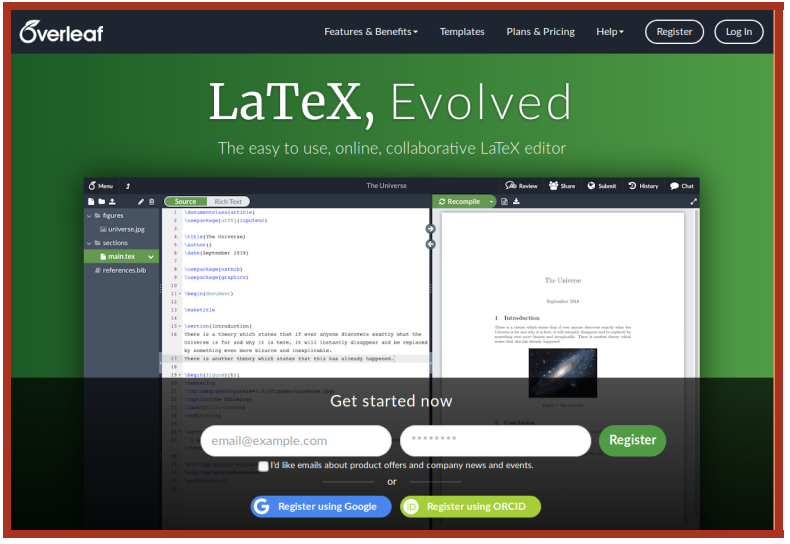
    `http://www.xm1math.net/texmaker/`
- **Mac**
  - **MacTex**

    `https://tug.org/mactex/`
- **Linux**
  - **Texmaker**

Installing LaTeX

- **Online Platforms**
  - **Overleaf**

`https://www.overleaf.com/`



Getting Started

Getting Started

- **Preamble:**
  - What type of document you are writing?

```
\documentclass{article}   or   \documentclass{book}
```

  - Start your document:

```
\begin{document}
```

  - Whatever begins must come to an end!

```
\end{document}
```

(You need these three commands in every document!)

- **Example**

```
\documentclass{article}

% Comment any lines you want
% to ignore with % symbols

\begin{document}

% Your document goes here

\end{document}
```

Giving your Document a Title

- **Adding a Title** Tell LaTeX the title and author of the document, LaTeX will do the formatting for you!

```
\title{My First LaTeX Document}
\author{Christopher Hampson}
\date{22 February 2019}

% this next line is important
\maketitle
```

(The `date` parameter is optional: default = today's date)

Sections and Subsections

- LaTeX groups content into the following blocks
  - **Chapter** (only used with the 'book' class; articles don't have chapters!)
  - **Section**
  - **Subsection**
  - **Subsubsection**
  - **Paragraph**

```
\chapter{Chapter Title}
\section{Section Title}
\subsection*{Unnumbered Subsection Title}
\subsubsection{Subsubsection Title}
\paragraph{Paragraph Title}
```

(Use an asterisk $*$ to suppress section numbering)

Tables of Contents, etc.

- LaTeX will build a **table of contents** and **list of figure / tables** each with a single command
  - **Table of Contents**

```
\tableofcontents
```

  - **List of Figures**

```
\listoffigures
```

  - **List of Tables**

```
\listoftables
```

(Add these to the start of your document after the `maketitle`)

Text Formatting and Stylizing

- **Font Weight**
  - You can **emboldened**, *italicize*, or underline text using the following commands:

```
\textbf{Bold}, \textit{Italics}, \textul{Underline}
```

- **Font Size**
  - LaTeX used the following standard sizing options:

- `\scriptsize`
- `\footnotesize`
- `\small`
- `\normalsize`
- `\large`
- `\Large`
- `\LARGE`
- `\huge`
- `\Huge`

(wrap the text you want to resize in braces e.g. {`\small hello`})

Text Formatting and Stylizing

- **Horizontal Spacing**
  - You can insert a **predefined** or **custom** horizontal space as follows:

```
\,    \:    \;    \quad    \qquad    \hspace{2cm}
```

(Additionally `\hfil` and `\hfill` will fill half/all of the remaining line)

- **Vertical Spacing**
  - Similarly can insert a **predefined** or **custom** vertical space as follows:

```
\smallskip    \medskip    \bigskip    \vspace{2cm}
```

(Additionally `\vfil` and `\vfill` will fill half/all of the remaining page)

Importing Packages

What are Packages?

- LaTeX Packages
  - Provide **additional environments** and **commands** that can be used in your document
  - **Load** packages at the start of your document,

```
\documentclass{article}

% Load any additional packages
\usepackage{graphicx}

\begin{document}
% Your document goes here
\end{document}
```

What are Packages?

