

Introduction to L^AT_EX

Lecture 2

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Interdisciplinary Training in
the Social Sciences

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Introduction



Outline of lectures

- Two lectures (February 9 & 16) for two hours
- Lecture one
 - History, culture, syntax, formatting, lists, tables
- Lecture two
 - Figures, math, document structure, bibliographies, presentations

Resources

- [User Guide](#). *The L^AT_EX Project*.
- [L^AT_EX](#). *Wikibooks*.
- [Documentation](#). *Overleaf*.
- [Learn L^AT_EX](#).
- [Getting to Grips with L^AT_EX](#).
- [L^AT_EX 2_ε Cheat Sheet](#).
- [StackOverflow](#).



- History, minimum viable examples, commands & environments
- Common bugs involving reserved characters & quotation marks
- Configuring the document with front matter's packages & preamble
- Formatting sections & styling text
- Working with lists & tables
- Demo Overleaf document is [here](#)

Today's agenda

- **Figures:** symbols and equations
- **Math:** symbols and equations
- **Modularity:** Multi-file documents
- **Bibliographies:** BibTeX and citations
- **Presentations:** beamer, tikz, and posters
- **Office Hours:** Debugging your projects!



Figures



Basics of figures

- `graphicx` provides `\includegraphics` that reads in image files
 - Vector images (PDF, EPS, SVG) » raster images (JPEG, PNG, GIF)
 - Scaling image size relative to document dimensions
- Like tables, it often makes sense for the graphics to be embedded within a figure environment defining alignment, caption, and label

A simple figure

```
\documentclass{article}
\usepackage{graphicx}
\begin{document}
Some text.
\begin{figure}
  \includegraphics[width=.5\textwidth]{image_file.png}
  \caption{Caption}
  \label{fig:my_label}
\end{figure}
\end{document}
```



Intermediate figures

- You may want **multiple sub-plots** in a single figure
 - Use the **caption** and **subcaption** packages



Side-by-side sub-figures

Side-by-side sub-figures

```
\documentclass{article}
\usepackage{graphicx,subcaption}
\begin{document}
Some text.
\begin{figure}
  \begin{subfigure}{.475\textwidth} % Subfigure width is a hair under half
    \includegraphics{image_file1.png}
    \caption{Caption for image 1}
    \label{fig:image1}
  \end{subfigure}\hfill % hfill makes the right image right-aligned
  \begin{subfigure}{.475\textwidth}
    \includegraphics{image_file2.png}
    \caption{Caption for image 2}
    \label{fig:image2}
  \end{subfigure}\caption{Caption for both images}
  \label{fig:both_images}
\end{figure}
\end{document}
```



Math



Typesetting math

- A primary motivation for Knuth to develop T_EX
- Arbitrarily complex equations possible inline or displayed
 - Dollar signs create the inline environment
 - The equation environment creates the display

Simple and less simple equations

```
\documentclass{article}\begin{document}
```

Einstein was very smart. He discovered $E=mc^2$.

It required a lot of math that looked like this:

```
\begin{equation}
```

```
% https://en.wikipedia.org/wiki/Mass%E2%80%93energy\_equivalence
```

```
K_{0}-K_{1}=E\left(\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}-1\right)
```

```
\end{equation}
```

```
\end{document}
```



Math symbols

- Many reserved characters can be used within a math environment
 - Symbols like: + - = ! / () [] < > | ' : *
- Lower- and upper-case Greek letters by cased name:
`\alpha \gamma \Delta` becomes $\alpha\gamma\Delta$
 - Annoyingly, `\Beta` does not resolve automatically, use `B` explicitly
- Powers/superscripts with carat, indices/subscripts with underscore
 - Enclose longer expressions within braces `{}`

Sub- and super-scripts

```
\documentclass{article}\begin{document}
\begin{equation}
\alpha_{\beta+1} = \gamma^2 + \alpha_{\gamma^2} - \alpha_{\beta-1}
\end{equation}
\end{document}
```



