MASTER IN COMPUTER SCIENCE - GUIDELINES FOR THE THESIS

Approved by the Degree Committee on 03.03.2010

THE THESIS

The thesis is *extremely* important. We give advice below on how to structure and present your thesis. Regulations will be found on the Faculty website.

The thesis serves to show what you have achieved and should demonstrate that:

- You understand the wider context of computing by relating your choice of project, and the approach you take, to existing products or research.

- You can apply the theoretical and practical techniques taught in the course to the problem you are addressing, and that you understand their relevance to the wider world of computing.

- You are capable of criticising your own work objectively and making constructive suggestions for improvements or further work based on your experiences so far.

- You can explain your thinking and working processes clearly and concisely to third parties who may not be experts in the field in which you are working.

Students can choose between two kinds of thesis:

- an **overview thesis**, which is a uniform overview of a Computer Science field for which a broad literature exists and no overviews taking the latest developments into account are available,

- a **research thesis**, which a description of new techniques and / or innovative and original results obtained by the author of the thesis in a specific field of Computer Science.

Remember that the commission, and other readers, will not have followed the project throughout. Make the presentation reasonably self-contained. State the objectives clearly; provide sufficient background material.

Many students underestimate the importance of the thesis report. You should consider that the aim of the project is to produce a good thesis and that software, hardware, theory etc. that you develop during the project are merely a means to this end. Do not make the mistake of leaving the write-up to the last minute. Ideally, you should produce the bulk of the thesis report as you go along and use the last month or two to bring it together into a coherent document.

A typical length for a overview thesis is 80-100 pages, single spaced. A typical length of a research thesis is 50-60 pages. These specifications are guidelines only.

Remember that quantity does not automatically guarantee quality. A 150 page report is not twice as good as a 75-page one, nor a 10,000 line implementation twice as good as a 5,000 line one. Conciseness, clarity and elegance are invaluable qualities in report writing, just as they are in programming, and will be rewarded appropriately. Also, it is important to appreciate that the appropriate size and structure of a report can vary significantly from one project to the next. Despite these variations, however, most good reports have the components below in common.

Presentation. Below we give an outline of how the thesis should be presented. The thesis must be bound in the university approved manner (the University Library offers for sale the official binders for each Faculty).

Acknowledgements. It is usual to thank those individuals who have provided particularly useful assistance, technical or otherwise, during your project. Your supervisor will obviously be pleased to be acknowledged as he or she will have invested quite a lot of time overseeing your progress.

Contents page. This should list the main chapters and (sub) sections of your report. Choose self-explanatory chapter and section titles and use double spacing for clarity. If possible you should include page numbers indicating where each chapter/section begins. The table of contents should not have more than two levels of headings (say chapters and sections within chapters).

Abstract. The abstract is a very brief summary of the report's contents. It should be about half a page long. Somebody unfamiliar with your project should have a good idea of what it is about having read the abstract alone and will know whether it will be of interest to them.

Introduction. This is one of the most important components of the report. It should begin with a clear statement of what the project is about so that the nature and scope of the project can be understood by the reader. It should summarise everything you set out to achieve, provide a clear summary of the project's background and relevance to other work and give pointers to the remaining sections of the report which contain the bulk of the technical material.

Background. The background section of the report should set the project into context by relating it to existing published work (or unpublished work) on which the project builds. The background section is sometimes included as part of the introduction but more usually is a separate chapter, or collection of chapters if the project involved an extensive amount of research. The published work may be in the form of research papers, articles, text books, technical manuals, or even existing software or hardware of which you have had experience. You must acknowledge the sources of your inspiration; you are expected to have seen and thought about other people's ideas; your contribution will be putting them into practice or developing them in some new direction. One rule is clear: if you present another person's work as your own and do not cite your sources of information/inspiration you are *cheating*. When referring to other pieces of work, cite the sources at the point they are referred to or used, rather than just listing them at the end. The University takes a very strict line on plagiarism: the antiplagiarism check is a mandatory part of your final examination and needs to be done before handing in the thesis. Instructions are available on the University website.

