LaTeX Tutorial Example

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0 Note-to-self: Making the Presentation Legible

- Make the font size enormous (Options/Configure Texmaker/Editor) so that everyone can read the projection

- Close the Structure pane (and possibly the Messages pane) to maximize the usable screen space

- Upon first opening of the `.pdf`, change the positioning and scaling so that it displays well on the projector [these settings will be preserved]

1 Basics: Hello World!

Create the source file:

- Create a working directory

- Open TeXmaker and create a new file. Save it in your working directory. Notes:

  - the file name must *not* have any spaces
  - the file *must* have extension `.tex`

Bare-bones example:

```
+ \documentclass{article}
+
+ \begin{document}
+
+ Hello World!
+
+ \end{document}
```

2 Title Block

2.1 Adding Title and Author fields

```
  \begin{document}
+
+ \title{Basic LaTeX Articles}
+ \author{Graham R. Hendra}
```

2.2 *Printing the Title*

```
  \author{Graham R. Hendra}
+ \maketitle
```

3 COMMENTS

Add comments to keep the source code neat:

```
+ %TITLE STUFF=====================================
  \title{Basic LaTeX Articles}
```

```
+ %MAIN DOCUMENT==================================
  Hello World!
```

4 SECTIONS & TABLE OF CONTENTS

4.1 *Adding a section*

```
+ \section{Introduction}
+ \subsection{Motivation}
+
  Hello World!
+
+ \subsection{Background Mathematics}
```

- Single line break, single space, and multiple spaces are all treated the same

- Empty lines indicate a paragraph break. Good rules of thumb are:

  - Before and after headings: include an empty line (although this typically won't make a difference)
  - Between paragraphs: include an empty line
  - Before and after equations: decide whether this is really a paragraph break. Generally speaking, equations only begin new paragraphs if they come immediately after headings. The text after an equation may or may not be a new paragraph, depending on context.

4.2 *Adding a Table of Contents*

```
  \maketitle
+
+ %TABLE OF CONTENTS==============================
+ \tableofcontents
```

- ToC is empty after first compile! Must compile *twice*

- LaTeX file flow: output from one compile is used as input for next (for ToC generation and cross-references).

- The title in the ToC can be set separately from in the text (typically used for shortening long titles)

5 EQUATIONS

5.1 *Add an Equation; Introduction to Environments*

```
\subsection{Background Mathematics}
+
+ The area of a circle is:
+ \begin{equation}
+ A = \pi r^2
+ \end{equation}
```

- Environments apply different formatting to their contents. They may also make different functions available, and have special effects at their introduction and closure (e.g. printing a title for the environment block at the outset)

  - "Abstract" is another commonly-used environment, for creating an initial Summary/Abstract with special formatting.

- Spacing is automatic — the amount of white space we add is irrelevant (although we need a space or a `{}` between `\pi` and `r` so that they aren't interpreted as the non-existent command `\pir`

- Most greek letters can be inserted by name while in math mode. The capital versions are inserted by capitalizing:

  - `\delta`: δ
  - `\Delta`: Δ

  The exceptions are letters like capital tau (T), which are not defined by name because they are identical to English letters

- Carat (^) indicates following single character should be in superscript; to place multiple characters in superscript, enclose them in curly braces

  - Subscript is also easy - use underscore (_) instead of carat (^)

- Most math commands (e.g. superscript) are only available in a math environment

5.2 Aligning within an equation

Use the package which allows math alignment:

```
  \documentclass{article}
+
+ \usepackage{amsmath}
```

Enable multiple lines and alignment:

```
  The area of a circle is:
  \begin{equation}
+ \begin{aligned}
  A = \pi r^2
+ \end{aligned}
  \end{equation}
```

Apply alignment:

```
  \begin{aligned}
- A = \pi r^2
+ A &= \pi r^2
+ \\ &= \pi \left( \frac{d}{2} \right)^2
  \end{aligned}
```

- \\ forces new line

- Lines typeset so that ampersands (&) align

- \frac sets up a fraction

- \left(and \right) are sized based on the text between them. They must be paired

- Adding an empty line [a paragraph break] within equation or aligned is still an error!

