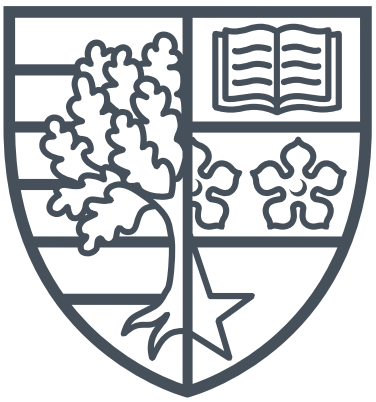
A REALLY AWESOME UNIVERSITY GUIDELINE-COMPLIANT THESIS

by

Your Name



Submitted for the degree of
Doctor of Philosophy

Institute of Photonics and Quantum Sciences
School of Engineering and Physical Sciences
Heriot-Watt University

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Abstract

Write the abstract here.

In accordance with the Academic Regulations the thesis must contain an abstract preferably not exceeding 200 words, bound in to precede the thesis. The abstract should appear on its own, on a single page. The format should be the sameas that of the main text. The abstract should provide a synopsis of the thesis and shall state clearly the nature and scope of the research undertaken and of the contribution made to the knowledge of the subject treated. There should be a brief statement of the method of investigation where appropriate, an outline of the major divisions or principal arguments of thework and a summary of any conclusions reached. The abstract must follow the Title Page.

Thesis guidelines can be found at:
`https://www.hw.ac.uk/uk/students/doc/guidelinesonsubmissionandformatofthesis.pdf`

The Introduction Chapter gives some more details, and provides an introduction to the features contained in this template

Disclaimer and Statement of Intent - This is an unofficial LaTeX template, updated by me, Alex. I am not an expert, so there may be small issues, but I have tested this offline in TeXworks, and online in Overleaf and it works in both those cases. I just did this to be nice, the spirit of education should encourage us all to help each other, even in the small ways. If this helps you save time and some annoyance, maybe think about some way you could make another persons life a little easier? As David Graeber put it: '*the ultimate, hidden truth of the world is that it is something that we make, and could just as easily make differently.*'

Acknowledgements

You can write whatever you want to in the Acknowledgements, I have seen thanks to videogames, rubber ducks, takeaway restaurants, Karl Marx and so on. Some people even go as far as to put down things or people that got in the way of their thesis. If you consider going that route, keep things civil! Still, this is your space, there's no real guidelines, include a fancy quote then several paragraphs about ghosts if you like, or maybe a poem that speaks to you. Have a think about it.

After this comes the mandatory table of contents.

Lists of Tables and Figures, Glossary, List of Publications by the Candidate

It is *optional* to provide these lists. If provided, then they should start on the page following the table of contents and be in the order: Tables, Figures, Glossary (list of abbreviations), Publications.

Items in lists of Tables and Figures should be in the order in which they occur in the text.

Contents

List of Tables

List of Figures

Acronyms

HMWWAWCIAWCCW How much wood would a woodchuck chuck if a woodchuck could chuck wood?

JAU Join a Union

Optional Including a list of used terms/acronyms is totally optional

WYSIWYG What you see is what you get

Chapter 1

Introduction

1.1 Thesis Structure Details

For the Degree of Doctor of Philosophy the thesis shall not normally exceed 80,000 words and shall not normally exceed 400 pages in length including Appendices, with a limit of no more than 100,000 words. In exceptional circumstances, the Research Degrees Committee will consider requests for thesis exceeding 100,000 on a case by case basis. The number of pages of a thesis exceeding 80,000 words in length shall be increased on a pro rata basis in accordance with the word limit. For the Degree of Doctor of Philosophy by Published Research, a critical review of the published research which shall be in the range of 10,000 to 25,000 words must be submitted.

Chapter 1 of the thesis must be an Introduction, so headed, defining the relation of the thesis to other work in the same field and referring appropriately to any findings, propositions or new discoveries contained in the thesis and to any important points about sources or treatment.

