LaTeX Workshop

QUT Maths Society

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1 Introduction

"LaTeX is a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeX is the de facto standard for the communication and publication of scientific documents. LaTeX is available as free software" (Project, 2022).

One of the key differences between LaTeX and more common word processors such as MS Word, LibreOffice etc., is the separation of content and presentation. In LaTeX, the author describes the general structure of the document (i.e., section headings, paragraphs, equations, and figures), and the layout and typesetting are handled by LaTeX (or rather the underlying TeX backend).

There are several advantages to this:

- The author can focus on the actual content without worrying about layout and presentation
- The presentation can be modified without introducing major changes to the document
- LaTeX's standard format allows authors to easily conform to styles provided by external publishers

LaTeX is written in plaintext and processed by an external program to generate output files (usually PDFs).

1.1 Pronunciation and Spelling

LaTeX is pronounced *lah-tech* or *lay-tech*, but TeX is never pronounced *tecks*. It is typeset using the `\LaTeX{}` macro or with the capitalisation "LaTeX".

1.2 Language Structures

There are two major language structures that we encounter when using LaTeX; *macros* and *environments*.

1.2.1 Macros

Macros (or commands) tell LaTeX how to do things. They use the following syntax

```
\commandname
% or
\commandname[optional args]{required args}
```

Macros provide functionality for layouts, symbols, styles, etc. As shown below, common font styles can be invoked using macros.

Bold face `\textbf{Text}` — **Text**

Italics `\textit{Text}` — *Text*

Emphasis `\emph{Text}` — *Text* (either upright or italics depending on surrounding text)

Underline `\underline{Text}` — Text

We can also define custom macros that combine other macros or simplify repetitive instructions.

```
\newcommand{\commandname}[number_of_arguments]{command_body}
```

Arguments can be referenced inside the command body with the `#argument_number` syntax. For example

```
\newcommand{\boldanditalics}[1]{\textbf{\textit{#1}}}
\boldanditalics{Bold and italics text}
```

Output

Bold and italics text

1.2.2 Environments

Environments are used to format large blocks of text which often contain many lines or multiple macros. Environments use opening `\begin` and closing `\end` tags so that everything inside those tags will be formatted in a special manner depending on the type of the environment.

```
\begin{environment_name}[optional_arguments]{required_arguments}
    ...
\end{environment_name}
```

Common environments include `figure`, `equation`, `itemize` (these will be discussed later), etc.

2 Basic Structure

2.1 Sections

Sections are used to divide the document into parts. A new section is started with the `\section` macro. Section titles are formatted to be bold and larger than regular text. The number preceding the title is automatically determined.

The table of contents (`\tableofcontents`) is also generated from these section macros, so that page numbers and section numbers are set automatically.

2.2 Subsections

We can split sections into smaller subsections `\subsection{Subsections}`,

2.2.1 Subsubsections

and also subsubsections `\subsubsection{Subsubsections}`.

Unnumbered sections

We can remove section numbering by using the starred version of the section macro i.e., `\subsection*{Unnumbered sections}`. As this also removes the section from the table of contents, we can manually add it using

```
\addcontentsline{toc}{subsection}{Unnumbered sections}
```

remembering to place this immediately after the section macro so that the reference is set to the correct location.

2.3 Lists

Unordered (bullet) lists are produced by the `itemize` environment, where each list entry starts by using the `\item` macro, which also generates the bullet symbol.

```
\begin{itemize}
    \item List entries ...
    \item We can ...
          \begin{itemize}
              \item We can ...
                    \begin{itemize}
                        \item The marker ...
                              \begin{itemize}
                                  \item List markers, ...
                              \end{itemize}
                    \end{itemize}
          \end{itemize}
\end{itemize}
```

Output

- List entries start with the `\item` macro and are indicated by the black dot
- We can create multiple entries
  - We can nest lists by creating another `itemize` environment
    - The marker changes in each nested list to reflect the depth
      - List markers, spacing, and other behaviour can be customised with the `enumitem` package

