Universität Paderborn — Fakultät EIM-I
Fachgebiet Rechnernetze
Prof. Dr. H. Karl

Masterarbeit

Writing a Masters Thesis using LATEX 2$_\varepsilon$ and Advice from Prof. John W. Chinneck

Manfred Mustermann

Abgabe-Datum hier eintragen

Betreut von:
Prof. Dr. Holger Karl
Mitarbeiter Sowieso

Masterarbeit
am Fachgebiet Rechnernetze Prof. Dr. Holger Karl

Institut für Informatik
Fakultät für Elektrotechnik, Informatik und Mathematik
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Betreut durch:
Prof. Dr. Holger Karl
Mitarbeiter Sowieso

Zweitgutachter:
Prof. Dr. Sowieso Sowieso

Zusammenfassung

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Abstract

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Contents

List of Figures

1 Introduction

This note describes how to organize the written thesis which is the central element of your graduate degree. To know how to organize the thesis document, you first have to understand what graduate-level research is all about, so that is covered too. In other words, this note should be helpful when you are just getting started in your graduate program, as well as later when you start to write your thesis.

1.0.1 What Graduate Research is All About

The distinguishing mark of graduate research is an original contribution to knowledge. The thesis is a formal document whose sole purpose is to prove that you have made an original contribution to knowledge. Failure to prove that you have made such a contribution generally leads to failure.

To this end, your thesis must show two important things:

- you have identified a worthwhile problem or question which has not been previously answered,

- you have solved the problem or answered the question.

Your contribution to knowledge generally lies in your solution or answer. What the Graduate Thesis is All About

Because the purpose of the graduate thesis is to prove that you have made an original and useful contribution to knowledge, the examiners read your thesis to find the answers to the following questions:

- What is this student's research question?

- Is it a good question? (has it been answered before? is it a useful question to work on?)

- Did the student convince me that the question was adequately answered?

- Has the student made an adequate contribution to knowledge?

A very clear statement of the question is essential to proving that you have made an original and worthwhile contribution to knowledge. To prove the originality and value of your contribution, you must present a thorough review of the existing literature on the subject, and on closely related subjects. Then, by making direct reference to your literature review, you must demonstrate that your question (a) has not been previously answered, and (b) is worth answering. Describing how you answered the question is usually easier to write about, since you have been intimately involved in the details over the course of your graduate work.

If your thesis does not provide adequate answers to the few questions listed above, you will likely be faced with a requirement for major revisions or you may fail your thesis defence outright. For this reason, the generic thesis skeleton given below is designed to highlight the answers to those questions with appropriate thesis organization and section titles. The generic thesis skeleton can be used for any thesis. While some professors may prefer a different organization, the essential elements in any thesis will be the same. Some further notes follow the skeleton.

Always remember that a thesis is a formal document: every item must be in the appropriate place, and repetition of material in different places should be eliminated.

1.0.2 A note from the template-author

This template is a skeleton, created after an article of Prof. John W. Chinneck [1]. Each following chapter will contain a short note on what Prof. Chinneck thinks the chapter should contain. Another article/presentation worth reading is this article by Michael A. Covington[2]. See the accompanied `thesis.bib` bibtex file for URL's to these articles.

1.0.3 What the introduction should contain

This is a general introduction to what the thesis is all about – it is not just a description of the contents of each section. Briefly summarize the question (you will be stating the question in detail later), some of the reasons why it is a worthwhile question, and perhaps give an overview of your main results. This is a birds-eye view of the answers to the main questions answered in the thesis (see above).

1.0.4 Some Blind Text as a filler

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2 Background Information (optional)

A brief section giving background information may be necessary, especially if your work spans two or more traditional fields. That means that your readers may not have any experience with some of the material needed to follow your thesis, so you need to give it to them. A different title than that given above is usually better; e.g., "A Brief Review of Frammis Algebra."

2.1 A note from the template-author

In a master thesis you might not need a background chapter. Discuss with your advisor, whether it is feasible to put background information either in the introduction or related-work chapter.

2.2 An example of a TikZ image within text

This section just demonstrates a coustom-macro for placing figures in the text. The source-code for this macro is found in the file 'macros.tex'. Here is a reference to figure 2.1 on the next page.

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Figure 2.1: The slightly longer caption, containing additional information for the figure itself.