Thesis guidelines can be found at:
`https://www.hw.ac.uk/uk/students/doc/guidelinesonsubmissionandformatofthesis.pdf`

Related documents and forms at: `https://www.hw.ac.uk/uk/students/studies/examinations/thesis.htm`

1.1.1 Layout details

In the main tex document `HWThesis.tex` the margins are set, and the left margin is larger than the right one. This is because the PhD thesis you submit will be printed one-side rather than double sided. So in any two spread the printed page will be the one on the right hand side. Therefore, the left side of every page will connect to the thesis binding, so you need an extra large margin to make sure none of your images or text are hidden by the binding.

1.1.1.1 Paragraph indentation

I have turned off the LaTeX default of having the first line of each paragraph be indented. If you want to turn that back on, simply go to the preamble in `HWThesis.tex` and comment out the line `\usepackage{parskip}`.

1.2 Template Structure

This LaTeX template is for you to have the format generally laid out, and an example structure. The main file is `HWThesis.tex`, that defines the title page, layout, packages, and a few other pieces of information. The file tree is set up for a long project, with a few folders. A `Figures` folder for all your figures, then a `Chapters` folder to keep the tex files for each chapter. This is just so you don't accidentally make one massive tex file where it gets really really difficult to correct LaTeX mistakes for example. You can change this structure if you'd like, for example with a different figures folder for every chapter.

I have also tried to make this structure modular. For large Theses, if they have lots of images, it can take a long time for them to render, but you are likely only wanting to update one chapter or appendix at a time. So I have introduced the `subfiles` package.

1.2.1 subfiles

The subfiles package allows you to render individual subdocuments within a larger document, keeping all the functionality from the main document intact. You can see how I have done this in `HWThesis.tex` where the introduction is added with the `subfile` command, rather than `input` or `include` command. Then each chapter just begins with one line of text
`documentclass[../HWThesis.tex]{subfiles}`, and has
`begin{document}, end{document}` around the rest of the chapter. See further down for details on generating per-chapter references.

1.2.1.1 What is the advantage?

With this, you can work on each chapter in isolation, and not worry about massively long typesetting times, or breaking the rest of your LaTeX document. The main thing that might not work is the citation numbering. This is done at the end of a document, so won't show the numbers correctly unless you render the whole `HWThesis.tex`, unless you do some workarounds.

1.3 What other features are in this template?

1.3.1 citations with biblatex

So you can use `biblatex` to define however you would like your references styled. You will have your bibliography in whatever your software of choice is, and you can use that (for example Zotero or Mendeley) to connect to an Overleaf document, or make BibItems / a big .bib file. This has to be loaded with the `\addbibresource{...}` command as I have done in the header. You can do this with multiple files if for example you have different bibliographies per paper.

Note, for the per-chapter features we are talking about, we need `backend = biber` - so if you are generating things offline, you will need to run biber, instead of bibtex to generate the correct behaviour.

I have also set some default arguments when loading `biblatex`. Lets talk about your citation options. For more detail, please search for the biblatex documentation.

1.3.1.1 citation sorting

I have set the default sorting=none. This means your bibliography will show things in the order you reference them. If you want them sorted by name, then year, then title, set sorting=nyt. For title, then name, then year, sorting=tny. There are lots of these options listed in the documentation, including sorting citations bby type of document etc.

1.3.1.2 formatting citations

I have set the default style for the citation and the bibliography to numeric-comp, meaning compressed numerical style, similar to Vancouver style citations [1]. This means where possible citations will be numbered. The compressed part means that if you cite a range of numbers with a few of them in a row, so instead of showing [1][2][3][5] it will show ranges as hyphenated like [1-3, 5] for example. You may change this to any style you like, or ideally what is used in your field. Let's see a citation range: [1–3]

1.3.1.3 Doing bibliographies per chapter, vs for the whole thesis

For the default whole-thesis bibliography, you just need a `\printbibliography` command at the end of your thesis, before the document ends, I have this set up already for you by default.

But if you have a lot of references and a lot of chapters, you may prefer separate bibliographies per chapter. `biblatex` makes doing sub-bibliographies very easy. You just need to set up a `begin refsection and end refsection` at the top and bottom of each chapter, and then have a `\printbibliography[heading=subbibliography]` command inside of it. You can do one of these per chapter (*so one per-subfile*). Lets do that now for this introduction chapter. Things are already set up so we can just print it right here (though normally we'd do that at the bottom of the chapter).

