

DR.-ING. MARK SCHUTERA

EXPENDABLE THESIS TEMPLATE

UNFINISHED LECTURE NOTES

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First printing, November 2025

"WE'RE JUST CLONES, SIR. WE'RE MEANT TO BE EXPENDABLE"

CLONE TROOPER OF THE 104TH BATTALION

Abstract

We have all been there - facing that empty stack of papers or pixels for that matter, ultimately facing the daunting task of writing a scientific thesis.

THIS TEMPLATE tries to bypass some of that empty paper anxiety by providing some inertia to get you going. Feel free to clone and adapt it to your needs. If you come across parts which you adapt, and think should be adapted in the template in general,

PLEASE CONTRIBUTE BACK - This project is open for contributions, via [GitHub](#) to report issues and suggest improvements and changes, submit a pull requests.

WHILE THIS TEMPLATE provides implicit guidance on structure, format and style, it is not a substitute for reading the companion guide.

To GET to the guide click [here](#)

THIS DOCUMENT IS A LIVING WORK AND SHOULD NOT BE CONSIDERED COMPLETE—there are approaches I have tested and refined, others I am still exploring, some I will adapt based on new insights, and perspectives I thought I understood but continue to evolve. That being said, in a near future this space will be ..

YOUR ABSTRACT. The abstract provides a concise summary of your thesis, including the research question, chosen approach, key findings, and their interpretation. It should be no longer than half a page. While optional, feel free to write the abstract in English and the native language of your institution. The abstract is best written after the main sections are complete, ensuring it accurately reflects the content and contributions of your work. This is probably the only part of your thesis that will be read by everyone, so make it count - and make the reader understand why to read on.

Acknowledgements

YOU WILL WANT TO THANK your supervisor(s), your industry partners and institute, colleagues, friends, family and anyone else who supported you during your journey. If you want to get personal and lyric, this is the place in your thesis to do so.

FOR MY PART, I want to express my sincere gratitude to all those who have and will have contributed to the development and refinement of this thesis template.

AND I WANT TO THANK MY WIFE, for putting up with me stealing weekends and evenings in exchange for this template.

Affirmation

Chances are high, that your institution or industrial partner requires a specific affirmation statement to be included in your thesis. Please make sure to adapt the text below to your specific needs and requirements. This is just a general template. I hereby affirm that this thesis is my own work and that I have not used any sources or aids other than those indicated. All passages taken from other works are clearly marked as such. I am aware that any false declaration may lead to legal consequences.

Dr.-Ing. Mark Schutera
Germany, Planet Earth, November 2025

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1

Introduction

EVERY CHAPTER, starts with a block of text, which introduces the chapter and its role in the overall thesis structure. At the same time this block of text opens up potential sections within the chapter. As for the introduction this first block takes care of the context and motivation, of your thesis. The introduction is 20 – 30% of the total thesis length.

1.1 Problem Statement

WHY IS THIS SPECIFIC FIELD OF RESEARCH IMPORTANT, NOW?

Then, quickly narrow down to the specific field you will be addressing. Broadly outline the current state of the art in this field, meaning all relevant fields for that matter, and how they relate to each other. Be diligent in preparing the ground for pointing out gaps you identified in existing knowledge or limitations in current approaches and the overarching problems that arise from the field. These gaps are often a combination of several factors, such as limitations of current approaches, gaps in theoretical knowledge, constraints in applications, or emerging developments that necessitate further investigation.

CITATIONS are essential in academic writing to give credit to original sources. To cite in text like this [1], use the `\cite{}` command. For selected references¹, which you feel the reader would benefit from

LENGTHY MOTIVATION SECTIONS

covering how autonomous driving brings down traffic accidents by 90%, reiteration of other broad concepts, or humble bragging in favor of your industrial partner, or similar topics, are to be avoided - A short single sentence will do. Then focus on motivating your specific field and research problem, this is in its own right a broad field.

¹ M. Schutera, T. Dickmeis, M. Mione, R. Peravali, D. Marcato, M. Reischl, R. Mikut, and C. Pylatiuk. Automated phenotype pattern recognition of zebrafish for high-throughput screening. *Bioengineered*, 7(4):261–265, 2016. DOI: 10.1080/21655979.2016.1197710. URL <https://doi.org/10.1080/21655979.2016.1197710>. PMID: 27285638

immediate access to the detailed bibliographic information in the margin, use the `\cite{}` command.

