



An Interactive Introduction to \LaTeX

TLC Workshop

Haziq Jamil
Mathematical Sciences, Faculty of Science, UBD
<https://haziqj.ml>

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Why L^AT_EX?

- It makes beautiful documents
- Open source and active community. Lots of packages available.
- Extensible document types (articles, presentation slides, books, theses, exam papers, etc.)

Reminder

Sign up for Overleaf if you haven't done so!

How does it work?

- You write your document in plain text with commands that describe its structure and meaning.
- The \LaTeX program then processes your text and commands to produce a beautifully formatted document.

The rain in Spain falls \emph{mainly} on the plain.

The rain in Spain falls *mainly* on the plain.

More examples of commands and output...

```
\begin{itemize}
  \item Tea
  \item Milk
  \item Biscuits
\end{itemize}
```

- Tea
- Milk
- Biscuits

```
\begin{figure}
  \includegraphics{gerbil}
\end{figure}
```

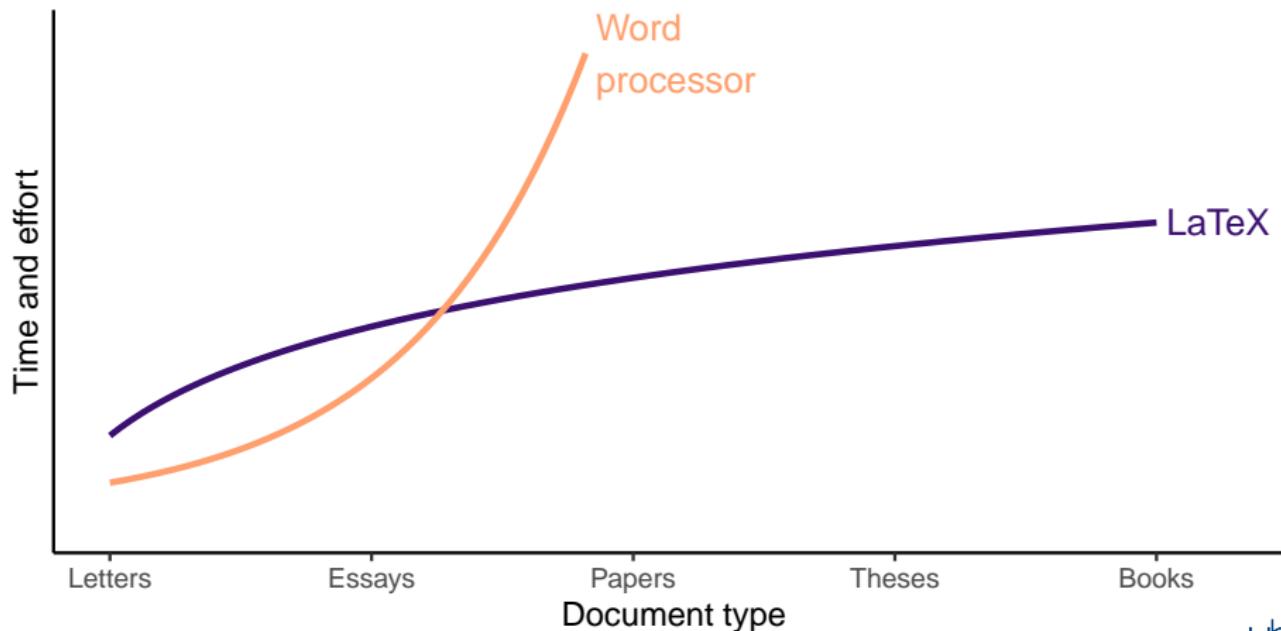


```
\begin{equation}
y = \alpha + \beta x
\end{equation}
```

$$y = \alpha + \beta x \quad (1)$$

Attitude adjustment

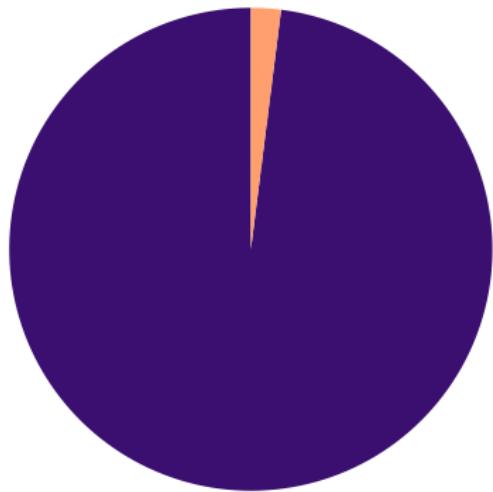
- Use commands to describe ‘what it is’ and not ‘how it looks’
- Focus on your content
- Let `LATEX` do its job



Things that it solves: Picture alignment/placement

LATEX takes care of figure placements automatically.

