

# **Guideline for Writing Bachelor thesis**

at the Department for Computer Engineering

Faculty of Computer Science

TU Chemnitz

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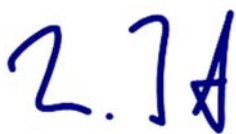
## Preface

By means of their Master Thesis students prove at the end of their studies that they are able to do independent work that is scientifically sound and focused on their respective occupational field. They need to apply a combination of gained knowledge and the technical ability to think scientifically to work on their given topic. If necessary, the thesis is part of development and research projects. Don't forget the final thesis is a scientific paper.

Hence important rules and advices for the topic and tasks are existing. You have to follow this. This guide gives instructions to you for successfully completion your final thesis and indicates the general process of a final thesis at the department Computer Engineering of the faculty Computer Science at TU Chemnitz.

You will come across new questions, while you are working on your final thesis at the Department of Computer Engineering. You will have to make decisions on methods, implementation problems and formulations and once in a while you will wonder how you are supposed to complete this project. That is very typical for a project of this size and an important experience at the end of your studies. I am sure that you will be successful because I trusted you with the subject.

Good luck!



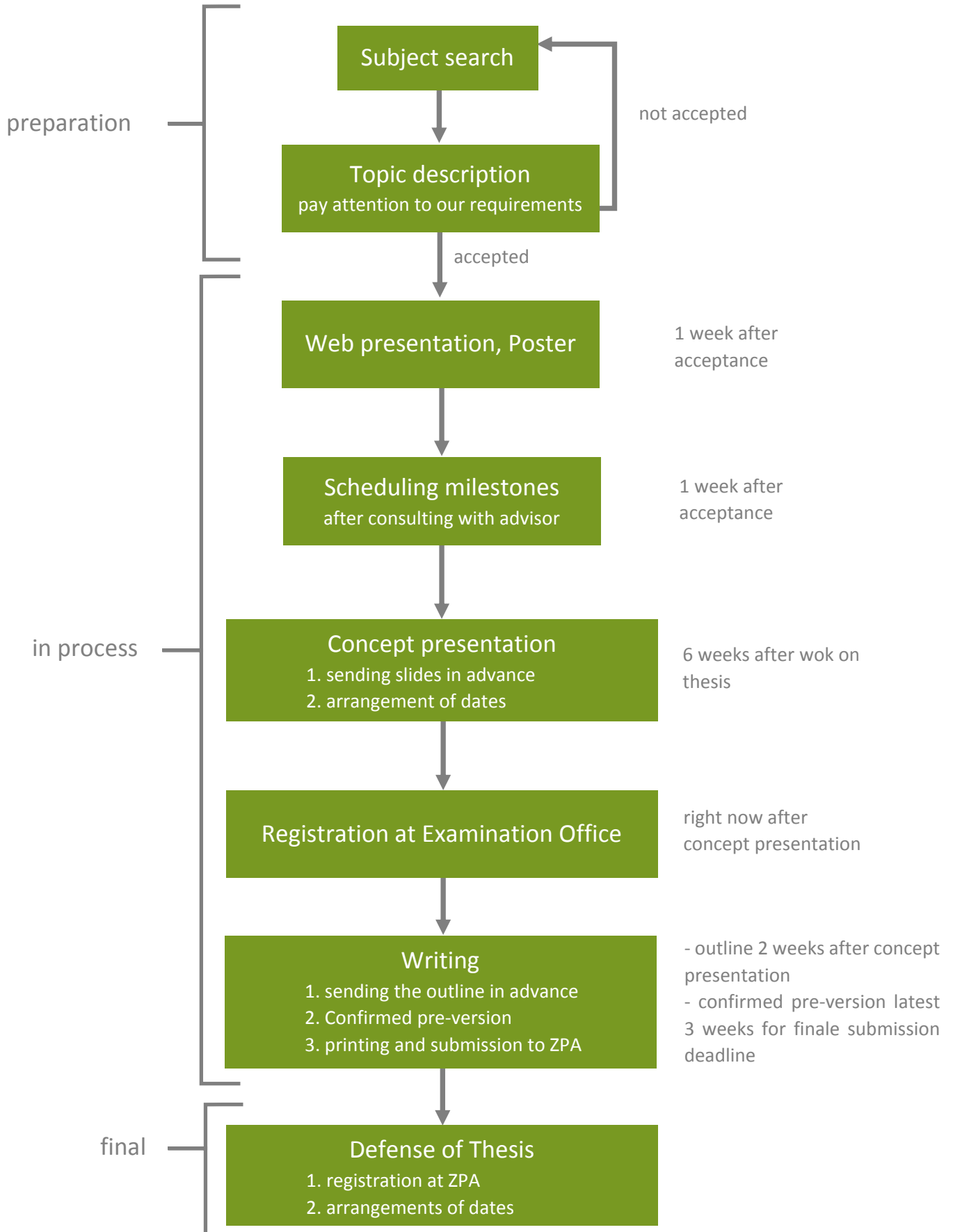
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## Overview of a bachelor thesis