- *Many* other symbols and accenting available!
 - [List of mathematical symbols](#) and [Comprehensive L^AT_EX Symbol List](#)
 - Technical syntax in [linguistics](#), [computer science](#) and [programming](#), and [chemistry](#) also supported
- Fractions (`\frac`), roots (`\sqrt`), sums (`\sum`), and integrals (`\int`), look like command with multiple parameters

$$\frac{n!}{k!(n-k)!} = \text{binom}\{n\}\{k\}$$

- Matrices are similar to tables: environments with columns delimited by `&` and rows delimited by newlines



Modularity



Making modular documents

- Good development practice suggests breaking code up into smaller sections rather than a monolithic document
 - Separate “child” .tex files for each chapter or section and a “parent” .tex files where ordering and preamble is managed
- Default “article” documentclass does not support chapters by default, use default documentclasses like `book` and `report` instead
- Two options for combining files into a finished documents
 - Use `\include` to force a page break, but it *cannot* be recursive (`\include` within `\include`) — best for chapters
 - `\input` does *not* force a page break and *can* be recursive (`\input` within `\input`) — better for modularizing manuscript sections

Example of a modularized parent document

- If we had separate files for each chapter of a dissertation, we could compile them all into a completed dissertation with a MVE parent document that looks like:

Modularized thesis or book

```
\documentclass{report} % notice the change in document class
%...other front matter
\begin{document}
\maketitle \tableofcontents \listoffigures \listoftables % make all the front material
\include{Chapter_1} % "Chapter_1.tex" is a file in the same directory
\include{Chapter_2}
\include{Chapter_3}
\include{Chapter_4}
\include{Chapter_5}
\end{document}
```



Collaborative writing and revision tracking

- Overleaf provides interfaces for leaving comments and (premium) services for tracking changes and syncing with GitHub repositories
- Version control can be overkill for smaller collaborations, but nevertheless a good opportunity to practice!
- Outside of Overleaf, packages like [todonotes](#) can be used to leave comments that are compiled into the document
- Use [latexdiff](#) or [changebar](#) to automatically highlight changes between versions for revise and resubmit cycles



Bibliographies



- BibTeX is a database for storing bibliographic information
 - a .bib file contains entries like “article”, “book”, “inproceedings”, *etc.*
 - Populate the .bib file using entries from your Zotero or Mendeley
 - Also use helper tools like [BetterBibTeX](#) to clean up output
- Each entry has a citation key to be referenced in the text, as well as the meta-data defining the reference (title, author, *etc.*)

BibTeX entry in bibliography.bib

```
% bibliography.bib
@book{kuhn1970structure, % reference type is "book" and citation key
  title={The Structure of Scientific Revolutions},
  author={Kuhn, Thomas S},
  volume={111},
  year={1970},
  publisher={Chicago University of Chicago Press}
}
```

Citing references

- In the body of the text, cite the reference using the `\cite{}` command and pass the citation key
 - Also include a non-breaking space character before the cite command to prevent orphaned citations: `~\cite`
- Pass multiple comma-separated keys that will be grouped together, depending on citation style
- Specific pages, chapters, tables, *etc.* can be referenced as an option

Citing

```
\documentclass{article}\begin{document}
```

```
Scientific knowledge does not accumulate smoothly~\cite{kuhn1970structure}.
```

```
\bibliography{bibliography}
```

```
\end{document}
```



Citation and bibliography styles

- Reference formatting standards abound, L^AT_EX supports [several](#) by default: `apalike`, `plain`, `abbrv`
- Define these styles with `\bibliographystyle` before referencing the bibliography file at (typically) the end of the document
- More advanced citation and bibliography style management can be customized with the [natbib](#) package

Citing

```
\documentclass{article}\begin{document}
Scientific knowledge does not accumulate smoothly~\cite{kuhn1970structure}.
\bibliographystyle{apalike} % Define the bibliography style
\bibliography{bibliography}
\end{document}
```



Presentations and figures



- You can also use \LaTeX to make presentations (like this one!)
 - There is a “slides” document class, but >99% chance you’d prefer [beamer](#) or a popular Beamer theme like [metropolis](#)
- \LaTeX can also make posters with the [beamerposter](#) and [tikzposter](#) templates



- [tikz](#) is a very powerful package for drawing diagrams and figures in \LaTeX
- You will definitely want to build on others' MVEs and resources
 - Examples at [Awesome TikZ](#), [TeXample](#), [Walmes](#)
- Derivative packages like [tikz-network](#)



Office hours