You'll see that it doesn't include any citations from the next chapter. [1, 4]

You can look through the biblatex documentation for how to split the bibliography by document type, keyword and all other sorts of things. But this minimal set up should be enough for you to copy paste and achieve something functional quite quickly.

You can also still print the per-chapter references outside of the refsections, there is an example at the end of this thesis. You just do `\printbibliography{section=1,heading=subbibliography}` where 1 means *the first refsection*. Note, the default title is *References*, to set a custom title, for example the name of the chapter you can set this manually by adding `title = your custom title`

1.3.1.4 Sub-bibliography numbering

The default for sub-bibliographies is that each `refsection` starts a new index. So each new bibliography starts from [1] again. If you want separate sub-bibliographies, but with the numbers to continue between chapters, use `refsegment` instead of `refsection`. And similarly for printing bibliographies, swap section for segment e.g. `\printbibliography{segment=1,heading=subbibliography}`

1.3.2 Linking to figures, equations and sections with `hyperref`

We can also reference prior sections, for example you might want to see section 1.1 for specifics on how to set up a thesis. These links should be clickable in the pdf thanks to the `hyperref` package. These links **will not show up when printing, they are digital only**. If you want to make them printable, you can do that with the help of the `hyperref` documentation. To link to anything, it needs a label. So label anything you want to reference with with \ and you will be good to go. You can also look up its documentation to change all kinds of behaviours, for example the default link looks like a box around numbers, you can also set it to be like a webpage where links are different colours, but have no boxes around them. Don't go too wild.

1.3.3 better internal references with `cleveref`

You will notice that when you use a `ref` command to point to somethign you have labelled (a subsection, figure, equation etc) - you only get the number. It might be more convenient to have it automatically say *eqn 2.2* rather than just *2.2*, forcing you to type eqn, fig, sec every time. That's what this package is here to help. This lets you type `\cref` instead of `\ref`, and it will automatically write eq./fig./sec. as appropriate. To capitalise (if at the beginning of a sentence) use Cref instead of cref.

If you want the full label (figure/equation/section instead of fig./eq./sec.) then you can add `[noabbrev]` before the curly brackets when loading cleveref.

So lets use `\ref` to reference a section (1.3.3), a figure (1.3), a table (1.1), and an equation (1.1)

Now the same with cleveref `\cref`: a section (section 1.3.3), a figure (fig. 1.3), a table (table 1.1), and an equation (eq. (1.1))

1.3.4 Colors

You may want to even change the color of text when working on it, you can do that like this there are some colors that are already named in `graphicx` but you can also define your own. So now I have a specific light blue color, very nice. You may want to have colours to highlight sections you are working on, but text needs to be black when you submit!

1.3.5 Acronyms, via `acro`

This thesis comes set up with acronyms so you can define terms you use repeatedly and make sure they're formatted correctly every time. A simple acronym is What you see is what you get (WYSIWYG), as this is the first time it is used in the thesis, we get the long version, with the short version following it in brackets. Now it has been used once, we can now simply write the acronym command `ac{wys}` again and we will just get the shortened version. For example: *unlike LaTeX, Microsoft Word*

is a WYSIWYG typesetting program.

These acronyms have to be defined in the preamble of `HWThesis.tex` . You will want to use these when you just don't want to have to type out a term over and over again, or you can invoke long and hard to spell terms like bacterial names, specific pieces of hardware used in experiments, or even lengthy phrases. This document is set up to include a page that lists used terms. Including a list of used terms/acronyms is totally optional.

Of course you can choose whether you want the long or short version of an acronym at any point, here is a quick summary of options:

first	`ac{lol}`	laughing out loud
second	`ac{lol}`	laughing out loud
long	`acl{lol}`	laughing out loud
short	`acs{lol}`	lol
full	`acf{lol}`	laughing out loud (lol)

Table 1.1: This is also an example of a table

This is a very versatile package that saves time and lets you say the important things, whether that is Join a Union (JAU) or How much wood would a woodchuck chuck if a woodchuck could chuck wood? (HMWWAWCIAWCCW)

1.4 Symbols

Top tip, if you are struggling to remember the name of a LaTeXsymbol you need, maybe play around with detexify, where you can draw a symbol, and it will try and find a matching one in LaTeX: `https://detexify.kirelabs.org/classify.html`.