Body of report. The central part of the report usually consists of three of four chapters detailing the technical work undertaken during the project. The structure of these chapters is highly project dependent. Usually they reflect the chronological development of the project, e.g. design, implementation, experimentation, optimisation, although this is not always the best approach. However you choose to structure this part of the report, you should make it clear how you arrived at your chosen approach in preference to the other alternatives documented in the background. For implementation projects you should describe and justify the design of your program at some high level, e.g. using dataflow diagrams, pseudocode, ADT specifications, Z, VDL, etc., and should document any interesting problems with, or features of, your implementation. Integration and testing are also important to describe. Your supervisor will advise you on the most suitable structure for these middle sections.

Conclusions and future work. All projects should conclude with an objective evaluation of the project's successes and failures and suggestions for future work which can take the project further. Even the very best pieces of work have their limitations. You will not have time, and you should not try, to tie up every loose end. You are expected to provide a proper critical appraisal of what you have done. Your assessors are bound to spot the limitations of your work and you are expected to be able to do the same.

Bibliography. This consists of a list of all the books, articles, manuals etc. used in the project and referred to in the report. You should provide enough information to allow the reader to find the source. You should give the full title and author and should state where it is published, including full issue number and date, and page numbers where necessary. In the case of a text book you should quote the name of the publisher as well as the author(s).

Appendix. The appendices contain information which is peripheral to the main body of the report. Information typically included are things like program listings, tables, proofs, graphs or any other material which would break up the flow of the text if it appeared. Large program listings are rarely required, and should be compressed as much as possible, e.g. by printing in multiple columns and by using small font sizes, omitting inessential code etc.

User guide. For projects which result in a new piece of software you should provide a proper User Guide providing easily understood instructions on how to use it. A particularly useful approach is to treat the User Guide as a walk-through of a typical session, or set of sessions, which collectively display all the features of your package. Technical details of how the package works are rarely required. Keep it concise and simple. The use of

diagrams illustrating the package in action can often be effective. A user guide is sometimes included as a chapter in the main body of the report, but is often better as an appendix to the main report. Do *not* include user guides for trivial pieces of code where these are not the main subject of the thesis.

Internal Chapter Structure

Each chapter should have an introduction stating its purpose within the thesis and why it is placed at that point, and outlining what is to be covered in the chapter and why.

Each chapter should finish with a summary describing what it has presented and what is to follow.

Chapters should not be overly long – it is important to show summaries of ideas and not simply repeat everything that has been read. A chapter of longer than 20 pages should usually be avoided. When a chapter is more than 30 pages it should generally be split into two (or more) chapters.

Proof Reading & Quality of English

It is extremely important that you carefully proof read your work. This should catch most typing errors that are not spelling errors, for example "form" instead of "from".

Proof reading means also checking for inconsistencies, disparities, missing paragraphs, unintelligible sentences, bad formatting of text, graph and drawings, etc.

The thesis report is expected to be written in English as practised by a native speaker. If English is not your first tongue then you should consult your supervisor to determine if you need additional help in this regard. This may involve outside help.

Note: the quality of the English in your thesis is your responsibility solely.

Spelling and Grammar Checking

You must spell check all parts of the thesis report. A number of tools are available for spell checking, for example in MS WORD. Such tools should be used where available.

Note: this is not instead of proofreading but as well as!

Additional guidelines include:

In general, the text should be justified left and right;

All chapter / (sub)section headings should be in bold-font – with increasingly less eye-catching presentation;

All figures/tables should be numbered and included in the table of contents;

All tables/figures must be referenced in the text;

The author should not normally refer to him/herself explicitly by using the first person, i.e. we should read the "author", "s/he", etc. instead of "I", "my", etc.

REFERENCING AND CITING

Referencing

When researching a piece of written work you will frequently read other peoples' ideas, theories or data that you will want to make reference to in your own work.

Citing

Making reference to other authors in your own work is called citing. The names of the authors who are cited in your text are listed in alphabetical order at the end of the written work. This is a reference list.

The process of citing authors and producing a reference list can be done in one of two common styles – the Harvard or the Numeric. A consistent approach to references should be adopted when citing in the text and in the reference section. This guide describes the Harvard Referencing System as it is the mostly commonly used, but you may use other standard systems.

Why reference?

To show evidence of the breadth and depth of your reading;

To acknowledge other peoples' ideas correctly;

To allow the reader of your work to locate the cited references easily, and so evaluate your interpretation of those ideas;

To avoid plagiarism.

What is the difference between a Reference List and a Bibliography?