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- Fivth item in a list

3 Review of the State of the Art

Here you review the state of the art relevant to your thesis. Again, a different title is probably appropriate; e.g., "State of the Art in Zylon Algorithms." The idea is to present (critical analysis comes a little bit later) the major ideas in the state of the art right up to, but not including, your own personal brilliant ideas.

You organize this section by idea, and not by author or by publication. For example if there have been three important main approaches to Zylon Algorithms to date, you might organize subsections around these three approaches, if necessary:

3.1 Iterative Approximation of Zylons

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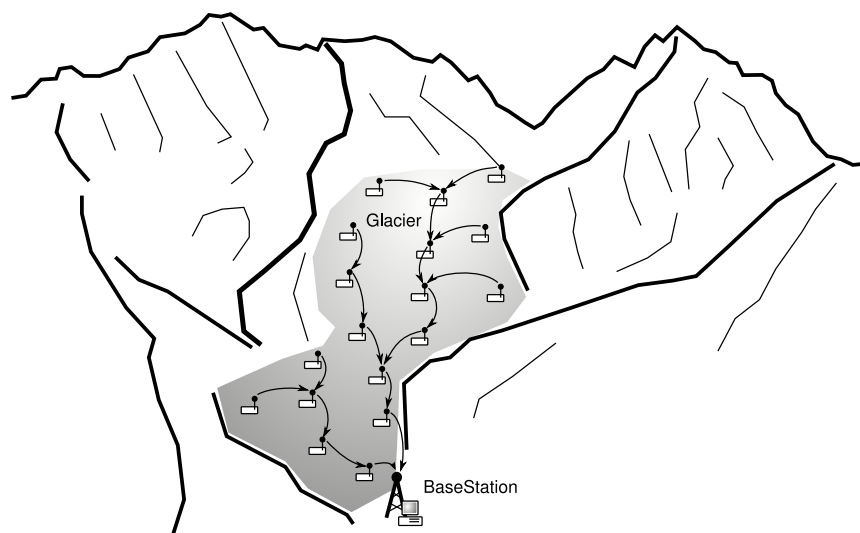
3.2 Statistical Weighting of Zylons

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3.3 Graph-Theoretic Approaches to Zylon Manipulation

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3.4 A note from the Template Author

If you are writing a master thesis, you can alternatively call this chapter simply **'Related Work'**. It's also a good idea to try to come up with more significant titles for your chapter than just these generic ones. If unsure, ask your advisor how he/she likes it best.

3.5 Some Filler Text to show a Sidewaysfigure

This section shows off a custom-macro for placing figures sidweways, in case they are to large and redesigning them is infeasible. As an example figure 3.1 shows a large architecture diagram.

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Figure 3.1: The slightly longer caption, containing additional information for the sidewaysfigure itself.

4 Research Question or Problem Statement

Engineering theses tend to refer to a "problem" to be solved where other disciplines talk in terms of a "question" to be answered. In either case, this section has three main parts:

1. A concise statement of the question that your thesis tackles

2. Justification, by direct reference to section 3, that your question is previously unanswered

3. Discussion of why it is worthwhile to answer this question.

Item 2 above is where you analyze the information which you presented in Section 3. For example, maybe your problem is to "develop a Zylon algorithm capable of handling very large scale problems in reasonable time" (you would further describe what you mean by "large scale" and "reasonable time" in the problem statement). Now in your analysis of the state of the art you would show how each class of current approaches fails (i.e. can handle only small problems, or takes too much time). In the last part of this section you would explain why having a large-scale fast Zylon algorithm is useful; e.g., by describing applications where it can be used.

Since this is one of the sections that the readers are definitely looking for, highlight it by using the word "problem" or "question" in the title: e.g. "Research Question" or "Problem Statement", or maybe something more specific such as "The Large-Scale Zylon Algorithm Problem."

4.1 A Note from the Template Author

Again, this chapter might not be feasible for the scope of a master thesis. Discuss with your advisor, if it is necessary, or if it might be better integrated as the intoductory section of your contributions or as the last section in the related work.