## 1. Preparation

### 1.1. Search for subject and expected results

The Bachelor Thesis is outlined by a given topic and the work on it leads to a solution, the result. The reasoning behind each result must be scientifically plausible. The result of a final thesis can fall into one of the following categories:

- Formal proof

An assertion made in the thesis is underpinned by developed evidence. Here, the full spectrum of theoretic computer science and mathematics can be made use of, for instance proof by induction or logical deduction. Please bear in mind that formalisms have to be written in standard or usual notations.

- Implementation of a procedure

A procedure is a set of processing routines that lead to a desired result. It has to be demonstrated that the aim is achieved, which could be done by implementing the processing routine in software or hardware. Due to the fact that this is not a formal proof, the reliability of the routine has to be proven by automated processing of typical examples, with the focus on respective result criteria, such as power consumption (e.g. mW), and their quantization. This proof includes concrete figures for the result criterion before and after the application of the implemented procedure for at least three examples.

- Negative conclusion

Not every problem can be solved, but knowing that there is no solution is better than not knowing. This is why a negative conclusion is an entirely acceptable result or approach. However, approaches to a solution can be modified to achieve a solution nevertheless. If that is possible, a modified solution is to be preferred to a negative conclusion

In many cases the topic implies one of these result types, which is why you should decide on your aspired result type as soon as possible. Then you should check whether the chosen type suits the problem. When the result type is determined, important milestones can be defined, for instance which evidence type is to be examined or which examples are to support the evaluation of a procedure. Document these decisions appropriately and discuss them with your supervisor.

### 1.2. Topic description

For the topic description, this means the topic including the task description, existing several requirements. The topic description have to fulfill and follow these requirements for a successful approval by Department of Computer Engineering.

Beside the title following items are necessary and have to be described

- classification of the topic
- state of the art (initial situation)
- research question (scientific challenge)
- aim

For a final thesis the research question (scientific challenge) is very important. A final thesis with priority on an implementation and therefore a pure technical realisation cannot be accepted.

The topic description of a final thesis should enclose a least half page DIN A4 and go into the above-named points.

The document with information of planned start, complete contact details of advisor and the current transcript of credit points (pdf file from SB Service) have to be **submitted latest one month before working on thesis to:** [ce-teaching@informatik.tu-chemnitz.de](mailto:ce-teaching@informatik.tu-chemnitz.de)

The topic description and associated scientific aspects are checked by the Department of Computer Engineering. If improvement or changes are necessary we get in touch with you to clarify it. If it is not running we will contact directly your advisor at the company.

## 2. Working on thesis

You can only start to work on your thesis after positive approval of the topic and description.

Work on a final thesis at the Department of Computer Engineering is considered and conducted as a complete project. A project is divided into phases that are marked by milestones. A milestone is a particular point of time when an important working result and thus an interim goal should be achieved. Milestones must be achievable and controllable throughout the course of the project.

This chapter details a list of milestones that have to be included into the project plan. Further milestones can be added according to the requirements of the problem. Each milestone needs to have a planned date of when the work on it will be completed

### 2.1. Web presentation und poster

The subject of the bachelor thesis as well as a brief description of the task is part of the public appearance of the Department of Computer Engineering. The poster gives you the possibility to structure your topic and task description in a right way. You have to write this description and prepare the poster for the department's website after accepting a subject as final thesis (assignment).

