

# Preparing your thesis with $\text{\LaTeX}$

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# Introduction

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# Follow the leader

- These slides contain links to exercises and further reading
- You can follow along with these slides on my website

[jwalton.info/teaching](http://jwalton.info/teaching)

# A little about me...

- I am a 4th year PhD student based in the School of Maths, Stats & Physics
- I have  $\sim 4$  years of  $\text{\LaTeX}$  experience
- I also teach the PGRDP course **Introduction to git and Github**

## A little about you...

- This course is intended for those who already have some  $\text{\LaTeX}$  experience
- If you want to brush up on the basics then SAgE offer an introduction to  $\text{\LaTeX}$  workshop (not taught by me)

# The game plan

- Angela will arrive to check attendance at 1pm
- I am more than happy informing Angela of any skivers (so don't skive)
- Exercises are included to break-up the monotony of me talking

# Table of contents

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# Motivation

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# But I already know $\text{\LaTeX}$ !

- Many of us learn  $\text{\LaTeX}$  “as we go”
- As such, it is easy to get into bad habits
- It's even easier to miss out on useful packages and features

# For inspiration...

- The Divine Liturgy of Saint John Chrysostom
- PhD thesis, Aaron Turon
- Trees, maps, and theorems, Jean-luc Doumont
- The slides and exercises produced for this course...

# Managing large documents

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- For smaller projects it is okay to keep everything in a single `.tex` file
- For more involved projects (your thesis) this approach quickly becomes cumbersome
- The `\include` command makes it possible to break your document down into smaller chunks
- Working with smaller chunks is more manageable

# Structure

An example structure for a thesis project could look like the following:

```
thesis/  
├── thesis.tex  
├── chapters/  
│   ├── chapter_1.tex  
│   ├── chapter_2.tex  
│   └── chapter_3.tex  
├── internal/  
│   └── preamble.tex  
├── fig/  
│   └── science.png  
└── references.bib
```

# Example thesis.tex

```
\documentclass[12pt]{report}
```

```
\include{internal/preamble}
```

```
\begin{document}
```

```
\include{chapters/chapter_1}
```

```
\include{chapters/chapter_2}
```

```
\include{chapters/chapter_3}
```

```
\bibliography{references}
```

```
\end{document}
```

# Example internal/preamble.tex

```
% Preamble, packages, commands etc.
\usepackage{microtype}
\usepackage{booktabs}
\usepackage{cleveref}
\usepackage{graphicx}
:

% Make it easier to include figures
\graphicspath{{fig/}}
```

# Example chapters/chapter\_1.tex

```
\chapter{Literature review}  
\label{cha:lit_review}
```

Here's stuff others did which I don't really  
understand\ldots



# Compile a single chapter

`\includeonly` allows the compilation of a single chapter, without messing up references, page numbers etc.

```
\documentclass[12pt]{report}
```

```
\include{internal/preamble}
```

```
\includeonly{chapters/chapter_2}
```

```
\begin{document}
```

```
\include{chapters/chapter_1}
```

```
\include{chapters/chapter_2}
```

```
\include{chapters/chapter_3}
```

```
⋮
```

- A thesis template for MSP students
- The template is modular and has a structure similar to the one given above
- For non-MSP students, or those who would like a different style, the 'classic thesis' style is a good option

# Version control

- Version control allows you to track and manage changes in code, and collaborate with others
- I'd recommend using version control to manage your thesis
- Plug: a colleague and I are teaching an upcoming PGRDP workshop [Introduction to Git and GitHub](#)

# Spell checking

Spell checking .tex files is complicated by latex commands.

For those comfortable working at the command line I'd recommend **aspell** (or **ispell** or **hunspell**).

Interactive spell-check:

```
$ aspell -t -c chapters/chapter1.tex
```

Non interactive spell-check (lists mistakes):

```
$ cat chapters/chapter1.tex | aspell list -t
```

Custom dictionary and commands to ignore can be added with `--add-extra-dicts` and `--conf` respectively

# Spell checking

Some IDEs have inbuilt spell checkers:

- **Texmaker** (checks contents of commands still)
- **Textstudio** (seems to have the best spellchecker)

More generally: [here is a list of editors](#) and their features

# Word count

For final submission (it will creep up on you, I promise) you *need* to submit a word count.