This section will be brimming with citations, as you have to include a reference to the original source in the text for every argument, source code, information, or line of thought that originates from another author. Failing to do so will result in your work being classified as plagiarism and considered an attempt to deceive. While of course you will be building upon recent work, always opt to cite seminal works, even if they are older.

1.2 Objectives

OPEN THIS with a 3-5 sentences which distill the derived problem statement. Then clearly (in 3-5 bullet points) outline the problem statement and articulate the contributions you will be making. When reading the bullet points, with your *Problem Statement* (see Sec. 1.1) as a prerequisite, it should be very clear to the reader how your contributions will impact the field, and its practitioners. You will want to be as specific as possible here, avoid vague statements and generalities.

SCHÖPFUNGSHÖHE, a certain level of originality and creativity required in academic work, is closely linked to the nature of your contributions. You will soon find yourself trading off between high-risk-high-impact ideas and more conservative incremental objectives. I advise to aim for a mix when defining your contributions: A workhorse (driven by execution and rigor), a staircase (small incremental improvement on a known method), a moonshot (high-impact idea or novel recombination, which might fail).

THE CONTRIBUTIONS of a work can be:

- Novel algorithms and methodologies, or an incremental improvement of such.
- Empirical and experimental findings and in-depth analysis of existing methods or data.
- Extended or curated datasets or benchmarks including metrics.
- New theoretical insights and frameworks.
- Interdisciplinary approaches, or applications and transfer of known methods to new domains.
- Combinations of the above, or other forms of contributions relevant to your specific field.

SPECIFIC CONTRIBUTIONS, could sound like: A new method for X, More sensitive metrics for Y, an empirical study on Z, a curated dataset for X, a data-driven analysis of Y, or an application of Z for a new domain. After reading the bullet points, the reader should be able to clearly understand what you are trying to achieve and what he will be walking away with.

HERE GOES THE OUTLINE OF YOUR THESIS STRUCTURE. It is not about reciting chapter titles (although you want to make sure to reference them in this block). It is rather about telling the story of your research journey:

Now, THAT the problem statement (see Sec. 1.1) is clearly defined, and the derived objectives have been outlined (see Sec. 1.2). The following section (see Sec. 1.3) provides the reader with the prerequisites, based on an in-depth analysis of the related work and further introduces fundamental concepts in detail.

The Methods chapter (see Ch. 2) initiates the approaches, definitions, concepts, algorithms, metrics, and frameworks used to address the research objectives.

Subsequently, results chapter (see Ch. 3) introduces experimental setups, experimental design, datasets used, hardware, implementation details, and presents the findings of your experiments and analyses. Concluding, the contributions and findings are interpreted in the context of the related work (see Ch. 4). Implications and limitations are discussed and future directions are recommended.

THE STRUCTURE IS FOR THE READER.

You read that right, the structure is not primarily for you. Of course a good structure helps you to organize and document your thoughts and work as you go - but it would be no good advice to limit yourself to that. Ultimately then, a well-organized thesis guides the reader through your research journey, helping them understand your objectives, methods, findings, contributions and conclusions. Again be as specific as possible in the outline.

1.3 *Related Work and Fundamental Concepts*

THE RELATED WORK section summarizes and connects relevant literature to highlight and organize existing knowledge. Here goes everything a reader needs to digest in order to be enabled to understand your own work. Do not shy away from citing a lot of sources here, quote equations, concepts and everything you will be needing to explain your own methods and work later on.

1.3.1 *First Sub-Field*

NO HEADER STANDS ALONE, so start with an introduction paragraph, by giving an overview of the general aspects of the sub-field.

OUTLINE THE SUB-FIELDS your work builds upon. Make sure to introduce and explain all relevant concepts, theories, models, and frameworks from these fields that are pertinent to your research.

1.3.2 *Second Sub-Field*

NO HEADER STANDS ALONE, so start with an introduction paragraph.