Numbered (ordered) lists use the same syntax as unordered lists but use the `enumerate` environment.

```
\begin{enumerate}
    \item List entries ...
    \item Nested lists ...
          \begin{enumerate}
              \item But use ...
                    \begin{enumerate}
                        \item Such as ...
                    \end{enumerate}
          \end{enumerate}
\end{enumerate}
```

Output

1. List entries are numbered automatically
2. Nested lists are also numbered
   (a) But use a different number format
       i. Such as lowercase letters and roman numerals

We can change the top-level number format by specifying a value to the `label` parameter.

```
\begin{enumerate}[label=label_specifier]
    \item ...
\end{enumerate}
```

The following label specifiers can be used to override the default numbering format:

1. — `[label=\arabic*.]` (Default)

<I> — `[label=<\Roman*>]`

i — `[label=\roman*]`

(a) — `[label=(\alph*)]`

Part A: — `[label=Part \Alph*:]`

3 Mathematics

One of LaTeX's strengths is how it formats mathematical expressions. There are two ways to format mathematical expressions; inline using `\( \)` and display style using `\[ \]`.

Mathematical expressions can be contained "inline" (within) text and require less space:

```
Let \(\mathbb{N}\) denote the set of all natural numbers.
```

Output

Let $\mathbb{N}$ denote the set of all natural numbers.

Mathematical expressions typeset outside paragraph text appear as standalone, display style math:

```
\[
    \lim_{\Delta{t} \to \infty} \frac{f\left( t + \Delta{t} \right) - f\left( t
    ↪ \right)}{\Delta{t}}
\]
```

Output

$$\lim_{\Delta t \to \infty} \frac{f\left(t + \Delta t\right) - f\left(t\right)}{\Delta t}$$

Note that we commonly use `\equation` environments for automatic vertical spacing and equation numbering (as with section headings).

```
\begin{equation}
    a^2 + b^2 = c^2
\end{equation}
```

Output

$$a^2 + b^2 = c^2 \tag{1}$$

We can use the starred version of this environment to remove the equation label.

```
\begin{equation*}
    a^2 + b^2 = c^2
\end{equation*}
```

Output

$$a^2 + b^2 = c^2$$

3.1 Paired Delimiters

Name	LaTeX Command	Inline	Display Style
Parentheses	`\left( a \right)`	(a)	(a)
Brackets	`\left[ a \right]`	$[a]$	$[a]$
Braces	`\left\{ a \right\}`	$\{a\}$	$\{a\}$
Angle brackets	`\left\langle a \right\rangle`	$\langle a\rangle$	$\langle a\rangle$
Pipes	`\left\lvert a \right\lvert`	$\lvert a\rvert$	$\lvert a\rvert$
Double Pipes	`\left\lVert a \right\lVert`	$\lVert a\rVert$	$\lVert a\rVert$
Ceiling	`\left\lceil a \right\rceil`	$\lceil a\rceil$	$\lceil a\rceil$
Floor	`\left\lfloor a \right\rfloor`	$\lfloor a\rfloor$	$\lfloor a\rfloor$

Table 1: Paired Delimiters in LaTeX.

Note that we can declare custom paired delimiters for the final five examples using the following syntax:

```
\DeclarePairedDelimiter{\paired_delimiter_name}{left_delimiter}{right_delimiter}
```

Here are a few suggestions

```
\DeclarePairedDelimiter{\ceil}{\lceil}{\rceil}
\DeclarePairedDelimiter{\floor}{\lfloor}{\rfloor}
\DeclarePairedDelimiter{\abracket}{\langle}{\rangle}
\DeclarePairedDelimiter{\abs}{\lvert}{\rvert}
\DeclarePairedDelimiter{\norm}{\lVert}{\rVert}
```

3.2 Arithmetic Operators

Name	LaTeX Command	Inline	Display Style
Addition	`a + b`	$a + b$	$a + b$
Subtraction	`a - b`	$a - b$	$a - b$
Multiplication	`a \cdot \left( b \times c \right)`	$a \cdot (b \times c)$	$a \cdot (b \times c)$
Inequalities	`a \ll b < c \leq d`	$a \ll b < c \leq d$	$a \ll b < c \leq d$
Fractions	`\frac{a}{b}`	$\frac{a}{b}$	$\frac{a}{b}$
Superscripts	`a^2`	a^2	a^2
Subscripts	`a_i`	a_i	a_i
Square root	`\sqrt{a}`	$\sqrt{a}$	$\sqrt{a}$

Table 2: Arithmetic operators in LaTeX.

