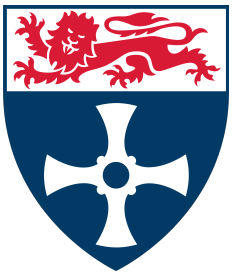
# simple-thesis: a LaTeX class for PhD theses



Philip Darke

School of Computing

Newcastle University

A thesis submitted for the degree of

*Doctor of Philosophy*

Month Year

This page is intentionally blank

*Dedication goes here*

This page is intentionally blank

## Abstract

Proin a luctus dui. Integer in metus a tellus venenatis luctus eget nec felis. Aenean mauris purus, egestas consequat consequat eu, aliquam et elit. Nulla molestie sem dui, vitae vulputate ante tempus ut. Vestibulum lacinia, nulla ac consequat laoreet, augue enim vehicula ipsum, non ultrices odio nulla et quam. Curabitur rutrum diam ante, et laoreet nisl viverra non. Nullam aliquet dapibus enim, a pretium purus pretium finibus. Etiam varius venenatis dui, vitae ultricies justo dictum vel. Integer orci sem, porta quis augue sit amet, elementum placerat est. Suspendisse non nunc auctor, molestie justo id, porttitor odio. In nisl lorem, scelerisque ut aliquet ac, dapibus quis est. Praesent a ex tempor, pharetra purus quis, ornare nisi. Nam sagittis, tellus non mattis maximus, nisl purus scelerisque ante, ac placerat massa tellus non dolor. Integer fermentum sem diam, a lobortis leo consequat a. Donec sagittis justo turpis, tempor ullamcorper massa lobortis nec. Nam quam ipsum, porta sed varius at, rutrum sed nisi.

Quisque pellentesque enim vitae ipsum lacinia congue. Pellentesque suscipit erat libero, eget luctus mauris sagittis a. Quisque suscipit velit id egestas pretium. Vestibulum diam ante, rutrum at odio quis, vulputate commodo lorem. Ut facilisis nisi turpis, vel maximus sapien blandit at. Curabitur eget scelerisque ex. Sed posuere in odio ac consequat. Nam nulla magna, ultrices et rutrum at, consequat scelerisque ligula. Sed a leo tortor. Quisque semper nibh non nisl mollis, eu bibendum risus porta. Aliquam at nisl id est mattis varius.

Duis vestibulum at quam sit amet aliquam. Vivamus viverra sagittis nisi. Vivamus ut orci ultricies, auctor magna non, vehicula ipsum. Suspendisse dapibus lacinia lobortis. Proin vitae lorem euismod, vulputate purus auctor, aliquet mauris. Vestibulum id maximus sem, nec efficitur massa. Fusce nisl nulla, pharetra vitae sapien vitae, iaculis iaculis sapien. Sed non ultricies nisi. Phasellus blandit risus quis commodo.

This page is intentionally blank

# Acknowledgements

Curabitur suscipit urna augue, egestas semper nulla congue vel. Donec imperdiet, mauris a finibus maximus, nisi enim eleifend mi, ut blandit elit dui ac metus. Duis ac augue a nibh facilisis porta et ut felis. Aenean varius in ipsum nec elementum. Proin ac elementum diam. Sed est ex, efficitur et risus a, porta euismod velit. Interdum et malesuada fames ac ante ipsum primis in faucibus. Suspendisse convallis placerat lectus vel condimentum. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Curabitur ut velit ex. Praesent sit amet dolor quis diam cursus sodales. Ut at dui vehicula, euismod arcu vel, elementum enim. Vestibulum id nunc non lacus lobortis efficitur ut non augue. Proin bibendum odio vitae placerat euismod. Cras gravida egestas fringilla. Aliquam in mi orci.