You have to discuss the presentation as well the poster with your supervisors. Requirements that may result from the relevance of the subject to industrial application have to be considered.

But also by so-called non-disclosure notes a web presentation and poster have to be prepared, if necessary you can prepare an adapted version.

The web presentation should be about a half page in length. It includes the title, task and the objective of the final thesis. To prepare the poster you have to use the poster generator (<https://www.tu-chemnitz.de/informatik/Medieninformatik/pGen/>) because the corporate design of TU Chemnitz is included.

**Both documents have to be submitted latest one week after acceptance to [ce-teaching@informatik-tu-chemnitz.de](mailto:ce-teaching@informatik-tu-chemnitz.de)**

## 2.2. Project Plan

The work on the final thesis is usually divided into several subtasks. The individual tasks and respective time planning are to be defined early.

Consider these tips while planning:

- **Literature research:** The research starts with a collection of keywords, followed by a list of definition that includes a preferred selection. Moreover, you should survey the state of the art, for which the literature of the department is very useful. Don't forget to reference all the sources you used!
- **Conceptualising:** Look for alternative solutions and compare them, develop your own solution.
- **Implementation:** Programming, write a source code documentation and a "user's guide"
- **Testing:** do comprehensible tests
- **Structuring and writing:** give sensible reasons for each statement

First you prepare a project plan that includes the phases of the project. The content and goal of each phase have to be defined. Each phase is concluded by a milestone. You have to discuss and finalise your project plan together with your supervisor.

You need to determine a certain period of time for the work in each phase, considering potential risks, such as acquiring material, connection to other projects/works, you cannot influence.

The project plan is documented in the form of a Gantt chart and **is updated throughout the project**. Thus, deviations can be detected early and have to be discussed with the supervisor concerning their cause, meaning and catch-up.

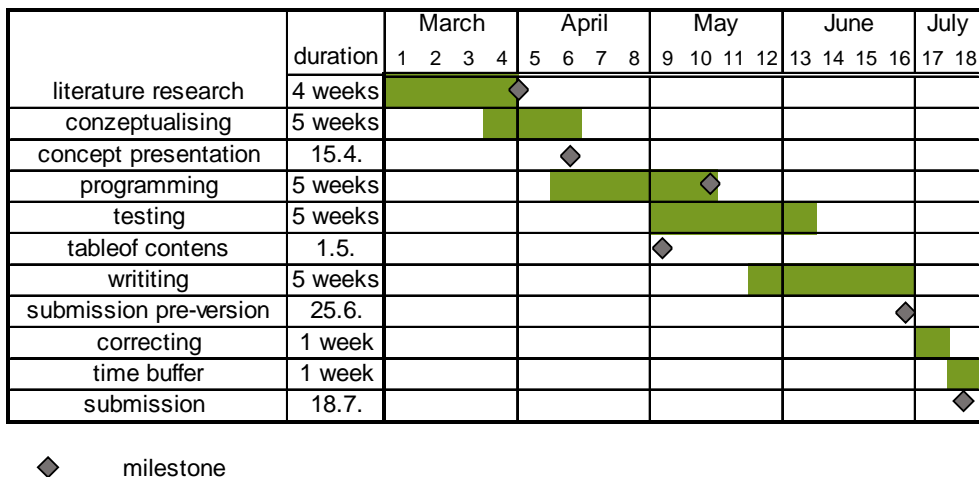


Figure 1: example for planning milestones (Gantt-chart)

Only after the specification of milestones is set out in writing and your supervisors confirmed the milestones you can start to work on your thesis.

### 2.3. Short report on Status

The progress of your Bachelor thesis has to be documented regularly. Therefore you have to send an email to [ce-teaching@informatik.tu-chemnitz.de](mailto:ce-teaching@informatik.tu-chemnitz.de) every two weeks with a short slide presentation about current status.

### 2.4. Presentation of the Concept

For presentation and confirmation your planned realization of bachelor thesis by university a so-called concept presentation takes place at the Department of Computer Engineering. The concept presentation is necessary to present your ideas and approach to solve the tasks within the bachelor thesis.

The 20-minute presentation has to cover the following points:

- motivation
- basics (technical background)
- result of literature research (state of the art, alternative approaches)
- own approach and explanation
- timeline with milestones (Gantt-chart)

A template for presentations is provided at the website of Computer Engineering and have to use (<http://www.tu-chemnitz.de/informatik/ce/lectures/master.php#template>).