3.3 Common Large Operators

Name	LaTeX Command	Inline	Display Style
Summations	`\sum_{n = 1}^\infty \frac{1}{n^s}`	$\sum_{n=1}^{\infty} \frac{1}{n^s}$	$\displaystyle\sum_{n=1}^{\infty} \frac{1}{n^s}$
Limits	`\lim_{x \to \infty} \frac{1}{x}`	$\lim_{x \to \infty} \frac{1}{x}$	$\displaystyle\lim_{x \to \infty} \frac{1}{x}$
Derivatives	`\odv[order=2]{f}{x} \pdv*{f}{t}`	$\frac{\mathrm{d}^2 f}{\mathrm{d}x^2} \frac{\partial}{\partial t} f$	$\displaystyle\frac{\mathrm{d}^2 f}{\mathrm{d}x^2} \frac{\partial}{\partial t} f$
Integrals	`\int_0^\infty e^{-x^2} \odif{x}`	$\int_0^{\infty} e^{-x^2} \, \mathrm{d}x$	$\displaystyle\int_0^{\infty} e^{-x^2} \, \mathrm{d}x$
Union	`\bigcup_{i = 1}^n S_i`	$\bigcup_{i=1}^{n} S_i$	$\displaystyle\bigcup_{i=1}^{n} S_i$

Table 3: Common large operators in LaTeX.

3.4 Common Mathematical Functions

Name	LaTeX Command	Inline	Display Style
Sine	`\sin{\left( x \right)}`	$\sin\left(x \right)$	$\sin\left(x \right)$
Inverse Sine	`\arcsin{\left( x \right)}`	$\arcsin\left(x \right)$	$\arcsin\left(x \right)$
Logarithm	`\log{\left( x \right)}`	$\log\left(x \right)$	$\log\left(x \right)$
Natural Logarithm	`\ln{\left( x \right)}`	$\ln\left(x \right)$	$\ln\left(x \right)$
Exponential	`\exp{\left( x \right)}`	$\exp\left(x \right)$	$\exp\left(x \right)$

Table 4: Common large operators in LaTeX.

3.5 Multi-line Equations

As `equation` only allows single line equations, we can use other environments to group multiple equations into one environment.

3.5.1 Gather

The `gather` environment allows us to display a set of consecutive equations with multiple lines. New lines are separated using `\\`.

```
\begin{gather}
    \sum_{i = 0}^n f\left( i \right) = f\left( 0 \right) + f\left( 1 \right) +
     ↪  \cdots + f\left( n \right) \\
    \prod_{i = 0}^n f\left( i \right) = f\left( 0 \right) \times f\left( 1
     ↪  \right) \times \cdots \times f\left( n \right)
\end{gather}
```

Output

$$\sum_{i=0}^{n} f(i) = f(0) + f(1) + \cdots + f(n) \tag{2}$$

$$\prod_{i=0}^{n} f(i) = f(0) \times f(1) \times \cdots \times f(n) \tag{3}$$

3.5.2 Align

The `align` environment allows us to display consecutive equations that are also aligned. The alignment is determined by the placement of the `&` character. This alignment character breaks the equation into "columns" that are either right or left aligned, following the pattern: `rlrlrl`....

```
\begin{align}
%   R &  L  & R & L & R & L &  R  & L
    R & = L & R & = & = & L & R = & L
\end{align}
```

Output

$$R = L \qquad R = \qquad =L \qquad R =L \tag{4}$$

This can be illustrated using a table where the ampersands (`&`) are horizontally aligned with the pipes (`|`).