4.2 Filler Text

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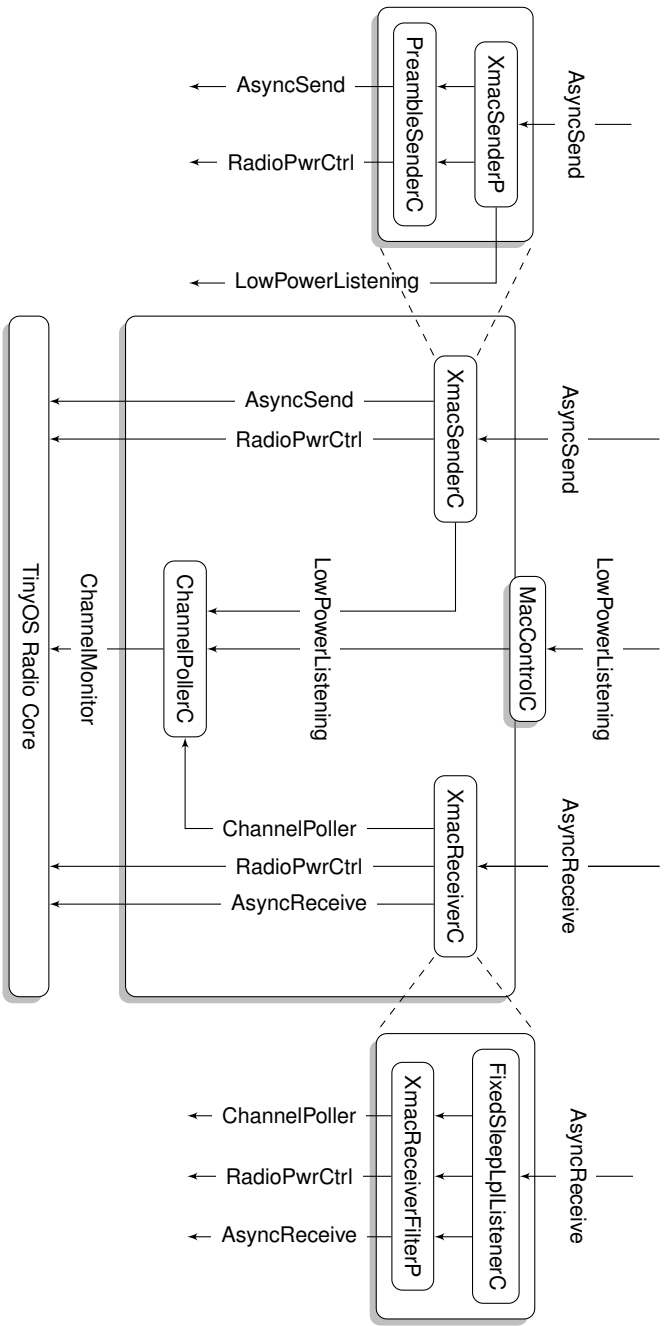
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5. Fivth item in a list

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5 Your Contribution

This part of the thesis is much more free-form. It may have one or several sections and subsections. But it all has only one purpose: to convince the examiners that you answered the question or solved the problem that you set for yourself in Section 4. So show what you did that is relevant to answering the question or solving the problem: if there were blind alleys and dead ends, do not include these, unless specifically relevant to the demonstration that you answered the thesis question.

5.1 Filler Text

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6 Your other Contribution

This part of the thesis is much more free-form. It may have one or several sections and subsections. But it all has only one purpose: to convince the examiners that you answered the question or solved the problem that you set for yourself in Section 4. So show what you did that is relevant to answering the question or solving the problem: if there were blind alleys and dead ends, do not include these, unless specifically relevant to the demonstration that you answered the thesis question.

6.1 A Note from the Template Author

You can span the text, describing your contribution over multiple chapters. Again, discuss with your advisor whether this is feasible. But don't annoy your advisor by asking him about how to structure your text. Think about what you want to say, then create a structure, outline the content of that structure and then present it to your advisor.

6.2 Filler Text

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7 Conclusions

You generally cover three things in the Conclusions section, and each of these usually merits a separate subsection:

1. Conclusions

2. Summary of Contributions

3. Future Research

Conclusions are not a rambling summary of the thesis: they are short, concise statements of the inferences that you have made because of your work. It helps to organize these as short numbered paragraphs, ordered from most to least important. All conclusions should be directly related to the research question stated in Section 4. Examples:

1. The problem stated in Section 4 has been solved: as shown in Sections ? to ??, an algorithm capable of handling large-scale Zylon problems in reasonable time has been developed.

