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School of Computing

College of Engineering, Computing and Cybernetics (CECC)

Template for Project Reports

— Honours project (S2/S1 2023–2024)

A thesis submitted for the degree
Bachelor of Advanced Computing

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Declaration:

I declare that this work:

- upholds the principles of academic integrity, as defined in the University Academic Misconduct Rules;
- is original, except where collaboration (for example group work) has been authorised in writing by the course convener in the class summary and/or Wattle site;
- is produced for the purposes of this assessment task and has not been submitted for assessment in any other context, except where authorised in writing by the course convener;
- gives appropriate acknowledgement of the ideas, scholarship and intellectual property of others insofar as these have been used;
- in no part involves copying, cheating, collusion, fabrication, plagiarism or recycling.

September, Xin Lu

Acknowledgements

If you wish to do so, you can include some Acknowledgements here. If you don't want to, just comment out the line where this file is included.

There is absolutely no need to write an Acknowledgement section, so only do so when you *want* to – it's always important to stay sincere. One reason for including an acknowledgement could be to thank your supervisor for extraordinary supervision (or any other reason you deem noteworthy). Some supervisors sacrifice a lot, e.g., are always available, meet on weekends, provide multiple rounds of corrections for theses reports, or the like (keep in mind that writing a thesis is special for you, but not for them, so they do actually not have any reason to sacrifice their private time for this!). Seeing acknowledgements in this report can feel like a nice appreciation of this voluntary effort. For large works that form the end of some studies (like an Honours or Master thesis), it is also not uncommon to read acknowledgements to one's parents or partner. But again, completely optional!

Abstract

An abstract is a very short summary (around 15 lines) of your entire work (that doesn't use citations by convention). There are plenty of examples you can take a look at – simply take a look at some papers published at top-tier venues, e.g., by your supervisor.

Table of Contents

Chapter 1

Introduction

Plan for the introduction: - what is choreography and it is deadlock-free and why is that desired - Kalas and other choreography language - research question

Chapter 2

Background

This section should explain all the technical background that is important for being able to read your report. Recall that your report must be completely self-contained, so you should only assume "mathematical understanding", but no specific knowledge. All such knowledge should be provided here, e.g., the formalization and vocabulary of the research areas in which your work resides.

Note that this is not the same as reviewing related work. Related work puts the work done/described in your report into context of other (mostly recent) work that's done by others. In contrast the current chapter is not so much about what work others have done, and more about the formalization (and possibly standard techniques) that you require to describe your contributions (but since you probably didn't come up with these formalizations, you of course still need to cite the respective authors).

Please make use of sections and subsections as it's reasonable to better structure this (or any) chapter.

Chapter 3

Related Work

This chapter reviews the work that is most related to the research questions investigated by you in this work. Please note that there are various options on *where* you include it.

- You could include it *here* (i.e., where you see it right now in the template). Since it's after the formal definitions (Chapter 2), you can explain what the other works have done on some level of detail, yet you need to keep in mind that you did not yet explain your own contributions (except abstractly in the abstract), which slightly limits the level of technical detail on which you can compare these approaches here.
- You could also make it a subsection of Chapter 2. This choice might also depend on the length of this chapter. Is it worth its own full chapter?
- Alternatively, you might include this chapter after the main part of your report, i.e., right before Chapter 9. When you do this, you can go into more technical detail since the readers will have read your entire work, so they know exactly what you've done and you can therefore discuss differences (like pros/cons etc.) in more detail.
- When you take a look at scientific papers (preferably at top-tier venues), you might notice that not every single paper has a related work section. This is because in principle related works might also be addressed/positioned in the introduction or in the main part of the work. But since this is not a "standardized scientific publication", it is very strongly advised that you devote its own section to related work as done in this template.

If you prefer any of the latter two options, discuss this with your supervisor(s).

Chapter 4

Reasonable Title for Main Content

This chapter holds your contributions. Depending on your exact topic, you might use only a single chapter for your actual contributions, or several. Even having several is not unusual. Discuss your proposal with your supervisor(s) and propose descriptive titles.

