How to write a Master Thesis: Guidelines

Fraunhofer
SCAI

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Note: Please do not share these guidelines with people outside LSI!!!

Why are we writing a Master Thesis?

- because at the end of your studies you should get involved with real scientific research
- because at the end of your studies you need to show that you can conduct scientific work supervised by an experienced scientist
- because the rules and regulations of the curriculum require it

What does the MPO say about the rules and regulations that apply for the Master Thesis?

(1) The master's thesis is a written dissertation on an independent research project and concludes the candidate's academic training. A master's thesis should demonstrate that the candidate is capable of conducting independent work on a problem taken from the Life Science Informatics field and of producing findings within a specified period of time under application of scientific methods.

What does the MPO say about the rules and regulations that apply for the Master Thesis?

(2) Any professor or person with qualification to lecture (Habilitation) from the participating faculties who regularly offers courses for the Life Science Informatics Master's Programme in accordance with Section 10, Para. 1, sentences 1 – 4, may assign the subject for a master's thesis; as a rule, the person who assigns the subject shall also act as supervisor for the thesis. Permission from the chairman of the Examination Committee shall be required when a professor who conducts research and teaches at an educational institution or facility outside the participating faculties provides the topic for the master's thesis and subsequently serves as the candidate's supervisor or when the candidate is to do his thesis at a facility outside the university.

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(3) Candidates may apply to the chairman of the Examination Committee to have a topic assigned them. In such cases, the chairman shall ensure that the candidate receives a topic for his master's thesis on a timely basis. The candidate shall be given an opportunity to submit proposals for the topic of his master's thesis.

(4) The chairman of the Examination Committee shall notify candidates of the topic of their master's thesis. A record shall be kept of the date of notification.

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(5) Candidates shall have six months from the date on which they were notified of the topic their thesis to the date on which they have to submit their thesis. The topic and the nature of the assigned task must be such that the master's thesis can be completed within the specified period. Candidates may decline a topic only once and only within the first month of notification. As an exception, the Examination Committee may extend the submission deadline by up to six weeks upon receipt of an application in which the candidate cites reasons that would justify an extension.

How do we find the right laboratory for doing a Master Thesis?

- We find out what science is cool and interesting for us
- get in touch with a professor teaching at B-IT who is working in that area
- try to get involved in research in the lab that does “cool and interesting” research in the 3rd semester (we have left Friday a free day in the 3rd semester to allow interested students to work one full day in the Department where they want to do their Master Thesis)

How do we find the right laboratory for doing a Master Thesis?

- perform well in previous semesters (and in particular in the topics taught by the professor with whom you want to do your Master Thesis); which increases your chances to do your Master Thesis in exactly the scientific area that you are interested in
- **we do not recommend to search for laboratories outside of B-IT.** Due to the bad experience in the past, professors teaching a B-IT are rather sceptical with serving as official supervisors for Master Theses done in laboratories outside of our direct reach.

Time Course of a Master Thesis and Organisation of the Time

1. According to the MPO, the Master Thesis has to be completed in 6 months. Exceptionally, it can be extended – upon request and based on a reasonable justification – for 6 weeks by the Head of the Curriculum, Prof. Bajorath.
2. Experimental work, literature studies and writing of the Master Thesis need to be **well organised**. We recommend to do a **backward planning of the project** “Master Thesis”, once the topic has been assigned by your professor. Backward planning starts with the day, when you hand-in your printed Master Thesis (typically 6 month after the official start point). From that goal (submission of your thesis) you move backwards in time. Please plan sufficient time for the writing of the thesis. A frequent problem with Master Theses is that students do lots and lots of experiments and run short of time analysing them and writing the thesis.

Time Course of a Master Thesis and Organisation of the Time

3. As a rule of thumb, we would suggest to calculate the following periods of time for the following tasks:

- Organising background literature on the Master Thesis topic: **at least two weeks**; careful preparation of the state of the art helps not only to do the right things, but also to do the things right (and, by the way: monitoring the literature and critical reading should be ongoing for all the time of your thesis).

Time Course of a Master Thesis and Organisation of the Time

- We strongly recommend that within the first two weeks you write an exposé that describes the thesis topic, the scientific challenge and the problem-solving approach that is planned. Writing that exposé is a wonderful exercise to clarify what the topic is, how the topic is "embedded" in a bigger scientific context and what you are going to do (research, development, implementation, testing, validation). The exposé also serves as a template for the **registration of your Master Thesis** (which should be done within the first 4 weeks of your Master Thesis).

Time Course of a Master Thesis and Organisation of the Time

- Experiments should be finished **latest (!) until 6 weeks before you submit** the printed version of your thesis. Experience shows, that you cannot write down your thesis if it turns into a “last minute action”.
- Structuring the Master Thesis, collecting references and collecting candidate figures and tables should be started early; there is no reason why you should not start working on the structure of your thesis and assemble references from the very first day on

Time Course of a Master Thesis and Organisation of the Time

- It is a good idea to present the topic and the research and implementation strategy of your Master Thesis in the regular seminar of the working group that you are affiliated with. At Fraunhofer SCAI, we do two seminars for each Master Thesis:
  - The first seminar within the first 6 weeks of the Master Thesis. This seminar introduces the thesis topic to the working group and the candidate (the student) is “defending” his or her problem-solving approach for the first time. Very important: the goal of the Master Thesis has to be clearly defined at that stage!
  - The second seminar is scheduled at the very end of the Master Thesis. The formal description of the goal of the Thesis, as presented in the first seminar, should be used to assess the achievements and the scientific progress made in the course of the Master Thesis.