Right	Left	Right	Left	Right	Left	Right	Left
$R\&= L$	&	$R\&=$	&	$=\&L$	&	$R =\&L$	

With this in mind, we can create aligned equations as shown below.

$$ax^2 + bx + c = 0 \tag{5}$$

$$a\left(x^2 + \frac{b}{a}x + \frac{c}{a}\right) = 0 \tag{6}$$

$$x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 + \frac{c}{a} = \left(\frac{b}{2a}\right)^2 \tag{7}$$

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2}{4a^2} - \frac{c}{a} \tag{8}$$

$$x + \frac{b}{2a} = \frac{\pm\sqrt{b^2 - 4ac}}{2a} \tag{9}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{10}$$

$$\begin{aligned}
\mathbf{v}_1 &= \mathbf{w}_1 & \mathbf{q}_1 &= \frac{\mathbf{v}_1}{\|\mathbf{v}_1\|} \\
\mathbf{v}_2 &= \mathbf{w}_2 - \operatorname{proj}_{\mathbf{q}_1}(\mathbf{w}_2) & \mathbf{q}_2 &= \frac{\mathbf{v}_2}{\|\mathbf{v}_2\|} \\
\mathbf{v}_3 &= \mathbf{w}_3 - \operatorname{proj}_{\mathbf{q}_1}(\mathbf{w}_3) - \operatorname{proj}_{\mathbf{q}_2}(\mathbf{w}_3) & \mathbf{q}_3 &= \frac{\mathbf{v}_3}{\|\mathbf{v}_3\|} \\
&\vdots & &\vdots \\
\mathbf{v}_i &= \mathbf{w}_i - \sum_{j=1}^{i-1} \operatorname{proj}_{\mathbf{q}_j}(\mathbf{w}_i) & \mathbf{q}_i &= \frac{\mathbf{v}_i}{\|\mathbf{v}_i\|}
\end{aligned}$$

3.6 Text Mode

If we want to write normal text in math mode, we need to use the `\text` macro.

```
\begin{align*}
    \text{Text in text mode} \\
    Text in math mode
\end{align*}
```

Output

$$\text{Text in text mode}$$
$$\mathit{Textinmathmode}$$

Notice that spaces are ignored in math mode.

3.7 Additional Environments & Symbols

The `amsmath` package also allows us to use many matrix environments using:

- `matrix` for a matrix without any enclosing symbols
- `pmatrix` for parentheses
- `bmatrix` for brackets
- `Bmatrix` for braces
- `vmatrix` for pipes
- `Vmatrix` for double pipes

Output

$$\begin{matrix} a & b \\ c & d \end{matrix} \quad \begin{pmatrix} a & b \\ c & d \end{pmatrix} \quad \begin{bmatrix} a & b \\ c & d \end{bmatrix} \quad \begin{Bmatrix} a & b \\ c & d \end{Bmatrix} \quad \begin{vmatrix} a & b \\ c & d \end{vmatrix} \quad \begin{Vmatrix} a & b \\ c & d \end{Vmatrix}$$

LaTeX provides lots of symbols that can be installed from the Comprehensive TeX Archive Network that are used in math mode, including the greek alphabet (shown below). A short (but extensive) list can be found at The Great, Big List of LaTeX Symbols.

$$\alpha\beta\gamma\delta\epsilon\varepsilon\zeta\eta\theta\vartheta\iota\kappa\lambda\mu\nu\xi\pi\varpi\rho\varrho\sigma\varsigma\tau\upsilon\phi\varphi\chi\psi\omega$$

$$\Gamma\Delta\Theta\Lambda\Xi\Pi\Sigma\Upsilon\Phi\Psi\Omega$$

Bringing all of these together can give pretty equations like:

$$\Gamma(z) = \int_0^\infty t^{z-1} e^{-t}\,\mathrm{d}t = \frac{e^{-\gamma z}}{z} \prod_{k=1}^{\infty} \left(1 + \frac{z}{k}\right)^{-1} e^{\frac{z}{k}}$$

$$\mathbf{G}_{\mu\nu} + \mathbf{\Lambda}\mathbf{g}_{\mu\nu} = \kappa\mathbf{T}_{\mu\nu}$$

$$\mathrm{Hg^{2+}} \xrightarrow{\mathrm{I^-}} \mathrm{HgI_2} \xrightarrow{\mathrm{I^-}} [\mathrm{Hg^{II}I_4}]^{2-}$$

$$i\hbar\frac{\partial}{\partial t}\Psi(x,\,t) = -\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\Psi(x,\,t) + V(x,\,t)\,\Psi(x,\,t) \tag{11}$$

