Prelude

A typical thesis will be structured according to a number of standard sections described in what follows. However, it is hard and perhaps even counter-productive to generalise: the goal of outlining this typical structure is *not* to be prescriptive, but simply to act as a guideline. In particular, the page counts given are important but not absolute: their aim is simply to highlight that a clear, concise description is better than a rambling alternative that makes it hard to separate important content and facts from trivia.

You can use this document as a LaTeX-based [1, 2] template for your own thesis by simply deleting extraneous sections (e.g., this one); keep in mind that the associated `Makefile` could be of use, in particular since it also executes BibTeX to deal with the bibliography. If you opt not to do this, which is perfectly acceptible, a standard cover and declaration of authorship produced online via

http://www.cs.bris.ac.uk/Teaching/Resources/cover.html

University of Bristol

DEPARTMENT OF COMPUTER SCIENCE

Some Structural Guidelines for CS MEng Theses

Daniel Page

A dissertation submitted to the University of Bristol in accordance with the requirements of the degree of Master of Engineering in the Faculty of Engineering.

Monday 17th September, 2012, CS-MEng-2012

Declaration

This dissertation is submitted to the University of Bristol in accordance with the requirements of the degree of MEng in the Faculty of Engineering. It has not been submitted for any other degree or diploma of any examining body. Except where specifically acknowledged, it is all the work of the Author.

Daniel Page, Monday 17$^{\text{th}}$ September, 2012

Contents

List of Figures

List of Tables

List of Algorithms

List of Listings

Executive Summary

A compulsory section, of at most 1 page

This section should précis the project context, aims and objectives and main contributions and achievements; the same section may be called an abstract elsewhere. The goal is to ensure the reader is clear about what the topic is, what you have done within this topic, *and* what your view of the outcome is.

The former aspects should be guided by your specification: essentially this section is a (very) short version of what is typically the first chapter. The latter aspects should be presented as a concise, factual bullet point list that summarises the main contributions and achievements. The points will of course differ for each project, but an example is as follows:

- I spent 120 hours collecting material on and learning about the Java garbage-collection sub-system.

- I wrote a total of 5000 lines of source code, comprising a Linux device driver for a robot (in C) and a GUI (in Java) that is used to control it.

- I designed a new algorithm for computing the non-linear mapping from A-space to B-space using a genetic algorithm, see page 17.

- I implemented a version of the algorithm proposed by Jones and Smith in [6], see page 12, corrected a mistake in it, and compared the results with several alternatives.

Supporting Technologies

A compulsory section, of at most 1 page

This section should present a detailed summary, in bullet point form, of any third-party resources (e.g., hardware and software components) used during the project. Use of such resources is perfectly acceptable: the goal of this section is simply to be clear about where and how they are used. The content can focus on the project topic itself (rather than, for example, including "I used LaTeX to prepare my thesis"); an example is as follows:

- I used the Java `BigInteger` class to support my implementation of RSA.
- I used a parts of the OpenCV computer vision library to capture images from a camera, and for various standard operations (e.g., threshold, edge detection).
- I used an FPGA device supplied by the Department, and altered it to support an open-source UART core obtained from http://opencores.org/.
- The web-interface component of my system was implemented by extending the open-source WordPress software available from http://wordpress.org/.

Notation and Acronyms

An optional section, of roughly 1 or 2 pages

Any well written document will introduce notation and acronyms before their use, *even if* they are standard in some way: this ensures any reader can understand the resulting self-contained content.

Said introduction can exist within the thesis itself, wherever that is appropriate. For an acronym, this is typically achieved at the first point of use via "Advanced Encryption Standard (AES)" or similar, noting the capitalisation of relevant letters. However, it can be useful to include an additional, dedicated list at the start of the thesis; the advantage of doing so is that you cannot mistakenly use an acronym, for example, before defining it. An example is as follows:

AES	:	Advanced Encryption Standard
DES	:	Data Encryption Standard
$\vdots$		
$\mathcal{H}(x)$	:	the Hamming weight of x
$\mathbb{F}_q$	:	a finite field with q elements
x_i	:	the i-th bit of some bit-sequence x

Acknowledgements

An optional section, of at most 1 page

It is common practice (although totally optional) to acknowledge any third-party advice, contribution or influence you have found useful during your work. Examples include support from friends or family, the input of your Supervisor, external organisations or persons who have supplied resources of some kind (e.g., funding, advice or time), and so on.

Chapter 1

Contextual Background

A compulsory chapter, of roughly 10 **pages**

This chapter is intended to describe the project context, and motivate the proposed aims and objectives. Ideally, it is written at a fairly high-level, and easily understood by a reader who is technically competent but not an expert in the topic itself.

In short, the goal is to answer three questions for the reader. First, what is the project topic, or problem being investigated? Second, why is the topic important, or rather why should the reader care about it? For example, why there is a need for this project (e.g., lack of similar software or deficiency in existing software), who will benefit from the project and in what way (e.g., end-users or software developers, or researchers), what work does the project build on and why is the selected approach important or interesting (e.g., fills a gap in literature, applies results from another field to a new problem). Finally, what are the central challenges involved and why are they significant?