1.4.1 Maths

As a physicist I have included a few packages for maths, these should be standard enough. Specifically I have added `amsmath` for maths environments and better equa-

tions, `amssymb` for extended mathematical symbols, and `amsthm` for better maths theorems.

$$e = \sum_{n=0}^{\infty} \frac{1}{n!} = 1 + \frac{1}{1} + \frac{1}{1 \cdot 2} + \frac{1}{1 \cdot 2 \cdot 3} + \cdots \tag{1.1}$$

An important note here - Thesis guidelines say every equation that appears on its own line, needs an associated number, even if you don't refer to it. So $2 = \sum_i^{\infty} 2^{-i}$ would not need a number, but the above equation 1.1 does. I also added in a different fraction option with the `nicefrac` package. So you can make your fractions like this $1/2$ as compared to the standard $\frac{1}{2}$, up to you!

1.4.2 SI Units via `siunitx`

The SI unit package is also include, one of the more common usages is to have a proper command for the degree symbol, for example 10 degrees becomes 10°. However the package also includes a lot of functions for using units like grams, candela, moles, electronvolts etc with numbers, so that the unit labels look the same whether in text mode or math mode. If you write a lot of units, maybe look into the documentation.

That is everything, the following chapters show some example plots, tables, and then an appendix with details on how an appendix should be set up.

1.5 Keeping Track

Todo list

1.5.1 Todo notes

If while writing you want some very visible coloured boxes to tell you what you have To Do, then use the todonotes package.

this is a yellow todo note in the margin

This lets you create todo notes, and empty figures. You can even make a list of your todo notes to see what you have left to do.

Here are some examples.

hello, this is a todo note that is inline

Now lets do a placeholder figure in fig. 1.1

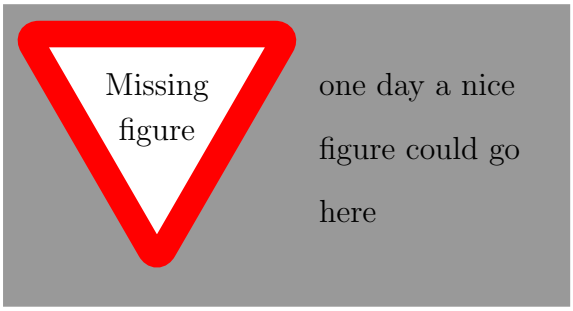

Figure 1.1: captions still work

And of course, above this subsection we generated a list of todos.

1.5.2 Subfigures and Subcaptions

I have both of these in the header for the main `HWThesis.tex` but I have not bothered to test them, play around at your own risk, I don't really like either package honestly.

1.6 Logos

Last last thing, I have included a new university crest for the title page, but you may want an alternative. Here I will quickly show you the ones I have included. You can then choose exactly which one you would like on your title page!