4 Figures, Tables, and Code

4.1 Figures and Tables

LaTeX allows us to use figures and tables which can be added raw or by using floats. We generally use floats to allow LaTeX to algorithmically place figures on a page, and move to the next page if it encounters a vertical overflow.

The float environment for figures is `figure` and `table` for tables. Floats are containers for objects that cannot be displayed over multiple pages. They should always have a descriptive caption (`\caption`) so that the reader does not have to rely on the contents, and also so that we can reference them using hyperlinks.

```
\begin{figure}[H]
    \centering
    \includegraphics[width=0.5\linewidth]{images/cat.jpg}
    \caption{This is a description of the figure.}\label{fig:cat}
\end{figure}
```

Output

Figure 1: This is a description of the figure.

Providing a second dimension may skew the image:

```
\begin{figure}[H]
    \centering
    \includegraphics[width=1cm, height=5cm]{images/cat.jpg}
    \caption{Skewed image of cat.}
\end{figure}
```

Output

Figure 2: Skewed image of cat.

An example using the `subfigure` environment.

```
\begin{figure}[H]
    \centering
    \begin{subfigure}{0.47\linewidth}
        \centering
        \includegraphics[height=3.5cm]{images/rabbit.jpg}
        \caption{The first subfigure.}
    \end{subfigure}
    \begin{subfigure}{0.47\linewidth}
        \centering
        \includegraphics[height=3.5cm]{images/turtle.jpg}
        \caption{The second subfigure.}\label{fig:turtle}
    \end{subfigure}
    \caption{A description for both subfigures.}
\end{figure}
```

Output

(a) The first subfigure.

(b) The second subfigure.

Figure 3: A caption for both subfigures.

An example of a table:

```
\begin{table}[H]
    \centering
    \caption{Table descriptions precede the table.}\label{tab:table}
    \begin{tabular}{l c r}
        \toprule
        \textbf{Column 1} & \textbf{Column 2} & \textbf{Column 3} \\
        \midrule
        3                 & 1                 & 4                 \\
        1                 & 5                 & 9                 \\
        2                 & 6                 & 5                 \\
        3                 & 5                 & 8                 \\
        \bottomrule
    \end{tabular}
\end{table}
```

Table 5: Table descriptions precede the table.

Column 1	Column 2	Column 3
3	1	4
1	5	9
2	6	5
3	5	8

Note that we also use the `\centering` macro to horizontally centre the contents of the floats.

4.2 List of Figures and Tables

A list of figures and tables can be printed with `\listoffigures` and `\listoftables`. These are similar to the table of contents.

4.3 Code

Source code can be displayed using the `minted` environment and in addition to the environment, code can also be displayed inline with the `\mintinline{tex}` macro (this is how code has been formatted throughout this document).

```
\begin{minted}{cpp}
#include <iostream>

int main() {
    std::cout << "Hello World!" << std::endl;
    return 0
}
\end{minted}
```

Output

```cpp
#include <iostream>

int main() {
    std::cout << "Hello World!" << std::endl;
    return 0;
}
```

Example inline code:

```
The \mintinline{tex}{System.Double} class is used for double precision
↪ floating-point values.
```

Output

The `System.Double` class is used for double precision floating-point values.

If the inline code contains braces (`{ }`), we need to delineate the argument using another symbol.

```
We define the array: \mintinline{tex}|int[] array = { 1, 2, 3 }|.
```

Output

We define the array: `int[] array = { 1, 2, 3 }`.