Counting words in a .tex file is again complicated by the presence of latex commands.

For command line users I'd recommend trying **detex** and **wc**:

```
$ detex -le equation,table thesis.tex | wc -w
```

# Word count

- **Online tool** (chapters counted one at a time)
- **Texmaker's** integrated pdf viewer has wordcount (right click pdf)
- **Texstudio** (tools → analyze text; chapters one at a time)

# Exercise 1



# Custom commands

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# Simple macros

Used to simplify repetitive and/or complex formatting.

Usually specified in the preamble

```
\newcommand{\name}{definition}
```

# Simple macros: an example

```
\newcommand{\R}{\mathbb{R}}
```

The set of real numbers are usually represented by a blackboard capital r:  $\mathbb{R}$ .

The set of real numbers are usually represented by a blackboard capital r:  $\mathbb{R}$ .

# Macros with parameters

Macros can also be constructed to accept parameters:

```
\newcommand{\name}[# params]{definition}
```

# Macros with parameters: an example

```
\newcommand{\bb}[1]{\mathbb{#1}}
```

Other numerical systems have similar notations. The complex numbers  $\mathbb{C}$ , the rational numbers  $\mathbb{Q}$  and the integer numbers  $\mathbb{Z}$ .

Other numerical systems have similar notations. The complex numbers  $\mathbb{C}$ , the rational numbers  $\mathbb{Q}$  and the integer numbers  $\mathbb{Z}$ .

# Macros with default parameters

It is also possible to define macros which take *default*

```
\newcommand{\name}[# params][default #1]{def.}
```

# Macros with default parameters

```
\newcommand{\plusbinomial}[3][2]{(#2 + #3)^#1}
```

We make a new command to save time writing expressions of the form  $\$ \backslash \text{plusbinomial}\{x\}\{y\} \$$  and  $\$ \backslash \text{plusbinomial}[4]\{a\}\{b\} \$$ .

We make a new command to save time writing expressions of the form  $(x + y)^2$  and  $(a + b)^4$ .

## **Exercise 2**



# **Managing a bibliography**

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BibTex can be used to manage bibliographies. (BibLaTeX is a more sophisticated alternative.)

- BibTex entries are stored in a `.bib` file
- I recommend maintaining a *single* centralised `.bib` file for the duration of your PhD.

# BibTex entries

A list of entry types which BibTex understands can be [found here](#).

```
@book{knuth84,  
  title="The texbook",  
  author="{Donald Ervin} Knuth and Duane Bibby",  
  volume="3",  
  year="1984",  
  publisher="Addison-Wesley Reading"  
}
```

# Referencing with BibTeX

- References are included as `\cite{knuth84}`, where `knuth84` is the `title` of a BibTeX entry
- Include your `.bib` file with `\bibliography{references}`, where `references` is the name of your file

# `\usepackage{natbib}`

- `natbib` can be used to implement author-year citations.
- Introduces commands `\citep` and `\citet`, to cite in parenthesis or text.
- `\citep*` and `\citet*` print full author list
- Multiple citations can be made as `\citep{paper1, paper2}`

# Compiling with BibTeX

BibTeX adds extra complexity to the processing of your manuscript. You will have to run  $\text{\LaTeX}$  a number of times.

1. `pdflatex thesis.tex`
2. `bibtex thesis.aux`
3. `pdflatex thesis.tex`
4. `pdflatex thesis.tex`

A Makefile can simplify compilation. However, I'd recommend using `latexmk`.

# Citations from Google Scholar

Google scholar can be used to export citations easily.

