

An Introduction to L^AT_EX

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10 April 2026

L^AT_EX?

- L^AT_EX is a *professional quality typesetting system*.
- You write your document (paper, report, essay, thesis, poster, book, letter, ...) in the L^AT_EX format (using any text editor), and the L^AT_EX program compiles this into PDF.
- The L^AT_EX format describes the structure of your document: title, sections and subsections, lists, etc.
- L^AT_EX has extensive knowledge on how to lay things out on the page, and applies many subtle nuances of fine typography.

Head to head: MSWord vs. \LaTeX

MSWord is far more widely used. Here's how they compare:

- Easy to use, no scary errors.
- Gives you complete freedom. Maintaining consistency is difficult.
- Dreadful at typesetting mathematics.
- Can import objects from other apps.
- Can extend using an awful programming language.
- Commercial, proprietary software.
- Steep learning curve.
- Strongly opinionated. Breaking the rules requires effort.
- The best system in existence for typesetting mathematics.
- Images, etc. need to be stored in separate files.
- Can extend using an awful programming language.
- Public domain, free, active support community.

Getting started

Login at
`http://www.overleaf.com`,
select “Log in with SSO” and
enter your Glasgow email.

Log in

We're making some changes to improve your login experience. You'll start seeing a new look, including mentions of our parent company, Digital Science. Don't worry, this won't change your account or login options.

 Log in with Google

 Log in with ORCID

 Log in with IEEE

OR

Email

Password

Log in

[Forgot password?](#)

OR

Work/university single sign-on

 Log in with SSO

Don't have an account? [Register](#)

Example project

- Click on “New Project” and select “Example Project”.
- Fix up the `\author` field, change the date to `\today`, and set the `\bibliographystyle` to `natbib`.
- Then press “Recompile”.
- **Post any errors, confusions, etc. in the chat window!**
- Some things to observe:
 - Sections and figures are automatically numbered.
 - Line breaks and word spacing are chosen by \LaTeX . Each full line has the exact same width.
 - References are extracted from the file `references.bib`, and formatted in the style specified.

Thing to trip you up

\LaTeX takes over certain characters; in particular:

- $\$$ is used to delimit mathematical formula¹
- $\&$ separates columns in a table.
- $\%$ is the start of a comment: \LaTeX ignores the rest of the line.
- \backslash starts a \LaTeX command.
- $\{$ and $\}$ delimit arguments to a \LaTeX command.
- \sim is a non-breaking space.
- $"$ is never used. Quotes are `` `` and `' '` (or `` `` and `' '`).
- \wedge and $_$ are used in mathematical formula (for superscript and subscript).

Usually, preceding the character with a backslash (\backslash) removes the special meaning (except for `"\`", which requires `\textbackslash`).

¹Chosen as a joke by Donald Knuth, the author of \TeX : commercial typesetters charged a premium 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}
```

Anything after `\end{document}` is ignored.

Exercise: add some lists

The `\begin{itemize}`, `\item` and `\end{itemize}` commands make a bullet list. Here are some for you to add, or you can make your own.

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

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

Exercise: add emphasis and 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`.
- Try these:

```
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}}.
```

Exercise: change the font size

- \LaTeX prefers to take care of the font size for you.
- If you *really, really* need to, the commands to change the text size 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.
```

Exercise: add 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}`

Add a label to each section, and insert some text referencing the label. E.g.

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

Figures and tables

- Large objects like figures and tables need to be made “floating”, so that surrounding text can be moved above or below. Otherwise, pages could end up with big chunks of blank space.
- Figures and tables require a caption and a label.
- Caption numbers are generated for you by L^AT_EX.

```
\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

- \LaTeX always inserts a figure at full resolution.
- You need to specify the size you would like the image to be scaled. This is usually done relative to the page size. E.g.

```
\includegraphics[width=.8\textwidth]{figure.png}
```
- (Note that square brackets are used for optional arguments).
- You can also rotate or crop the image, set the transparency, etc.

Quick glimpse at mathematics

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

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

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

- The Resources below have links to some good primers on math typesetting.

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 Bib \TeX .
- Bib \TeX 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 L^AT_EX side

- Every BibT_EX reference requires a sort name you can refer to in your L^AT_EX source.
- E.g. “In `\cite{greenwade:TUGBoat:14.3}`, ...”.
- You need to tell L^AT_EX 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 L^AT_EX once, so it knows which references you have used. Then (separately) run BibT_EX, then run L^AT_EX again.

Formatting a thesis

- Check out the Theses templates in Overleaf. e.g. <https://www.overleaf.com/gallery/tagged/glasgow>
- Set the additional required fields for the title page; e.g. `\title`, `\qualification`, `\university`.
- Chapter contents are organised in sub-folders `chapter1/`, `chapter2/` etc.
- Included in main document using `\include{chapter1/chapter1}` etc.
- You can comment out the `\include` line for chapter you're not currently working on, to speed up processing.

TikZ — a drawing package

- <https://tikz.dev/>
- High-quality, hard-to-use \LaTeX library for vector graphics
- Great for mathematical diagrams (e.g. matrices, automata), circuit diagrams, mind maps, graphs and trees, plots and other data visualisations,
- Extensive set of “libraries within the library”
- Examples: <https://texample.net/tikz/examples/>

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>
- Bib \TeX : http://en.wikibooks.org/wiki/LaTeX/Bibliography_Management
- <https://tikz.dev> – a drawing package
- The Comprehensive \TeX Archive Network, www.ctan.org