Here we can use the same symbol to delineate the arguments inside the macro. In this case we use pipes (`|`), but we can use any symbol apart from the percentage sign (%), i.e., `\mintinline{tex}%code%` will not compile.

4.4 References & Labels

Throughout this document, many elements are numbered (e.g. equations, sections, figures, tables, etc.).

These elements (and others) can be marked using the `\label` macro. This marker can then be referenced anywhere in the document (even before it is defined) with the `\ref` macro, and its page number can be obtained through the `\pageref` macro.

The examples in Section 4.1 contained many caption markers, and the following example will show how they are referenced.

```
\begin{itemize}
    \item Cat figure: Figure~\ref{fig:cat}
    \item Turtle subfigure: Figure~\ref{fig:turtle}
    \item Example table: Table~\ref{tab:table}
    \item Schrödinger's equation: Equation~\ref{eq:schrodingers_equation}
    \item Figures \& Tables subsection: Section~\ref{sec:figures_and_tables} on
    ↪ Page~\pageref{sec:figures_and_tables}
\end{itemize}
```

Output

- Cat figure: Figure 1
- Turtle subfigure: Figure 3b
- Example table: Table 5
- Schrödinger's equation: Equation 11
- Figures & Tables subsection: Section 4.1 on Page 11

If we were to add an additional label, LaTeX will automatically renumber all existing references the next time we compile the document.

4.4.1 Hyperlinks

We recommend using the `hyperref` package to convert references into hyperlinks for easy navigation on a PDF viewer. This package also allows us to add custom text for references such as:

```
See the \LaTeX{} Project \href{https://www.latex-project.org/}{here}.

View \hyperref[eq:schrodingers_equation]{Schrödinger's Equation}.
```

Output

See the LaTeX Project here.
View Schrödinger's Equation.

5 Diagrams

If we wish to generate simple plots of functions, or complex diagrams, we can do so with LaTeX itself. The `tikz` library provides a multitude of packages for various kinds of diagrams.

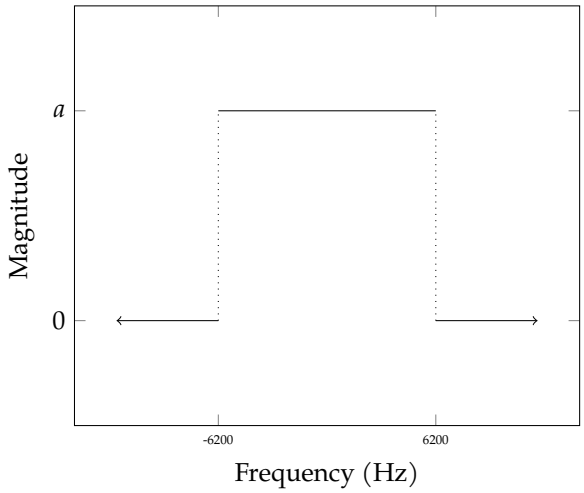

Figure 4: Band pass filter.

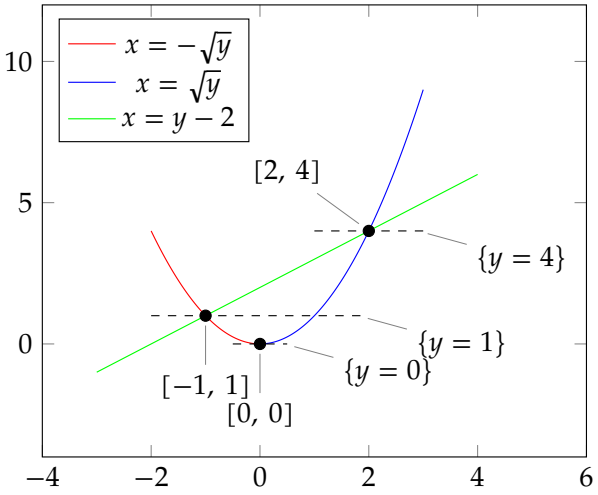

Figure 5: Graph of three functions.