TOPIC 1 Nunc sed pede. Praesent vitae lectus. Praesent neque justo, vehicula eget, interdum id, facilisis et, nibh. Phasellus at purus et libero lacinia dictum. Fusce aliquet. Nulla eu ante placerat leo semper dictum. Mauris metus. Curabitur lobortis. Curabitur sollicitudin hendrerit nunc. Donec ultrices lacus id ipsum.

TOPIC 2 Pellentesque interdum sapien sed nulla. Proin tincidunt. Aliquam volutpat est vel massa. Sed dolor lacus, imperdiet non, ornare non, commodo eu, neque. Integer pretium semper justo. Proin risus. Nullam id quam. Nam neque. Duis vitae wisi ullamcorper diam congue ultricies. Quisque ligula. Mauris vehicula.

DON'T WRITE A TEXTBOOK. While this section can be comprehensive, a base-level understanding of the field is assumed. As a rule of thumb, a base-level understanding is everything you can read in a standard textbook. Do not re-explain established concepts in great detail, rather reference seminal papers, and carry on. For example do not explain backpropagation in detail, rather reference the original paper briefly and move on to the specific variant you are using (if that is relevant to your work later on, otherwise omit it). Go in-depth quickly, and fan out into the relevant parts there.

Methods

THE METHODS SECTION is structured into sections reflecting the different aspects of your research. These sections initiate your novel approaches, concepts, designs, algorithms, metrics, evaluation strategies, analysis methods, and frameworks used to address the research objectives. Include all relevant mathematical formulations, algorithms, hyperparameters and procedural steps necessary to understand your work. Ensure that the description is sufficiently detailed to allow readers to reproduce your approach and achieve comparable results.

START WITH AN OVERVIEW that depicts your overall system, architecture, framework, and process flows. Think of this as the blueprint for your methods chapter. My doctoral advisor used to call this schematic *the thesis in one slide*. The different components and their interactions should be clearly outlined. It is nifty to repurpose the visuals of the components in the following sections, adding more detail there, while referencing back to the overview.

WHERE POSSIBLE these components can also map back to or even mirror the objectives defined in the Introduction. In any case do not lose touch with the problem statement and make sure to have it in mind when writing this Chapter and its sections.

AFTER THE OVERVIEW, proceed to describe each component on a high level in text as well. If you are designing an entire new frame-

THIS CHAPTER IS THE PLACE for visuals, schematics, pseudo code and mathematical equations.

DON'T CITE!, reference. The methods section outlines your work, not the work of others. Existing knowledge needs to be described and introduced in the Introduction (see Sec. 1.3). If you feel the need to refresh the reader on established methods, do so by referencing back.

work or system. This is also the place to introduce new definitions, notations, or terminology that will be used throughout the rest of the thesis.

2.1 *First Component*

THEN PROCEED TO DESCRIBE the individual components in dedicated sections.

Remember you wanted to reuse parts of the overview visuals here.

The transition between sections need to be motivated and logical, often advancements in one component bring about needs, which are then addressed in following components. For example you might have a new data collection method, which in turn enables a new optimal model architecture,

$$\hat{y} = \theta^*(x), \quad (2.1)$$

which in turn requires a new evaluation metric. And so forth. Of course this is not always that linear, but try to keep a logical flow - branching out is expected.

MAKE USE OF MARGIN NOTES to provide ancillary definitions, extended explanations, walkthrough examples, or additional context which would otherwise disrupt the main narrative. Things that are nice to know, or support the reader, but which are not essential to the core understanding.

2.2 *Second Component*

THE MOTIVATION OF A NEW SECTION should be in the beginning of that very section, so that the section itself is self-contained.

Remember you wanted to reuse parts of the overview visuals here.

This Chapter is usually where the beauty (see for yourself in Alg. 1) of your work is to be found, having honed and refined your approaches over long hours.

Require: Initial parameters θ_0 , learning rate ϵ , loss function $L(\theta)$

```
1:  $t \leftarrow 0$ 
2: while not converged do
3:   Compute gradient:  $g_t \leftarrow \nabla_{\theta} L(\theta_t)$ 
4:   Update parameters:  $\theta_{t+1} \leftarrow \theta_t - \epsilon g_t$ 
5:    $t \leftarrow t + 1$ 
6: end while return  $\theta_t$ 
```

Algorithm 1: Pseudo-code for Gradient Descent Optimization. If this is not beautiful, I don't know what is.

