Guidelines for bachelor and master thesis

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1 Before you start writing

1.1 Structure and length of a thesis

A typical bachelor thesis is no longer than 20 pages and can be written in English or German. A typical master thesis is not longer than 50 pages and written in English. Either thesis contains the following chapters in this order: Introduction, Data and Methods, Results, Conclusions, References. The chapters can be divided using subheadings. A table of contents should be placed before the introduction and link to the individual (sub-)sections. A list of figures and a list of tables are not necessary and supplementary material can be placed in an appendix.

1.2 Research question and scientific essence

The research question reflects the topic of the thesis. While the overarching question is usually (but not necessarily) provided by the advisor, the student is expected to develop their own concrete question to be answered in the thesis. A good research question addresses a specific scientific gap and can be answered in the scope of the thesis. Having a precise research question early in the thesis process can help finding the right reading material, developing appropriate analysis scripts or arguments, and focusing the work in general.
In his workshop on *Advanced Scientific Writing* Dallas Murphy recommends to summarize the scientific essence before starting to write the actual thesis. This essence addresses the questions stated below and **does not need to be formulated nicely**, it is rather a way to ensure the student and supervisor agree on the essentials before starting to work on the details. Therefore I also recommend to start with that and I'm happy to take the time to discuss it.
1-3 pages, no figures, and no (or very limited) citations to answer the following:

- What gap did you identify in present knowledge and why must that gap be filled?
- What is your new scientific contribution and how does it fill that gap?
- What methods and data did you use?
- What did you conclude?

1.3 On the use of AI tools

AI tools can be very helpful for spellchecking, improving grammar, and even formulating whole sentences. Please use them – responsibly. A good take, that I generally agree with giving some more detail is included at the end.

1.4 Acknowledging the work of others

If you build on the work of others, you should always acknowledge them. For information from scientific papers, this typically means citing them (see below). If you build on data or code provided by others, you should also disclose this, for example in the Data and Methods section: "The pre-processed data were provided by...".
You can also reuse figures from existing work (particularly in the introduction), then you should state this at the end of the figure caption like: "Figure reprinted/adapted from...". Note that some journals have a copyright that prohibits the reprinting of figures.
Please cite using the author-year style only (e.g., Kapitein et al. 2005) and link citations to their respective entry in the references chapter. If the citation is part of the sentence only the year should be in parentheses like this Kapitein et al. (2005). When working with LaTeXyou should make use of bibtex and .bib files (see, for example, here). To create an in-sentence citation you can use \textcite, for the end of the sentence \parencite.

1.5 Some more general (English) writing remarks

- Write the important information first at each level: chapter, paragraph, sentence.
- Write short sentences. They are easier to read.
- Always use the same word for the same thing. Switching between, e.g., hot extreme and temperature extreme when referring to the same phenomenon might make the text harder to follow and less precise.
- Use the word "significant" only in the context of statistical significance. A good alternative otherwise is "considerable".
- Don't mislead your audience: only write things that contribute to your final goal (which is mainly motivating or answering your research question). Use the principle of Chekhov's gun to interrogate every sentence, if it does not contribute "kill your darlings".

2 Abstract

The abstract should summarise the motivation for the work, the main findings, and their impacts in a broader context. A good guide for the structure of an abstract can be found here: https://www.nature.com/documents/nature-summary-paragraph.pdf

3 Introduction

The introduction provides an interesting entry point into the thesis and introduces the topic. It can begin with a motivation that goes (slightly) beyond the specific topic and highlights the broader relevance of the work. It should cover the current state of research in the field(s) relevant to the topic of the thesis, citing key literature. It should frame the gap and guide the reader towards the research question.

4 Data and Methods

A description of all data and methods used in the thesis. As short and concise as possible without omitting important details. It does not have to read exiting.

5 Results

This chapter is the main part of the thesis, it presents and describes the results of the work and their implications. If results are based on figures, they should go beyond a simple description of the figure. Avoid sentences like: "Figure 1a shows a large bias in the North Atlantic in blue colors." This can already be seen in the figure, rather try to write something like: "The large bias in the North Atlantic shown in figure 1a provides evidence for.../is a result of.../develops due to..." (see also section on figures below).
If there is previous work on the topic you can also compare and contextualise your results.