It is necessary that your advisor confirmed the prepared concept presentation slides. Afterwards the presentation file have to send [ce-teaching@informatik.tu-chemnitz.de](mailto:ce-teaching@informatik.tu-chemnitz.de).



After positive check of the submitted presentation slides an appointment is determined for the concept presentation. Basically the external advisor should take part. In reasonable cases a video conference can be carried out.

The concept of your master thesis should be present after successfully introduction phase with literature research and conceptualising. It is around 6 weeks after start date.

## 2.5. Registration at Examination Office

After successfully finished the concept presentation the bachelor thesis can be announced by the central examination office (ZPA) of TU Chemnitz. You have to fill in the formal registration document of examination office and bring this with you by concept presentation. The task description can be enclosed on an additional page.

[http://www.tu-chemnitz.de/studentenservice/zpa/formulare/allgemeineformulare/abschlussarbeit\\_anmeldung.pdf](http://www.tu-chemnitz.de/studentenservice/zpa/formulare/allgemeineformulare/abschlussarbeit_anmeldung.pdf)

You will get an official confirmation about your bachelor thesis registration with the final submission date from examination office. The deadline on your confirmation sheet is final. An extension of the deadline is rarely possible and should be avoided by all means. So please be careful to meet the deadlines of your working phases.

## 2.6. Structuring and Writing

The written composition is an essential part of the bachelor thesis. Hence, enough time is to be scheduled for this. Please, keep in mind not only the successful implementation (technical realisation) is important. Because your master thesis is a scientific paper the research part including your own approach and the written part of your thesis should be key points.

The structure of your bachelor thesis should be developed early in the form of a table of contents. Your supervisor have to confirm your prepared table of contents. After confirmation you have to send it for review to [ce-teaching@informatik.tu-chemnitz.de](mailto:ce-teaching@informatik.tu-chemnitz.de). The table of contents should be carried out around 2 weeks after concept presentation.

The bachelor thesis serves as a proof for the ability to describe complex relations in a structured and comprehensible way, which includes features of formal correctness, such as spelling, punctuation and references. The thesis can be written in German or English. The thesis is to be written in a top-down manner. First, the problem is introduced and subdivided in various steps, which are to be described then. Avoid the reverse approach that states many technical details and constructs a solution using them. For writing your thesis, you will need practical results. Minimum six weeks should be dedicated to writing alone to give you enough time to ensure an appropriate representation with regard to content and style. The length of a bachelor thesis cannot be restricted to a particular number of pages. Cases where a brilliant idea with motivation, background and realisation is written out on less than 30 pages are fairly scarce. Also a length of more than 120 pages (without appendix) is hardly justifiable.

Your study documents with the modul description of master thesis gives an orientation with 60 pages.

The thesis is subdivided into chapters and paragraphs. Three levels of subdivisions are appropriate and should only be exceeded in a few exceptional cases. Take also into account the layout of the cover page and set up a list of figures and a list of tables. Where appropriate, a list of abbreviations and a keyword index may be useful.

The pre-version has to be checked by your supervisor. Your advisor has to confirm the pre-version by signature on the cover. This confirmed version has to be sent latest 2 weeks before the final deadline to: [ce-teaching@informatik.tu-chemnitz.de](mailto:ce-teaching@informatik.tu-chemnitz.de). Only after positive feedback from Department of Computer Engineering the thesis can be submitted in printed form to the examination office.

Within delivery of the thesis to examination office the registration of the defense can occur directly!

### 3. Final defense presentation

The last milestone of your bachelor thesis is the defense presentation. Requirement for this is the submission of the written thesis in printed form to the examination office and an assessment of the thesis work by your (external) supervisor.

If all these requirements are fulfilled, an appointment for your defense presentation at Department of Computer Engineering can be arranged. The participation of your external supervisor is necessary for this. The defense consists of a 30-minute presentation which is open to all students and employees of the university. The subsequent question and answer session of at least 30 minutes conducted by supervisors or members of the Faculty of Computer Science allows the student to prove their competence in the field of their thesis.

