An Introduction to LaTeX

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What, how, where?

- LaTeX is a *fine typesetting system*. You write your document (paper, report, essay, thesis, poster, book, letter, ...) in the LaTeX format using a *text editor*. The LaTeX program converts this into PDF.
- Use the LaTeX format to describe the *structure* of your document: title, sections and subsections, lists, etc. LaTeX has extensive built-in knowledge on how best to lay things out on the page. It hyphenates words, justifies lines of text, adjusts spacing between paragraphs, etc.
- Online: `www.overleaf.com` (basic version free, but requires registering)
- MSWindows users can download MikTeX (`www.miktex.org`). GNU Linux users have TeX Live (`http://www.tug.org/texlive`). MacOS users have MacTeX (`http://www.tug.org/mactex`). All are free.

Why?

Why not just use MSWord? MSWord is much easier to learn, and some publishers and co-authors insist on MSWord documents.

- Some publishers and co-authors insist on LaTeX.
- LaTeX produces better looking output.
- Longer documents are easier to write in LaTeX: you can move tables and figures around and cross references keep up, LaTeX has great bibliography tools, section numbering "just happens".
- LaTeX is one of the best systems in existence for typesetting mathematics.
- LaTeX is built on top of TeX–one of the most stable and reliable programs every written.

Getting started

- Run `miktex-portable.cmd`.
- Find the the MikTEX icon in the notification area of the Windows Taskbar, and right-click to open TEXworks.
- Type in the following sample document:

```
\documentclass{article}
\begin{document}
  Hello! This is my first \LaTeX{} document.
\end{document}
```

- Pay careful attention to the backslash and curly brace characters!
- Then, press the green arrow.

Things you need to know

LaTeX attaches a special meaning to certain characters, in particular:

- $ — used to delimit mathematical formula[1]
- \ — starts a LaTeX command.
- & — separates columns in a table.
- { and } — delimit arguments to a LaTeX command.
- % — start of a comment: LaTeX ignores the rest of the line.
- ~ — a non-breaking space.
- " — use `` and '' for double-quotes.
- _, ^ — used in mathematical formula.

Usually, preceeding the character with a backslash (\) removes the special meaning (but for "\" use \textbackslash).

[1] Chosen as a joke by Donald Knuth, the author of TeX: typesetters charged more for mathematics!

Document structure

A LaTeX document is organised in two parts: a *prelude* that specifies the type of document, loads any optional packages and other setup actions; and a *body* that contains the text of the document.
The end of the prelude is marked by a `\begin{document}` line.

```
\documentclass{article}
...optional packages and setup actions appear here
\begin{document}
```

```
...the text of the document appears here
\end{document}
```

The document must end with a line `\end{document}`. Anything after this line is ignored.

Sectioning

Edit your document to include some sections; e.g.

```
\documentclass{article}
\usepackage{lipsum}
\title{My First Document}
\author{I forgot to put my name here}
\date{\today}
\begin{document}
```

```
\maketitle
\section{Introduction}
\lipsum[1-2]
\section{Background}
\lipsum[3-5]
\section{Conclusions}
\lipsum[6]
\end{document}
```

Lists

Use the \begin{itemize}, \item and \end{itemize} commands to make a bullet list:

```
\begin{itemize}
\item A bullet list.
\item Each item starts with \textbackslash item.
\end{itemize}

\begin{enumerate}
\item A numbered list.
\item \LaTeX{} does all the numbering.
\end{enumerate}
```

Emphasis, bolding

- The text style commands take a single argument, enclosed in curly braces immediately after the command name.
- The \emph command puts text in *italics*.
- \textbf puts its argument in **bold** font.
- There is also \textsc (Small Caps), \textsl *(slanted)*, \texttt `(teletype)` and \textnormal.
- E.g.

```
This paragraph illustrates the use of
\emph{emphasis}, \textbf{bold}, \textsl{slanted}
and \texttt{fixed width}. Some combinations are
\emph{\textbf{available}}, but not
\textsc{\emph{all}}.
```

Changing font size

- LaTeX generally takes care of the font size for you.
- If you *really* need to, the commands to change the text size (in order) are: \tiny, \scriptsize, \footnotesize, \small, \normalsize, \large, \Large, \LARGE, \huge and \Huge.
- These commands differ from the text style commands by being *modal*; i.e. they don't take an argument, and text size is changed for all following text in the current block.

```
{\LARGE A curly brace starts a block.}
Font size is normal now.
```

Cross referencing

- Sections, figures, formula, etc. can be given mnemonic names ("labels") that you can use to refer to elsewhere in your document.
- Define the label using `\label{`*your mnemonic name*`}`
- Add a reference to the label using `\ref{`*your mnemonic name*`}`

E.g.

```
\section{Introduction}\label{sec:intro}
...
as discussed in Section~\ref{sec:intro}.
```

