Writing a master's thesis

1 Parts of the master's thesis

See latex template on `http://www.cs.joensuu.fi/pages/whamalai/sciwri/thesis.htm`

1.1 Abstract

- Tells compactly the research problem, methods and results.

- At most 1 page, no literature references.

- In the end ACM classes + possibly key words.
  $\rightarrow$ See `http://www.acm.org/class/1998/overview.html`

1.2 Introduction

Typically 4-7 pages.

The introduction should define the problem clearly and give suffiecient background information for the following chapters. However, no details, yet!

- What is the purpose of the research? Main research questions?

- What is the scope? Indicate explicitely all limitations and restricting assumptions!

- Why the topic is important or interesting?

- What methods are used?

- Briefly references to related research (just the main references – more references in chapter "Related research" or throughout the thesis)

- Emphasize your own contribution: what is original or new?

- In the end the organization of the thesis (division to chapters)

Introduction can be divided into sections, if it is easier to write, but it is not necessary.
E.g. three sections:

1. Problem description, motivation and background (the heading could be "Overview", "Problem", "Motivation and background" etc.)

2. Results and contributions (what was done, what was new)

3. Organization (the chapters)

1.3 Main chapters

Usually 4-5 chapters (in addition to Introduction and Conclusions). A good idea is to begin from background theory or related research.

1.4 Conclusions

Just 1-3 pages!

- Summarize the main results in a general level.

- Tell what was your own conctribution and what was based on other sources.

- Possibly also critics (e.g. limitations), alternative approaches, topics for future research.

- No more new results and seldomly any references (at most for alterantive, unmentioned approaches)

1.5 References

- A rule of thumb: at least 20 references, but no more than 50. 30-35 is often the ideal.

- The number of references depends on the topic. More references are required in a literature review than in empirical research or an "application report".

- The number of references is not a merit, but their quality is more important!

- The references should be relevant, up-to-date, and represent different approaches or schools among researchers.

- **Important**: all sources (listed in References) must be referred in the text and the text should not contain any references which are not listed! → Bibtex takes care of this automatically. If you type references manually, latex complains only about missing references, but not about extra references.

1.6   Appendixes

- Additional material which is relevant to the research and is referred in the text. E.g. if you have made a questionnaire, you can put the form into appendix.

- No chapter numbers, but enumerate the appendixes (Appendix A, Appendix B,...). If you have only one appendix, then just "Appendix".

1.7   Examples of master's theses

1.7.1   A new application or method

Thesis is written around a new application (a program). However, it has to be related to the existing research and evaluated.

- Introduction: the problem

- Background theory and main concepts

- Related research (other existing solutions to the same or similar problems)

- Your own application

- Evaluation: comparison to other methods, empirical tests, or theoretical analysis

- Conclusions

1.7.2 Literature review

A theory or a model is analyzed based on literature. Often a comparison of different approaches.

Your own contribution: how the results are described in a uniform manner, analyzed and compared.

Now the existing literature is referred in all chapters, no need for a separate chapter "Related research".

- Introduction
- Main concepts
- Approaches + their analysis (2-3 chapters)
- Or a chapter for comparison and analysis of all approaches
- Conclusions

Variation: analysis of the suitablity of existing approaches to a new problem.

- Introduction
- The new problem + criteria for an ideal solution method
- Potential solution methods + analysis of their suitability (2-3 chapters)
- Possibly discussion (comparison, new solution ideas)
- Conclusions

1.7.3 Empirical research

E.g. a new method or tool is tested with real users or students' products are analyzed.

- Introduction: Begin by introducing the research problem: what was the goal of the empirical study.
- Main concepts and background theories (one chapter) and
- Related research (one chapter) (or both in one chapter)
- Experiment and results (one chapter), e.g. four sections: Material, Methods, Results, and Discussion
- Conclusions

2 Master's thesis process

"The purpose of a thesis is to train the mind of the writer and to show how far it has been trained." [**?**, 141]

2.1 Reading literature

Problem: you should get a wide view of the existing research on the topic, but your time to search and read literature is limited!

- Try to find the most relevant articles.

- To get a wider perspective, search papers by different authors/research groups. If there are several approaches to solve or study the problem, try to study something from all of them (or all of the main approaches).