Reference list - this list provides all the information about the published works - books, journals and newspaper articles etc., you have mentioned within your text. It is organised alphabetically by the family names of the authors (or originators). The list appears at the end of the work and gives full details of the author's name, what the work is called, the date of publication and where it was published.

Bibliography – a list of all works read in the course of your preparatory reading. This includes material that has been helpful for reading around the subject area but has not been referred to directly in the text. It is still important to acknowledge this work. This list is also arranged alphabetically by authors' family name and is located after the reference list.

Some people mix the list of references from within the text (references) and the references to wider reading (bibliography) together in one list, which they call the Bibliography. This is discouraged, because it creates difficulties for your examiner, who has to sort out which is which, in order to be clear about the accuracy of your referencing.

For more in-depth guidelines on referencing and citing, see the Appendix "Citing in your text.

SCIENTIFIC WRITING

The Masters Thesis Report should have a purpose and tell a story.

Similarly each chapter should have a purpose which contributes to the Masters Thesis Report's purpose; each section should contribute to the chapter's purpose; each paragraph to the section; and each sentence to the paragraph.

Each sentence should contribute to the overall purpose of the Thesis Report. If a sentence does not fit in its current place then consideration should be given as to whether it contributes, if it does then an alternative location for it should be considered, if there is no alternative then it is usually indicative of a poor structure. If the sentence does not contribute it should be removed.

A number of internal dependencies, forward or backward, within the text are usually indicative of a poor structure. In this case the structure should be reviewed.

All opinions and conclusions must be justified by you or referenced to their source, results should be fully presented and discussed, and experiments should be presented in enough detail to be repeatable by the reader.

When approaches and results are being evaluated this must be done based on given criteria, thus results are only "good" with reference to stated criteria. Similarly one approach is "better" than another only with reference to stated criteria. As far as possible these criteria should be measurable and quantifiable.

Sentences should be short and to the point; the use of subjective adjectives (e.g. nice) should be avoided. Long sentences often lead to misunderstanding or ambiguity and should be avoided.

FORMALITIES

Format. The Faculty of Computer Science requires that theses are submitted in a certain format:

- Page format: A4
- Formatting: single spaced, 10 pt. (in the style of LaTeX standard article 10 pt.), easily readable font (e.g., Arial, Helvetica, Times New Roman)
- Margin: normal

Make sure that your thesis is in the required format (there are various `style files' to help with this), otherwise it may not be accepted at submission time.

Submission. All theses are to be digitally uploaded in the student portal within the deadline. Instructions for this are available on the university website.

ASSESSMENT OF THE THESIS

Thesiss are normally assessed on the following broad criteria:

Background research. This assesses your awareness of relevant background work and how your project builds upon or exploits existing techniques or results. For implementation projects, it assesses the way you arrived at your initial project specification, work programme and list of objectives.

General competence. This assesses your general approach, the clarity of your objectives, and your ability to relate the significance of your achievements to the state-of-the-art.

Technical accuracy. This assesses the main technical output from the project, as regards correctness, elegance, usability etc. of the final product, theoretical or practical, and the techniques employed.

Report. This assesses the quality of the write-up itself: the organisation of the material, quality of the prose, clarity of explanations, spelling, punctuation, legibility, relevance of diagrams, etc. Note that reports falling below minimum acceptable standards will not be accepted.

Finally... Remember that one of your supervisor's main responsibilities is to advise on how to write-up your project results. You are not expected to be able to produce a perfect thesis without help. You should discuss with your supervisor all aspects of the thesis, but particularly its structure and how to present the material. You might find it useful to look at MSc theses from previous years.

PITFALLS

Why do some projects go wrong? Here are some of the common causes of failure:

Choosing or starting the project too late. Start the project as soon as you can: the longer you leave it the harder it is to get motivated, especially when all your friends seem to be flying ahead. You should aim to have completed most of the project well in advance, thus leaving sufficient time to fill in gaps and write the thesis.

Failing to meet your supervisor regularly. If you arrange a meeting with your supervisor, turn up at the agreed time. If you are stuck for any reason and you have no meeting arranged, contact him or her immediately. You gain *no* sympathy from anyone if you lose contact with your supervisor and produce a poor project as a result. Your supervisor will be happy to help you but he or she can do nothing if they are unaware that you are having trouble. Also, make sure that you are prepared for each meeting with your supervisor. This may take the form of a completed piece of work that you have done ready to demonstrate to your supervisor; or it may be that you have hit some problem, in which case come along prepared to explain the problem so that you both can attempt to solve it. Always bring your laboratory workbook and any results you have to each supervision.