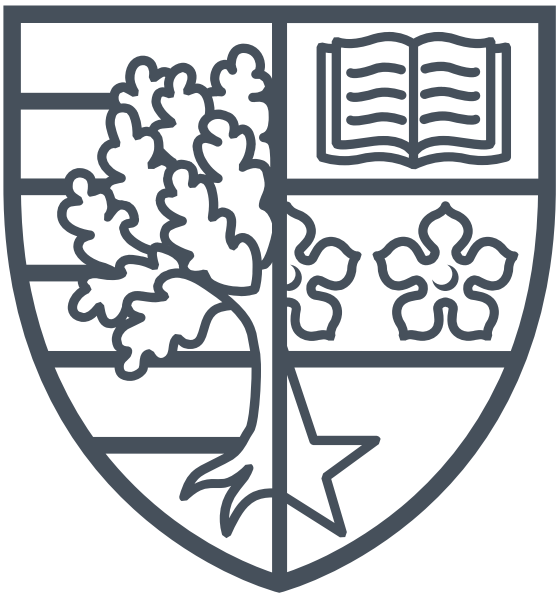

Figure 1.2: The default HW_shield, that I cropped from the full logo svg

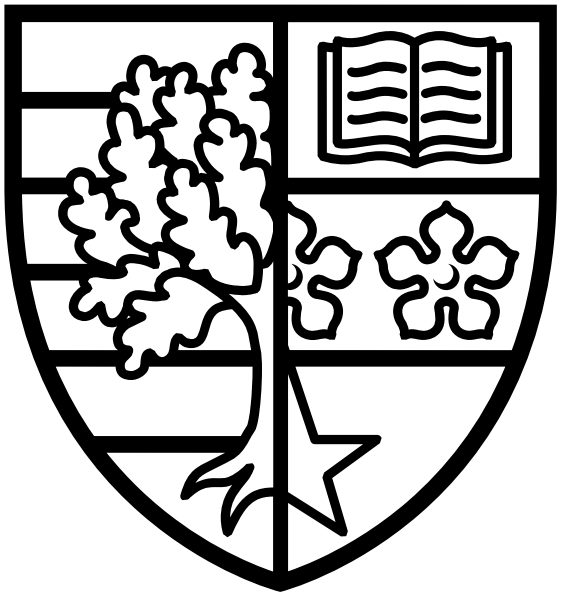

Figure 1.3: The black HW_shield.pdf, that I also cropped from the full logo svg

Figure 1.4: The JPEG HW_logo from the intranet

Figure 1.5: Lastly... the black JPEG HW_logo from the intranet.

Bibliography

[1] Philip W. Trinder et al. "GUM: a portable implementation of Haskell". In: *Proceedings of Programming Language Design and Implementation*. Philadephia, USA, May 1996.

[2] Patrick Maier. *The Design of SymGrid-Par II*. Tech. rep. Dec. 2010.

[3] Phil W. Trinder et al. "GUM: a Portable Parallel Implementation of Haskell". In: *PLDI '96, Philadelphia, USA*. ACM Press, 1996, pp. 78–88.

[4] Domenico Talia. "MODELS AND TRENDS IN PARALLEL PROGRAMMING". In: *Parallel Algorithms and Applications* 16.2 (2001), pp. 145–180.

Chapter 2

Background

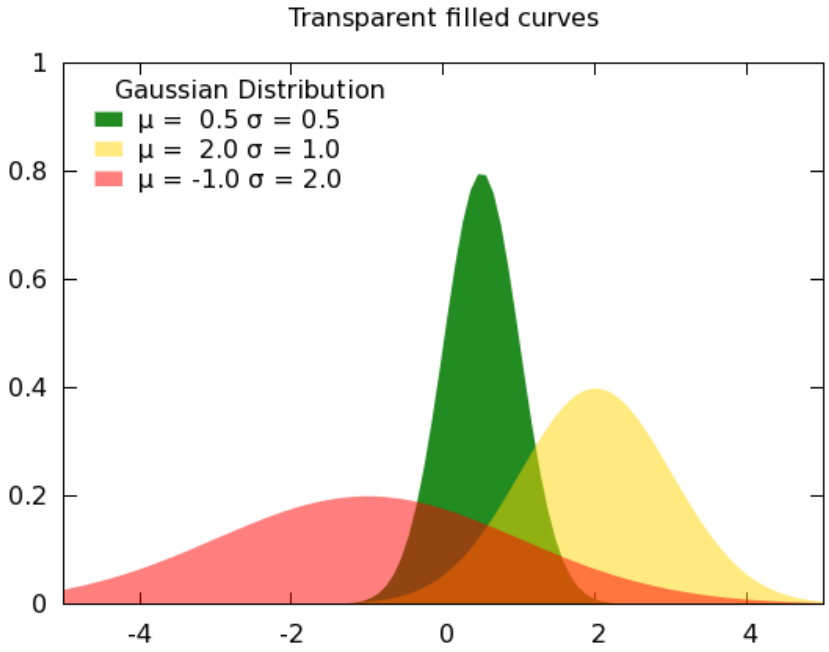

Figure 2.1: Figure Caption.

Some default citations: [1, 2]

2.0.1 Subsection

Case	Method#1	Method#2	Method#3
1	50	837	970
2	47	877	230
3	31	25	415
4	35	144	2356
5	45	300	556

Table 2.1: Table Caption

2.0.1.1 Subsubsection

Chapter 3

Design

Write..

3.1 Section

According to [1] ...