The chapter should conclude with a concise bullet point list that summarises the aims and objectives. For example:

> The high-level objective of this project is to reduce the performance gap between hardware and software implementations of modular arithmetic. More specifically, the concrete aims are:
>
> 1. Research and survey literature on public-key cryptography and identify the state of the art in exponentiation algorithms.
>
> 2. Improve the state of the art algorithm so that it can be used in an effective and flexible way on constrained devices.
>
> 3. Implement a framework for describing exponentiation algorithms and populate it with suitable examples from the literature on an ARM7 platform.
>
> 4. Use the framework to perform a study of algorithm performance in terms of time and space, and show the proposed improvements are worthwhile.

Chapter 2

Technical Background

A compulsory chapter, of roughly 10 to 20 pages

This chapter is intended to describe the technical basis on which execution of the project depends. The goal is to provide a detailed explanation of the specific problem at hand, and any previous or related work in the area (e.g., descriptions of supporting technologies, existing algorithms that you use, alternative solutions proposed).

Put another way, after reading this chapter a non-expert reader should have obtained enough background to understand what *you* have done, and then assess how novel, challenging and rigorous your work is. You might view an additional goal as giving the reader confidence that you are able to absorb and understand research-level material.

Chapter 3

Project Execution

A topic-specific chapter, of roughly 20 pages

This chapter is intended to describe what you did: the goal is to explain the main activity or activities, of any type, which constituted your work during the project. The content is highly topic-specific, but for many projects it will make sense to split the chapter into two sections: one will discuss the design of something (e.g., some hardware or an algorithm), inc. any rationale or decisions made, and the other will discuss how this design was realised via some form of implementation.

This is, of course, far from ideal for *many* project topics. Some situations which clearly require a different approach include:

- In a project where asymptotic analysis of some algorithm is the goal, there is no real "design and implementation" in a traditional sense even though the activity of analysis is clearly within the remit of this chapter.

- In a project where analysis of some results is as major, or a more major goal than the implementation that produced them, it might be sensible to merge this chapter with the next one: the main activity is such that discussion of the results cannot be viewed separately.

Note that evidence of "best practice" project management (e.g., use of version control, choice of programming language and so on) should only be included if there is a clear reason to do so.

3.1   Example Section

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foo

Figure 3.1: This is an example figure.

foo	bar	baz
0	0	0
1	1	1
⋮	⋮	⋮
9	9	9

Table 3.1: This is an example table.

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3.1.1 Example Sub-section

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for $i = 0$ **upto** n **do**
$\quad | \quad t_i \leftarrow 0$
end

Algorithm 3.1: This is an example algorithm.

```
for( i = 0; i < n; i++ ) {
  t[ i ] = 0;
}
```

Listing 3.1: This is an example listing.

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Example paragraph. This is an example paragraph; note the trailing full-stop in the title, which is common style intended to ensure it does not run into the text.

Chapter 4

Critical Evaluation

A topic-specific chapter, of roughly 10 **pages**

This chapter is intended to evaluate what you did. The content is highly topic-specific, but for many projects will have flavours of the following:

1. functional testing, inc. analysis of failure cases,

2. performance results, and analysis of said results that draw some form of conclusion, and

3. evaluation of options and decisions within the project, and/or a comparison with alternatives.

This chapter often acts to differentiate project quality: even if the work completed is of a high technical quality, critical yet objective evaluation and comparison of the outcomes is crucial. In essence, the reader wants to learn something, so the worst examples amount to simple statements of fact (e.g., "graph X shows the result is Y"); the best examples are analytical and exploratory (e.g., "graph X shows the result is Y, which means Z; this contradicts [1], which may be because I use a different assumption"). As such, both positive *and* negative outcomes are valid *if* presented in a suitable manner.

Chapter 5

Conclusion

A compulsory chapter, of roughly 2 pages

The concluding chapter of a thesis is often underutilised, in part because it is often left until close to the deadline and hence does not get enough attention. Ideally, the chapter will consist of three parts:

1. (Re)summarise the main contributions and achievements, in essence summing up the content.

2. Clearly state the current project status (e.g., "X is working, Y is not") and evaluate what has been achieved with respect to the initial aims and objectives (e.g., "I completed aim X outlined previously, the evidence for this is within Chapter Y"). There is no problem including aims which were not completed, but it is important to evaluate and/or justify why this is the case.

3. Outline any open problems or future plans. Rather than treat this only as an exercise in what you *could* have done given more time, try to focus on any unexplored options or interesting outcomes (e.g., "my experiment for X gave counter-intuitive results, this could be because Y and would form an interesting area for further study").

Bibliography

[1] L. Lamport. *LATEX: A Document Preparation System*. Addison-Wesley, 1986.

[2] F. Mittelbach, M. Goossens, J. Braams, D. Carlisle, and C. Rowley. *The LATEX Companion*. Addison-Wesley, 2nd edition, 2004.

Appendix A

An Example Appendix

Content which is not central to, but may enhance the thesis can be included in one or more appendices; examples include, but are not limited to

- lengthy mathematical proofs, numerical or graphical results which are summarised in the main body,

- sample or example calculations, and

- results of user studies or questionnaires.

Note that in line with most research conferences, the marking panel is not obliged to read such appendices.