Moving a picture in MS Word



- You mess up the whole document
- It actually does what you want



College Student
@CollegeStudent

using microsoft word

moves an image 1 mm to the left

all text and images shift. 4 new pages appear. in the distance, sirens.

10:12 AM · Sep 24, 2017 · Twitter Web Client

52.3K Retweets 1,694 Quote Tweets 171.8K Likes



Things that it solves: References and bibliography

Sometimes, however, what others tell us is important as *corroboration* of what we have already found out (or think we have found out) for ourselves. The Scottish philosopher Thomas Reid makes this point in connection with mathematical research in the belief that, if it applies to the science ‘in which, of all sciences, authority is acknowledged to have least weight’ [2], it will be even more significant in other areas of thought and practice... Russell, as we shall see in a later chapter, considered this aspect of our reliance upon testimony essential to the understanding of what it is to be a physical thing and he criticized logical positivism for its failure to appreciate the implications of this point [4]. In the Analysis of Matter he says explicitly, ‘I mean here by “objective” not anything metaphysical but merely “agreeing with the testimony of others”’ [3].

Excerpt from *Testimony: A Philosophical Study* by C. A. J. Coady (1992)

References

- [1] C. A. J. Coady. *Testimony: A philosophical study*. Clarendon Press, 1992.
- [2] T. Reid, D. Brookes, and K. Haakonssen. "Thomas Reid: Essays on the Intellectual Powers of Man." In: *Thomas Reid-Essays on the Intellectual Powers of Man*. Edinburgh University Press, 2002.
- [3] B. Russell. "Analysis of Matter (1927)." In: *Consciousness in the Physical World: Perspectives on Russellian Monism* (2015), p. 29.
- [4] B. Russell. *Logic and knowledge: Essays 1901-1950*. Spokesman Books, 2007.

Things that it solves: Mathematical equations

Typesetting mathematics and equation referencing.

Theorem 1 (Central Limit Theorem)

Let X_1, \dots, X_n be an independent random sample from a distribution whose mean is μ and variance is σ^2 . Then $\bar{X}_n := \frac{1}{n} \sum_{i=1}^n X_i$ converges in distribution to a random variable whose density function is

$$f(x) = \frac{1}{\sqrt{2\pi}} \exp \left[-\frac{1}{2} \left(\frac{x - \mu}{\sigma/\sqrt{n}} \right)^2 \right] \quad (2)$$

The proof of Theorem 1 uses *characteristic functions*, whereby the standardised version of (2) is obtained in the limit.

A chemistry example

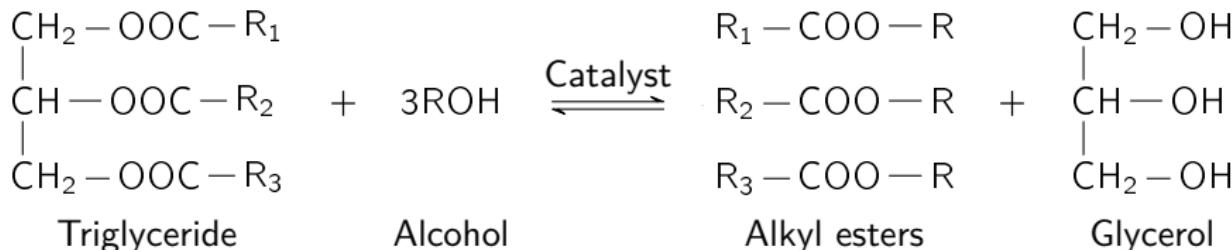
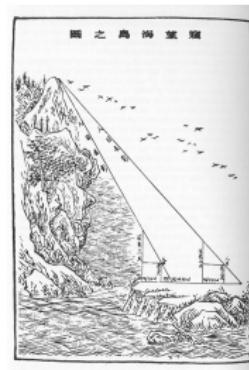


Figure 1: Transesterification of triglyceride with alcohol.