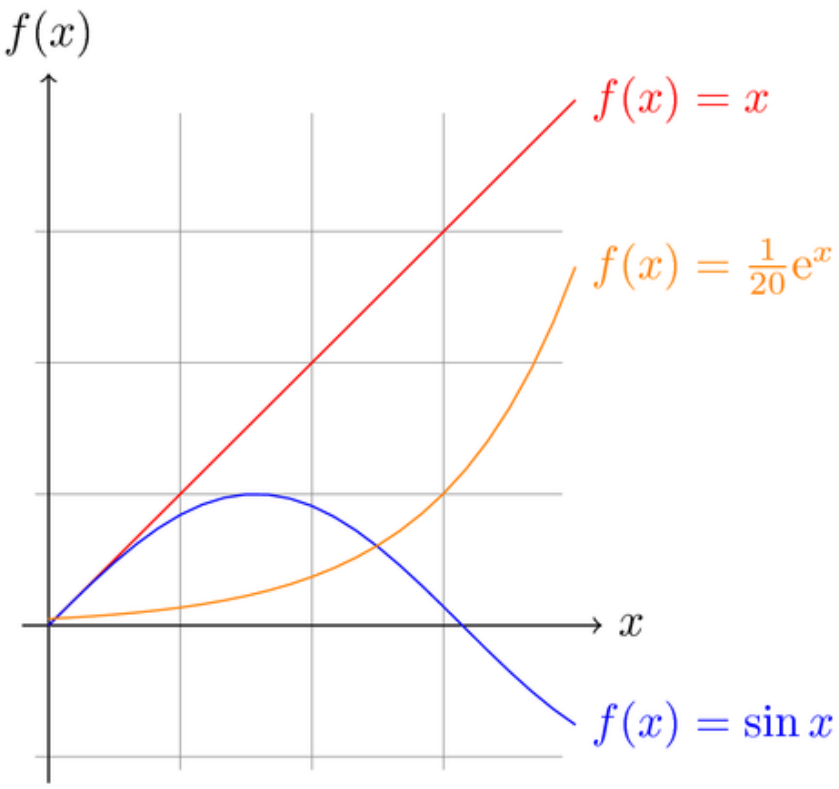

Figure 3.1: Figure Caption.

3.1.1 Subsection

Audio Name	Sum of Extracted Bits						
Police	5	-1	5	5	-7	-5	3
Midnight	7	-3	5	3	-1	-3	5
News	9	-3	7	9	-5	-1	9

Table 3.1: Table Caption

3.1.1.1 Subsubsection

Chapter 4

Conclusion and Future Work

Appendix A

Foo

Hi I'm an appendix

Appendices, labelled A, B etc., should be treated as additional chapters and should normally follow the main text. Appendices may consist of supporting material of considerable length or of lists, documents, commentaries, tables or other evidence that if included in the main text, would interrupt its flow. The style of appendices must be consistent with the style of the main text. Long appendices may be divided into sections, labelled as Appendix A.1 etc., with corresponding subsection numbering, which must be entered in the table of contents. Alternatively, short appendices may be attached to individual chapters, as an extra section with a heading of style 3.7 Appendix.

Bibliography

Introduction

[1] Philip W. Trinder et al. "GUM: a portable implementation of Haskell". In: *Proceedings of Programming Language Design and Implementation*. Philadephia, USA, May 1996.

[2] Patrick Maier. *The Design of SymGrid-Par II*. Tech. rep. Dec. 2010.

[3] Phil W. Trinder et al. "GUM: a Portable Parallel Implementation of Haskell". In: *PLDI '96, Philadelphia, USA*. ACM Press, 1996, pp. 78–88.

[4] Domenico Talia. "MODELS AND TRENDS IN PARALLEL PROGRAMMING". In: *Parallel Algorithms and Applications* 16.2 (2001), pp. 145–180.

some random custom title

[1] Phil W. Trinder et al. "GUM: a Portable Parallel Implementation of Haskell". In: *PLDI '96, Philadelphia, USA*. ACM Press, 1996, pp. 78–88.

[2] Tim Harris, Simon Marlow, and Simon Peyton Jones. "Haskell on a Shared-Memory Multiprocessor". In: *Proceedings of the 2005 ACM SIGPLAN workshop on Haskell*. Haskell '05. Tallinn, Estonia: ACM, 2005, pp. 49–61. ISBN: 1-59593-071-X.