5.1 Figures

Well-designed figures are often the most effective way of presenting information. It is, therefore, worth thinking about how to best visualise a given result and investing some time in polishing the figures at the end.
Here are some points to consider:

- What is the best way to visualise a result? (lineplot, barplot, boxplot, map with shading, etc.)
- Is all the information needed to interpret the figure included? (title, axis labels, units, legend, etc.)

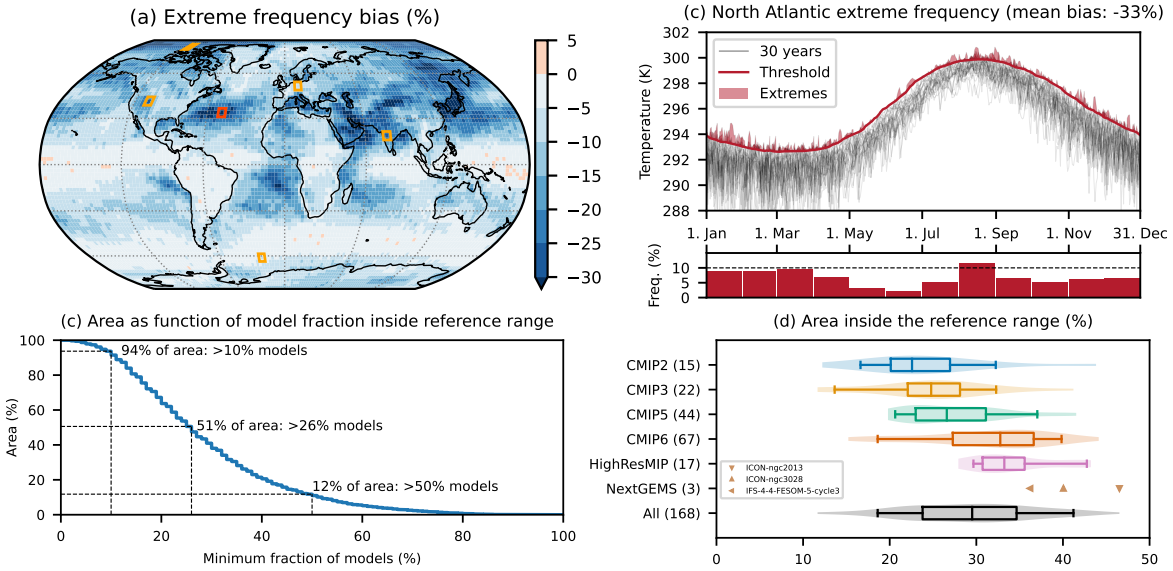

Figure 1: Examples of different figures.

- Could the figure be misleading to a reader? (e.g.: multiple sub-figures beside each other showing similar metrics should use the same colorbar range, except for rare exceptions; blue is often associated with negative temperature anomalies but positive precipitation anomalies)
- For figures using shading, the use of discrete color levels is often preferable to a continuous color gradient as values and colors are easier to match.
- Does the figure have a precise figure caption (introducing any acronyms or technical terms used in the figure even when they have already been introduced in the text; do not describe results in the figure caption!)
- Does the figure use colorblind and perceptually uniform colormaps where possible? (see, e.g., here)
- Is the font size of the labels and other text in the figure large enough? (ideally, it should have a similar font size to the rest of the text)
- Is the resolution high enough (and not so high that file size becomes a problem)? Ideally figures are included as vector graphics such as PDF.

5.2 Tables

Tables are less exciting than figures but can help to structure results – use them.

