Scientific Communication CITS7200

Computer Science & Software Engineering

Lecture 13

Writing a thesis

A thesis is an unusually long paper containing a detailed discussion of a *unifying hypothesis* regarding the work you have undertaken in your research. Whether it is for Honours, Masters, or PhD, your thesis must describe your own work and thinking, and will be the one publication where you prove that you can work independently, accurately, and critically.

Much of the discussion in previous lectures relating to the details of writing a paper is relevant when writing a thesis. In this lecture we will consider those details specifically related to a thesis.

Your thesis is likely to have very few readers: you, your supervisor, perhaps one of your fellow students, your examiners, and maybe some younger research students looking at extending your work. However, it is vitally important that it be well done as your supervisor and perhaps your examiners are likely to be your referees for future positions.

1 Regulations

Check with your department on the University regulations governing the writing of a thesis. CS&SE has guidelines for the production of an Honours thesis using both Word and LaTeX. For higher degrees, regulations governing the binding and submission of the thesis can be obtained from the rele-

vant Faculty Office or the Board of Postgraduate Studies. Also available are guidelines on research ethics and research misconduct.

2 Planning your writing

Many experts recommend that you start your writing about two-thirds of the way through your course. You may think this is ridiculous when you feel that you have no results, but there are always some parts you can start on. Write about the materials and methods section first, and then describe the experiments as you do them. Generate tables, images, and diagrams to describe the work you are doing. From Day 1, keep an up-to-date bibliographic file from which you can simply cite references in your thesis.

Always keep backups of your results and your written work. Some authors recommend backup copies locked in fire-proof and water-proof safes, and stored in a separate building. Although this may seem excessive, there are certainly many students who have lost the sole copy of all their work, including all the experimental data, after three years of hard work.

Don't underestimate the amount of time it takes to write a thesis and to revise your draft copies. It always takes longer than you think. An Honours student can reasonably expect to spend at least 1 month; a PhD student who has completed all the work and is writing full-time would expect to spend 3–6 months on this task.

3 The form of a thesis

Here is the general outline of a thesis:

Title Page

Acknowledgements

Abstract

Preface Only include a preface if the work you are presenting has been published elsewhere or you need to establish how much of the work is your own.

Contents

List of Figures

List of Tables

Chapter 1. Introduction Give an overview of the problem and state the hypothesis that your thesis presents.

Chapter 2. Review of the literature Present previous work in this area that is relevant to the approach you have taken or that makes a complete story.

Chapter 3. Methods Describe the methods and materials of your work. This might be the details of existing theory, mathematical developments, experimental procedures, and details about equipment.

Chapter 4 to n. Results Give the experiments you have conducted and the results you have found. Introduce each experiment with the particular hypothesis you were testing in that experiment. List the results clearly in tables or graphs, and discuss how they relate to the hypothesis of the experiment.

Chapter $n+1$. Discussion and Conclusion Draw together all your results and discuss how they relate to the unifying hypothesis introduced in the Introduction.

Bibliography

Appendices

3.1 The Title Page

The title page should hold the title of your Honours thesis and your name, centered so as to be visible through the window of the cover page.

The Title of My Thesis

M. Y. Surname

At the bottom of the page, the following words should appear:

This report is submitted as partial fulfillment
of the requirements for the Honours Programme of the
School of Computer Science & Software Engineering
The University of Western Australia
2006

Regulations for a Masters and PhD thesis are similar and should be consulted.

3.2 The Abstract

An abstract is defined as "an abbreviated, accurate representation of the contents of a document, without added interpretation or criticism and without distinction as to who wrote the abstract". In the abstract it is important to keep sentences short and simple, dealing with just one topic each, and excluding irrelevant points.

An informative abstract answers, in about 100 – 250 words, the following questions:

- Why did you start?
- What did you do, and how?
- What did you find?
- What do your findings mean?

If your paper is about a new method, the last two questions might be replaced with:

- What are the advantages of the method?
- How well does it work?

Try to include in the abstract all the main information covered in your thesis. However, do not refer to anything that is not in your thesis. To help in computer searches, use significant keywords in your abstract. Avoid unfamiliar terms, acronyms, abbreviations, or symbols. Do not include tables, diagrams, equations, or code. Avoid citing other work, but if you must, give the full reference in the abstract - "As P. J. Brown pointed out (*Comm. ACM*, 1990; 20: 11-13)".

At the end of the Abstract, give a list of Keywords and the CR Classification.

3.3 Preface

A Preface does not normally appear as part of an Honours thesis, but often forms part of a Masters or PhD thesis. In the Preface you indicate your contribution to the work described in the thesis. Often, with higher degrees in Science, the thesis is built upon a number of publications, and in many cases these are joint publications with your supervisor and often other members

of the research team. List the publications that have appeared, explain how they relate to the material presented in the thesis, and explain clearly your contribution to the publication.

3.4 Acknowledgements

Acknowledge briefly any help you have received from organisations or individuals in the form of scholarships, materials, technical assistance, or advice. Acknowledge all those who went out of their way to help you or who did most of the day-to-day work, but not those whose assistance was merely part of their daily duties. If you include any previously published material in your thesis, it is sometimes appropriate to acknowledge the copyright holders.

