How to write a thesis

how to get started, some Do's and Don'ts

... particularly in case I'm your supervisor ;-)
Some tips:

• Your thesis is (typically) a monograph,* it shall have a clear structure and a running story that you tell throughout.

• Your thesis is not a collection of excerpts of the literature, i.e.:
  • it is ok to start with summarizing even copying text from papers you find as a part of your structured literature review
  • i.e. doing excerpts is not enough, but only a first step...
  • ... you rather should do a structured literature review.

* for PhD theses and Habilitation theses sometimes also cumulative theses (i.e. collections of own original works) are allowed, but that does not apply to Master or Bachelor theses.
"Phases" of doing a thesis:

- The second point of the last slide cannot be stressed enough...
  - ... write-up of your thesis should be considered a separate task/phase of your thesis project!
    - it takes considerable time
    - "mingling" this with the data/literature collection phase, i.e. collecting information and writing the thesis in one go is a common "recipe for failure"

- Consider your thesis a project and plan it like a project!
  - Example phases of a thesis project:
    1. research/literature collection phase - understand the problem
    2. methodological familiarization phase: practice, familiarize yourself with needed technology (document what you learn here, this will be valuable for a "preliminaries section" in your thesis)
    3. design of your approach
    4. implementation phase
    5. evaluation phase (again, this may need a design phase for the evaluation, deciding on data to be used, how you want to analyse this data)
    6. write-up phase
      - start from an empty document
      - continue with a coherent structure
      - write each section from scratch, drawing from the documentation and texts you produced in the earlier phases
      - write the conclusions last, think about limitations and things you had to leave open in your work
The importance of reading:

• Start reading now...
  • Read a lot of scientific articles
  • Look at other theses and how they are structured

• Reading will help you
  • Understanding how scientific work is best structured and presented → follow the examples, but find your own "mix".
  • Read articles several times or iteratively
    • 1st time "skim"
      • Start with getting the ideas, collecting articles,
      • define which articles are in scope and which ones are "future work"
    • which ones are relevant, which ones are not
  • Read the in-scope articles in more detail
  • Be ready to read more along the way
  • Decide where you stop collecting more literature

• I.e. reading and summarizing papers helps you to
  • scope & understand
    the relevant literature

Tools you can use:
• make a mindmap
• categorize papers (postits, labels, keywords)
A structured literature review:

• There are techniques for collecting and scoping literature in a structured manner:

• A complete and well done structured literature review may be
  • a part of your work to scope related works
  • worth a BSc or even an MSc thesis alone (*exception*),
    *if done exhaustively and rigorously*

• First step: collect ALL references you come across in a BibTex database, and keep the bibtex entries tidy (always add authors, title, proper information how the source has been published, etc.)
Some words on *self-containedness* ... What do you need to explain? What not?

• Your thesis should be *self-contained*, in the sense that it is readable for your colleagues, or clear where they find the explanations they need.

• I.e., someone who studied with you would be able to understand it, without having to read/redo your work, and could potentially continue your work.
  • only write things you understood
    • in a way that someone else can also understand them
  • write down how you understood them, i.e. either
    • explain them in your own words
    • provide a reference, where there's a good explanation that helped you understand
  • most importantly, don't copy or use terms and definitions you cannot explain.

• Read this:
Scope & Management

• One of your main tasks in regular meetings with your supervisor is to manage the scope of your thesis!

• We will push potentially many ideas and suggestions to you how and where you can start and which particular aspects of your thesis topic you could investigate.

• It is your task to define a scoped topic out of these suggestions

• i.e., take the literature tips of your supervisor as starting points, but don't follow all routes at the same time --> it's up to you to define and argue the scope and to demonstrate that you have followed the literature deeply enough.
Scope & Management

• One of your main tasks in regular meetings with your supervisor is to manage the progress of your thesis!