This page is intentionally blank

# Contents

**Abstract** i

**Acknowledgements** iii

**Contents** v

**List of Figures** vii

**List of Tables** ix

**1 Introduction** 1

1.1 Background . . . 1
1.2 Aims and Objectives . . . 2
1.3 Thesis Introduction . . . 2
1.4 Summary . . . 2

**2 How to Use the Class** 5

2.1 Package Options . . . 5
2.2 Thesis Formatting . . . 5
2.2.1 Chapters and sections . . . 5
2.2.2 Tables and figures . . . 5
2.2.3 Mathematics . . . 6
2.2.4 Cross-references . . . 6
2.2.5 Bibliography . . . 7
2.2.6 Notation, acronyms and abbreviations . . . 10
2.2.7 Index . . . 10
2.2.8 Quotes . . . 10
2.2.9 Formatting numbers . . . 10
2.2.10 University logo . . . 11
2.3 To-Do Notes . . . 11
2.4 Building the PDF . . . 11
2.4.1 GitHub Actions . . . 11
2.4.2 Locally . . . 11

**3 Conclusion** **13**
3.1 Summary . . . . . 13
3.2 Future Work . . . . . 13

**A Packages Used** **15**

**Bibliography** **16**

**Notation** **19**

**Acronyms and abbreviations** **21**

**Index** **23**

# List of Figures

2.1 Example figure with three sub-figures. Larger margins and a smaller font are used to help distinguish captions from the main text. . . . . 6

2.2 Example landscape figure (image by Penny from Pixabay). Newcastle University thesis guidelines state the "*top of tables/figures printed sideways should align to the left of the page*". The `rotating` package aligns them centrally and a bug prevents changing this (easily). If this is important to you, a workaround is to add `\vspace{Xmm}\hspace{0pt}` below the caption. Adjust `X` to push the table/figure up to the correct position. . . . 8

This page is intentionally blank

# List of Tables

2.1 Example table. Tables are formatted with `booktabs` and additional spacing between rows. . . . . 6
2.2 Example landscape table using `threeparttable` to add footnotes. Aligned using the same trick as figure 2.2 but centering the table would look better? 9

A.1 Packages loaded by `simple-thesis` in a `longtable` environment spanning two pages. . . . . 16

This page is intentionally blank

# Chapter 1. Introduction

Aenean imperdiet ex vitae mi imperdiet iaculis. Fusce in dictum tortor, quis dignissim dolor. Interdum et malesuada fames ac ante ipsum primis in faucibus. Etiam vitae posuere libero, id viverra nulla. Curabitur mattis elit in tortor egestas ultricies. Pellentesque elit risus, vehicula a porta sed, tristique et mauris. Sed quis aliquam urna. Sed interdum suscipit purus, vel cursus ex. Morbi imperdiet purus sit amet enim scelerisque elementum. Integer vel efficitur mi, faucibus condimentum mauris. Nulla vel quam ut eros mattis maximus. Aenean sit amet tincidunt tortor. Donec placerat lectus massa, et sagittis dolor pulvinar quis.

Suspendisse tellus neque, sagittis ut felis vel, imperdiet vestibulum magna. Nullam et arcu quis tortor consectetur dignissim. Vivamus eu ipsum venenatis, laoreet elit quis, euismod odio. Suspendisse eget pharetra tellus. Proin fermentum orci ex, vitae vulputate felis pharetra at. Vivamus placerat orci nisl, at facilisis augue sollicitudin eget. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aliquam mollis, felis eget vestibulum interdum, felis nibh volutpat nibh, et sollicitudin ante augue non turpis. Cras vitae condimentum massa, vel condimentum metus. Mauris in sem finibus, cursus nulla quis, egestas diam. Fusce eget lorem felis. Ut euismod commodo ligula nec volutpat. Integer eros eros, eleifend sed pharetra accumsan, imperdiet at quam.

## 1.1 Background

Suspendisse iaculis nisi ut massa feugiat, ut rutrum metus facilisis. Sed ut risus quam. Aliquam quis rhoncus quam. Aenean imperdiet varius justo in efficitur. Sed posuere magna et ipsum placerat mollis. Suspendisse tempor ipsum ut est condimentum viverra. Fusce non libero augue. Ut tempor ut ipsum id blandit. Donec suscipit tempus purus, eu tempus diam vestibulum sit amet. Sed velit lacus, molestie vitae iaculis sit amet, lacinia eu purus. Donec ac tempus eros. Ut eget aliquet sem. Cras vitae augue porta, posuere mauris sit amet, luctus lacus. Sed porttitor massa eros, quis interdum erat mollis in.