- **Incomplete list of useful packages**

`https://en.wikibooks.org/wiki/LaTeX/Package_Reference`

  - Many common packages will be **pre-installed**,
  - Others packages can be installed or simply placed in the same directory as your `.tex` document

    (also the case if using Overleaf)
  - LaTeX packages carry a `.sty` (style) extension.

Itemized and Enumerated Lists

- **Itemized Lists**
  - You can add **itemized lists** to your document:

```
\begin{itemize}          % start itemize environment

        \item This is item 1
        \item This is item 2

        \item[(iii)] We can use numerals instead of
                     bullets...

        \item[4.] Or numbers...

        \item[Other] Or anything we like...
\end{itemize}            % close itemize environment
```

(bullet points can be overridden with any custom number or symbol)

- **Enumerated Lists**
  - For enumerated lists you can use the **enumerate environment** which automatically increments the number for you.

```
\begin{enumerate}[(i)]  % start itemize environment
        \item This is item 1
        \item This is item 2
        \item This is item 3
\end{enumerate}         % close itemize environment
```

(the optional parameter can be customized for i,ii,iii,..., a,b,c..., 1,2,3,..., etc.)

Required Packages

`enumerate, enumitem`

Figures and Tables

Figures and Graphics

- **Figures** and **Graphics** can be added to your document:

```
\begin{figure}          % start figure environment
        \centering      % centres your image

        % add the image
        \includegraphics[scale=0.5]{image.jpg}

        % add a caption to the figure
        \caption{This is an image}
\end{figure}            % close figure environment
```

(use the optional 'scale' parameter to resize your images)

Required Packages

`graphicx`

Tables

- **Tables are a bit awkward...**

```
\begin{table}           % start table environment
        \centering      % centres your table

        % add the table
        \begin{tabular}{lcr}
                Cell 1 & Cell 2 & Cell 3 \\
                \hline  % adds a horizontal line
                Cell 4 & Cell 5 & Cell 6 \\
                Cell 7 & Cell 8 & Cell 9 \\
        \end{tabular}

        % add a caption to the table
        \caption{This is a table}

\end{table}             % close table environment
```

Tables

- **Easy LaTeX Tables**

  `http://www.tablesgenerator.com/latex_tables`

  - **Import** or **Paste** tables from MS Spreadsheet / Google Sheets / etc.
  - **Generate** LaTeX code
  - **Copy to Clipboard** and paste into your LaTeX document

Positioning Figures and Tables

- **Positioning**
  - LaTeX will attempt to position your figures / tables at an **'appropriate'** place on the page,
  - This may not be where you intended them to be!
  - You can help LaTeX decide where to put your figure / table using the following parameters: `h` **(here)**, `t` **(top)**, `b` **(bottom)**

```
\begin{figure}[ht]
% position figure HERE or TOP

\end{figure}
```

Equations and Algorithms

Mathematics and Equations

- **In-line equations / formulas**
  - All in-line formulas should be enclosed by `$...$` signs

- **Block equations**
  - For important equations/formulas that you want to stand out from the main text you can use the **equation environment**

```
\begin{equation}
        n > 2 \Rightarrow a^n + b^n \not= c^n
\end{equation}
```

(you can suppress numbering by using `equation*`)

- **Equation Arrays**
  - Sometimes you may wish for your equations to be aligned; this can be done with the **eqnarray environment**

```
\begin{eqnarray}
        T(0) & = & 1\\
        T(n) & = & T(n-1) + T(n-2)
\end{eqnarray}
```

Required Packages

`amsmath, amsthm, amssymb`

- **Algorithm2e package**
  - The **algorithm environment** can be used to specify pseudo-code

```
\begin{algorithm}[H]
 \While{not at end of this document}{
  read current\;
  \eIf{understand}{
   go to next section\;
   current section becomes this one\;
   }{
   go back to the beginning of current section\;
  }
 }
 \caption{How to write
                algorithms}
\end{algorithm}
```

while *not at end of this document* **do**
  read current;
  if *understand* **then**
    go to next section;
    current section becomes this one;
  else
    go back to the beginning of current section;
  end
end

Algorithm 1: How to write algorithms

- **Listings Environment**
  - You can insert snippets of code using the **listings environment**

```
\begin{lstlisting}
  % your code goes here
\end {lstlisting}
```

  - You can also **import** source code snippets from a **external file**

```
\lstinputlisting{source_filename.py}
```

Required Packages

`listings,` `algorithm2e,` `algorithmic`

Cross-referencing

Cross-referencing

- **Labels** Tag elements that you can later refer to in your document
  - **Example:** Figures, Tables, Equations Sections, Chapters, etc.

```
\label{figure1}
```

(labels are not displayed in the document!)