Slides are crucial for the presentation because they serve more than one purpose. They help the listener to follow the presentation and the speaker with remembering and explaining the matter. Good slides are fundamental for a successful presentation.

Bear in mind the following points:

- consistent layout
- the first slide is a cover slide
- each other slide has titles and numbering
- 7±2 points per slide
- use graphics, charts or tables

There can be a mock presentation at the request of the student. In any case, the presentation slides are to be send to the supervisor and [ce-teaching@informatik.tu-chemnitz.de](mailto:ce-teaching@informatik.tu-chemnitz.de) one week before the defense.

## 4. Hints

### 4.1. Literature Research

A literature research is about obtaining relevant literature, for which there are several sources:

**Library catalogue** You can search the literature collection of the university library online with the catalogue <https://katalog.bibliothek.tu-chemnitz.de/> Thus, it is easy to obtain textbooks with extensive contents, but they rarely provide recent and specific information.

**e-Books** E-books are another possibility. You can access various e-books via another library catalogue <http://www.tu-chemnitz.de/ub/suchen-und-finden/emedien/ebooks/ebooks.html>

**Essays** Essays often contain the latest approaches and scientific discussions.

**Journals** It is beneficial to look through scientific journals to find recent research results. Renowned Computer Science journals are IEEE, Communication of the ACM and GI-Informatik Spektrum. The library provides an extensive selection of electronic journal on <http://www.tu-chemnitz.de/ub/suchen-und-finden/emedien/ejournals/ejournals.html>. The articles contain recent specific information, but it should be considered that they might be biased (the author focuses mainly on the strengths of their idea)

**Proceedings** Their contributions contain even more recent information compared to journals. Bear in mind that workshops and symposia introduce lectures that reflect a current project status and thus may not be full-fledged.

**Databases** Several specific databases for computer science can be found on [http://dbis.uni-regensburg.de/dbinfo/dbliste.php?bib\\_id=tuche&colors=31&ocolors=40&lett=f&gebiete=30](http://dbis.uni-regensburg.de/dbinfo/dbliste.php?bib_id=tuche&colors=31&ocolors=40&lett=f&gebiete=30)

**Internet** Via common search and meta search engines, you have fast and easy access to information, which should be mainly used to get an overview of recent events in particular fields. Moreover, you can single out renowned persons of these fields and useful publications. Further internet research should be examined critically concerning quality and safe reference.

When you look for further literature/authors, you can make use of references. Look through footnotes or references of relevant specific literature to find authors that have also dealt with the respective subject.

After you finished your search for relevant literature, you can start to study it. There are several methods to study huge quantities of sources:

- **Skimming:** Looking at the title, the date of publication and the tables of contents you can get a first impression. Then you check whether the work is relevant to your subject or not. The content of the publication can be quickly but superficially grasped through so-called diagonal reading, which means that the reader scans the text for headlines, captions, emphasizes and keywords of connections such as “finally”, “most important” ,“therefore” and “than”.
- **In-depth reading:** After the relevant passages are found, they need to be studied carefully. The reading focuses on several aspects, such as basic approach, facts and their argumentation and especially: which facts are important for your Master thesis.
- **Excerption:** The most important pieces of information are to be highlighted or written out or rather excerpted. Write down the most important theses and relate them to each other by using arrows. Do not forget to write down the reference. Afterwards, you should establish a relation to subject matters that you already know. [2, 4, 1]

#### 4.2. Research question: own approach

It is important that your work on your own approach and the evaluation is methodical. The found approach based on the literature analysis is the starting point that is fleshed out, combined or extended in the thesis. The approach is, apart from words, to be described using formal methods that emphasize the specification and modeling aspect. Examples for this are [3]:

- Mathematical forms of description
- Entity-Relationship models
- UML, petri nets, data flow diagrams, graphs, electrical networks

The evaluation of the approach can be quantitative or qualitative. A general classification is also possible. Qualitative evaluation emphasize what the approach can achieve compared to existing ones. The measurement of characteristics of the approach (run time, behavior) is a quantitative assessment. A general classification highlights under which conditions the approach works especially well. The work on this complex has to be structured as follows [3]:

1. Solution conception
2. Implementation of the solution approach
3. Application on sufficiently extensive examples
4. Documentation of the results

## 4.3. Writing

### 4.3.1. Structuring

The bachelor thesis has to be sensibly structured, which is reflected in the content and the sequence of the chapters. The individual chapters should be based on each other, which means that there should be no forward references, whereas references to preceding chapters relate the current text passage to previous results and thus emphasize the logically consistent structure of the thesis.