Allowing too little time for the thesis report. You should try to produce as much of your report as you can as you go along, even though you don't know in advance its exact structure. Written work along the way has two forms: (1) written accounts which describe a piece of work you have completed along the way. Write these at the time that each stage is completed--it is much easier then; and (2) an evolving plan of your thesis--chapters, sections and their contents. This changes as the project evolves, but will provide guidance to the overall structure. The last two weeks of the project should be dedicated to pulling together the material you have accumulated and producing a polished final product.

Failing to plan a fall-back position if the planned work is not completed on time. Try to plan your project in stages so that if things go wrong in a later stage you have a completed stage to fall back on.

Trying to satisfy an external customer at the expense of your academic work. Do not let any outside interests interfere with your work. The guidance for your project should come from your supervisor, not your prospective employer.

Over- or under-ambition. Try to be realistic about what you can achieve in the time available. A good project requires a lot of input from you and should prove to be technically challenging throughout. At the same time, however, it is better to do a small job well than it is to fail to do a big job. Your supervisor will advise you on his or her expectations of the project and this will help you to set your sights accordingly.

Submission of preliminary drafts. Do not submit your thesis without letting your supervisor read drafts first. He or she will invariably have comments and suggestions for improvement. Don't leave this to the last moment. Give your supervisor a good period to read and comment as he or she will possibly have several to look at, and it can take a while to read through a draft. You should normally expect to revise the complete draft at least once. Theses failing to meet minimum standards will not be accepted for award of the MSc degree.

The thesis has to be your own original work. Guidance on the antiplagiarism check is available on the University website.

APPENDIX - CITING IN YOUR TEXT

The Harvard System (sometimes called the Name and Date System) uses the family name of the author of the work you wish to cite and the date it was published. These are incorporated into the text of your work each time you make reference to that person's ideas.

Citing a single author

The author and the date of publication are provided

> For example:
>
> Smith (1993) has suggested that …..
>
> OR
>
> Some commentators suggest that ….. (Smith, 1993), whilst others believe more complex relationships exist.

Citing more than one author

If there are two authors, the names of both should be given in the text and in the reference list. When citing and referencing use the same format for both, and words are preferable to symbols. For example, Smith and Jones not Smith & Jones.

If there are more than two authors, the name of the first author only should be given in the text, followed by the abbreviation 'et al.' (meaning 'and others' in Latin).

> For example:
>
> Bennet et al. (1997) showed that …..
>
> Note that et al is in italics and is followed by a full stop.

In your reference list, however, you will list **all** the authors who compose the et al.

> For example:
>
> Bennet, S., McRobb, S. and Farmer, R. (2002) Object-Oriented Systems Analysis and Design. London: McGraw Hill.
>
> Note that in the reference list the family name and initial are inverted.

Distinguishing several publications in the same year by an author

Sometimes you will find that an author has published two or more books, journal articles, etc. in a given year. It is important to distinguish between the different publications by adding letters (a, b, c, etc.) to the date in the text.

> For example:
>
> Johnson (1991a) has progressed both experimental and practical aspects of software technology to the point where they provide a serious challenge to Pacific Belt dominance (Johnson, 1991b).

In the reference list the articles are presented alphabetically: 1991a, then 1991b and so on.

> For example:
>
> Johnson, C. (1991a) Software: The way ahead ….
>
> Johnson, C. (1991b) Changing Global Markets ….

The Required Information

You will find all the information that you need to build up a reference from the title page of the book or document you are citing. Remember to

- Keep the order of authors' names the same as on the title page

- Cite the first named place of publication.

Note that edition dates are not reprint dates (new editions will have new text and must be cited as such). The copyright sign will often indicate the date of production.

If the work to be referenced has not originated from a commercial publisher and lacks obvious title page data – for example, papers presented at conferences but not published – then the appropriate information should be obtained from any part of the document.

A book's editor is referenced in exactly the same way as an author, adding (ed.).

