

Chapter 9

Writing and Defending a Thesis

1987: Student writes Ph.D. thesis completely in `verbatim` environment.

— DAVID F. GRIFFITHS and DESMOND J. HIGHAM,
*Great Moments in \LaTeX History*¹⁵ (1997)

Calvin: I think we've got enough information now, don't you?

Hobbes: All we have is one "fact" you made up.

*Calvin: That's plenty. By the time we add an introduction,
a few illustrations, and a conclusion,
it will look like a graduate thesis.*

— CALVIN, *Calvin and Hobbes* by Bill Watterson (1991)

Remember to begin by writing the easiest parts first. . .

It is surprising how many people believe that a thesis. . .

should be written in the order

that it will be printed and subsequently read.

— ESTELLE M. PHILLIPS and D. S. PUGH, *How to Get a PhD* (1994)

¹⁵In [118].

Virtually all that has been said in Chapters 6 and 7 about writing and revising a paper applies to theses. (The term “dissertation” is synonymous with thesis, and is preferred by some.) In this chapter I give some specific advice that takes into account the special nature and purposes of a thesis written for an advanced degree. Much of the discussion applies to undergraduate level projects too.

9.1. The Purpose of a Thesis

The purpose of a thesis varies with the type of degree (Masters or Ph.D.) and the institution. The thesis might have to satisfy one or more of the following criteria:

- show that the student has read and understood a body of research literature,
- provide evidence that the student *is capable* of carrying out original research,
- show that the student has carried out original research,
- represent a significant contribution to the field.

It is worth checking what is expected by your institution.

9.2. Content

A thesis differs from a paper in several ways.

1. A thesis must be self-contained. Whereas a paper may direct the reader to another reference for details of a method, experimental results, or further analysis of a problem, a thesis must stand on its own as a complete account of the author’s work on the subject of investigation.
2. A thesis is formatted like a book, broken into chapters rather than sections.
3. A thesis may include more than one topic, whereas a paper usually focuses on one.
4. A thesis is usually longer than an average paper, making good organization particularly important.

5. The primary readers of a thesis (possibly the only readers) are its judges, and they will read it with at least as much care as do the referees of a paper.

Since there is less pressure to save space than when writing a paper for a journal, you should generally include details in a thesis. It is important to demonstrate understanding of the subject, and phrases such as “it is easily shown that” and “we omit the proof” used in the presentation of original results may seem suspicious when you have no track record in the subject (the examiners may, of course, ask for such gaps to be filled during the oral examination). Trying to anticipate the examiners’ questions should help you to decide what and how much to say on each topic.

The thesis should not be padded with unnecessary material (many theses are too long), but results that would not normally be published can be included, perhaps in an appendix, either because they might be of use to future workers or because you might want to refer to them in a paper based on the thesis. There is no “ideal” number of pages beyond which a thesis gains respectability, and indeed there is great variation in the length of theses among different subjects and even within a subject. The supervisor (UK) or thesis advisor (US) can offer advice about the suitable length.

A thesis has a fairly rigid structure. In the first one or two chapters the problem being addressed must be clearly described and put into context. You are expected to demonstrate a sound knowledge and understanding of the existing work on the topic by providing a critical survey of the relevant literature. If there is more than one possible approach to the problem, the choice of method must be justified. For a computational project the method developed or investigated in the thesis would normally be compared experimentally with the major alternatives.

At the end of the thesis, conclusions must be carefully drawn and the overall contribution of the thesis assessed. It is a good idea to identify open problems and future directions for research, since being able to do so is one of the attributes required of a researcher. Note that a thesis does not necessarily have to present major new or improved results; in many cases the key requirement is the development and communication of original ideas using sound techniques.

When you write a thesis you are usually relatively inexperienced at technical writing, so it is important to avoid inadvertently committing plagiarism (see §6.16). If you copy text word for word from another source you must put it in quotation marks and cite the source. If you find yourself copying, or paraphrasing, someone else’s proof of a theorem, ask yourself if you need to give the proof—if it is not your own work, will it add anything to the thesis? Examiners will be particularly alert to the possibility

of plagiarism, so be careful to avoid committing this sin.

9.3. Presentation

Each institution has rules about the presentation of a thesis. Page, font and margin sizes, line spacing (often required to be double or one and a half times the standard spacing) and the form of binding may all be tightly regulated, and non-conforming theses may be rejected on submission. The opening pages will be required to follow a standard format, typically comprising the following items (some of which will be optional).