The following sections give additional advice that is specifically tailored to students who are new to either LaTeX or scientific writing. I *strongly* suggest that you read the entire document carefully! Also use it as checklist after you started writing and after finishing.

4.1 Abstract Advice

- **Start early.** Writing a report is hard and takes time. More than you think. *Hofstadter's Law:* "It always takes longer than you expect, even when you take into account Hofstadter's Law." – *So start early!*
- **Read and check your work!** Each LaTeX editor has a spellchecker. Use it!! Read your work *carefully* and *multiple times* before showing it to your supervisor. And *please* read the next sections before doing so! I *guarantee* that it explains errors that you do! Prevent them! Use the next section as checklist!
- **Involve your supervisor!** Don't be afraid to reach out to your supervisor(s)! It's quite literally his/her/their job to supervise you and help you succeed! :) So make sure you get what you need to be successful, don't hold back. But make it easy for them. Most academics are overworked...
- **Choose your title page.** This template has two distinct title pages. Choose the one you like more by setting up the configuration file accordingly. You could even change the template if you like. It's not to restrict you but to save you time.

4.2 Building the PDF

The file mainfile.tex needs to be compiled to obtain the desired output.

The easiest way is however so simply type "make", which will compile everything for you: The makefile is set up to use *latexmk* by default. This very useful commandline tool works on all standard operating systems: Linux, macOS, and Windows. The installation overhead is minimal, and on Linux and macOS it should even already be installed. Check it out here: https://mg.readthedocs.io/latexmk.html – this is the preferred option since it's the most convenient and takes the least time to compile a document. This is because LaTeX documents might have to be compiled up to *five* times! But latexmk knows the exact amount of compilations required based on compiled files available.

Instructions on how to use the makefile:

- **Type "make"**. Just calling "make" without arguments will invoke the build tool *latexmk* in its *online mode*, which automatically updates your PDF every single time you save an updated tex file. (So the terminal you used to invoke make will remain forever idle.) Note that when it encounteres a compilation error it often requires a terminal input from you. In this case, fix the LaTeX error(s) and then type X to continue. **This is the preferred mode! So just type "make".**
- **Type "make mk"**. Calling make with the argument *mk* will also invoke *latexmk*, but without its online mode. So you will have to call it each time you want to have an updated PDF.
- **Type "make all"**. Calling make with the argument "all" will invoke the LaTeX and bibtex compiler manually the maximal amount of times to compile the document. This is more time-intense than simply letting latexmk make its job. Not recommended.
- **Type "make quick"**. Calling make with the argument "quick" will simply compile the document a single time with the LaTeX compiler. This is quick, but is mostly not enough to show the updated PDF. Not recommended.
- **Type "make clear"** (or "make clean"). Calling make with the argument "clear" or "clean" will delete all temporary files, such as .aux, .log and so on. This is very rarely required. However, sometimes when you produce very wrong code, LaTeX compilation simply fails until you delete all these files from previous compilations. In such a rare scenario, "make clear" will help.

Alternatively you should also be able to copy the template onto Overleaf, which will then deal with the compilation for you. Once you copied it over, make sure everything works (i.e., that the PDF is created successfully) before you make any changes. The template as provided should already work (=compile) without the need to make *any changes*.

Advice: Please do not ignore any warnings! They usually should be fixed...

Chapter 5

General Rules and Writing Advice

This chapter provides general beginner's advice on writing a scientific report. It should be read once in advance before starting your work and then occasionally be used during writing as a checklist.

5.1 Capitalization Rules

In Scientific works there are some rules on what and how to capitalize.

- **Chapter, Section, and Subsection titles.** They all must be capitalized according to specific rules. Basically everything is written capitalized except for some specific words (like in, on, the, ...). Just search for these capitalization rules. You can even find "online title capitalization tools", which make it easy for you *and* establish consistency easily.

- **Figure, Table, Listing, Equation, Chapter (etc.) references.** Whenever you cite something that has a number, you will have to write it capitalized. This very sentence, which cites Table 6.1 for looking great as it uses the BOOKTABS package, is an example of correct usage of capitalization. Note that we only capitalize if we cite something specific. So for example, in this very sentence, which is part of the current section, "section" is *not* capitalized although we would have to if we had written that this sentence is part of Section 5.1 – because then we actual reference something.