This is where you demonstrate your creativity, and problem-solving abilities.

Results

THE RESULTS SECTION introduces experimental setups, experimental design, datasets used, hardware, implementation details, and presents the findings of your experiments and analyses around your novel methods - in a quantitative manner. Results should be presented as objectively as possible, without blending in interpretations or discussions at this point. Focus on reporting the findings clearly and concisely, using neutral language and avoiding subjective statements.

Category	Value 1	Value 2
Example A	42	3.14
Example B	17	2.71

Table 3.1: Example of a well-formatted table with a clear, concise caption. Make sure to go *full width* for tables and figures, and embrace *horizontal lines*, while avoiding vertical lines.

ALWAYS HAVE SEVERAL (AT LEAST TWO) BENCHMARKS OR BASELINES to compare your results against. Great baselines are human performance, state-of-the-art methods, other established baselines, theoretical limits, or heuristics and simple models for starters. Present quantitative results with appropriate statistical measures (e.g., means, standard deviations, confidence intervals). Deciding what and how to measure is crucial. Aligning your metrics and evaluation criteria with your research objectives is a field of study in its own right. Whenever possible, use established benchmarks and metrics from the literature (you will have introduced them in your Introduction, in Section 1.3) to ensure comparability. New developments and designs in this are shows in the Methods Chapter (see Ch. 2).

USE TABLES TO ORGANIZE numerical data (see Tab. 3.1) and figures (see Fig. 3.1) to illustrate trends, patterns, or relationships.

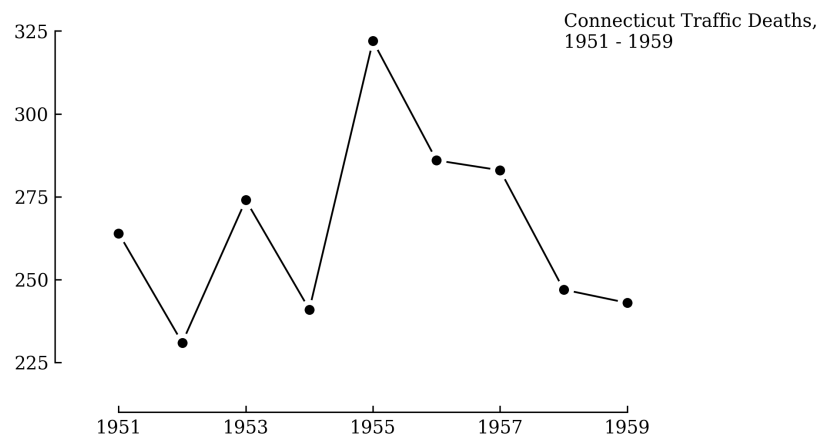


Figure 3.1: Basic line graph after Tufte. Data emphasized, axes info in title, minimal ticks, reduced non-data ink.

3.1 *Experimental Design*

IF YOU HAVE NON-TRIVIAL experimental setups or designs, describe them here. This includes the design of experiments used to evaluate your methods.

3.2 *Implementation Details*

THIS ALSO HOLDS for details about datasets, hardware, software frameworks, and implementation specifics. Again, focus on the things that are necessary to understand and reproduce your results - not every package you installed is relevant. A lot will be documented in your code repository and code documentation anyway, so focus on the important bits here. And remember to use margin notes for ancillary information - this is especially powerful in this chapter.

A GOOD PRACTICE is to have a code demo ready to showcase your results interactively. This could be a Jupyter notebook, a web application, or any other way of hosting software in this century that allows users to engage with your findings and contributions. Make sure that

this demo is properly documented and accessible, ideally set up for easy deployment (better application).

3.3 *First Finding*

STRUCTURE YOUR RESULTS by grouping related findings and presenting them in a logical order (some might call this story telling) that reflects your research objectives. Each result should be linkable to one or multiple corresponding problem statements.

3.4 *Second Finding*

EVERY METHOD presented in the Methods chapter should have corresponding results here. Often your methods are evaluated along multiple dimensions, such as performance metrics, qualitative observations, and comparative analyses.