Sed in elit sit amet lectus ornare rhoncus vel ut velit. Aliquam sit amet magna quam. Vestibulum ullamcorper justo id nunc tincidunt mattis. Ut sem purus, molestie a imperdiet vitae, tempor sed erat. Maecenas egestas tincidunt nisl, sit amet egestas felis laoreet nec. Phasellus sodales aliquet porttitor. Nulla libero orci, fringilla ac laoreet volutpat, ultricies sed magna. Mauris ac diam nec elit imperdiet auctor tempor in tellus. In ullamcorper odio in mollis dictum. Suspendisse blandit, tortor sit amet interdum gravida, ante leo iaculis orci, a maximus turpis erat id eros.

## 1.2 Aims and Objectives

Vivamus pretium est a lacus faucibus, sit amet mollis lacus tincidunt. Mauris interdum, dui ut dictum venenatis, ante ligula molestie arcu, quis pulvinar sapien orci ut nisl. Ut sit amet hendrerit elit, feugiat finibus felis. Nulla quis ex at justo bibendum hendrerit. Aliquam sed hendrerit ipsum. Pellentesque efficitur ligula at fermentum malesuada. Etiam rhoncus est ex, vel luctus ante porta et.

Aliquam tortor felis, pulvinar eget euismod convallis, tincidunt non velit. In hac habitasse platea dictumst. Quisque dignissim nunc sollicitudin, cursus risus nec, ultrices ipsum. Vivamus turpis urna, ornare nec feugiat vel, lobortis sed mauris. Nunc dignissim erat sed neque dignissim, in ullamcorper libero pellentesque. Aenean rutrum dolor sed sapien fringilla egestas. Vestibulum scelerisque, orci nec rhoncus molestie, ipsum neque aliquet eros, vitae hendrerit lacus purus in ex. Suspendisse tempor turpis dolor, in efficitur dolor rutrum sed. Integer maximus sem augue, ac pharetra augue porta vitae. Mauris ipsum felis, lobortis eu luctus vitae, condimentum id turpis. Nunc at aliquet nulla, sed aliquet libero.

## 1.3 Thesis Introduction

In vestibulum sit amet odio a euismod. Vestibulum turpis purus, condimentum in tempus a, consectetur eu orci. Integer nec euismod sem, eget porta purus. Integer cursus purus felis, et vestibulum ipsum fermentum sed. Morbi viverra consectetur sollicitudin. Phasellus ullamcorper facilisis nunc eu varius. Nam in enim quis libero dictum commodo dapibus ut tellus. Sed ornare at ante ut sagittis. Etiam efficitur interdum elit et commodo. Ut justo ex, vehicula vel tempor quis, vestibulum et mauris. Proin in lobortis quam. Mauris nec auctor lectus. Phasellus egestas est at purus vulputate, ut lobortis metus euismod.

Maecenas sollicitudin velit sit amet ullamcorper hendrerit. Vivamus a massa non tellus viverra bibendum ac ac purus. Vivamus a lacinia turpis. Integer id sem fringilla augue aliquet fermentum id sed lacus. In et porttitor ante. Maecenas interdum cursus dignissim. Cras tempus hendrerit hendrerit. Morbi lacus purus, iaculis vitae molestie et, sollicitudin eget ex. Vestibulum dui lacus, consequat a dolor id, eleifend fringilla risus. Curabitur at turpis dolor. Nulla vel nibh pulvinar nibh rhoncus scelerisque ac in dolor. Aenean volutpat odio eu nisl luctus consequat. Sed a aliquet quam. Sed nec est tortor.