5.2 General Notes on Increasing Appearance – Don't be Careless!

Don't forget that your work isn't parsed by a robot, but read by a human being. So make it pleasant for them, i.e., optically pleasing. Some rules to follow:

- *Page and Line Breaks:*
  - If some headline ends up at the end of a page, that might look ugly. Consider adding `\pagebreak` right before it to force placing it on the next page. That will likely look much nicer.
  - Sometimes you might also want to enforce a linebreak, for example within section titles or even the thesis title. Just decide what looks best! For example, this section title got a line break as I believe it looks nicer like this. In LaTeX, the following three commands might be useful in this context:
    * `\\` is a linebreak that will not stretch the current line. Usually, you never use this command, maybe with the exception of the thesis title. (Or done for this section title as illustration.)
    * `\pagebreak` also breaks the line, but it will stretch the entire line to the end so that the text remains in block mode.
    * `\mbox{}` might be useful, which prevents a linebreak of the word(s) specified as argument.
- *Big Gaps in the Document:* Make sure that there are no huge gaps in the middle of your report/text, e.g.:
  - For example, make sure that a chapter doesn't end with a single line on a new page, that's just ugly and thus careless. The same applies for the table of contents: If it happens to have so many entries (sections/subsections etc.) that it jumps to a next page just because of one or two lines/entries, then just search (e.g., using stackoverflow) how to reduce the space between the lines so that it fits. Show some effort.
  - Also make sure that when including figures or tables that there is no huge gap before them, that may happen depending on their size.
- *Respect Boundaries!* As children, most of us had those coloring books with pictures that we had to color in without going over the lines. The same basically remains true for scientific works; yet most make it wrong. This is actually strictly forbidden in the context of publishing a paper.
  - When including graphics and in particular tables, make sure that they do not reach into the border.

  - This also (very) often happens in text, and mostly for formulae. That is ugly and careless, so rephrase to prevent that.

  To find those errors easily, you can add "draft" as optional package argument to the documentclass (first line in the mainfile). Then, every verylongwordthatdoesnotbreak (which all produce an "overfull box") will be shown with a black box next to it. ***Try it now!*** (You will find such a box here!)

- *Number of subsections and their introductions:*
  - Always have at least one line of "glue text" between the chapter title and the first section, i.e., anything that briefly introduces what comes next.
  - Never use exactly one section. If you use sections, there should be at least two – because otherwise it's just pointless; you could (if you had just one section) just eliminate it as otherwise the chapter title should then already reflect the content.

Do all of this only *briefly before you hand in*, as all that depends on your final layout. Adding, changing, and removing text will of course change the appearance, so do all this in a very final step. **I advise that the entire Chapter 5 and 6 are used as a checklist**, but this subsection in particular should be implemented when everything is final.

5.3 Bibliography / References

There are various points that you should consider when you add a publication into your bibtex file. The first basic rule is: ***never blindly copy some bibtex entry from the internet*** – most of them are of very poor quality (or contain lots of information that's usually not included). Instead, double-check each entry by hand via trustworthy sources, such as DBLP (https://dblp.org/), the publisher's webpage, or the websites by the authors. For each entry, consider the following:

- *Correctness:* Is all the data you put in correct? E.g.,
  - is the type correct? For example, papers published in conferences should be "inproceedings", papers published in journals are "article". These are often wrong when using non-trustworthy internet sources.
  - is each content correct? For example, page numbers are often incorrect, the venue of publication might have some issue (e.g., you might say it's published at a specific conference, but in reality it was only accepted at one of the conference's *workshops*, which is not the same).
  - is everything capitalized correctly? Note that capitalization is automatically done by the used style, and often everything is written in lower-case letters. However several words have to be written according to specific capitalization

rules. This is in particular true for abbreviations (e.g., "IPC" stands for the International Planning Competition). Just writing "IPC" in the bibtex will most likely however produce "ipc", or maybe even "Ipc", though both is wrong – it *has* to be "IPC". You can enforce this by putting curled parenthesis around the respective word. E.g., if your paper title contains "IPC", you would instead put "{IPC}" into the bibtex entry. Make sure to do this for all words that should be capitalized in a certain way.