> For example:
>
> Cibora, C.U. (ed.) (1996) Groupware and teamwork: invisible aid or technical hindrance?. Chichester:Wiley.
>
> or
>
> Grosz, B.J., Sparck Jones, K. and Webber, B.L. (eds.) (1986) Readings in Natural Language Processing. Los Altos: Morgan Kaufman.

Note, the capitalisation of the title should be the same as on the source.

Corporate Authors

Sometimes it is not possible to name an individual as an author. For example, where there has been a shared, 'corporate' responsibility for the production of the material. In such cases the 'corporate name' becomes the author (often called the 'corporate author').

Corporate authors can be government bodies, companies, professional bodies, clubs or societies, international organisations.

> For example:
>
> Institute of Waste Management (1995) Ways to Improve Recycling. Northampton: Institute of Waste Management.

The 'corporate author' appears in the text in the same way as authors.

Chapters in edited books

An edited book will often have a number of authors for different chapters. To refer to a specific author's ideas (from a chapter), cite him or her in the text, not the editors. In the reference list indicate the chapter details and the book details from which it was published.

> For example:
>
> Whitehead, C. (1991) 'Charismatic Leadership'. In: W. Harrison and D. Cole (eds.) Recent Advances in Leadership Theory. London: Waverley. pp. 73-89.

> Note the use of 'in' to link the chapter to the book, and the use of page numbers.
>
> Whitehead's name would appear as the author in your text, and in the reference list. The year of publication is only given once in the reference list.

Secondary sources

A journal article or book someone else cites that you have not seen is called a secondary source.

You should try and find the bibliographic details of the source yourself and cite them in the normal way. It is important that when criticising ideas you do it 'first hand'.

If you are unable to locate the bibliographic details of the secondary source, you may cite it in your text using the text that is your primary source.

In your text and reference list you must link these two items with the term 'cited in'.

The format is:

Author of original work's family name, initials, (Year of original publication), Title of original work. Place of publication: Publisher. Cited in Author/editor surname, initials. (Year) Title. Place of publications: Publisher.

> For example:
>
> A change in family circumstances can affect a child's emotional stability (Pollock, 1995) cited in Jones (1996).
>
> Pollock, T. (1995) Children in Contemporary Society. Cited in Jones, P. (1996) A Family Affair. London: Butterworth.
>
> Note that only the primary source title is italicised and both years are included.

No publication details given

Occasionally you will find documents that lack basic publication details. It is common practice to indicate that this information is not available by using a series of generally accepted abbreviations:

- author/corporate author not given use (Anon.)
- no date   use (n.d.)
- no place (sine loco)   use (s.l.)
- no publisher (sine nomine)   use (s.n.)
- not known   use (n.k.)

Quotations

If you quote from a publication directly, then you must place the page number within the citation. In the reference list, however, it is not necessary to indicate the page number.

a.   Short Quotations

Short quotations, meaning the use of a phrase or part of a sentence. Short quotations used within the text require the use of single quotation marks.

> For example:
>
> Whilst it is possible that poor parenting has little effect on primary educational development, 'it more profoundly affects secondary or higher educational achievement' (Healey, 1993, p. 22).

b.   Longer Quotations

Quotations that are one sentence or more should be distinguished from the rest of the text by indenting the quotation by an equal amount from both side margins and placing in single space format (as opposed to the rest of the text which should be in 1.5 or double spaced format). Note the example below of a long quotation set with text. You may also use a smaller font size to further distinguish the quoted text.

Indented quotations should still be placed in quotation marks.

> For example:
>
> "The rise of capitalism and the expansion of the world market have made international trade an essential part of modern society. The industrialised core has developed, and continues to maintain its lifestyle, by exploiting the labour and resources of the periphery. Because the developed countries hold the power they dictate the terms, not only with regard to pricing but also the uses to which resources are put.
>
> The resource depletion cost of individual people in the North is much greater than that in the South: 80 per cent of the world's resource consumption is by 20 per cent of the people. This 20 per cent live mainly in the North. Since many resources are transferred (at prices favourable to the purchaser) from the South to the North, much of the cost is paid in the South."
>
> (Kirby et al, 1995 p.4)
>
> "This uneven development is the central argument of the neo-Marxist point of view."

Never split a quotation in your text. If it does not fit completely on a page then start a new one so that the whole quotation is kept together.