## 1.4 Summary

Proin eu sapien ligula. Etiam nec eleifend magna, nec blandit elit. Quisque maximus tincidunt mi. In aliquam tempor tortor, volutpat facilisis neque molestie ac. Praesent in fermentum metus. Nullam fermentum libero sed massa aliquam, sit amet venenatis arcu lobortis. Cras ornare, libero et facilisis rutrum, dolor eros hendrerit eros, eu rutrum urna nulla vitae felis. Quisque ac metus vel nulla convallis placerat. Suspendisse quis libero lacinia, consequat eros vel, porttitor mi. Pellentesque habitant morbi tristique senectus

et netus et malesuada fames ac turpis egestas. Suspendisse mauris magna, consequat eu diam vitae, porttitor elementum lorem.

Cras non rhoncus urna. Morbi egestas tellus et turpis suscipit hendrerit. Nulla facilisis ante enim, sit amet congue ligula volutpat quis. Vivamus metus enim, eleifend eu pellentesque ut, congue feugiat est. Etiam aliquet tortor quis orci malesuada, at pulvinar ex accumsan. Curabitur non justo dui. Morbi molestie erat in justo fermentum sagittis.

This page is intentionally blank

# Chapter 2. How to Use the Class

Use the provided directory structure for your content. Chapters and appendices should be placed in directories called `chapterX` and `appendixX` respectively.[1] Update `thesis.tex` where highlighted and build the PDF to create the thesis.

## 2.1 Package Options

`oneside` Double-sided is the default. Use the `oneside` option for a single-sided thesis.[2]

`draft` Use the `draft` option to add a word count, line numbers etc and enable to-do notes (see section 2.3). Remove the draft option to create the final thesis for printing.

`pdf` You may wish to also disseminate your thesis as a PDF. Use the `pdf` option to format the thesis for reading on screen.[3]

## 2.2 Thesis Formatting

### *2.2.1 Chapters and sections*

Use the `\thesischapter` command to create a new chapter. Sections and sub-sections are created using `\thesissection` and `\thesissubsection` respectively. Chapter and section titles will be converted to Title Case when using these commands. Alternatively, the usual `\chapter`, `\section` and `\subsection` commands work as normal.

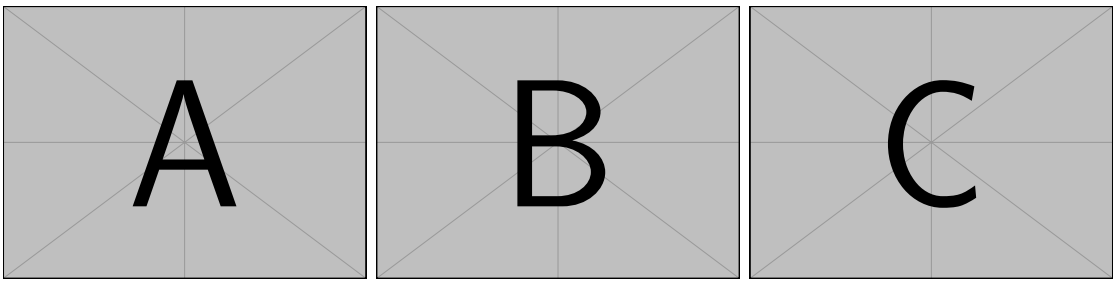
### *2.2.2 Tables and figures*

Include tables and figures in the usual way. Captions should be placed at the bottom. LaTeX will look in the `images/` and `figures/` directories for graphics.

[1] You can use a different structure but this may break the word count and PDF builds on GitHub.

[2] Single-sided theses appear to be more common. A double-sided thesis includes blank pages to ensure that chapters start on the right (i.e. odd) page. These blank pages can however look odd when viewing as a PDF – see the `pdf` option.

[3] Hyperlinks are shown in blue, pages with landscape tables/figures are rotated and blank pages inserted in two-sided theses are marked "This page is intentionally blank". Margins are equalised to remove the binding edge.