Figure 1 obtained from <https://tex.stackexchange.com/a/472486>

Languages



الْكِتَابُ الْمُخْتَصِرُ فِي حِسَابِ الْجَبْرِ وَالْمُقَابَلَةِ
(The Compendious Book on
Calculation by Completion and
Balancing), also known as
الْجَبْرِ (Al-Jabr), written by
مُحَمَّدْ بْنُ مُوسَى الْخَوَارِزْمِيِّ (Muhammad ibn Mūsā
al-Khwārizmī) around 820 CE.

海岛算经 (Hǎidǎo suàn jīng—The Sea Island Mathematical Manual) was written by 刘徽 (Liú Huī) ca. 200 CE. The Chinese were aware of a good approximation of $\pi \approx 355/113 = 3.1415929204$ very early on (祖冲之 Zǔ Chōng Zhī, 500 CE).

For teaching

- Setting of question papers (assignments, tests, exams, etc.)
- Syllabus documents
- Presentations

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Getting started

A minimal \LaTeX document

```
\documentclass{article}  
\begin{document}  
Hello, World! % your content goes here...  
\end{document}
```

- Commands start with a backslash \
- Every document starts with a \documentclass command
- The *argument* in curly braces { } tells \LaTeX what kind of document we are creating (in this case, an article)
- A percent sign % starts a *comment*— \LaTeX will ignore the rest of the line

Getting started



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

- Overleaf is a website for writing documents in \LaTeX .
- It ‘compiles’ your \LaTeX document online to show you the results.
- As we go through the following slides, try out the examples by typing them into the example document on Overleaf!

Exercise (Hello world)

Click [Hello World](#) to open the “Hello world” document in **Overleaf** (you’ll need to sign in first). Let’s get started!

Typesetting text

- Type your text between `\begin{document}` and `\end{document}`.
- For the most part, you can just type your text normally.

Words are separated by one or more spaces.

Paragraphs are separated by one or more blank lines.

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Paragraphs are separated by one or more blank lines.

- Blank space in the source file is collapsed in the output.

The rain in Spain
falls mainly on the plain.

The rain in Spain falls mainly on the plain.

Typesetting text (Caveats)

- Quotation marks a bit tricky: Use a backtick ``` on the left and an apostrophe `'` on the right.

Single quotes: ``text'`.

Single quotes: `'text'`.

Double quotes: ```text''`.

Double quotes: `"text"`.

- Some common characters have special meanings in \LaTeX :
 - `%` is used to comment text
 - `#` is used for macros definitions
 - `&` is used for alignment
 - `$` is used for maths
- If you just type these, you'll get an error. If you want one to appear in the output, you have to *escape* it by preceding it with a backslash `\`.

`\$ \% \& \#`

`\$ \% \& \#`

Handling errors

- \LaTeX can get confused when it is trying to compile your document. If it does, it stops with an error, which you must fix before it will produce any output.
- For example, if you misspell `\emph` as `\meph`, \LaTeX will stop with an undefined control sequence error, because `\meph` is not one of the commands it knows.

Advice on errors

1. Don't panic! Errors happen. The error messages can give a clue as to what's wrong.
2. Fix them as soon as they arise—if what you just typed caused an error, you can start your debugging there.
3. If there are multiple errors, start with the first one—the cause may even be above it.

Exercise 1

Typeset the following paragraph¹ in L^AT_EX:

In March 2006, Congress raised that ceiling an additional \$0.79 trillion to \$8.97 trillion, which is approximately 68% of GDP. As of October 4, 2008, the “Emergency Economic Stabilization Act of 2008” raised the current debt ceiling to \$11.3 trillion.

Exercise 1

Click [Exercise 1](#) to open this exercise in Overleaf.

Watch out for

- characters with special meanings % # & \$
- typesetting quotation marks correctly.

¹http://en.wikipedia.org/wiki/Economy_of_the_United_States

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What's next?

Inline equations

- Dollar signs \$ are used to mark mathematics in text.

% not so good:

Let a and b be distinct positive integers, and let $c = a - b + 1$.

% much better:

Let $\$a\$$ and $\$b\$$ be distinct positive integers, and let $\$c = a - b + 1\$$.

Let a and b be distinct positive integers, and let $c = a - b + 1$.

Let a and b be distinct positive integers, and let $c = a - b + 1$.

- Always use dollar signs in pairs—one to **begin** and one to **end**.
- \LaTeX handles spacing automatically; it ignores your spaces.

Let $\$y=mx+c\$$ be \ldots

Let $y = mx + c$ be ...

Let $\$y = m x + c\$$ be \ldots

Let $y = mx + c$ be ...