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https://www.oxbridgeessays.com/blog/guide-writing-masters-dissertation/

Structure and composition of a good Master Thesis

- A good Master Thesis is well structured and provides all information required to understand the motivation, the scientific rational, the scientific challenge, the state-of-the-art at the time when the thesis work started and a clear description of the strategy, in particular the problem-solving approach. Attention should be paid to the **description of the goal of the thesis**; at Fraunhofer SCAI, we ask the students to describe the goal in a separate section (maximum one page). Other working groups and other Professors might want to see the goal being described in the context of the introduction section (typically at the end of the introduction); whatever format is being asked for: make sure that you make the goal(s) of the Master Thesis explicit!

Structure and composition of a good Master Thesis

- The typical structure of a Master Thesis is based on a couple of Chapters that should be part of every Master Thesis. Assignment of Chapters can be handled in a flexible way, but essential Chapters that should be part of every Master Thesis are:
  - **Abstract** (this is the short summary describing the essentials of the thesis, very much alike the abstract of a scientific paper)
  - **Introduction** (an overview on the research question and the “big picture” of the research topic. Do not re-produce text book knowledge at this point; no need to explain again, how DNA makes RNA makes protein …)
    - At SCAI, we position our separate **goal-definition** at this point, right after the introduction. This is usually a single page.

Structure and composition of a good Master Thesis

- **State of the Art** (an analysis of the relevant scientific literature in the area under investigation; this part is frequently fused with the Introduction. Ask your supervisor what he or she recommends)
- **Methodology** (tools and methods used, compute infrastructures, workflow engines, data and knowledge sources, algorithms, web services etc.). In Biomedicine, this chapter is usually called “Material & Methods”; but in Life Science Informatics “Methodology” appears to be the more appropriate term

Structure and composition of a good Master Thesis

- **Results** (often combined with Discussion: **“Results & Discussion”**; this is the place where all the results of your work go and they should be embedded in a discussion and critical reflection of your work. You can already start to point at similar findings by others; you can discuss the results given the results of others.)
- **Conclusion** (often named **“Conclusion & Outlook”**; this is usually the final Chapter of a thesis and it should NOT repeat your results. It should, ideally, put your work in the bigger context of what the others did, what you did and what follows from the synopsis.)

Structure and composition of a good Master Thesis

Here is an example of the assessment schema that some of the professors at B-IT use to assess the quality of a Master Thesis. The schema provides a sort of formalism for the assessment; using this schema allows for a certain degree of standardisation of the review of Master Theses between Professors:

Criteria of Assessment	Grade				
	1	2	3	4	5
Formal Criteria					
Structure and composition of the thesis					
Completeness and integration of references					
Correctness of terminology and adequacy of terms					
Proper use of diagrams, pictures, etc					
Assessment of Content					
Assessment and solution of the main problem of this thesis					
Literature research and its integration into the thesis					
Theoretical level of work					
Quality of the methodological work					
Quality of the presentation of the results					
General Criteria					
Analytical and reflexive competence					
Quality of results					

References

- These days it is quite easy to find references by either using Google Scholar or Medline or searches in library portals (such as the library portal of the University of Bonn library search interface or various Science Gateways like ScienceDirect).
- References can easily be managed using a reference manager (either systems linked to social networks of scientists like Mendeley; ResearchGate; or private ones that have to be filled by yourself like (JabRef; CiteUlike etc.).
- The availability of digital content has lead – not only at the student level, but also at the level of mature scientists – to a culture of “quick reading” and a consumption of scientific information that seems to be the scientific information equivalent to McDonalds fast food nutrition.

References

- Critical reading of literature is something that we try to promote in various seminars. However, we often stumble over Master Theses that contain references which clearly are not relevant and have been copied / pasted from a Medline search using more or less relevant keywords.

- Although reviewers of Master Theses usually do not check all references individually, I do that randomly for approx. 10 – 20 references in a Master Thesis that I review. I do extrapolate any rate of irrelevant or inappropriate referencing that I detect.

References

- Good referencing follows some basic principles:
- https://en.wikipedia.org/wiki/Wikipedia:Scientific_citation_guidelines
- https://ctl.yale.edu/writing/using-sources/citing-internet-sources
- Full citations can be represented in various formats; Google Scholar does most times offer more than one format for referencing.
- The problem with Google Scholar, however, is, that it misleads in particular young scientists and makes them cite work that matches search terms and is identified by google ranking algorithms, but the relevance of the cited paper for the context introduced or discussed in your thesis remains often dubious. The same applies to Medline searches and references that are based on Medline abstracts.

Proper citation of thoughts, findings, and concepts developed by others:

- In the past, I have seen entire sections copied and pasted from Wikipedia. In one case, the plagiarism was easily detectable because of the dramatic change in English expressions (from a clearly “non-native-speaker” to a clearly “native-East-Coast-US-English”). Professors at B-IT regularly check Master Theses for plagiarism (e.g. by sending short sections through Google Scholar, which is an easy way to find Wikipedia entries and other plagiarisms where students tried to camouflage their copying and pasting by mild modifications of wording)


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