(a) A sub-figure... (b) ...another... (c) ...and another

Figure 2.1: Example figure with three sub-figures. Larger margins and a smaller font are used to help distinguish captions from the main text.

| | Metric A | Metric B | Metric C | Metric D |
|---|---|---|---|---|
| Model A | 10.431 | 0.154 | 0.715 | 28.871 |
| Model B | 25.488 | 0.279 | 0.190 | 14.992 |
| Model C | 14.992 | 0.396 | 0.280 | 20.947 |
| Model D | 20.947 | 0.362 | 0.412 | 20.558 |
| Model E | 21.137 | 0.006 | 0.411 | 2.665 |
| Model F | 19.445 | 0.513 | 0.242 | 16.087 |

Table 2.1: Example table. Tables are formatted with `booktabs` and additional spacing between rows.

### 2.2.3 Mathematics

Use the `\vect`, `\matr` and `\tens` commands to format vectors, matrices and tensors respectively. These are all bold italic by default ($\boldsymbol{x}$, $\boldsymbol{X}$ and $\boldsymbol{\mathsf{X}}$ respectively) and can be customised from lines 176 in `simple-thesis.cls`. The `isomath` package is used to comply with ISO 80000-2 e.g. sans-serif tensors.

The `amsmath`, `amssymb` and `amsthm` packages are used to typeset equations and theorems:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right) \tag{2.1}$$

**Theorem 1.** *Your theorem here.*

*Proof.* Your elegant proof. □

### 2.2.4 Cross-references

Insert cross-references using `\cref{label}` for "figure 2.1" or `\Cref{label}` for a capitalised reference e.g. "Figure 2.1". Sub-figures can also be referenced e.g. figure 2.1a. See `cleveref` for more information.

### 2.2.5 Bibliography

The `biblatex`[4] bibliography management package is used. Update `refs.bib` and use `\cite{}` or `\parencite{}` to insert a numbered reference e.g. [1]. Author names can be included using `\textcite{}` e.g. "LeCun *et al.* [1] state that ...". The default citation style is `numeric-comp`[5] which is similar to IEEE but compressed e.g. multiple authors show as "*et al.*" and multiple citations as [1, 2] or [1-3]. The bibliography style is `IEEE`[6]. These can be updated in `simple-thesis.cls`, see the "Bibliography" section.

[4] See https://www.overleaf.com/learn/latex/Bibliography_management_with_biblatex.
[5] See https://www.overleaf.com/learn/latex/Biblatex_citation_styles.
[6] See https://www.overleaf.com/learn/latex/Biblatex_bibliography_styles.

Figure 2.2: Example landscape figure (image by Penny from Pixabay). Newcastle University thesis guidelines state the "*top of tables/figures printed sideways should align to the left of the page*". The `rotating` package aligns them centrally and a bug prevents changing this (easily). If this is important to you, a workaround is to add `\vspace{Xmm}\hspace{0pt}` below the caption. Adjust `X` to push the table/figure up to the correct position.

| | Metric A | Metric B | Metric C[1] | Metric D | Metric E | Metric F | Metric G[2] | Metric H | Metric I | Metric J |
|---|---|---|---|---|---|---|---|---|---|---|
| *Results on first data set*[3] | | | | | | | | | | |
| Model A | 0.226 | 0.101 | 10.233 | **26.374** | **24.131** | **0.088** | **10.431** | 0.154 | 0.715 | 28.871 |
| Model B | 0.141 | 0.639 | 2.667 | 5.598 | 21.113 | 0.116 | 25.488 | 0.279 | **0.190** | **14.992** |
| Model C[4] | 0.416 | 0.992 | **29.190** | 12.098 | 16.279 | 0.127 | 14.992 | **0.396** | 0.280 | 20.947 |
| Model D | **0.107** | **0.033** | 4.021 | 19.004 | 17.760 | 0.388 | 20.947 | 0.362 | 0.412 | 20.558 |
| *Results on second data set* | | | | | | | | | | |
| Model A | 0.597 | 0.319 | 22.949 | 5.168 | **23.286** | 0.569 | 21.137 | 0.006 | 0.411 | **2.665** |
| Model B | **0.157** | 0.365 | 25.848 | 12.653 | 20.702 | **0.180** | 19.445 | 0.513 | **0.242** | 16.087 |
| Model C[4] | 0.707 | **0.181** | 26.791 | 15.969 | 17.307 | 0.129 | 17.946 | 0.553 | 0.695 | 19.445 |
| Model D | 0.496 | 0.861 | **26.956** | **20.050** | 13.525 | 0.272 | **2.665** | **0.902** | 0.291 | 7.472 |

[1] A note about metric C.
[2] A note about metric G.
[3] Caveat about the first data set.
[4] Important point about model C.