- *Completeness:* Make sure that each entry contains all fields that are required (like authors, title, booktitle etc.) but also those that are "usually specified". The latter is hard for a beginner, so this is the recommendation: Also provide page numbers, publisher, year. Also don't overdo "completeness". In particular when downloading bibtex entries from DBLP, you will often see lots of irrelevant information (like the conference venue or exact date), which one usually does not include in bibtex entries.

- *Consistency:* Make sure that the various entries are consistent to each other. For example, conference papers usually use acronyms. Make sure to either always add the respective acronym (preferred) or never. If you add it, add it always in the same way. E.g., don't add "..., IJCAI-12", "... (IJCAI-12)", "... (IJCAI '13)", "... (IJCAI 2015)" – use always the the systematicity. Likewise with the conference titles. For example, do not write "Proceedings" for one but "Proc." for another. Stay consistent.

5.4 How to Cite Papers

In most cases, you place a citation right behind the respective proposition that you want to back up. Let's assume that the next citation backs up the sentence that you currently read (**?**), it was thus plausible to put it exactly there – and not at another position of this sentence.

However, if for some reason you need or wish to use the *paper explicitly* within your sentence, then refer to its *authors* (not the paper). For example, I can claim that the work by **?** will be quite funny once it will have been done! This is just nicer than claiming that the work "described in (**?**)" will be influential. The reason is again consistency, because normally citations like the very first one (where everything is contained by parentheses, not just the year) are not objects of the sentence. So using them sometimes as objects and sometimes not would be inconsistent.

Here are a few example:

- This is a statement (**?**), followed by another that is not backed up. **Correct**: statements are backed up by citations after the respective statement.

- **?** state X. **Correct**: A group of people can state something.

- **?** states X. **Wrong**: This is a group of people, so we meed plural.
- In **?**, X was proved. **Wrong**: This is a group of people, not a paper. Nothing was proved in this group of people.
- X was proved in **?**. **Wrong**: Same as above.
- X was proved in (**?**). **Wrong**: This kind of citation is used at the end of a statement, and it does *not* form an object one can explicitly refer to.
- X was proved by (**?**). **Wrong**: As explained before.
- X was proved by **?**. **Correct**: X was proved by that group of people.

LaTeX provides different commands for these different kinds of citations. In this template, those those are `citep{}` and `cite{}`, but they may be different when using other authorkits. The command `\citeauthor{}` is also sometimes useful. This just lists the author(s), but without the year. I.e., it's an alternative to `cite{}` that you should use when you want to mention the authors whereas you used similar citations before so that there is just no need to add the year again. (Make sure to never write out author names by hand! Always use a LaTeX command to get them.) Finally, note that you can easily cite multiple works with one command as shown in (the code of) this sentence (**??**).

5.5 How to Provide Definitions and Theorems.

In theses or project reports in computer science or engineering you are bound to have definitions. It is at your discretion whether you provide some definition purely "in-text" or whether you make aware of it more prominently by using a definition environment. It's sometimes hard to judge what should go into the former and what should to into the latter, in particular for beginners. In my experience, beginners put too much into formal definitions, because they think everything is important. :) If in doubt, reach out to your supervisor early, he/she will know! My personal stands on that is that you should only use a formal definition environment if at least one of the following criteria is satisfied: The definition will be referenced/mentioned later on again (rather than just "using" it), or the defined concept is simply very "important" or "central" (again, it might be hard for you to judge what that means, so reach out to your supervisor if in doubt).

For a sake of providing an example for how it looks in this (PDF) document, but also so that you can see how to use the LaTeX commands, I borrow from some simple concepts of AI planning.

> In planning, we talk about *states*. States are subsets of *propositions* or *facts* taken from a finite set of available fact F that can used to describe our system/world. Thus, states $s \subseteq F$ are those facts which are true in the respective current world state s. ... The finite set of actions A is given by ... A given sequence of actions $\bar{a} = a_1 \dots a_n$ applied to a state $s \in 2^F$ leads to a state $s' \in 2^F$ if and only if ...