- Use several digital libraries or bibliographies for searching – one collection may be biassed.

- Plan how much time you can spend for studying literature! In some point you have to stop collecting new material and begin to write.
  $\rightarrow$ Suggestion: In the end of Aug, your it-project is finished and you have collected and **selected relevant material** for your thesis.

2.2 Planning

Well planned is halfly done!

- Begin by brainstorming. Draw concept maps. Discuss with your friends or supervisors. Write down all ideas which come into your mind.

- Collect literature and scan through it. Select the most important sources.

- Try to write the disposition as early as possible. Process it with your supervisor until it looks good (logical structure and order).

- List the main research problems (in the form of questions) and write the introductory paragraphs for the chapters.

2.3 Difficulty to get started

Hints:

- Arrange a comfortable working place. Reserve time for writing every day. Try to make writing a routine for you!

- Set deadlines. Preferrably fix them with your supervisor – it is always more effective.

- Work together with your friend. You can set the deadlines, discuss your topics, and read each other's texts. After good work you can reward yourself by doing something fun.

- Imagine that you are writing to your friend about your research topic!

- Summarize articles you have read. It is never waste of time – at least you learn!

- Begin to write immediately, when your disposition is finished.

- Write down ideas when they come – even in the middle of night.

- Invent good examples and write them down.

- If some part is difficult to write, beging from an easier one. Write the difficult parts, when you are in a good working mood.

- Draw a figure which describes some method or model and write a description for it.

- Try to divide the problem or phenomenon into subproblems or parts and describe them separately.

- Collect main concepts and write definitions for them. Fix the notations.

How to write the beginning of chapters?

- Look at the opening sentences of similar compositions by other people

- Begin, for example, with a summary, a statement of the problem, a hypothesis, necessary and interesting background information, a new idea, an accepted procedure (then explain advantages of another procedure), ...

- Don't spend too much time trying to find an effective beginning – you can always modify it afterwards.

- Go straight to the point and, if possible, refer to things that you expect your readers to know (vs. contructivism).

2.4   Revising

"The time taken in planning, writing and revising is time for thought. It is well spent, for when the work is complete your understanding of the subject will have been improved." [?, 44]

- First of all, admit that the first draft(s) is not perfect! Ask critics and respect it. Good critics is really valuable.

- If possible, ask at least two people to read your thesis. Preferrably one who is an expert on the subject, and one who is not. E.g. your supervisor and one of your student colleagues.

- You can write and revise your work for ever, but in some point you have to stop! One trick is that you don't allow yourself to gather any more new literature.

- Have a break when your work is finished. At least, sleep one night before revising the text yourself.

Technical hints:

- Read text aloud and check if it sounds well.

- Check all references. Especially, are names correctly spelled?

- Save old versions, you may need them afterwards.

2.5   Technical notes

2.5.1   Technical terms

If there is no widely accepted definition for a term, then

1. tell whose definition you follow and give this definition with a reference, or

2. define the term yourself and tell that in this work the term is defined as given.

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"If a technical term is used as a substitute for an explanation, it gives no more than an impression of knowledge. ... Unless a technical term can be defined clearly and then used with accuracy and precision, it may conceal our ignorance and obscure the need for further research, and it should have no place in scientific writing." [**?**, 62]

2.5.2 Symbols

- Don't use the same symbol for different things!

- Try to use also indexes in a uniform manner. E.g. if $i = 1, ..., n$ is the number of rows and $j = 1, ..., k$ the number of attributes in one place, don't change them in another place.

- If some special notation is widely used in literature, follow it.

- If different sources use different notations, harmonize them. (Fix one notation and translate all notations to your own "language".)

- Do not use Greek (or Hebrew) letters if there is no reason. If there is a danger of confusion e.g. with values of variables, then Greek letters are justified.

2.5.3 Equations

Avoid listing mathematical equations! Try to integrate equations into sentences so that the result is readable.

Do not replace words by mathematical symbols (e.g. $\forall$) in the text.

References

[1] R. Barras: Scientists must write. A guide to better writing for scientists, engineers and students. Chapman and Hall, London, New York, year?