**Title page:** The layout of the title page has to conform to the specifications of TU Chemnitz. Examples can be found in our provided templates

**Table of contents:** The table of contents lists the numbered titles of chapters and subchapters with their respective page numbers. The subdivision should not exceed four levels. One level should include at least two subchapters otherwise the level can be omitted.

**List of figures:** The list of figures lists figures chapter by chapter. The numbering always includes the chapter number. Example: figure 3.4 refers to the fourth figure in chapter 3.

**List of tables:** The list of tables is structured in the same way as the list of figures.

**Introduction:** The thesis begins with an introduction leading to the subject and highlights the relevance of the subject, which should be explained clearly. In addition, you should illustrate the subject by using a clear example. Get back to this example in the chapter discussing the results to close the circle. An overview of the structure closes the thesis.

**Introducing chapters:** The thesis must be comprehensible without reading additional technical literature. This is why an explanation of relevant terms and aspects is necessary. The reader, who only has a general knowledge of the topic, is thus provided with important extra information. Another, very essential task of these chapters is to put the Master thesis in the context of the state of the art. The following questions are answered: Are there other works about this problem with other solution approaches? How was the problem solved until now? Why are my ideas new?

**Main chapters:** The core chapters should show the chosen working method and the achieved results in a well-structured way (top-down perspective). The formulation of the reasons for choice of this particular working method, the presentation of all significant details and the interpretation of the results are the most important aspects.

Details about the implementation of software are only relevant if they are crucial to the thesis.

**Summaries:** Each chapter ends with a summary that presents the most important points in a well-arranged way: “What did I learn in this chapter?” Summaries are never longer than half a page.

**Outlook:** The thesis ends with a summary and an outlook. Essential findings are mentioned again without addressing the achievement of the results. The outlook contains information on what more could/would have been done if there had been more time. Thus the author can prove that they are able to realize generalizations of their solution or rather an application of their approach to other fields.

**References:** The thesis is embedded in relevant technical literature and refers to it by references in the text. The technical literature is listed in the references at the end of the thesis in alphabetical order by author or in numerical order.

**Appendix:** It is possible to add a list of abbreviations, a glossary or other appendices, such as technical documents for consulting, complete list or descriptions of characteristics (e.g. the syntax of a language, language definitions), extensive examples, essential algorithms, directions for use, installation guide, large tables, such as performance data. These pieces of data do not fit into the chapter structure and disrupt the text. If some of these documents are not necessary for the understanding of the thesis or to round off the overall impression, they can be stored on a CD, along with the software documentation. The implemented program is not part of the appendix! Put the comprehensive documentation of the implementation in a separate document and on the same CD, which is to be enclosed to the Master thesis. The table of contents of the CD has to be listed in the appendix

The introduction and the concluding chapter “summary/outlook” should also make sense when read without the chapters in between. They should make the reader curious to read the whole work.

### 4.3.2. Formulation and Style

You will find some tips on the formulation and style of your thesis in the following:

- Start each chapter with a short overview of its content and objectives. Think carefully about them before you start writing.
- Sensibly subdivide the sections (except introduction and conclusion) chapters and these, if necessary, in subchapters. The hierarchy should not have too many levels. Chapters or subchapters should not be shorter than half a page.
- Avoid “phenomenological” listings, such as enumerating descriptions of all constructs of a programming language or all functions of a system. These kinds of text belong in the appendix. The chapters are used to describe and illustrate concepts.
- Exemplify your points with suitable examples. The understanding of connections can often be improved by using a particular example consistently.
- Do not turn your thesis into a development history of the system (bottom-up style). Describe your result (top-down style) and point out alternatives.
- Avoid overlong and over complex sentences.
- Avoid complex participle constructions, such as “The efficiency losses determined after a thorough analysis of the algorithm were considerable.”
- Avoid too many passive formulations
- Put a suitable, short caption under each figure/table. Interpret and reference the respective figure/table in the following paragraphs.

## References

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