Note that all concepts described here are of course quite foundational, but none of them seems to be "evolved enough" to warrant putting them into a formal definition environment. It is much more natural so simply introduce these (formal!) definitions within a text. Some of these components introduced above together form the components of a *planning problem*, which is essentially the main concept in AI planning. If thus deserves its own *formal* definition, which will appear as follows:

Definition 1 (Planning Problem)**.** A *planning problem* is a 4-tuple $\langle F, A, s_o, G\rangle$ consisting of:

- F, a finite set of *facts*,
- $A \subseteq F \times F \times F$, a finite set of *actions*,
- $s_0 \in 2^F$, the *initial state*,
- $G \subseteq F$, the *goal description.*

Some text that's still part of the definition. ■

You may see that sometimes it's hard to recognize where a definition ends and where the normal thesis/report text continues. For this reason I added a black box at the end of all definitions. If you don't like that use the "definition" environment rather than this "defn" environment. Also note that your definition gets numbered! This for example is Def. 1. You can configure how definition numbers are shown, e.g., whether they are simply consecutive (as it's right now) or whether these numbers are prepended by the chapter/section number to make finding them easier. Just use the AMSTHM's package manual and stackoverflow to find out!

Finally, but *really* important for any beginner: Note that formal definitions can *never* contain explanations. They only contain plain boring definitions themselves (as above). Explanations thereof must come after the respective definition, but they can't be part of it!

Depending on your work you might also need theorems such as the following one:

Theorem 1. *Let $\mathcal{P} = \langle F, A, s_o, G\rangle$ be a planning problem. Deciding whether $\mathcal{P}$ has a solution is* ***PSPACE-complete****.*

Note that you might not only need theorems, but also Propositions, Lemmata, and Corollaries. You find their definitions (i.e., environment names) as well as a very short explanation on when to use which in the macros.tex file.

Finally, every theorem (etc.) needs a proof!

Proof. Membership: We show how we can ...
Hardness: For hardness we reduce from ... □

There is a box again! This wasn't added by me but it's already standard behavior by the respective package. A white empty box at the end of proofs is a general convention to have to indicate the respective proof's end. (You can google its origin if interested!)

In older papers or maths scripts you might also find "q.e.d." instead, Latin for "quod erat demonstrandum" (Eng.: "what was to be shown").

This concludes my selection on what I found a useful general advice while minimalistic advice for anybody starting to write scientific works.

If you have any advice on how it could be improved further,
please reach out to me!

— Pascal — pascal.bercher@anu.edu.au

Chapter 6

Some Rules on how to use LaTeX Correctly

This chapter provides advice specifically on LaTeX. Even if you are strong in LaTeX already, you should carefully read this chapter because you might still make many errors that explained in here – many of them are even still be done by actual scientists, so please don't skip this section. You should also use it as a checklist before you submit your work (or better yet: before you show it your supervisor(s)).

6.1 Special Care with Dots that don't end Sentences

You need to "escape" all blanks following a dot that does not end a sentence. E.g., "This is 6 pt. project." needs to be coded "`This is 6 pt.\ project.`" as otherwise it looks as follows: "This is 6 pt. project." – you see that in here the spacing after "pt." is way too large. This is because LaTeX interprets each dot (with a following space) as one that ends a sentence – after which more space is allocated. An escaped space in contrast produces a fixed space that doesn't get stretched. (Fun fact: when (mechanical) typewriters were still a thing, authors were hitting the space twice after each "sentence-ending dot" to produce exactly the behavior that LaTeX does automatically.)

Interestingly, LaTeX even adds this extra space if a dot is within an ending parentheses (like here.) I assume this is because in such cases one is not supposed to add another dot after the parenthesis to end the sentence, so it interprets this dot as ending the sentence although it's placed within a parenthesis. If this is not the case in your context, you will have to protect the space following the parenthesis, as in "`Figure, Table, Listing, Equation, Chapter (etc.)\ references`", as otherwise, as shown in "Figure, Table, Listing, Equation, Chapter (etc.) references", the space will be slightly too large.

