

Garching, May 19, 2025

How to write a thesis

To whom it may concern,

here are my recommendations on how to write a Bachelor or Master thesis. This is not a full list, just some important points I learned throughout the years. If you are one of my students, I expect you to know and follow the content of this document.

For more information, also see <https://gitlab.lrz.de/tum-i05/public/studentstarterclues> (accessible with TUM account only)

Starting your thesis project

There are three necessary requirements if you want to write a thesis with me (and at TUM):

1. Send me some information about yourself through

<https://collab.dvb.bayern/spaces/TUMphysicsenhancedmachinelearning/pages/799441927/Thesis+application+form>

This is important for me, so that I know when you want to (and have to) hand in your project, your study programme, etc.

2. Fill out and submit the supervision form we have at the chair:

<https://nextcloud.cit.tum.de/index.php/apps/forms/s/cTD5pxYL6FwktHRCBcyotr4E>

This is to resolve copyright and data privacy issues, and to let us know what we can and cannot publish on the website. Please do this as soon as possible, ideally immediately after we register your thesis.

3. Send me your "Matrikelnummer" and a preliminary thesis title, so I (or your advisor from my group) can register your thesis on this website: <https://portal.cit.tum.de/en/Theses/>. This is necessary to officially start your thesis project. Once we register your thesis on the website, you have three/four (Bachelor, depending on the study program) to six months (Master) to complete your work and hand in your thesis.

4. You have to hand in the thesis by uploading it on this website <https://portal.cit.tum.de/en/Theses/>, but be aware that your study program may have some additional requirements (e.g., in mathematics course programs they need more).

In general, depending on the type of your thesis (Bachelor's or Master's), there is a certain expectation for what you have to achieve, related to what I call the "frontier of knowledge of humanity". Bachelor students do not have to produce work that is new, it is enough if they reproduce existing results or work incrementally (e.g. develop a small add-on to a software, or redo a proof of an existing, proven theorem). Master students have to "reach the frontier", i.e. thoroughly read the literature on their topic and know what the current limitations are. It is still enough if you only work within known territory (you do not have to produce entirely new results), but it is necessary that you at least touch upon the boundary - so that, for example, you could then continue as a PhD in the topic. A PhD student is required to go beyond what is known and produce new results in their field.

The thesis document

The following are guidelines, and include everything from cover pages, figures, and references. You can write 10-20 pages more than that, but should not write less.

Bachelor thesis: 30-40 pages, Master thesis: 50-60 pages.

As a template for Informatics, I recommend the one you can use as a "new project" in ShareLatex:

<https://sharelatex.tum.de/project>

Be careful what your individual program requires, especially about the cover page. The university/departments website has more information. You do not have to install LaTeX to compile the template if you use Overleaf. CSE students can start with the CSE template on github, but be aware that (a) no "chapter" should be used and (b) there are many unnecessary parts included in the template (quote at the beginning, list of tables/figures/etc.).

A good outline of the document early on helps you to structure the entire project. You have to use this one, with individual subsections only for number 2. and 3.:

Abstract (not numbered, about half to one page)

1. Introduction (no subsections, 1-3 pages)
2. State of the art (three to four subsections, each for one of the related topics you need in the main part, 20-30 percent of the text)
3. Main part (the title of this section can be exactly the title of your thesis. It should have four to six subsections, possibly having sub-subsections as well. 40-60 percent of the text)
4. Conclusions (can be without subsections, and with at most three paragraphs: "summary", "discussion", and "outlook". 1-3 pages)

Bibliography

Appendix (if any - try to avoid it)

The "Bibliography" should be placed before the appendix, and you should generally avoid to have any appendix altogether. Lists of figures and tables are not necessary either, but you can add them if you like.

Organizing your time throughout the project

Your main objective is to **write the document**. All software development, research, literature review, and so on are additional (but very necessary!) steps toward that objective. For you, everything has to be focused on the document, because this is what will be graded at the end.

A good work flow contains the following items, not necessarily in that order, and also not done consecutively (i.e. you can switch back and forth between these steps). If you are not motivated to continue in one of these steps, maybe try to switch to another one and then get back to the original after a few days!

1. Thorough literature research (10-20 percent of the time). This should be done (a) early and (b) thoroughly, because it feels very bad if you work for a long time and then discover that somebody has done it all five years ago. If you just read a paper that was relevant to your thesis work: **ALWAYS** write down at least one sentence IN YOUR THESIS (e.g. in the section on the state of the art), and directly cite the paper after this sentence. This will help you save a lot of time later in the project, where you do not need to re-read all the papers if you write your thoughts down immediately.
2. Software development / mathematical proofs / etc. (20-30 percent of the time). This is the main work you need to do to get some results. Be very careful to properly document and structure this work, because it will not only help you later but also helps others who want to build up on your work.
3. Writing the document (30-40 percent of the time). Try to follow the four stages described here, where the "mad man" technique is the most helpful one in my opinion, because it helps to reduce writer's block. Also: write as soon as you can, as often as you can, and especially if you have some good thoughts that you can write down easily and quickly. Remember: the document is what is most important for you!
4. Trying, testing and refining (20-30 percent of the time). This part is more important for Master's theses than for Bachelor's theses, since Master students are expected to go further towards (or beyond) the "frontier of knowledge of humanity" (see "starting your thesis project").