Table 2.2: Example landscape table using `threeparttable` to add footnotes. Aligned using the same trick as figure 2.2 but centering the table would look better?

### 2.2.6 Notation, acronyms and abbreviations

It is helpful to include a section with the definitions of any acronyms and abbreviations used in your work. This is automated using glossaries. When introducing a new acronym/abbreviation, define it with `\newacronym{tag}{acronym}{definition}`[7], for example `\newacronym{nn}{NN}{neural network}`.

The acronym is inserted using `\gls{tag}`. The first instance of `\gls{nn}` shows as "neural network (NN)". Subsequent uses are abbreviated with a hyperlink[8] to the glossary e.g. "NN". `\Gls{tag}` capitalises the initial letter of the abbreviation, and `\Glspl{tag}` and `\glspl{tag}` use the plural form.

The notation section is populated by adding definitions to `notation/notation.tex`. The `name` is required for sorting but the `symbol` and `description` are displayed, e.g.:

```
\newglossaryentry{n}{
  name={N},
  description={Set of natural numbers \{0, 1, 2, \dots\}},
  symbol={\ensuremath{\mathbb{N}}}
}
```

### 2.2.7 Index

An index is generated by including the `\index{topic}` command when you discuss a topic. Index entries can also have sub-items e.g. `\index{topic!subtopic}`. The index includes hyperlinks to the relevant page.

### 2.2.8 Quotes

Enclose quotes between `\begin{quote}[source]{author}` and `\end{quote}`. The `source` and `author` should be left empty if unused i.e. `\begin{quote}[]{}`).

> ...there is a useful and meaningful distinction between text numerals and mathematical numerals. Text numerals are used in contexts like "1776" and "Chapter 5"..., where the numbers are essentially part of the English language; mathematical numerals, by contrast, are used in contexts like "the greatest common divisor of 12 and 18 is 6", where the numbers are part of the mathematics.
>
> *Donald E. Knuth — Typesetting Concrete Mathematics*

### 2.2.9 Formatting numbers

Note the difference between the two sets of numerals in the quote. Use `\oldnum` for "old style" numerals (0123456789). `\num` formats "lined" numerals (0123456789) for exam-

[7] The definition should be lower case and singular.
[8] To improve readability, glossary links are only highlighted in draft mode e.g. NN.

ple with separating commas (`\num{1234567.890123}` = 1,234,567.890 123) or scientific notation (`\num{1.234e-5}` = $1.234 \times 10^{-5}$). The `siunitx` package can also typeset units.

#### 2.2.10 University logo

Replace `logo.png` in the `./images/` directory to update the title page logo.

### 2.3 To-Do Notes

To-do notes are provided by `todonotes`. Use:

- `\todonote{}` to create a to-do
- `\reference{}` to note a missing reference
- `\issue{}` to highlight a problem
- `\misc{}` for a miscellaneous note

When the `draft` package option is used, to-do notes are summarised on the first page. All to-do notes are disabled when producing the final thesis. Text can also be highlighted using `\hl{}`.

### 2.4 Building the PDF

#### 2.4.1 GitHub Actions

The thesis is built each time you push the repository to GitHub![9] Go to the `Actions` tab, choose the commit (the top one is the most recent) and download by clicking `thesis-[TIMESTAMP]` under `Artifacts`.

#### 2.4.2 Locally

Type `make` in the thesis directory to build the PDF.[10] This has been tested on Ubuntu with TexLive[11] and MacOS with MacTeX[12]. If the document fails to build, try `make purge` to delete all output and intermediate files[13].