  • Keep record of meetings (minutes) and send those to the supervisor
  • Have a timeplan & milestones and discuss it with your supervisor
  • Agree on next meeting in the end of each meeting
  • Agree on concrete things you plan to achieve until the next meeting

• Do not expect your supervisor to remember the details of your thesis/last meeting:
  • i.e. start each meeting with a summary and status report and what was agreed in the last meeting!
Format:

- In English (German *really* an exception only)
  - English is the main language of our scientific discipline (and literature)
  - most terminology doesn’t translate well anyway to German
  - makes your thesis more accessible internationally

- Take care of proofreading and English language check, plan time for it

- A bachelor thesis has a page limit of 40 pages text (not including cover, table of content, references, appendices).
- A master thesis has a page limit of 80 pages text (not including cover, table of content, references, appendices).
- A MBA thesis has a page limit of about 60 pages text and slightly different formatting guide by ExAc

- If you have more material, think of moving parts to an appendix.
- If you have less material, do NOT fill up pages, it is really NOT about pages.

- If you want to write an academic thesis well: read a lot of scientific articles! start now!
How to write a good research paper/proposal/thesis?

Make your thesis an interesting read!
i.e., don't annoy the reviewer/reader ;-)
Heilmeier’s catchism:

George H. Heilmeier, Director of DARPA (1975 – 1977)
Critical questions for ANY research project/paper/thesis:

A set of questions credited to George Heilmeier that anyone proposing a research project or product development effort should be able to answer.¹

- **What are you trying to do?** Articulate your objectives using absolutely no jargon.
- **How is it done today**, and what are the limits of current practice?
- **What's new** in your approach and why do you think it will be successful?
- **Who cares?**
- If you're successful, **what difference will it make?**
- What are the **risks** and the payoffs?
- **How much will it cost?**
- **How long** will it take?
- **What are the midterm and final "exams" to check for success?**

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Structure:

My own „default“ structure of a research paper (mainly suitable for the "case study" style):

0. Abstract
1. Introduction (Motivation)
2. Background
   Introduce background as necessary for the reader
   Often useful to add a „running example/scenario“
3. <Your proposed solution>
4. Evaluation
5. Related works
6. Future Work & Conclusions
7. References
   • (Appendices: proofs, details on experiments)

→ Variations of this scheme may apply, depending on your audience & purpose:
   • Purpose: magazine article, vs. scientific journal vs. Seminar article vs. Diploma thesis)
   • Audience: research community (Database vs. Economists), students vs. experienced researchers vs. Layman audience
   • The main thing is : A thesis is a monography → Tell one coherent story
   • Tell Your story: i.e. follow the structure in spirit, but adapt it to your needs, do not blindly use the same section headings!

Important:
DON'T USE THIS (or any other "generic" structure!!!

Your supervisor (and other readers) should already see from the content structure what you worked on!!!

*Optional:* For PMBA theses: see also Section 2.2 of the PMBA Thesis guide
Structure: "award-winning" example" (TALENTA)
Some words on style:

• use passive voice sparsely (rather use an inclusive "we")
• don't state the obvious
• Don't use subheadings directly after another heading

...
There are tons of books on Style...
... some examples from my shelf

If you look for good examples, take the base articles as a reference!
Some words on style

• Most importantly: Don’t annoy the reader/reviewer
  • use a spell-checker ;-)  
  • avoid to repeat yourself  
  • explain the “big picture” before you jump into technical details  
  • avoid to state the obvious  
  • Avoid “Germanisms”, e.g.
    • again: in English passive voice is less common than in German  
    • In English, often people avoid using ”I” in favor of a (reader-inclusive) “we”, even in single author papers!
  • use proper citation  
  • be concise

„If I had more time I would have written a shorter letter“ (Blaise Pascal? Mark Twain?)