- **Referencing** Refer to labels that appear in the document
  - **Example:**

```
Our results are presented in Figure~\ref{figure1}.
```

(using ~ will prevent a linebreak between 'Figure' and the reference)

Referencing with BibTeX

Referencing / Citations

- BibTeX is a reference management system that is typically used together with LaTeX.
- **BibTeX tags** are stored in a separate `.bib` file:

```
@book{knuth1998art,
  title          = {The art of computer programming:
                          sorting and searching},
  author         = {Knuth, Donald Ervin},
  volume         = {3},
  year           = {1998},
  publisher      = {Pearson Education}
}
```

Referencing / Citations

- **Citations** Cite your sources in your `.tex` document using the BibTeX tags
  - **Example:**

```
In what follows we use the Topological
Sort Algorithm as described by
Knuth~\cite{knuth1998art}.
```

(labels are not displayed in the document!)

- **Add Reference List** Append a reference list to the end of your document
  - **Example:**

```
\bibliographystyle{plain}        % set the style
\bibliography{mybibfile}         % use mybibfile.bib
```

Referencing / Citations

- **Compiling BibTeX**
  - LaTeX and BibTeX must be compiled separately in the following sequence:
    - LaTeX
    - BibTeX
    - LaTeX (+ sometimes LaTeX again...)
  - This is due to the way that LaTeX builds your document.

(Online editors will usually take care of this for you!)

If it doesn't look right, try compiling again!

Customizing LaTeX

- **Adding your own commands**
  - One of the strengths of LaTeX is the ability to **define your own** commands / tags

```
\newcommand{\myint}{\int_{-\infty}^{\infty}e^{x^2}dx}
```

```
We can use our new command $\myint$ like any other.
This is helpful if you need to write $\myint$ many
times but don't want to keep writing $\myint$.
```

Result

We can use our new command $\int_{-\infty}^{\infty} e^{x^2} dx$ like any other. This is helpful if you need to write $\int_{-\infty}^{\infty} e^{x^2} dx$ many times but don't want to keep writing $\int_{-\infty}^{\infty} e^{x^2} dx$.

- **Adding your own commands**
  - You can easily **update or modify** your commands if you change your mind at a later date!

```
\newcommand{\myint}{\int_{0}^{\infty}e^{t^2}dt}
```

```
We can use our new command $\myint$ like any other.
This is helpful if you need to write $\myint$ many
times but don't want to keep writing $\myint$.
```

Result

We can use our new command $\int_0^\infty e^{t^2}dt$ like any other. This is helpful if you need to write $\int_0^\infty e^{t^2}dt$ many times but don't want to keep writing $\int_0^\infty e^{t^2}dt$.

- **Adding your own commands + parameters**
  - You can specify commends with **parameters**

```
% custom command with 2 parameters
\newcommand{\mypair}[2]{\langle{#1,#2}\rangle}

% custom command with 1 parameter + 1 optional parameter
\newcommand{\mycos}[2][\theta]{#2\cos(#1)}
```

(the first bracket specifies the *total* number of parameters)

- `\mypair{1}{4}` **becomes** $\langle 1, 4 \rangle$
- `\mycos{5}` **becomes** $5\cos(\theta)$
- `\mycos[x]{5}` **becomes** $5\cos(x)$

Pet Peeves of LaTeX

Pet Peeves of LaTeX

- **Quotation marks**
  - **DON'T** use quotation marks (ASCII 034) at all!
  - **INSTEAD** use **grave** (×2) (ASCII 096) to open and **apostrophe** (×2) (ASCII 039) to close
    - `"hello"` **becomes** "hello" ✗
    - ``` ``hello'' ``` **becomes** "hello" ✓
- **Subscripts and superscripts**
  - Subscripts and superscripts should be **enclosed in braces** `{...}`.
    - `2^10=1024` **becomes** $2^10 = 1024$ ✗
    - `2^{10}=2014` **becomes** $2^{10} = 1024$ ✓

Pet Peeves of LaTeX

- **Hypens, en-dashes, and em-dashes**
  - Use a **single hyphen** (`ASCII 045`) to hypenate words,
    - `double-barrelled` **becomes** double-barrelled
  - Use two hyphens to insert an **en-dash** for date and number ranges
    - `Pages 28--45` **becomes** Pages 28–45
  - Use three hyphens to insert an **em-dash** for parenthesis
    - `Proper formatting---as you may infer---is very important!`

      becomes

      Proper formatting—as you may infer—is very important!

Some Additional Resources

Some Additional Resources

- **Books**
  - N.J. Higham, **Handbook of writing for the mathematical sciences**. Siam, 1998.
- **Online Resources**
  - T. Oetiker, **The Not so short introduction to LaTeX**

    `https://tobi.oetiker.ch/lshort/lshort.pdf`
  - **Wiki Books: LaTeX**

    `https://en.wikibooks.org/wiki/LaTeX`
  - **Overleaf Tutorials**

    `https://www.overleaf.com/learn/`

End of Slides!