5.3 Add an Inline Equation

```
  \end{equation}
+ We can rearrange this to show that $d = \sqrt{4A/\pi}$.
```

- The \sqrt command places its contents under a square root sign

5.4   *Taking Advantage of Macros*

Suppose we add another equation:

```
  \end{aligned}
  \end{equation}
- We can rearrange this to show that $d = \sqrt{4A/\pi}$.
+ We can rearrange this to show that $d = \sqrt{4A/\pi}$.
It's also true that
+ \begin{align*}
+ \int_a^b \frac{1}{x} dx &= \ln \frac{b}{a}
+ \end{align*}
```

- `align*` has multiple lines, with alignment, but no equation number.

- The ampersand does nothing when there's only one line, but I usually add them out of habit

- Note that `ln` is escaped so that it's formatted in upright font (like the function name that it is) rather than italics (like the product of variables l and n)

We can add a few things to improve the output:

```
  \begin{align*}
- \int_a^b \frac{1}{x}dx &= \ln \frac{b}{a}
+ \int_a^b \frac{1}{x}\ \text{d}x &= \ln \frac{b}{a}
  \end{align*}
```

- "`\ `" forces a space, visually separating the integrand and differential

- `\text{d}` typesets "d" in upright font, to clarify that "$\mathrm{d}x$" is an integration variable, not the product of variables d and x.

This can be simplified a little bit using macros:

```
+ \newcommand{\diff}{\text{d}}
+ \newcommand{\inv}[1]{\frac{1}{#1}}
  \begin{align*}
- \int_a^b \frac{1}{x}\ \text{d}x &= \ln \frac{b}{a}
+ \int_a^b \inv{x} \diff x &= \ln \frac{b}{a}
  \end{align*}
```

- The first macro takes zero arguments; the second takes one

- They didn't really do much here, but if we were typing out a lot of integrals or inverses, they could help save time and keep the equations neat

6 CROSS-REFERENCES

Add a reference to the numbered equation using labels:

```
  \end{aligned}
+ \label{Eq:circle}
  \end{equation}
- We can rearrange this to show that $d = \sqrt{4A/\pi}$.
It's also true that
+ We can rearrange Equation \ref{Eq:circle} to show that
$d = \sqrt{4A/\pi}$. It's also true that
```

- Including `Eq:` in the label is totally optional, but often convenient

- `\label` stores the value of the most recent auto-number printed in the current scope. After a section heading, this is the section number. Within an equation environment, this is the equation number.

- Note that a second compile is necessary again

7 NON-BREAKING SPACES

Switch to a non-breaking space between "Equation" and the reference

```
- We can rearrange Equation \ref{Eq:circle} to show that
$d = \sqrt{4A/\pi}$. It's also true that
+ We can rearrange Equation~\ref{Eq:circle} to show that
$d = \sqrt{4A/\pi}$. It's also true that
```

8 FIGURES

8.1 Environment and Caption

```
  \end{align*}
+
+ \subsection{Colours}
+
+ \begin{figure}
+ \caption{A section of the CIE ``Lab'' Colour Space}
+ \end{figure}
```

- Figures are floats

- Opening and closing quotes are entered explicitly. Apostrophes are the same as in word processors.

8.2 Including and Centering Graphics

- Create `Figurefolder/Figurename.png` within the working directory

- Include `graphicx` package

```
  \usepackage{amsmath}
+ \usepackage{graphicx}
```

- Include the image

```
  \begin{figure}
+ \includegraphics[width=0.6\textwidth]{Figurefolder
/Figurename}
  \caption{A section of the CIE ``Lab'' Colour Space}
  \end{figure}
```

  - The first argument is in square brackets because it's optional
  - Compiling to `.pdf` will look for a `.png`, `.jpg`, or `.pdf`; compiling to `.dvi` will look `for .eps`

- Centering is often necessary

```
+ \centering
  \includegraphics[width=0.6\textwidth]{Figurefolder
/Figurename}
```

  The `\centering` command centres everything within the current scope so long as the scope ends with a paragraph break.

