

How to Produce a Computer Science Thesis

Table of Contents

How to Produce a Computer Science Thesis	1
1 Introduction	1
2 Traditional or “5 Chapter” Thesis	2
2.1 Thesis statement	2
2.2 Contributions	2
2.3 Introduction	3
2.4 Literature Survey/Review	3
2.5 Methodology and Implementation	3
2.6 Evaluation	4
2.7 Conclusions, Summary and Future Work	4
2.8 The Five Chapter Thesis Heuristic	4
2.9 Appendices vs. More Chapters	4
2.10 Flexibility	5
3 Thesis by Manuscript	6
3.1 Criteria for Selecting this form of Thesis	6
3.2 Formatting	6
3.3 Citations and Other Matters	7
3.4 A Final Chapter Should be Added	7

1 Introduction

This document is intended as a brief guide to students in Toronto Metropolitan University (TMU) Computer Science Masters and Doctoral programs who are at the stage in their studies where they need to report on the fruits of their labors— it is the written thesis. This document does not address any of the front or back matter of a thesis¹ but speaks to the core of it. While a broad variance is permissible in the organization of the core, what is presented here should serve as a broad description of what needs to be present so that a successful outcome will be more likely.

There are essentially two forms that your thesis can take. The first form is often called a “traditional” thesis and sometimes a “5 chapter thesis”. This document will discuss this form of thesis first starting in section 2. The second form of thesis is sometimes called “thesis by manuscript” in which you use your published peer-reviewed papers to form the chapters of the thesis. This form of thesis is discussed in section 3.

¹ Extremely detailed instructions for the physical production of a thesis document can be found at:
<https://www.torontomu.ca/graduate/>

2 Traditional or “5 Chapter” Thesis

The following sections discuss the core parts of this type of thesis with the goal of allowing you to form your thoughts around writing a document whose form is well-understood by all who may read it but whose content helps you defend it as a new work, worthy of the degree you seek.



There are seven essential elements to this type of thesis document:

1. Thesis Statement
2. Contributions
3. Introduction
4. Literature Survey
5. Methodology and Implementation
6. Evaluation
7. Conclusions, Summary and Future Work

2.1 Thesis statement

The word “thesis” roughly translates from the Greek word for “position”. The thesis statement is a refined and succinct set of arguments that define what you will demonstrate or prove in the thesis—it is your position. It is the “point” of your work. The statement can be very short or many pages in length. If an oral defense were a battle, this is the ground you fight to hold. Sometimes this statement is made into a question and becomes the question you answer in your thesis document.

2.2 Contributions

This is a list of things that you did that you believe expand the bounds of what Computer Science is in the context of your thesis statement. If one thinks of the massed knowledge accumulated over decades as bricks being used to build a tower that reaches ever higher, your contributions--once examined--are the bricks that help build that tower.

Contributions are always made in relationship to both the discipline of Computer Science and the thesis statement you have made. For example, writing a piece of software would not normally be considered a contribution. However, defining a methodology or algorithm that supports your thesis statement may.

2.3 Introduction

This is where you lead the reader into the core of your thesis. It is where you frame what you will present in future chapters. It explains the context in which your work has taken place. This might make reference to a particular field or perhaps a problem that your work addresses. The introduction contains your thesis statement and your contributions. It also describes how the rest of your thesis will be organized. It normally, is not very long, should be compelling and typically forms chapter one of your thesis.

2.4 Literature Survey/Review

This section is a review of all relevant research that impinges on your thesis. It is the work done by others that relates to what you hope to demonstrate with your work. This is also where the literature related to methods that you used in your work should be introduced.

Essentially, this part of your thesis document will form the bulk of your citations. The literature survey should reference only publicly available material. The purpose of this section is to illuminate the area of research, not to reference “magic documents” that are impossible to find. Essentially, the literature survey forms chapter two although some of the literature survey may begin in the introduction to your thesis to help prime the reader. This section also helps guide the reader through the rest of your thesis in the sense that it provides direction as to what bodies of knowledge you used in support of your thesis statement.

It is good practice to cite seminal and significant works directly, rather than cite work that relies on the work of others. These are considered primary sources. It is also good practice, and extremely useful, to cite ones own peer-reviewed works that adds to your arguments and demonstrates that others have already examined your work and have accepted it. This lets any examining committee know that you have already gone through peer review and have survived it.