The screenshot shows the Google Scholar interface with the search term "bayesian data analysis". The search results are displayed in a list format. On the left side, there are filters for "Any time", "Since 2019", "Since 2018", "Since 2015", and "Custom range...". Below these, there are options to "Sort by relevance" and "Sort by date". Further down, there are checkboxes for "include patents" and "include citations", and a "Create alert" button. The search results list includes the following entries:

- [BOOK] Bayesian data analysis** by A. Gelman, J.B. Carlin, H.S. Stern, D.B. Dunson, A. Vehtari, ... - 2013 - taylorfrancis.com. This book is intended to have three roles and to serve three associated audiences: an introductory text on Bayesian inference starting from first principles, a graduate text on effective current approaches to Bayesian modeling and computation in statistics and related ... Cited by 24690. Related articles. All 22 versions. [PDF] psu.edu
- Nonparametric Bayesian data analysis** by P. Müller, F.A. Quintana - Statistical science, 2004 - JSTOR. We review the current state of nonparametric Bayesian inference. The discussion follows a list of important statistical inference problems, including density estimation, regression, survival analysis, hierarchical models and model validation. For each inference problem we ... Cited by 487. Related articles. All 14 versions. Web of Science: 225. [PDF] jstor.org Full View
- [BOOK] Doing Bayesian data analysis: A tutorial with R, JAGS, and Stan** by J. Kruschke - 2014 - books.google.com. Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan, Second Edition provides an accessible approach for conducting Bayesian data analysis, as material is explained clearly with concrete examples. Included are step-by-step instructions on how to carry out ... Cited by 1932. Related articles. All 10 versions. [PDF] yorku.ca
- [HTML] What to believe: Bayesian methods for data analysis** by J.K. Kruschke - Trends in cognitive sciences, 2010 - Elsevier. Although Bayesian models of mind have attracted great interest from cognitive scientists, Bayesian methods for data analysis have not. This article reviews several advantages of Bayesian data analysis over traditional null-hypothesis significance testing. Bayesian ... Cited by 248. Related articles. All 14 versions. Web of Science: 131. [HTML] sciencedirect.com Find @ Newcastle

# Citations from Google Scholar

Google scholar can be used to export citations easily.

The screenshot shows the Google Scholar interface. The search bar contains 'bayesian data analysis' and shows 'About 2,300,000 results (0.06 sec)'. The left sidebar has filters for 'Any time', 'Sort by relevance', and 'include citations'. The main results list includes articles like 'Bayesian data analysis' by Gelman et al. and 'Doing Bayesian data analysis' by Kruschke. A 'Cite' dialog box is open, showing citation formats for MLA, APA, Chicago, Harvard, and Vancouver. The 'BibTeX' option is circled in orange. To the right of the dialog, links for PDF files from various institutions (psu.edu, jstor.org, yorku.ca, sciencedirect.com) are visible.

Google Scholar

bayesian data analysis

Articles

About 2,300,000 results (0.06 sec)

My profile

Any time

Since 1919

Since 1918

Since 1915

Custom range...

Sort by relevance

Sort by date

☒ include patents

☒ include citations

Create alert

[BOOK] Bayesian data analysis

A. Gelman, J.B. Carlin, H.S. Stern, D.B. Dunson, D.B. Vehtari, A. Rubin. (2013). *Bayesian data analysis*. Chapman and Hall/CRC, 2013.

☆ Cited by 24690

Nonparametric Bayesian data analysis

P. Müller, F.A. Quintana - Statistics & Probability Letters

We review the current state of the art in nonparametric Bayesian data analysis. We list of important statistical inference methods for survival analysis, hierarchical models, and other applications.

☆ Cited by 487

[BOOK] Doing Bayesian data analysis

J. Kruschke - 2014 - books.google.com

Doing Bayesian Data Analysis: A tutorial by example, with applications in psychology, political science, education, medicine, economics, and other fields. This book provides an accessible approach for conducting Bayesian data analysis, clearly with concrete examples, and with a focus on understanding the underlying concepts.

☆ Cited by 1932

[HTML] What to believe: Bayesian data analysis

J.K. Kruschke - Trends in cognitive sciences

Although Bayesian models of mind have attracted great interest from cognitive scientists, Bayesian methods for data analysis have not. This article reviews several advantages of Bayesian data analysis over traditional null-hypothesis significance testing. Bayesian ...

☆ Cited by 248

Related articles

All 14 versions

Web of Science: 131

Cite

MLA Gelman, Andrew, et al. *Bayesian data analysis*. Chapman and Hall/CRC, 2013.