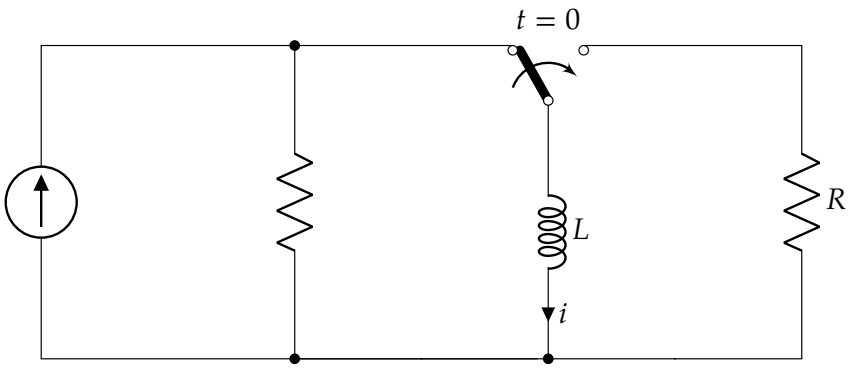

Figure 6: RL circuit.

6 Citations, Bibliographies & Reference Lists

There are many ways to manage citations, bibliographies, and reference lists in LaTeX. This document will introduce a method that combines BibLaTeX with Biber.

BibLaTeX is the frontend in LaTeX that prints the bibliography and Biber is the backend that manages the database which contains all references.

When importing the `biblatex` package we must supply the reference style as follows:

```
\usepackage[style=APA]{biblatex}
```

This affects both the citations and bibliography.

The references are stored in a Bibliographical Database file that uses the `.bib` extension. A sample database file has been provided in the project directory.

The database file is added with

```
\addbibresource{path/to/database.bib}
```

To cite the sources in this file, we can use the following macros:

```
\cite{reference_name}
\parencite{reference_name}
```

For example:

```
Source 1 ---~\parencite{colu92}

Source 2 ---~\cite{phil99}
```

Output

Source 1 — (Columbus, 1492)
Source 2 — Phillips, 1999

The bibliography can be printed with the `\printbibliography` macro, which will only print sources that are cited in the document.

7 Miscellaneous

7.1 Horizontal Spacing

The following macros control horizontal spacing:

```
\begin{align*}
    A & \!      B \\
    A &         B \\
    A & \,      B \\
    A & \:      B \\
    A & \;      B \\
    A & \       B \\
    A & \quad   B \\
    A & \qquad B
\end{align*}
```

Output

$$
\begin{aligned}
AB \\
AB \\
A\,B \\
A\,B \\
A\,B \\
A\,B \\
A \quad B \\
A \qquad B
\end{aligned}
$$

7.2 Managing Large Documents

If we want to organise large LaTeX project files, we can split our source code up into multiple files using the `\input` macro.

The following example requires the file: `src‣extras.tex`. If we place the following code in the document (right after this text), then we should see an additional section appear.

```
\input{src/extras.tex}
```

Output

7.3 Extra Section

Congrats you found the extra section! Here's a bonus equation:

$$\psi^{(m)}(z) = \frac{\mathrm{d}^{m+1}}{\mathrm{d}z^{m+1}} \ln\left(\Gamma(z)\right) = (-1)^{m+1} \int_0^\infty \frac{t^m e^{-zt}}{1-e^{-t}}\,\mathrm{d}t \tag{12}$$

We can even reference the markers that were defined in this file:

```
1 The polygamma function is summarised by Equation~\ref{eq:bonus}.
```

Output

The polygamma function is summarised by Equation 12.

8 Other Resources

- Wikibooks — Reference documentation and guides
- Overleaf — Reference documentation and guides
- The TEX Stack Exchange — Q&A site for both LATEX and typesetting issues
- The Comprehensive TEX Archive Network (CTAN) — Package database

References

Columbus, C. (1492). *How I discovered America*. Hispanic Press.

Phillips, T. P. (1999). Possible influence of the magnetosphere on American history. *J. Oddball Res.*, *98*, 1000–1003.

Project, T. L. (2022). *LaTeX - a document preparation system*. Retrieved April 19, 2022, from https://www.latex-project.org/