Writing tips (also regarding AI)

Here are a few tips I already gave out many times, so it makes sense to list them all in one place. I will update this list continuously.

Regarding tools

- Use overleaf.com or sharelatex.tum.de to store your document online and write on it in the browser. Note that these websites also offer to sync your project with GIT version control, so you can even work offline and then push.
- Do not use ChatGPT. It is not designed to write scientific text, and it will only slow you down because you have to fact-check every sentence. It will also just blow up the size of your text without adding significant information.
- If you want to use a good "AI-based" tool, use Grammarly. It is endorsed by TUM, and you can even get access to more features through your student account:

<https://www.digitalisierung.tum.de/en/grammarly-available-for-all-tum-members/>

Title page

This is how the title page and page two looks like for CSE (and accordingly for other programs, but without the CSE logo):

 School of Computation, Information and Technology Technische Universität München Master's Thesis in Computational Science and Engineering Title of your thesis Your name 	 School of Computation, Information and Technology Technische Universität München Master's Thesis in Computational Science and Engineering title of your thesis Author: Examiner: Prof. Dr. Felix Dietrich Assistant advisor: Submission Date: 
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Regarding the text

- You have to be consistent with numbering equations. You can use the following rule: "only number equations that are referenced in the text, others should not be numbered". OR, you can

also just use the rule to "number all equations". What is not ok is to just randomly number and not number some equations, independent if they are referenced or not.

- Use the "cleverref" package in Latex. Never write

`In section 3\~\ref{sec:main part}...`

but write instead

`In\~\Cref{sec:main part}`

- then cleverref adds the "Section 3" link automatically.

- If you write "on the other hand", you have to write "on the one hand" first.
- If you start a sentence with "therefore", "furthermore", "in addition", etc., you must put a comma after this first word.
- Citations work like this:

`...a sentence where I cite two main sources\~\cite{paper1,paper2}.`

That means the citation is at the end of the sentence, separated with a space (`\ ~`) and BEFORE the period.

- Citations must be either numbered ("`[2]`" etc.) or in the style "(Buona and Dellaportas, 2024)" with round parenthesis. Use latex for this, it does it automatically for you with

`\cite, \citep, \citet`

etc. You can also work in the author names in the sentence ("Buona and Dellaportas (2024) work on this and that"), but do NOT write "(Buona and Dellaportas, 2024) work on this and that", or "`[2]` work on this and that" - the latter two styles of citations should not be part of the sentence.

- Formulas are part of the surrounding sentence, even if they are placed inside an equation environment. Example: "the formula is

$$x = 1 + 2. \tag{1}$$

See how the period is INSIDE the equation?

- Again, put another way: You can think of equations as single words in a sentence, even if they are separated by LaTeX and have a number (1,2,3...). So, why would you write a single word somewhere without a surrounding sentence? Do not do this: "...the formula is the following:

$$x = y \tag{2}$$

And the next sentence starts here..." Instead, write this: "...the formula is

$$x = y, \tag{3}$$

where x is important. The next sentence starts here..." You can also end a sentence in an equation, as mentioned above.

- For more than one equation, they are still part of a sentence:

...we can have more than one equation, such as

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\begin{eqnarray}
  x&=&1+2, \\
  y&=&x*2,
\end{eqnarray}
```

and here the sentence ends.

See how the commas are used as if the formulas are in a list?

- Do not use contractions in a thesis ("do not" instead of "don't", "cannot" instead of "can't" etc.).
- Figure captions must be complete sentences.
- If you take an image from another paper, you MUST cite the paper directly in the figure caption, e.g. write "..., taken from Buona and Dellaportas (2024)." or "..., adapted version of Figure 2 [3]".
- Figure captions must be placed below the figure, table captions must be placed on top of the table.
- ALL floats (figures, captions, listings, ...) must be referenced in the text somewhere ("In Figure 3, ...").
- Enumerations and itemize environments should not have more than 5 items. Otherwise, use a table!
- There can never be one subsection point only - if that is the case in an outline, you can directly merge it with the super-section.
- If you want to have subtitles of figures (like (a), (b), etc.) to be able to reference them in the label or the text, I recommend to use a tabular environment inside the figure environment:

```
\begin{figure}
  \centering
  \begin{tabular}{ccc}
    ...[three figures] ...
    (a)&(b)&(c)
    ...other figures...
  \end{tabular}
\end{figure}
```

Presenting your work

Take a look at the section "how can I prepare a great talk" at the website of the SCCS colloquium.

Formally, the first slide should contain

1. The title and type of your project (Master's/Bachelor's thesis, Application Project, etc.)

2. Your name
3. The date of the presentation
4. The names of your examiner (usually a professor) and your advisor
5. The name of the chair (Scientific Computing in Computer Science) and university
6. If you are doing an external thesis with a company: company name, logo, and advisor's name at the company

Conclusions

Have fun with your project! I hope it is not just "yet another assignment" for you to complete, but something you can be proud of later, and maybe even build up upon in your Master or PhD, or in a company.

Other resources

You can also take a look at what others think about writing a thesis:

- <https://thesisguide.org/>
- In general, it is a good idea to visit the TUM English Writing Center a few times
- You can even join their Thesis Writers' Workshop).

That's it. I hope it helps.

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