2. The principal mechanism needed in the improved Zylon algorithm is the Grooty mechanism.

3. Etc.

The Summary of Contributions will be much sought and carefully read by the examiners. Here you list the contributions of new knowledge that your thesis makes. Of course, the thesis itself must substantiate any claims made here. There is often some overlap with the Conclusions, but that's okay. Concise numbered paragraphs are again best. Organize from most to least important. Examples:

1. Developed a much quicker algorithm for large-scale Zylon problems.

2. Demonstrated the first use of the Grooty mechanism for Zylon calculations.

3. Etc.

The Future Research subsection is included so that researchers picking up this work in future have the benefit of the ideas that you generated while you were working on the project. Again, concise numbered paragraphs are usually best.

Appendix

A What goes in the appendices

Any material which impedes the smooth development of your presentation, but which is important to justify the results of a thesis. Generally it is material that is of too nitty-gritty a level of detail for inclusion in the main body of the thesis, but which should be available for perusal by the examiners to convince them sufficiently. Examples include program listings, immense tables of data, lengthy mathematical proofs or derivations, etc.

A.1 Filler Text

Hello, here is some text without a meaning. This text should show, how a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like »Huardest gefburn«? Kjift – Never mind! A blind text like this gives you information about the selected font, how the letters are written and the impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for a special contents, but the length of words should match to the language.

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B Further remarks by Prof. Chinneck

This appendix contains some remarks which followed the skeletal outline in the original article by Prof. Chinneck. I needed to replace several things to make them work with this template.

B.1 Comments on the Thesis Skeleton

Again, the thesis is a formal document designed to address the examiner's two main questions. Chapter 3 and 4 show that you have chosen a good problem, and Chapters 5 and 6 show that you solved it. Chapters 1 and 2 lead the reader into the problem, and Chapter 7 highlights the main knowledge generated by the whole exercise.

Note also that everything that others did is carefully separated from everything that you did. Knowing who did what is important to the examiners. Section 4, the problem statement, is the obvious dividing line. That's the main reason for putting it in the middle in this formal document.

B.2 Getting Started

The best way to get started on your thesis is to prepare an extended outline. You begin by making up the Table of Contents, listing each section and subsection that you propose to include. For each section and subsection, write a brief point-form description of the contents of that section. The entire outline might be 2 to 5 pages long. Now you and your thesis supervisor should carefully review this outline: is there unnecessary material (i.e. not directly related to the problem statement)? Then remove. Is there missing material? Then add. It is much less painful and more time-efficient to make such decisions early, during the outline phase, rather than after you've already done a lot of writing which has to be thrown away.

B.3 How Long Does it Take to Write a Thesis?

Longer than you think. Even after the research itself is all done – models built, calculations complete – it is wise to allow at least one complete term for writing the thesis. It's not the physical act of typing that takes so long, it's the fact that writing the thesis requires the complete organization of your arguments and results. It's during this formalization of your results into a well-organized thesis document capable of withstanding the scrutiny of expert examiners that you discover weaknesses. It's fixing those weaknesses that takes time.

This is also probably the first time that your supervisor has seen the formal expression of concepts that may have been approved previously in an informal manner. Now is when you discover any misunderstandings or shortcomings in the informal agreements. It takes time to

fix these. Students for whom english is not the mother tongue may have difficulty in getting ideas across, so that numerous revisions are required. And, truth be known, supervisors are sometimes not quick at reviewing and returning drafts.

Bottom line:

leave yourself enough time. A rush job has painful consequences at the defence[1]

B.4 Tips

Always keep the reader's backgrounds in mind. Who is your audience? How much can you reasonably expect them to know about the subject before picking up your thesis? Usually they are pretty knowledgeable about the general problem, but they haven't been intimately involved with the details over the last couple of years like you have: spell difficult new concepts out clearly. It sometimes helps to mentally picture a real person that you know who has the appropriate background, and to imagine that you are explaining your ideas directly to that person.

Don't make the readers work too hard! This is fundamentally important. You know what few questions the examiners need answers for (see above). Choose section titles and wordings to clearly give them this information. The harder they have to work to ferret out your problem, your defence of the problem, your answer to the problem, your conclusions and contributions, the worse mood they will be in, and the more likely that your thesis will need major revisions.

A corollary of the above: it's impossible to be too clear! Spell things out carefully, highlight important parts by appropriate titles etc. There's a huge amount of information in a thesis: make sure you direct the readers to the answers to the important questions.

Remember that a thesis is not a story: it usually doesn't follow the chronology of things that you tried. It's a formal document designed to answer only a few major questions.