APA Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., & Rubin, D. B. (2013). *Bayesian data analysis*. Chapman and Hall/CRC.

Chicago Gelman, Andrew, John B. Carlin, Hal S. Stern, David B. Dunson, Aki Vehtari, and Donald B. Rubin. *Bayesian data analysis*. Chapman and Hall/CRC, 2013.

Harvard Gelman, A., Carlin, J.B., Stern, H.S., Dunson, D.B., Vehtari, A. and Rubin, D.B., 2013. *Bayesian data analysis*. Chapman and Hall/CRC.

Vancouver Gelman A, Carlin JB, Stern HS, Dunson DB, Vehtari A, Rubin DB. *Bayesian data analysis*. Chapman and Hall/CRC; 2013 Nov 27.

BibTeX EndNote RefMan RefWorks

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## **Packages: a few favourites**

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# `\usepackage{cleveref}`

cleveref formats cross-references automatically

See ??.



**Figure 1:** T<sub>E</sub>X the Lion.

# `\usepackage{cleveref}`

```
% Reference as Figure 1, instead of fig. 1
```

```
\usepackage[capitalise,noabbrev]{cleveref}
```

```
:
```

```
See \cref{fig:lion}.
```

```
\begin{figure}
```

```
  \centering
```

```
  \includegraphics[width=0.4\textwidth]{Lion.png}
```

```
  \caption{\TeX\ the Lion.}
```

```
  \label{fig:lion}
```

```
\end{figure}
```

# `\usepackage{hyperref}`

- Adds hypertext links to cross-references.
- See e.g. *this link to the Table of Contents*, the links in the table of contents and the external hyperlinks throughout.
- `hyperref` takes many options to alter how links are displayed

# `\usepackage{booktabs}`

Booktabs can be used to enhance default tabular.

Item		Price (\$)
Animal	Sold	
Gnat	per gram	13.65
	each	0.01
Gnu	stuffed	92.50
Emu	stuffed	33.33

**Table 1:** Default  $\text{\LaTeX}$  table.

# \usepackage{booktabs}

```
\begin{tabular}{|l|l|r|}  
  \hline  
  \multicolumn{2}{|c|}{Item} & \\\cline{1-2}  
  Animal          & Sold          & Price (\$) \\\hline  
  Gnat            & per gram      & 13.65      \\  
                  & each          & 0.01       \\  
  Gnu             & stuffed       & 92.50      \\  
  Emu             & stuffed       & 33.33      \\\hline  
\end{tabular}  
\caption{Default \LaTeX\ table.}
```

## `\usepackage{booktabs}`

Item		
Animal	Sold	Price (\$)
Gnat	per gram	13.65
	each	0.01
Gnu	stuffed	92.50
Emu	stuffed	33.33

**Table 2:** Booktabs table and styling.

# \usepackage{booktabs}

```
\begin{tabular}{llr}  
  \toprule  
  \multicolumn{2}{c}{Item} & \\\cmidrule{1-2}  
  Animal          & Sold          & Price (\$) \\\midrule  
  Gnat            & per gram      & 13.65      \\  
                  & each          & 0.01       \\  
  Gnu             & stuffed       & 92.50      \\  
  Emu             & stuffed       & 33.33      \\  
  \bottomrule  
\end{tabular}  
\caption{Booktabs improves table spacing.}
```



# `\usepackage{pgfplotstable}`

pgfplotstable can read data in from file (e.g. a `.csv` file) and automatically format the data as a table.