  - Figures automatically end with a paragraph break so we didn't need to explicitly insert one
  - You will sometimes need to insert `\par` (or its equivalent, an empty line) explicitly

8.3 Positioning Floats

- Optional placement specifiers (`htbp` = here, top, bottom, page) and urgency specifier (! = override internal parameters for evaluating "good" figure placement)

- The `float` package provides the `[H]` (HERE! option). This goes against the LaTeX paradigm but is often more consistent with what users used to a traditional word processor are expecting

```
  \usepackage{graphicx}
+ \usepackage{float}
```

⋮

```
- \begin{figure}
+ \begin{figure}[H]
```

8.4 Cross-Referencing

```
+ A visualization of the ``Lab'' colour space is shown in
Figure~\ref{Fig:Lab}.
  \begin{figure}[H]
```

⋮

```
  \caption{A section of the CIE ``Lab'' Colour Space}
+ \label{Fig:Lab}
```

- Note that \label must appear *after* caption in order to reference the figure correctly (if it's placed before the caption, it will reference the section instead)

9 TABLES

Insufficient time, but:

- Tables are a bit annoying to work with — you have to describe the physical layout (how many columns, which are merged, where one cell ends) using symbols

- Tables are floats

- Cool feature: aligning a column of numbers so that the decimal place is in the same position for each entry (even when numbers have a different number of decimal places)

10 LISTS OF FIGURES AND TABLES

10.1 List of Figures

```
  \tableofcontents
+
+ \listoffigures
```

- List of Tables is similar (\listoftables)

10.2 Including entries for lists in the ToC

```
+ \addcontentsline{toc}{section}{List of Figures}
  \listoffigures
```

10.3 *Adding Auto-Complete of* `\addcontentsline`

- Click `User/Customize Completion`

- Place cursor in top left box

- Type `\addcontentsline{@}{@}{@}`

- Click `Add` and then `OK`

- Typing `\ad` will now prompt Texmaker to suggest `\addcontentsline` with 3 blank spaces for arguments

10.4 *Cleardoublepage*

```
%MAIN DOCUMENT======================================
+ \cleardoublepage
```

- Advances to next odd page in two-sided mode and next even page in one-sided mode. Slightly different from a page break as it also outputs any floats before the break.

  - Easy to switch to a two-sided document (a document-wide option), but no example in this tutorial

11 ENUMERATE AND ITEMIZE

11.1 *Itemize*

```
  \end{table}
+
+ \section{Bullets and Enumeration}
+
+ \begin{itemize}
+ \item We need to make more money
+ \end{itemize}
```

11.2 *Sub-list with enumerate*

```
  \item We need to make more money
+ \item I have a three-step plan for this:
+ \begin{enumerate}
+ \item Plan to make more money
+ \item ???
+ \item Profit
+ \end{enumerate}
```

- Enumerate and itemize can be nested multiple times, in any order

---

11.3 Source Code Indentation

- Select the contents of the `enumerate` and hit Ctrl-Shift->. This indents the text, which does nothing to the output but make the input more legible.

12 REFERENCES

12.1 Thebibliography

```
  \end{itemize}
+
+ \begin{thebibliography}{9}
+
+ \bibitem{cfdbook} A book about CFD
+
+ \end{thebibliography}
```

- "9" is one digit wide, so all bibliography references will be given space for 1 digit. This is appropriate for 9 or fewer references

- length of reference number (`{9}`) is not an optional argument! This is an easy stumbling block

  ○ Command is not included in Texmaker by default; can add `\begin{the-bibliography}{@}` and `\end{thebibliography}` will also be printed automatically

12.2 Adding ToC Entry

"References" is not automatically included in ToC; must add explicitly if desired

```
  \begin{thebibliography}{9}
+ \addcontentsline{toc}{section}{References}
```

12.3 Citations

```
  \end{itemize}
+
+ \section{CFD}
+
+ An excellent resource for CFD information is \cite{cfdbook}.
+
```

12.4 Formatting in bibliography entries

```
- \bibitem{cfdbook} A book about CFD
+ \bibitem{cfdbook} Ferziger, J.H. \& Peric, M.
```

```
(2002). \textit{Computational Methods for Fluid
Dynamics}.  New York: Springer.
```

- Must escape the ampersand

- `\emph` **(LaTeX style)** vs `\textit` **(literal style)**