Avoid using phrases like "Clearly, this is the case..." or "Obviously, it follows that ..."; these imply that, if the readers don't understand, then they must be stupid. They might not have understood because you explained it poorly.

Avoid red flags, claims (like "software is the most important part of a computer system") that are really only your personal opinion and not substantiated by the literature or the solution you have presented. Examiners like to pick on sentences like that and ask questions like, "Can you demonstrate that software is the most important part of a computer system?"

B.5 A Note on Computer Programs and Other Prototypes

The purpose of your thesis is to clearly document an original contribution to knowledge. You may develop computer programs, prototypes, or other tools as a means of proving your points, but remember, the thesis is not about the tool, it is about the contribution to knowledge. Tools such as computer programs are fine and useful products, but you can't get an advanced

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[1]Template Author's note: in case of a master thesis this is not a defence but only a 'final presentation'. In any way, you need to present your work and you might get awkward questions, based on the quality of your work.

degree just for the tool. You must use the tool to demonstrate that you have made an original contribution to knowledge; e.g., through its use, or ideas it embodies.

B.6 Master's vs. PhD Thesis

There are different expectations for Master's theses and for Doctoral theses. This difference is not in format but in the significance and level of discovery as evidenced by the problem to be solved and the summary of contributions; a Doctoral thesis necessarily requires a more difficult problem to be solved, and consequently more substantial contributions.

The contribution to knowledge of a Master's thesis can be in the nature of an incremental improvement in an area of knowledge, or the application of known techniques in a new area. The Ph.D. must be a substantial and innovative contribution to knowledge.

C Used Acronyms

API application programming interface

A& F Amplify & Forward

ACK acknowledgment

ARP address resolution protocol

BLR Beaconless Routing

BPSK binary phase shift keying

CA collision avoidance

CCA clear channel assessment

CI confidence interval

CL confidence level

C& F Compress & Forward

CPU Central Processing Unit

cRTS cooperative request-to-send

CSMA carrier sense multiple access

CSMA/CA carrier sense multiple access (CSMA) with collision avoidance (CA)

CTS clear-to-send

CTP Collection Tree Protocol

CVS concurrent versioning system

DCF distributed coordination function

DIFS DCF inter-frame spacing

DMA direct memory access

D& F Decode & Forward

DSP digital signal processor

EIFS extended inter-frame spacing

EMA exponential moving average

ETX expected transmissions

ExOR Extremely Opportunistic Routing

FCS frame checksum

FER frame error rate

FPGA field programmable gate array

FTP file transfer protocol

GeRaF Geographic Random Forwarding

GP goodput

GPS Global Positioning System

HF high frequency

IEEE Institute of Electrical and Electronics Engineers

IHP Innovations for High Performance Microelectronics

IP Internet Protocol

ISR interrupt service routine

JTAG Joint Test Action Group

LAN local area network

LED light emitting diode

LOS line-of-sight

LSB least significant bit

MAC medium access control

MLA MAC Layer Architecture

MLME MAC layer management entity

MS milestone

MSC message sequence chart

MTU maximum transmission unit

NAV network allocation vector

NesC Networked embedded systems C

NIF noise-and-interference floor

NLOS non-line-of-sight

OFDM orthogonal frequency-division multiplexing

ORM object-relational mapping

PER packet error rate

PG1 Project Group Mobile Communications 1

PG2 Project Group Mobile Communications 2

PHY physical

RBS referece brodcast synchronization scheme

RF radio frontend

RSSI received signal strength indicator

RTS request-to-send

SDF selection decode & forward

SDL Specification and Description Language

SDR software-defined radio

SIFS short inter-frame spacing

SINR signal-to-interference-and-noise ratio

SORBAS Signalion Software Radio Based Prototyping System

SSH secure shell

SSID service set identifier

Sterm SORBAS terminal

TX transmission

TDMA Time Division Multiple Access

TEP TinyOS Enhancement Proposal

UDP User Datagram Protocol

USB Universal Serial Bus

UPMA Unified radio Power Management Architecture

VisualDSP Visual Digital Signal Processor

VMware VMware Virtualization Software

VoIP voice over IP

WinTerm SORBAS Windows Terminal

WLAN wireless LAN

WMA weighted moving average

WSN wireless sensor network

D Bibliography

[1] Prof. John W. Chinneck. How to organize your thesis, Sept. 1999.

[2] Michael A. Covington. How to write more clearly, think more clearly, and learn complex material more easily.

Erklärung der Urheberschaft

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