2.5 Methodology and Implementation

This is the section of your thesis where you will present the methodological framework for your research. It discusses how you would do what you have already done, if you were to start again. Methodology chapters are intended to be complete, detailed reports of what someone would need to do to replicate your results with the objective that any other researcher could repeat your work to determine if your results can be replicated.

This section will also describe any experiments you may have run, it will also discuss any testing methodologies and how these would be actually applied in your case. In essence, this is the section where you disclose how you measure your results to the world but do not actually give the results. This section of your thesis typically becomes chapter three.

2.6 Evaluation

In this section you will report the results of your work with reference to the methodology you discussed in the previous section. It is very important that you report the results of your evaluation in relation to your thesis statement. This will bolster your arguments concerning the validity of your statement and will make it more difficult to attack. In many cases the claims you made in the first section of your thesis can now be repeated and substantiated.

Generally speaking, it is a good idea to break this part of your thesis into sections where each section addresses a single claimed (contribution) that you have made supporting your thesis statement, and shows how your methodology has allowed you to prove your claim.

This section will normally form chapter four and is essentially the “meat” of your document and may (in rare cases) take more than one chapter to present.

2.7 Conclusions, Summary and Future Work

This section allows you to explain to the reader all conclusions that can be drawn from evidence that you have presented in previous sections. In addition, you should again present your contributions and make reference to how you validated them in your thesis. Finally, it is very important that you present a roadmap for continuing the research you have reported. You should present all questions that you did not address in your work and discuss why they are significant questions and beyond the scope of what you have done. This section is the last part of your core work. As such it will form chapter 5.

2.8 The Five Chapter Thesis Heuristic

Perhaps a good assumption is that you will be producing a document with approximately five chapters in it. When considering what should go into any additional chapters it is helpful to ask the question, “Is the material in question so different from what I am putting in this chapter that it warrants another chapter?” It is usually the case that the answer is “maybe”. This means that the material may be reworded to fit well into the existing framework. The five-chapter thesis is often labeled “traditional” but it is well understood, has served many, and places your new work in a well-understood context.

2.9 Appendices vs. More Chapters

Often, situations arise where material, directly related to your thesis, but of a background nature, may be included in your work. This is where the use of appendices may be of considerable help. Appendices can be referenced by your main text, are available to the reader when necessary, but do not oblige the reader to examine the contents of the

appendices if they are already familiar with the contents or they simply wish to examine the gist of your arguments without the clutter of background. If you feel that the reader should be coaxed into examining the material, you may simply consider adding an appropriately named chapter.

When deciding what should go in an appendix or additional chapter you should ask yourself;

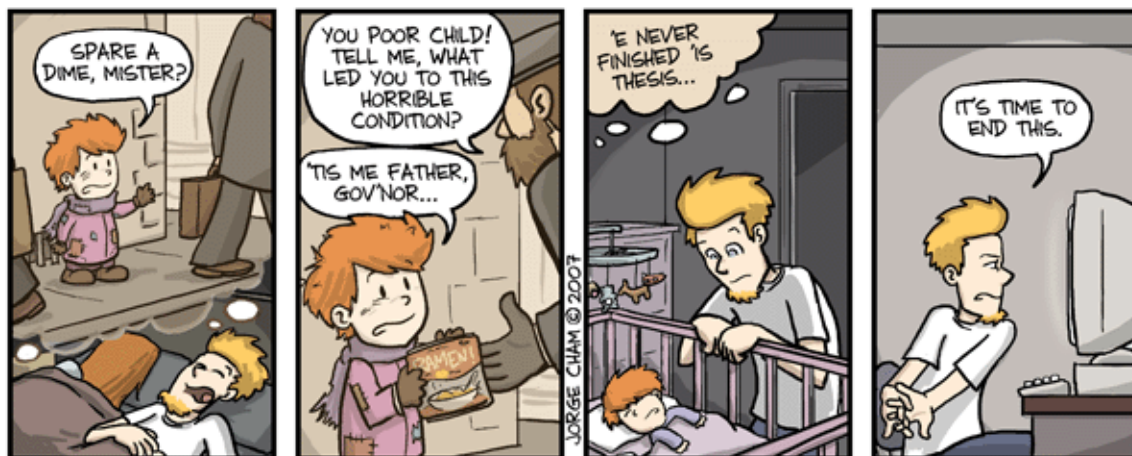
1. Is this material necessary to support my arguments?
2. Is this material something that needs to be introduced and not simply cited?