6.2 Use the right Dashes

In LaTeX, there are three kinds of dashes/hyphens:

- - (in LaTeX: `-`), hyphen: This hyphen is *only* used to concatenate words, e.g., when you write "state-of-the-art approach". (A spelling rule often done wrong is that we still have to write "this approach is state of the art", although it would be "this is a state-of-the-art approach".)
- – (in LaTeX: `--`), en dash: This is a dash and usually used to depict ranges, e.g., instead to writing "on pages 23 to 42" we could write "on pages 23–42".
- — (in LaTeX: `---`), em dash: This longer dash is usually used to set off some information. For example, I hope that adding this section leads towards no student using a hyphen where a dash would be required — although I assume that many will still do this wrong. :(

The most important message here is that you should basically never use the hyphen where a dash is required. Whether you use the en dash or the em dash is however not of major importance as long as you stay consistent.

6.3 Use the right Quotation Marks

An error extremely often done in LaTeX, is using the wrong quotation marks. These are "correct quotation marks", whereas these are "wrong ones". Just remember that correct quotation marks are always "66/99", whereas many students/LaTeX beginners often incorrectly use "99/99". In LaTeX code, this looks like:

- 66/99, "correct quotation marks"; keyboard symbols: `and ', so it's ``...''
- 99/99, "**wrong** pair of quotation marks"; ''...'' or "..." in the code.
- 66/66, "another **wrong** pair of quotation marks"; ``...`` in the code.

In fact, when somebody makes this error, it's most likely because they use the keyboard symbol " both on the left and on the right, but on the left you need a different symbol, i.e., use ‘ twice! On the right, it does not matter whether you use the symbol ' twice or the symbol " once as both produce the same symbol in the PDF.

6.4 Variables Names

Very often, variable names will not be single letters, but *words*, such as *pre* for pre-condition or *eff* for *effects*. Since variables are often used in math mode, there's the temptation to just write them in math mode, e.g., `$\langle pre,eff\rangle$`, resulting into "$\langle pre, eff\rangle$". You hopefully see that this looks incredibly ugly – because LaTeX sets the text incorrectly. Instead, you should put it into math italics. To save you effort, you should define a new macro:

```
\newcommand{\Pre} {\ensuremath{\mathit{pre}}}
\newcommand{\Eff} {\ensuremath{\mathit{eff}}}
```

With this you can now simply write `$\langle \Pre,\Eff\rangle$`, which now results into $\langle pre, eff \rangle$, which looks exactly as it should. (This template includes the file macros.tex, which you can use for all your macros.)

6.5 Using Graphics/Plots/Tables/Pictures correctly

Figure 6.1: A caption for the illustrated graphic (**?**). It's made long on purpose so that you can see that it simply doesn't look good that the caption is below – since there is now a lot a free/unused space. It would have been a better choice to place the caption next to it, which you can see in Figure 6.2.

Figure 6.2: Captions should not explain/interpret graphics, but enable the reader to read it. Further interpretations and conclusions should be in the text only. For this graphic the following caption might be appropriate: "Motivational expressions written and pinned on a wooden fence (**?**)."

Also note how in this case the caption should be on the left (and not below the graphic as in Figure 6.1) as otherwise there would be a lot of free/unused space. The code for this is a bit more complicated, but now you can simply change it, so it should be fine... :)

- Graphics "float". LaTeX decides where they should be placed, not you. You can of course still influence that a bit (via the arguments for the figure environment,

cf. https://tex.stackexchange.com/questions/39017/how-to-influence-the-position-of-float-environments-like-figure-and-table-in-lat), depending on where you put the source code that includes the graphics, but LaTeX will have the final word on where *exactly* it will appear. Still, please make sure that your graphics appear at reasonable places so that reading the document remains being a pleasure. That means that you will have to reference each graphic. Thus, the reader will take a look at a graphic (i.e., figure) exactly when you reference it in the text, not when it's "being seen". (This also means that graphics/figures that are not referenced could and should be deleted from your work.)

- In Figure 6.1 you see an example figure with its caption below – which looks very ugly. Do that if the graphic is centered and wide enough. In contrast, Figure 6.2 provides the caption next to the figure – which in this case looks quite good since the graphic is portrait rather than landscape, i.e., now there is no lost space.