Figures and tables

- These are "floating" blocks that may appear in a different place from the surrounding text.
- Some journals want floats at the end, otherwise there are rules regarding how many floats can appear on one page.
- Figures and tables require a caption and a label. Figure numbers are generated by LaTeX.

```
\begin{figure}
  \centering
(The actual figure will go here)
  \caption{My fabulous figure}
  \label{fig:fabulous}
\end{figure}
```

Image figures

- LaTeX can include bitmap image files (PNG, JPG, etc.), or "vector graphics" images (e.g. PDF).
- Images are kept in separate files, and do not appear directly in the LaTeX source.

```
\documentclass{article}
\usepackage{graphicx}
```

```
\begin{figure}
  \centering
  \includegraphics{name-of-my-figure-file.png}
  \caption{My fabulous figure}
  \label{fig:fabulous}
\end{figure}
```

Image manipulation

- You can specify the size you would like the image to be scaled. This is usually done relative to the page size:
  `\includegraphics[width=.8\textwidth]`
  `{name-of-my-figure-file.png}`
- Not a general image processing system, but you can rotate, crop the image, etc.

Mathematics

```
The square root of two is typeset $\sqrt{2}$.
```

- Try: `$\sqrt{a^2 + b^2}$`
- `$\int \zeta^{2}(x) \, dx$`
- `$\lim_{x \to a} \frac{f(x) - f(a)}{x - a}$` and compare with

```
\[
\lim_{x \to a} \frac{f(x) - f(a)}{x - a}
\]
```

Tabular layout

- Use the `tabular` environment for tables

```
\begin{tabular}{lr}
  Name & Email \\
  John & john.hamer@glasgow.ac.uk \\
  ...
\end{tabular}
```

- The `{lr}` means two columns, the first left-aligned and the second right-aligned.
- Can add horizontal rules to separate the column headers:

```
  \begin{tabular}{lr}
\hline \textbf{Name} & \textbf{Email} \\
\hline John & john.hamer@glasgow.ac.uk \\
    ...\\
\hline
  \end{tabular}
```

Spanning columns

`\multicolumn` is used to place text over several columns, or to change the alignment of a particular cell.

```
\begin{tabular}{llr}
    \multicolumn{2}{c}{\textbf{Name}}
  & \multicolumn{1}{c}{\textbf{Email}} \\
    \multicolumn{1}{c}{\emph{First}}
  & \multicolumn{1}{c}{\emph{Last}} \\
\hline
    John & Hamer & john.hamer@glasgow.ac.uk \\
    ...
\end{tabular}
```

Bibliography

- LaTeX is typically used in combination with a system called BibTeX.
- BibTeX extracts and formats entries from a database of books and articles.
- Entries in the database look like:

```
@article{greenwade:TUGBoat:14.3,
    author  = "George D. Greenwade",
    title   = "The {C}omprehensive {T}ex {A}rchive {
    year    = 1993,
    journal = {TUGBoat},
    volume  = 14,
    number  = 3,
    pages   = "342--351"
}
```

The LaTeX side

- Every BibTeX reference requires a sort name you can refer to in your LaTeX source.
- E.g. "In `\cite{greenwade:TUGBoat:14.3}`, …".
- You need to tell LaTeX which referencing style to use; e.g.

```
\bibliographystyle{alpha}
```

- And where you'd like your bibliography to appear (along with the file containing your references):

```
\bibliography{my-ref-file-name}
```

- Run LaTeX once, so it knows which references you have used. Then (separately) run BibTeX, then run LaTeX again.

Formatting a thesis

- Several LaTeX styles exist; e.g. `https://github.com/impleri/glasgow-thesis`
- Download glasgow-thesis.sty
- Change the document class to report, and load glasgow-thesis:

```
\documentclass[a4paper,12pt]{report}
\usepackage{glasgow-thesis}
```

- Set the additional required fields for the title page; e.g.

```
\qualifications{M.A, University of Glasgow \\
  B.A., University of Glasgow}
\degree{Doctor of Philosophy}
\school{Engineering}
\college{Sciences}
```

Formatting a thesis (cont.)

- Change page numbering to roman for the title page and abstract:

```
\pagenumbering{roman}
\maketitle
\begin{abstract}
  \lipsum[1-3]
\end{abstract}
\tableofcontents
\clearpage
\setcounter{page}{0}
\pagenumbering{arabic}
```

Formatting a thesis (cont.)

- Since this is now a report (rather than an article), the major sectioning unit is the chapter:

```
\chapter{Introduction}
\lipsum[4-12]

\chapter{Background}
\lipsum[13-21]

\chapter{Conclusions}
\lipsum[22-25]
```

Resources

- `www.miktex.org` – LaTeX for MSWindows
- `www.overleaf.com` – LaTeX online
- `https://tobi.oetiker.ch/lshort/lshort.pdf`
- `https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf`
- For more on mathematics, see `http://tex.loria.fr/general/mil.pdf`
- BibTeX: `http://en.wikibooks.org/wiki/LaTeX/Bibliography_Management`
- `https://en.wikibooks.org/wiki/LaTeX/PGF/TikZ` – a drawing package
- The Comprehensive TeX Archive Network, `www.ctan.org`