WHEN WORKING ON PROPRIETARY or sensitive data, make use of a toy dataset or environment.

VISUAL AIDS such as images, technical drawings, tables, graphs, and charts are invaluable. Yet, make sure the text itself can transfer the results self-sustained.

4

Discussion

THE DISCUSSION SECTION is the place to interpret and contextualize your results, linking them amongst each other. Usually things become easier when branching out the *Conclusion* part together with the *Future Research* part. While in the Chapter on Results (see Ch. 3) you presented your findings and experiments more or less isolated, and in neutral objectivity, this Chapter helps the reader to make meaning out of them. The meaning arises from putting your results in context against benchmarks and baselines.

SHORT EXCURSION ON BENCHMARKS AND BASELINES. Baselines, are simpler or previously existing approaches that serve as a starting point for comparison. Such as heuristics, or human performance. Benchmarks, on the other hand, are established standards or reference points against which your results can be compared. They often represent the best-known performance or widely accepted methods in your field and usually provide means to test against them. The quantitative calculations are of course done already in the Results Chapter, but the interpretation and discussion happens here.

BY COMPARING YOUR RESULTS against benchmarks and baselines, you can demonstrate and discuss the significance and limitations of your work. While this is a quantitative exercise at first, the discussion allows for thoughtful qualitative interpretation. However, be careful to not over-interpret your results, nor is this the moment to introduce new ideas or hypotheses. Another important aspect of the discussion is to openly address limitations, white spots, and potential sources of

THIS IS THE TIME, to show-off the deltas you worked so hard for.

error, meaning expected variances and biases, in your study.

4.1 *Conclusion*

THE CONCLUSION SECTION serves to succinctly summarize the main contributions of your thesis work. Clearly distill the main contributions of your work, and reflect on their implications. While the discussion section interprets the results in detail, the conclusion is more about showing the reader what they walk away with.

FOR EACH OBJECTIVE, in your Section 1.2, mirror your contributions in dedicated blocks here. Begin by restating the objective in a single sentence, followed by elaborating on how your methods and results addressed it.

REMEMBER, this could be a new algorithm, model, framework, dataset, or empirical finding - or something in those lines.

CONCLUDING, make the linkage to your objectives explicit, by using a bullet point list mirroring the objectives from Section 1.2, again. Start out with a key statement, which summarizes the contribution when taking a holistic view:

- Then, for each objective, briefly discuss how your results contribute to it. Make it one to three sentences per contribution.
- If you have artifacts (code, data, models) to share, reference them here and provide permanent accessibility.

4.2 *Recommendations for Future Research*

BASED ON THE FINDINGS AND LIMITATIONS DISCUSSED, outline potential avenues for future research that could build upon your work. This could include exploring unanswered questions, testing your methods in different contexts, or addressing limitations identified in

IT IS A GOOD HABIT, to treat this section like a backlog. Documenting work packages which have been in scope of this thesis, but exceeded the available time or resources. Of course you need to prioritize this backlog before drafting this section.

your study. While writing this, keep the next student or researcher in mind who might pick up where you left off - knowing everything you know now, what would you recommend them to include in their problem statement (compare with yours in Sec. [1.1](#))?

Bibliography

- [1] M. Schutera, T. Dickmeis, M. Mione, R. Peravali, D. Marcato, M. Reischl, R. Mikut, and C. Pylatiuk. Automated phenotype pattern recognition of zebrafish for high-throughput screening. *Bioengineered*, 7(4):261–265, 2016. DOI: 10.1080/21655979.2016.1197710. URL <https://doi.org/10.1080/21655979.2016.1197710>. PMID: 27285638.

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Appendices

APPENDIX 1 and a short description of appendix 1. This description is between 2-3 sentences long. The main text must reference the appendix where appropriate.

APPENDIX 2 contains tables, data, questionnaires, proofs, derivations, and other ancillary information that might otherwise negatively affect the flow of the main text.

THE APPENDIX is not a dumping ground for material that does not fit into the main text due to page limitations. Appendices are optional, include an appendix only when necessary. Often enough you do not need it.