More notation

- Use caret/hat $\hat{}$ for superscripts and underscore $\underline{}$ for subscripts.

```
$y = c_2 x^2 + c_1 x + c_0$
```

$$y = c_2 x^2 + c_1 x + c_0$$

- Use curly braces $\{ \} \{ \}$ to group supers/sub scripts.

```
% oops!
```

```
$F_n = F_{n-1} + F_{n-2}$
```

$$F_n = F_{n-1} + F_{n-2}$$

```
% ok!
```

```
$F_n = F_{\{n-1\}} + F_{\{n-2\}}$
```

$$F_n = F_{n-1} + F_{n-2}$$

- There are commands for Greek letters and common notation.

```
$\mu = A e^{\{Q/RT\}}
```

$$\mu = A e^{Q/RT}$$

```
$\Omega = \sum_{k=1}^n \omega_k
```

$$\Omega = \sum_{k=1}^n \omega_k$$

Detexify

The screenshot shows a web browser window for the Detexify LaTeX handwritten symbol recognition service. The address bar displays the URL detexify.kirelabs.org. The main interface features a large input area on the left where a handwritten symbol resembling a Greek letter beta is drawn. A red 'X' icon is positioned in the top right corner of this input area. To the right of the input area, three recognition results are listed, each consisting of a rendered symbol, a score, and the corresponding LaTeX command and mode.

Symbol	Score	LaTeX Command	Mode
β	0.10291823112281329	<code>\beta</code>	mathmode
β	0.11024688463388	<code>\ss</code>	textmode
β	0.1218880372150471	<code>\usepackage{ marvosym }</code> <code>\Shilling</code>	textmode

Score: 0.13370433935413875

Displayed equations

- If the mathematics is big and scary, *display* it on its own line using `\begin{equation}` and `\end{equation}`

The roots of a quadratic equation are given by

$$\begin{aligned} \text{\textbackslash begin\{equation\}} \\ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \end{aligned}$$

`\end{equation}`

where `a`, `b` and `c` are `\ldots`

The roots of a quadratic equation are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (3)$$

where a , b and c are ...

Caution

\LaTeX mostly ignores your spaces in mathematics, but it can't handle blank lines in equations—don't put blank lines in your mathematics.

Interlude: Environments

- equation is an *environment* (a context).
- The `\begin` and `\end` commands are used to create many different environments. E.g., `itemize` and `enumerate` for lists:

```
\begin{itemize} % for bullet points
```

```
\item Biscuits
\item Tea
\end{itemize}
```

- Biscuits
- Tea

```
\begin{enumerate} % for numbers
```

```
\item Biscuits
\item Tea
\end{enumerate}
```

1. Biscuits
2. Tea

Interlude: Packages

- All of the commands and environments we've used so far are built into \LaTeX .
- *Packages* are libraries of extra commands and environments. There are thousands of freely available packages.
- We have to load each package we want to use with a `\usepackage` command in the *preamble*.
- Example: `amsmath` from the American Mathematical Society.

```
\documentclass{article}
\usepackage{amsmath} % preamble
\begin{document}
% now we can use commands from amsmath here...
\end{document}
```

An example with amsmath

- Align a sequence of equations at the equals sign

$$\begin{aligned}(x + 1)^3 &= (x + 1)(x + 1)(x + 1) \\&= (x + 1)(x^2 + 2x + 1) \\&= x^3 + 3x^2 + 3x + 1\end{aligned}$$

with the `align*` environment.

```
\begin{align*}
(x+1)^3 &= (x+1)(x+1)(x+1) \\
&\quad \&= (x+1)(x^2 + 2x + 1) \\
&\quad \&= x^3 + 3x^2 + 3x + 1
\end{align*}
```

- An ampersand `&` separates the left column (before the `=`) from the right column (after the `=`).
- A double backslash `\\"` starts a new line.

Exercise 2

Exercise 2

Typeset the following paragraph in \LaTeX :

Let X_1, X_2, \dots, X_n be a sequence of independent and identically distributed random variables with $E[X_i] = \mu$ and $\text{Var}[X_i] = \sigma^2 < \infty$, and let

$$S_n = \frac{1}{n} \sum_{i=1}^n X_i$$

denote their mean. Then as n approaches infinity, the random variables $\sqrt{n}(S_n - \mu)$ converge in distribution to a normal $N(0, \sigma^2)$.

Click [Exercise 2](#) to open this exercise in **Overleaf**.

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What's next?

Thanks!