`make standalone` builds a standalone PDF for a single chapter. See the example stub file `chapter1/chapter1-standalone.tex` which should be placed in each chapter directory.

If you are unable to use `make` or `latexmk`, or prefer to use a recipe in Visual Studio Code or TeXStudio:

[9] The main `.tex` file must be named `thesis.tex`, and the `introduction/`, `chapterX/`, `conclusion/` directory structure must be followed.

[10] This uses `latexmk` to automate the build with the `pdflatex` engine, `biber` for references and the glossary/index configuration in `.latexmkrc`.

[11] Ubuntu 18.04, 20.04 and 22.04 with TexLive installed using `sudo apt install texlive-full`

[12] MacOS Monterey 12.5.1 with MacTeX installed using `brew install --cask mactex-no-gui`

[13] The `make clean` command removes intermediate files only.

1. To generate the word count files run:

```
texcount abstract/* *.tex -sum=1,0,1 -inc -out=wordcount.txt
texcount abstract/* -sum=1,0,1 -1 -out=wordcount.abstract
texcount introduction/* chapter*/* conclusion/* -sum=1,0,1 -brief -out=wordcount.summary
texcount introduction/* chapter*/* conclusion/* -sum=1,0,1 -1 -out=wordcount.total
```

2. To generate the bibliography, acronyms and index sections run:

```
pdflatex thesis.tex
biber thesis
makeglossaries thesis
makeindex thesis
```

3. To build the final thesis, you will need to run `pdflatex thesis.tex` at least another two times to add all the sections and update the table of contents.

# Chapter 3. Conclusion

Mauris sollicitudin dictum nulla eleifend pulvinar. Nulla sodales, tellus nec molestie tempor, ligula sem sollicitudin mauris, quis hendrerit enim ipsum ac metus. Proin at tincidunt purus. Cras rutrum vel tortor vel posuere. Aliquam erat volutpat. Nunc scelerisque maximus orci, ut maximus nisi congue vel. Fusce vitae lectus id arcu volutpat tristique semper nec sem.

## 3.1 Summary

Pellentesque elementum, risus ac pulvinar efficitur, mauris ipsum dictum sem, nec varius mauris neque at tellus. Quisque pulvinar sem eget est tempus cursus. Donec ipsum nunc, euismod quis sodales id, condimentum vel tellus. Nunc ultrices, tortor in placerat cursus, erat diam scelerisque odio, luctus bibendum velit ante ac est. Praesent fringilla sollicitudin felis sit amet auctor. Curabitur eros arcu, porta non laoreet vitae, feugiat at orci. Donec efficitur est in sodales pellentesque. Maecenas a elit nec ligula dictum tristique eget ac nibh. Duis in tempus erat, pretium blandit nisl. Sed a maximus leo.

Vestibulum ac ultrices ante, in gravida justo. In hendrerit tellus ac nibh suscipit, sed elementum sem mollis. Orci varius natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Morbi non semper orci, et ornare libero. Aliquam erat volutpat. Mauris interdum a tellus quis aliquam. Sed dignissim, tortor et accumsan dapibus, nisl nisl mattis magna, sit amet tincidunt eros lorem at ipsum. Sed a nunc sit amet quam venenatis sodales. Pellentesque ut ipsum neque. Phasellus accumsan tellus et purus semper, at sollicitudin neque pellentesque. Mauris varius erat et justo sodales, sit amet vulputate elit varius. Morbi quis dolor non ante dictum faucibus. Morbi aliquam pretium elit. Donec a ligula lacus.

## 3.2 Future Work

Ut feugiat, tortor id sagittis maximus, libero sem auctor nisi, rutrum mattis lacus velit ut odio. Nulla pretium tincidunt iaculis. Vivamus est purus, iaculis vel ornare eu, gravida eu est. Aenean ac porttitor augue. Etiam sit amet maximus enim. Donec semper, justo ut scelerisque porta, risus libero porttitor est, quis mattis urna enim eget lorem. Maecenas nec est quam. Morbi rhoncus diam a vehicula finibus. Curabitur fermentum, libero a venenatis dictum, nibh nisl luctus velit, in consequat nibh eros a erat. Sed sagittis molestie nisi, sed tristique eros malesuada vitae. Praesent tempor sed dui sed vehicula.