6 Conclusions

May also be called "Summary and Conclusions" or "Conclusions and Outlook" or any other combination, depending on the focus. Here, the conclusions that can be drawn from the results are presented and contextualised. You can also provide your own interpretation, but always make a clear distinction between conclusions objectively based on the results and subjective opinions.
The conclusions chapter often opens with a short summary of the results, written in the past tense. This summary should be broadly understandable to someone who has not read the rest of the thesis in detail. It should, therefore, contain no acronyms and only make very limited use of references to other parts of the thesis.
Questions that remained open and could not be answered in the thesis can also be briefly discussed here. As well as possible new questions that arose in the course of the study. Suggestions for further studies or how the results might be applied in the future can be given in a short outlook at the end.

7 References

Kapitein, L. C., E. J. G. Peterman, B. H. Kwok, J. H. Kim, T. M. Kapoor, and C. F. Schmidt (2005). "The bipolar mitotic kinesin Eg5 moves on both microtubules that it crosslinks". *Nature* 435.7038, pp. 114–118. DOI: 10.1038/nature03503.

A Appendix

How to construct a *Nature* summary paragraph

Annotated example taken from *Nature* **435,** 114–118 (5 May 2005).

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.

One sentence clearly stating the **general problem** being addressed by this particular study.

One sentence summarizing the main result (with the words "**here we show**" or their equivalent).

Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

One or two sentences to put the results into a more **general context**.

Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline, may be included in the first paragraph if the editor considers that the accessibility of the paper is significantly enhanced by their inclusion. Under these circumstances, the length of the paragraph can be up to 300 words. (This example is 190 words without the final section, and 250 words with it).

During cell division, mitotic spindles are assembled by microtubule-based motor proteins[1,2]. The bipolar organization of spindles is essential for proper segregation of chromosomes, and requires plus-end-directed homotetrameric motor proteins of the widely conserved kinesin-5 (BimC) family[3]. Hypotheses for bipolar spindle formation include the 'push–pull mitotic muscle' model, in which kinesin-5 and opposing motor proteins act between overlapping microtubules[2,4,5]. However, the precise roles of kinesin-5 during this process are unknown. Here we show that the vertebrate kinesin-5 Eg5 drives the sliding of microtubules depending on their relative orientation. We found in controlled *in vitro* assays that Eg5 has the remarkable capability of simultaneously moving at ~20 nm s^{-1} towards the plus-ends of each of the two microtubules it crosslinks. For anti-parallel microtubules, this results in relative sliding at ~40 nm s^{-1}, comparable to spindle pole separation rates *in vivo*[6]. Furthermore, we found that Eg5 can tether microtubule plus-ends, suggesting an additional microtubule-binding mode for Eg5. Our results demonstrate how members of the kinesin-5 family are likely to function in mitosis, pushing apart interpolar microtubules as well as recruiting microtubules into bundles that are subsequently polarized by relative sliding. We anticipate our assay to be a starting point for more sophisticated *in vitro* models of mitotic spindles. For example, the individual and combined action of multiple mitotic motors could be tested, including minus-end-directed motors opposing Eg5 motility. Furthermore, Eg5 inhibition is a major target of anti-cancer drug development, and a well-defined and quantitative assay for motor function will be relevant for such developments.

A.I. Guidelines—Syllabus*

Timo Seidl

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I encourage you to use large language models like *ChatGPT* to improve, speed up, or challenge your writing (be that of text or code)—I regularly do so myself. However, not only do I expect you do make every use very (!) transparent. I also want you to reflect on three things: First, current large language models are not very useful if it's really important to get things right. If you see yourself working in an area where this matters, you will have to learn how to get things right. Second, current large language models are much more useful if you actually know what you're doing - much like a cheat code in a video game is much more useful to someone who is actually good at the game. So if you want to be augmented instead of replaced by large language models, keep learning stuff. Lastly, by routinely relying on AI shortcuts you relinquish, as English professor Thomas Pfau puts it, 'the experience of intellectual achievement and growth, which can only ever be the fruit of *sustained* personal effort'. Your time at university will become 'a relentless series of logistical challenges', rather than 'a process of learning and intellectual and personal growth'. So think very clearly about what you are giving up—and risking—when trying to save some time.

*This text reflects my current thinking, which is far from settled. Let me know if you have any feedback, but also feel free to use this or parts of it in your own syllabi (no attribution needed).