一份互動式的 LaTeX 介紹

第一部：基礎

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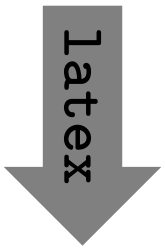
為什麼使用 LaTeX？

- 高品質的文件
  - 特別是跟數學有關的
- 被科學家為科學家創造
  - 龐大且活躍的使用者社群
- 強大、靈活 — 你甚至可以自行擴展
  - 針對論文、報告、試算表… 的巨集 …

LaTeX 是如何工作的？

- 你將文件用純文字 (plain text) 與描述文字結構和意義的命令 (commands)
- latex 將你的文字與命令轉換成格式優美的文件

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



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

更多範例

```
\begin{itemize}
\item 茶
\item 牛奶
\item 餅乾
\end{itemize}
```

- 茶
- 牛奶
- 餅乾

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

```
\begin{equation}
\alpha + \beta + 1
\end{equation}
```

$$\alpha + \beta + 1 \qquad (1)$$

Attitude adjustment

- 使用命令去描述他是什麼，而不是他是看起來怎樣
- 專注在你的文件內容裡
- 讓 LaTeX 完成他的工作

準備開始

- 最簡單的 LaTeX 文件：

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

- 指令以反斜線開頭的\ .
- 所有文件都以\documentclass為開頭
- 引數被花括號包圍{ } 告訴 LaTeX 我們想要的文件類型 **article**.
- 百分符號% 開始註解 *comment* — LaTeX 會忽略該行剩餘的部分

準備開始 與 Overleaf

- Overleaf 是線上的 LaTeX 編譯器
- 他自動編譯你的 LaTeX 文件並產出結果

點擊這裡以在 **Overleaf** 中打開範例文件

為得到最好的使用體驗，推薦使用 Google Chrome 或 FireFox.

- As we go through the following slides, try out the examples by typing them into the example document on Overleaf.
- **No really, you should try them out as we go!**

基礎排版

- 將你的文字打在 \begin{document}與\end{document}之間
- 在大多分的時間，你就正常的打字

文字被一個 或更多 的空格分離 段落被一個或更多的空白行分離	文字被一個或更多的空格分離 段落被一個或更多的空白行分離

- 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.

基礎排版：注意事項

- Quotation marks are 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:

  % percent sign
  # hash (pound / sharp) sign
  & ampersand
  $ dollar sign

- 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.
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.

牛刀小試

Typeset this in LaTeX: [1]

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.

點擊以在 **Overleaf** 中開啟

- 提示：注意那些有特殊意義的符號
- 嘗試完之後 點擊這裡來看我的解答.

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

Typesetting Mathematics: Dollar Signs

- Why are dollar signs $ special? We use them 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 the mathematics, and one to end it.
- LaTeX handles spacing automatically; it ignores your spaces.

```
Let $y=mx+b$ be \ldots

Let $y = m x + b$ be \ldots
```

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

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

Typesetting Mathematics: Notation

- Use caret ^ for superscripts and underscore _ 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 superscripts and subscripts.

```
$F_n = F_n-1 + F_n-2$      % oops!

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

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

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

$\mu = Ae^{Q/RT}$

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

Typesetting Mathematics: Displayed Equations

- If it's 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{equation}
x = \frac{-b \pm \sqrt{b^2 - 4ac}}
         {2a}
\end{equation}
where $a$, $b$ and $c$ are \ldots
```

The roots of a quadratic equation are given by

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

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.
- A command can produce different output in different contexts.

```
We can write
$ \Omega = \sum_{k=1}^{n} \omega_k $
in text, or we can write
\begin{equation}
  \Omega = \sum_{k=1}^{n} \omega_k
\end{equation}
to display it.
```

We can write $\Omega = \sum_{k=1}^{n} \omega_k$ in text, or we can write

$$\Omega = \sum_{k=1}^{n} \omega_k \qquad (3)$$

to display it.

- Note how the Σ is bigger in the **`equation`** environment, and how the subscripts and superscripts change position, even though we used the same commands.

In fact, we could have written `$...$` as `\begin{math}...\end{math}`.

Interlude: Environments

- The **\begin** and **\end** commands are used to create many different environments.
- The **itemize** and **enumerate** environments generate lists.

```
\begin{itemize} % for bullet points
\item Biscuits
\item Tea
\end{itemize}

\begin{enumerate} % for numbers
\item Biscuits
\item Tea
\end{enumerate}
```

- Biscuits
- Tea

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 of the packages 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}
```

Typesetting Mathematics: Examples with **amsmath**

- Use **equation*** ("equation-star") for unnumbered equations.

```
\begin{equation*}
  \Omega = \sum_{k=1}^{n} \omega_k
\end{equation*}
```

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

- LaTeX treats adjacent letters as variables multiplied together, which is not always what you want. **amsmath** defines commands for many common mathematical operators.

```
\begin{equation*} % bad!
 min_{x,y} (1-x)^2 + 100(y-x^2)^2
\end{equation*}
\begin{equation*} % good!
\min_{x,y}{(1-x)^2 + 100(y-x^2)^2}
\end{equation*}
```

$$min_{x,y}(1-x)^2+100(y-x^2)^2$$

$$\min_{x,y} (1-x)^2 + 100(y-x^2)^2$$

- You can use **\operatorname** for others.

```
\begin{equation*}
\beta_i =
\frac{\operatorname{Cov}(R_i, R_m)}
     {\operatorname{Var}(R_m)}
\end{equation*}
```

$$\beta_i = \frac{\operatorname{Cov}(R_i, R_m)}{\operatorname{Var}(R_m)}$$

Typesetting Mathematics: Examples 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) \\
        &= (x+1)(x^2 + 2x + 1) \\
        &= 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.

牛刀小試

Typeset this in LaTeX:

Let $X_1, X_2, \ldots, X_n$ be a sequence of independent and identically distributed random variables with $\mathrm{E}[X_i] = \mu$ and $\mathrm{Var}[X_i] = \sigma^2 < \infty$, 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 to open this exercise in **Overleaf**

- Hint: the command for ∞ is `\infty`.
- Once you've tried, click here to see my solution.

End of Part 1

- 恭喜！你已經學會了如何...
  - 在 LaTeX 中排版文字
  - 使用多種不同的指令
  - 處理發生的問題
  - 排版美麗的數學公式
  - 使用多種不同的環境
  - 使用巨集
- 這真神奇
- 在 Part 2 我們將探討如何使用 LaTeX 寫下有結構的文件，包含了小節、交互引用、圖片和參考書目，下集待續。