Nullam vehicula urna nec malesuada placerat. Quisque pulvinar tortor orci, posuere cursus magna eleifend at. In varius sagittis fermentum. Nullam volutpat eros quam, eu volutpat diam fermentum vestibulum. Integer ut orci vehicula, ultrices arcu vel, aliquam sem. Duis pulvinar tellus et ex molestie, vitae sagittis tellus venenatis. Vestibulum ultrices pretium blandit. Integer eget mi suscipit, laoreet ante ac, accumsan diam. Curabitur pulvinar, augue egestas pharetra volutpat, lectus risus accumsan velit, sed imperdiet nunc felis ac neque.

# Appendix A. Packages Used

| Package | Used to... |
|---|---|
| *Typesetting* | |
| `anyfontsize` | Set font sizes e.g. 14pt headings |
| `emptypage` | Empty pages when printing two-sided |
| `enumitem` | Customise enumerate and itemize environments |
| `fancyhdr` | Customise headers and footers |
| `geometry` | Set page margins |
| `microtype` | Improve typesetting |
| `pdflscape` | Rotate landscape pages in PDF |
| `setspace` | Change line spacing |
| `siunitx` | Format numbers and units |
| `titlecaps` | Typeset chapter and section headings in Title Case |
| `titlesec` | Customise headings |
| `tocbibind` | Include bibliography etc in table of contents |
| `xcolor` | Set colours |
| *Referencing* | |
| `biblatex` | Reference sources |
| `cleveref` | Format cross-references |
| `glossaries` | Create acronyms and abbreviations section |
| `hyperref` | Create hyperlinks |
| `hypcap` | Ensure hyperlinks point to top of tables/figures |
| `makeidx` | Create index |
| `url` | Easy website links |
| *Tables and figures* | |
| `array` | Format table cells |
| `booktabs` | Format tables |
| `caption` | Customise captions |
| `float` | Place table/figures with `H` |
| `graphicx` | Include figures |
| `longtable` | Span long tables over pages |

*continued on next page...*

*. . . continued from previous page*

| | |
|---|---|
| `multirow` | Format multi-row cells in tables |
| `rotating` | Add landscape tables and figures |
| `subcaption` | Add sub-captions to figures |
| `tabularx` | Control table widths |
| `threeparttable` | Add table footnotes |
| *Mathematics* | |
| `amsmath` | Typeset equations |
| `amssymb` | Typeset equations |
| `amsthm` | Typeset theorems/lemmas etc |
| `bm` | Typeset matrices |
| *Draft package option* | |
| `datetime2` | Add date/time in footer |
| `draftwatermark` | Add draft watermark |
| `lineno` | Add line numbers |
| `soul` | Highlight text |
| `todonotes` | Add to-do notes |
| *Other packages* | |
| `etoolbox` | Environment hooks etc |
| `ifdraft` | Control logic in class file |
| `ifthen` | Control logic in class file |
| `verbatim` | Include the word count file |

Table A.1: Packages loaded by `simple-thesis` in a `longtable` environment spanning two pages.

# Bibliography

[1] Y. LeCun, Y. Bengio, and G. Hinton, "Deep learning," *Nature*, vol. 521, no. 7553, pp. 436–444, May 2015. DOI: 10.1038/nature14539.

This page is intentionally blank

# Notation

$\mathbb{N}$ Set of natural numbers $\{0, 1, 2, \dots\}$

This page is intentionally blank

# Acronyms and abbreviations

NN neural network

This page is intentionally blank

# Index

Building the PDF, 11
    Using GitHub, 11

Formatting
    acronyms, 10
    chapters, 5
    cross-references, 6
    equations, 6
    figures, 5
    notation, 10
    numbers, 10
    quotes, 10
    sections, 5
    tables, 5
    theorems, 6
    title-page logo, 11