3.5 Contents

Draw up a list of headings, including the chapter sections and subsections, and the appendices. Page numbering should be arranged so that page 1 is the first page of Chapter 1. Prior to that point, use little roman numbering. The contents page can be generated automatically in LaTeX.

3.6 Lists of Figures and Tables

As with the contents, give a List of Figures and a List of Tables, listing for each its number, its caption, and the page on which it appears. Again, this can be done automatically in LaTeX.

3.7 Introduction

In the introduction you discuss the background of your research work, and set up what is known as the *unifying hypothesis*. The unifying hypothesis is a general hypothesis that provides a reasoned argument for why the series of experiments you did, or the series of theorems you proved, or the series of techniques you developed, should be considered as an ensemble. Such a hypothesis will be less specific than the hypotheses governing a single experiment/theorem/technique, and you may not discover the precise form of this unifying hypothesis until late in your thesis work.

Thus, say why you did the work, and what its purpose was. Announce the general topic, and state which particular aspect of it you are dealing with.

Set the scene by giving some background work, but do not list all the papers on the subject, nor criticise them in detail. Such work belongs more properly in the Review of the Literature section. End the introduction with a sentence that leads into the next chapter, such as:

> It therefore seemed appropriate to try to discover how much of the effect Y was due to the variable X.

3.8 Review of the Literature

The literature review for a thesis is roughly the same as one for a research paper. It is meant to act as a base for the experimental part of your thesis, if you have one, or to explain the process by which you have been led to develop a new theory. Some universities and some supervisors might demand that the literature review demonstrate that you have "mastered the field" by reading and critically reviewing every relevant paper in your area, but this is an unrealistic expectation for an Honours thesis.

Those parts of your literature review that are directly related to your thesis should take the reader almost, but not quite, to the point where your specific hypotheses are mentioned. This makes your experiments obvious, and means that the introduction to each experiment can be kept to a minimum.

3.9 Materials and Methods

In this section give the full details of what you have studied and how you have studied it. Provide enough information for others to reproduce your results, remembering that apart from your supervisor and examiners, your other readers are likely to be graduate students. In this section you are likely to be describing the underlying principles of your work, the theory behind the algorithms you use, and the methods used in implementing your algorithms.

3.10 Experimental results

The results section should answer the question:

- What did you find or see?

Write this section so that it stands on its own, without the reader having to refer to other sections of your thesis. Present your data in tables or figures,

as necessary. Give enough detail so that your experiments can be reproduced by other graduate students.

If possible, make all tables and figures "portrait" style to save readers from having to turn your thesis on its side. Make sure that tables and figures don't go over one page each in length, and that you have left adequate margins for binding.

Summarise the results of this section in a concise list of numbered points.

3.11 Discussion and Conclusion

Return to your original unifying hypothesis and start your discussion by deciding whether the results you have presented support or reject the hypothesis. A well-chosen hypothesis allows discussion and comparison of the results of your experiments.

3.12 Bibliography

List all the references cited in the body of your thesis. Details on the construction of a bibliography were given in Lecture 5.

3.13 Appendices

If you want to include lengthy material related to your theme but not essential to the development of your argument, put that material in an appendix. Typically, appendices contain detailed mathematical analyses related to the results you use, detailed tables, or diagrams and images not essential to the body of the text.

An honours thesis should also include as an appendix the original research proposal, and an appendix on possible future work.

4 Writing the Thesis

Before you begin writing you are likely to wonder whether you have enough to write about. After you have started the biggest problem is to remember where you are in the mass of material you are trying to describe.

To help with both these problems, it is useful to construct a working summary. Some authors recommend that you simply construct something akin to your table of contents before you start writing, then write whichever chapters seem the easiest to deal with first. Another technique is to use skeleton sheets: pieces of paper with the main ideas of each chapter that you fill in as the work progresses. An alternative, that has been suggested by someone who writes books, is to write on little cards all the ideas you think you would like to put into your thesis. Write these cards throughout the year, so that they contain comments about the papers you have read, descriptions of the experiments you have conducted, and your results. Then when it is time to start writing, put all the cards on a big table and shuffle them around until you think you have them in the right order.

Whichever technique you choose, you can consider the working summary as the first draft of your thesis, so that the expanded version is the second draft. The supervisor or a fellow student should now read this version before the next draft is written. Make sure you use a spelling checker *before* you ask someone else to read your work. There might be large changes suggested at this stage, so a third draft is highly likely. Then comes the fine detail: are all the citations correct? are there typographical errors in the bibliography? are the equations, tables, and diagrams numbered correctly? are all mathematical analyses flawless? etc.

What about general writing principles? Can you eliminate any "wicked whiches"? Do any sentences start with a numeral or variable? Can any phrases be shortened? Are all meaningless words eliminated?

Remember that it is far better to correct everything *before* the examiners see your thesis than it is to deal with typographical errors or worse still, more experiments or detailed analyses afterwards.