The answer to the first question lets you decide if the information should be included at all. The answer to the second question provides you insight into what to do with the material.

For example, if your thesis relies on algorithms or computer software to make your case, you may wish to provide explanations in an appendix. This is especially true if you feel that providing the information will help the committee examining your thesis to see the merit of your arguments.

2.10 Flexibility

The goal of a thesis is to present a clearly defined thesis statement with the arguments that support it. As such, there is a great deal of flexibility that is permissible in the actual production of the thesis document. If you feel that the material being presented requires an alternative form than the one this document has discussed, it is always your option to pursue it. Having said this, no matter what the format of your thesis, the seven components presented in this document will usually form the basis of your work and it is up to you to make it clear to the reader that you have provided them.



WWW.PHDCOMICS.COM

3 Thesis by Manuscript

An alternative to the traditional thesis is the manuscript-style thesis consisting of a collection of papers of which you are an author or co-author². These papers must be presented in a “cohesive manner” and with a “coherent theme”. This form of thesis has the benefits of avoiding quite a lot of new writing but has the disadvantage of requiring you to explain how the papers you use fit together and support any claims that you make in order to earn the degree you seek.

3.1 Criteria for Selecting this form of Thesis

The most important criteria is that you have actually published your work in peer-reviewed venues—normally we refer to these works as “papers”. Other disciplines often call papers, “manuscripts”.

The following additional criteria also apply when deciding if this is the form of thesis that will best serve you:

1. You must be the first or primary author (that is, the author who has made the most substantial contribution) of the papers included in the thesis.
2. At most one paper included in the thesis may be submitted but not yet accepted.
3. The papers should be published, “in-press”, or accepted for publication in peer-reviewed venues³ arguably associated with the field of Computer Science.
4. If you are preparing a Master’s thesis, the thesis must contain a minimum of one paper.
5. If you are preparing a Doctoral thesis, the thesis must contain a minimum of three papers.

3.2 Formatting

As a preface or part of a general introduction, you must include a “statement of co-authorship” describing what role you played in the authoring of each paper. For papers where you have co-authors, you must outline their contributions to the work reported in the paper⁴.

In the introduction to the thesis, emphasis should be placed on explaining the relationships between the papers and providing a coherent theme for the overall thesis. Usually this means that you must provide arguments that the papers support any research

² This form of thesis and the rules associated with it are fully described in the Yeates School of Graduate Studies (YSGS) document, “Guidelines for Manuscript-Style Master’s or Doctoral Theses” which can be found at: <https://www.torontomu.ca/graduate/>

³ In the field of Computer Science our acceptable venues for publication include peer-reviewed conferences, symposia or similar meetings and journals. Other venues may also be acceptable. Students should consult with the Graduate Program Director if other venues are in doubt.

⁴ You must explain your involvement in the paper with respect to the conception of the experiments, data collection, data analysis, and writing the text. Data that was collected or experimental techniques that were conducted by someone other than the student must be clearly indicated.

claims that you wish to make. This is somewhat more challenging using this thesis style than the traditional thesis style that allows you to definitively state your research contributions.

Each paper forms a separate chapter in the thesis. In each chapter, the YSGS guidelines indicated that “rather than repeating each of the individual introductions, redundancy should be avoided. To ensure logical flow, connecting text should be included bridging each chapter to the next and previous ones.” What this means in practice is that you must provide any clarifying explanations that may not be present in the original papers that relates them to one another. This is important because academic papers follow a format not necessarily conducive to reading them as a group.

3.3 Citations and Other Matters

Citations, cross-references, figures, and tables, etc. must be re-numbered to conform to the appropriate chapter of the thesis. Multiple reference lists must be avoided. For papers included in the thesis, full citations to those publications must be included in the thesis.

3.4 A Final Chapter Should be Added

A concluding chapter should be included which ties together topics and themes from the papers and points towards future work.