• don’t jump, follow a consistent line of arguments („roter Faden“)
• always try to consider the viewpoint of your reader/audience

• Don't don't (i.e. avoid short forms like don't doesn't, can't ...)
• Use section structuring properly, e.g.
More **bad** examples 1/4:

- Avoid to state the obvious:
  - „This seminar paper was written for the course `Forschungsseminar Systemanalyse` in Summer term 2015“
  - ... Not relevant. Look at accepted conference papers, nobody writes:
    - „This paper was written as a submission to the World Wide Web conference.“

i.e. the motivation/introduction section should explain **what is the problem**, not why you had to write the thesis. ;-)
More **bad** examples 2/4:

- use proper citation in the text, e.g. do not use citation as subject of a sentence:

  [5] developed the Web of concepts approach by …

- Better, e.g.:

  Dalvi et al. developed an approach called “Web of concepts” [5] …
  
or:
  
The “Web of concepts” approach [5] …

References

…


…
More **bad** examples 3/4:

- use of domain-specific terminology in your paper without explaining them, or giving a concrete reference where it is explained. E.g. if you write...

  "The *k*-means algorithm always finds a solution, which is not necessarily the **optimal** solution. Finding an optimal partitioning belongs to the class of **NP-hard** problems."

- ... What do you mean by **optimal**? Can you define it? Can you expect the reader to know what **NP-hardness** means? Would you be able to explain it, if your supervisor asks you? If not:
  - Read up on it!!!!
  - Explain it in the preliminaries

- Better:
  - Explain **all** relevant domain-specific terms in a leading "Background" or "Preliminaries section" and/or add a good reference (**ATTENTION**: only explain those terms relevant for your theses, finding the right balance between explaining too little and too much is an art ;-))
More bad examples 4/4:

• similarly, use of abbreviations without explaining them:

  "We want to show which sub-question can be answered using SPARQL queries on the MAKG."

• Better:
  • Explain each abbreviation at its first use in the thesis, provide references:

  "We want to show which sub-question can be answered using queries in the SPARQL query language [1] on the Microsoft Academic Knowledge Graph (MAKG)."

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1 available at http://ma-graph.org/, last accessed 27.2.2021
Follow back to original References:

"We use PageRank [1], ..."

• Cite the original, e.g.
  • don't cite Wikipedia for PageRank
    

  • don't cite another paper that uses PageRank, e.g.
    

  • but cite the original reference:
    

• General rule: cite webpages ONLY as a last resort (if there's no good textbook or academic paper explaining it), and, for Webpages, always add a "last accessed" date.
  • Additionally, Check if URLs are indexed at the Web archive and if yes, ideally refer to the specific version you mean, e.g. the example from the last slide:
... I could go on forever here, but once again to conclude:

- learn from reading good papers!
- not only from their content, but also from their
  - structure
  - use of references
  - explanations of related backgrounds
  - style
- start reading and searching for literature now! 😊
Examples of good theses?

• Some excellent theses that truly fulfilled or exceeded these expectations (at various levels, incl. 4 WU TALENTA awards!):

http://polleres.net/supervised_theses/

(Hint: unless you're a PhD student ...
... of course you're NOT expected to do a CS PhD thesis ;-)))

To get equally great results:
• plan & manage your thesis (and your supervisor ;-))
Further information

• formatting

• Why use LaTeX?
  • the main tool used in scientific writing!
    • Makes keeping of references **really** easy (using BibTex)!
    • For our undergraduate thesis we actually provide a LaTeX thesis template it (which in case someone is interested, we could adapt):
      • You can work using online tools, e.g. [https://www.overleaf.com/](https://www.overleaf.com/) (many good tutorials on their page as well!)

• ... again: find it here: [https://www.wu.ac.at/dpkm/topics/how-to-write-a-thesis/](https://www.wu.ac.at/dpkm/topics/how-to-write-a-thesis/)
A word on plagiarism...

• ALL (no exceptions) inspirations you took from elsewhere should be referenced

• We use a plagiarism checker!
  • reformulate and explain things you read elsewhere IN YOUR OWN WORDS
  • any literal quotes have to be clearly marked as such (*using quotes and italic*)

• Also **figures and images** need to be referenced!!!!
  • I also use image search engines to check figures

• Again: follow references to the **original** source! (cf. slide 20)
Any additional questions?

In this order:

• contact your supervisor!
  • write a friendly reminder if you don’t get an answer within 2-3 days

• backup (sometimes emails may get lost, just too many 😞):
  • contact backoffice@ai.wu.ac.at