1. A title page, listing the author, title, department, type of degree, and year (and possibly month) of submission.
2. A declaration that the work has not been used in another degree submission.
3. A statement on copyright and the ownership of intellectual property rights.
4. A list of notation.
5. A brief statement of the author's research career.
6. Acknowledgements and dedications.
7. Table of contents.
8. List of figures.
9. List of tables.
10. Abstract. The abstract may need to be repeated on a separate application form. Once the degree has been obtained, the abstract is likely to be entered into a database such as *Dissertation Abstracts International* or *Index to Theses* (for theses from universities in Great Britain and Ireland, and available on the Web for registered users at <http://www.theses.com>).

The opening pages are also the place to indicate which parts of the thesis (if any) have already been published, and which parts are joint work.

Your library will contain previous successful theses, which you can inspect to check the required format—but bear in mind that rules of presentation can and do change. It is likely that a \LaTeX package will be available at your institution for typesetting theses in the official style.

I recommend producing an index for the thesis, although this practice is not common. A well-prepared index (see §13.4) can be a significant aid to examiners and readers.

When should you start to write the thesis? My advice is to start sooner rather than later. In the early months of study in which you become familiar with the problem and the literature you can begin to draft the first few chapters. You should also start immediately to collect references for the bibliography—it is difficult in the later stages to hunt for half-remembered references. One reason for making an early start on writing the background and survey material is that at this stage you will be enthusiastic—later, you may know this material so well that it seems dull and boring.

I encourage my students to write up their work in \LaTeX as they progress through the period of study, so that when the time comes to produce the thesis much of the writing has been done. Since most students now typeset their own theses, this approach allows them to learn the typesetting system when they are least stressed, rather than in the last hectic months. If the thesis work has progressed rapidly, they may be in the pleasant position of having one or more papers already written, upon which they can base the thesis.

Unlike a published paper, a thesis will not be read by a copy editor or proofreader. It is therefore particularly important that you thoroughly read and check the thesis before it is submitted. Your thesis advisor should read and comment on the thesis, and it is worthwhile recruiting fellow students as readers, too; even if they are not specialists in the area they should be able to offer useful suggestions for improvement.

9.4. The Thesis Defence

The oral defence of a thesis takes different forms in different countries. For example, in the UK the candidate answers questions posed by the examiners, but does not usually give a formal presentation, whereas in other European countries it is more common for the candidate to give a presentation followed by questions from the jury. The number of examiners also varies greatly between countries.

Perhaps the most important piece of advice applicable to all forms of defence is to read the thesis beforehand. The defence may take place weeks or months after you submitted the thesis, and in the meantime you may forget exactly what material you included in the thesis and where it is located. To be properly prepared you need to know the thesis inside out.

One of the purposes of the defence is for the examiners to satisfy themselves that you (not someone else) did the work you claim to have done and that you understand it. As well as asking straightforward questions about

the thesis, they may therefore ask you why you took the approaches you did and to justify assumptions and amplify arguments. You can also expect questions that explore your knowledge of the literature outside the immediate area of the thesis, as the examiners gauge your general familiarity with the research area.

It is important that you listen to questions carefully and answer the question that is asked, not some other question. When you are under pressure it is easy to misunderstand what the examiners ask you. If you do not understand a question, say so, and the question will be repeated or rephrased.

If you give a formal presentation (typically 40–50 minutes long) you should aim to give an overview of the research area and the work you have done and not to go too deeply into the details. The examiners will want to see that you appreciate the context and significance of your work and that you are aware of problems remaining for future research. Consult Chapters 10 and 11 for practical advice on writing and giving the talk.

Finally, note that an examiner who has carefully read your thesis and attended the defence should know enough about you to write a reference for your job applications. The examiners may even be able to offer advice on where to seek employment.

Oral Examination Procedure (extract)

1. *Before beginning the examination, make it clear to the examinee that his whole professional career may turn on his performance. Stress the importance and formality of the occasion. Put him in his proper place at the outset.*
2. *Throw out your hardest question first. (This is very important. If your first question is sufficiently difficult or involved, he will be too rattled to answer subsequent questions, no matter how simple they may be.) ...*
9. *Every few minutes, ask him if he is nervous ...*
11. *Wear dark glasses. Inscrutability is unnerving.*
- 12 *Terminate the examination by telling the examinee, "Don't call us; we will call you."*

— S. D. MASON, in *A Random Walk in Science* (1973)

9.5. Further Reading

Books are available that give advice on the whole process of doing research for a Ph.D., including writing the thesis. For a UK perspective, Phillips and Pugh [226] can be recommended, while Sternberg [258] and Rudestam and Newton [241] offer a US viewpoint.