Consider that I have some `.csv` file:

Element ,	Number ,	Mass
H ,	1 ,	1.00794
He ,	2 ,	4.00260
Li ,	3 ,	6.94100
Be ,	4 ,	9.01218

# `\usepackage{pgfplotstable}`

Element	Atomic	
	Number	Mass
H	1	1.00794
He	2	4.00260
Li	3	6.94100
Be	4	9.01218

**Table 3:** pgfplotstable can read input files.

# `\usepackage{pgfplotstable}`

```
\pgfplotstabletypeset[col sep=comma,
  string type,

  every head row/.style={
    before row={\toprule
                 & \multicolumn{2}{c}{Atomic}
                 \\ \cmidrule{2-3}},
    after row={\midrule}},

  every last row/.style={after row=\bottomrule}
]{elements.csv}
\caption{pgfplotstable can read input files.}
```

# `\usepackage{pgfplotstable}`

pgfplotstable can round numbers as desired:

Element	Atomic	
	Number	Mass
H	1	1.008
He	2	4.003
Li	3	6.941
Be	4	9.012

**Table 4:** pgfplotstable understands precision and rounding.

# `\usepackage{pgfplotstable}`

```
\pgfplotstabletypeset[col sep=comma,  
  columns/Number/.style={string type},  
  columns/Element/.style={string type},  
  columns/Mass/.style={fixed zerofill,  
                        precision=3},
```

:

: (As in earlier example)

:

```
\caption{pgfplotstable understands precision  
         and rounding.}
```

## Even *more* table generators

In addition to pgfplotstable there are various other table generators:

- `pandas.DataFrame.to_latex` (Python users)
- `xtable` (R users)
- `Excel2latex` (Excel users)
- `matrix2latex` (Matlab users)

# A few others

- tikz
- standalone
- fancyhdr
- multirow
- ifdraft
- titlesec
- microtype
- natbib
- geometry
- todonotes

## Exercise 3



# Common mistakes

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## Hyphen, en-dash and em-dash (-, –, —)

- The **hyphen** (-) is used to join words in a compound construction. “A long-term solution”
- An **en-dash** (–) appears in page ranges. “See pages 1–3”
- An **em-dash** (—) is typically used as a stand-in for a comma or parenthesis to separate out phrases. “Against all odds, Boris — the class clown — became prime minister.”

# Quotes

$\text{\LaTeX}$  requires you to use separate markup for opening and closing quotes.

Opening quotes are ‘ ‘

Closing quotes are ’ ’

Quotes should look “like this” not "like this".

# Capitalisation in BibTeX

Your BibTeX style will handle most capitalisation. For some words (names, places, ...) capitalisation must be ensured

```
@book{springer57,  
  title="Introduction to {R}iemann surfaces",  
  author="Springer, George",  
  volume="473",  
  year="1957",  
  publisher="Addison-Wesley Reading"  
}
```

# Typing maths

Brackets should be large enough to completely enclose all they contain.

$$\left(\sum_{i=1}^{n-1} i\right) + n$$

`(\sum_{i=1}^{n-1} i) + n`

$$\left(\sum_{i=1}^{n-1} i\right) + n$$

`\bigg( \sum_{i=1}^{n-1} i \bigg) + n`

# Typing maths

`$a, b, c, d, e \text{ and } f$`

*$a, b, c, d, e$  and  $f$*

`$a$, $b$, $c$, $d$, $e$ and $f$`

*$a, b, c, d, e$  and  $f$*

`$i=1,\dots,10$`

*$i = 1, \dots, 10$*

`$i=1,\ldots,10$`

*$i = 1, \dots, 10$*

`$\sin(x)^2 + \cos(x)^2 = 1$`

*$\sin(x)^2 + \cos(x)^2 = 1$*

`$\sin(x)^2 + \cos(x)^2 = 1$`

*$\sin(x)^2 + \cos(x)^2 = 1$*

## **Exercise 4**

# Conclusion

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# Resources

- First point of call: [stack exchange](#)
- [The not so short introduction to  \$\text{\LaTeX}\$  2 \$\epsilon\$](#)
- [More Math into  \$\text{\LaTeX}\$  4th edition](#) (hard copies available at library)
- [CTAN](#): comprehensive  $\text{\TeX}$  Archive Network
- You should be aware of: [official university guidelines](#)

Leslise Lamport, initial developer of  $\text{\LaTeX}$ , was asked what three  $\text{\LaTeX}$  mistakes people should stop making:

1. Worrying too much about formatting and not enough about content.
2. Worrying too much about formatting and not enough about content.
3. Worrying too much about formatting and not enough about content.

Source

# Feedback and the future

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- Please complete workshop evaluation
- Feedback is anonymous