6.6 Tables

Standard LaTeX tables don't look particularly pleasing. Thus, it's generally recommended to use the `booktabs` package, which was designed to produce aesthetically pleasing tables. Table 6.1 provides an example, taken from the official manual (slightly adapted). One of the most important rules: Do not use vertical lines. Note that the table caption appears on top. This is set on purpose to align with several publishers, who demand that captions for tables are *above* tables, whereas those for figures (i.e., everything else: graphics, plots etc.) are *below*.

Table 6.1: This table lists prices for different kinds of animal meat.

Item		
Animal	**Description**	**Price** ($)
Gnat	per gram	13.65
	each	0.01
Gnu	stuffed	92.50
Emu	stuffed	33.33
Armadillo	frozen	8.99

6.7 Colored Links

By default you will see that all hyperlinks (e.g., to figures like Figure 6.2, citations like by **?**, etc.) are colored. Personally, I (the author of this template) find that easier to read in the PDF than the alternative. The alternative is that hyperlinks are indicated by colored boxes that surround them (where the text itself remains black). You can choose between the two by the setting the option `colorlinks = true` or `colorlinks = false`

in the hyperref definitions (where `true` colors the words, whereas `false` produces the box). Note a major difference between the two: The box is an annotation, so it's not visible when printing. If the text itself is colored then that's an actual text color, so it will appear as you see it in the PDF also in the printout. You can of course also change the colors.

6.8 Math environments

Just a very few very short notes on math environments. Very short since this is not supposed to be a LaTeXcourse! Please use google to find tutorials etc. if needed.

- Inline math like $\sum_{i=1}^{n} i = \frac{1}{2}(n \cdot (n+1))$ can be set using `$`*math stuff*`$`.
- To have something appear in its own new line and centered like the following:

$$\sum_{i} = 1^n i = \frac{1}{2}(n \cdot (n+1))$$

  For this you have to use `\[`*math stuff*`\]`. Note that `$$`*math stuff*`$$` technically works as well, but this is actually *wrong*! Just never use this syntax. If curious why (although it seems to work as well), just google it.
- If you want to show several equations or a sequence thereof, there are useful environments like "align" or "align*" (where the latter suppresses equation numbers). Again, just google it! But here's one example:

$$\sum_{i=1}^{n} i = 1 + 2 + 3 + 4 + \cdots + n \tag{6.1}$$

$$\text{fibonacci series: } = 1\ 1\ 2\ 3\ 5\ 8 \ldots \tag{6.2}$$

  If your thesis is math-heavy, I strongly recommend to read through the AMSMATH package documentation or google related tutorials.

6.9 Algorithms

The following is a short example code using the `algorithm2e` package. There are other packages for this, but this is one of the most frequently used ones.

Algorithm 1: Example algorithm using algorithm2e

Data: Your input data
Result: Result of the algorithm
1 **Function** `Main()`:
    `/* initialize variables */`
2 $sum \leftarrow 0$
3 **for** $i \leftarrow 1$ **to** n **do**
        `/* process each element */`
4 $sum \leftarrow sum + i$
5 **return** sum

When you look into the LaTeX code of Algorithm 1, you see that you can define labels for individual lines. This has been done as example for Line 2. It is very important to always use dynamic references (i.e., labels), in this case also for line numbers. This is because your algorithm might still change, and then your numbers would get outdated.

6.10 Further LaTeX Issues or Questions?

In case your document doesn't compile, check out the log file and search for "error", often that points towards the problem quickly. I also recommend the following sources:

- If you are a LaTeX beginner, you might also want to take a look at a well-known LaTeX introduction (**?**), which in the current version – according to **?** – takes "only" a bit more than two hours to work through.
- chatGPT can analyze your code, error messages, and even write code. Try it!
- If that doesn't help, use https://stackoverflow.com/.

This concludes the section on LaTeX advice. Much of the advice provided is made wrong even by experienced scientists. So please use this section also as checklist, during writing your thesis and before handing it in.

If you have any advice on how it could be improved further, please reach out to me!

— Pascal — pascal.bercher@anu.edu.au

Chapter 7

Some Information on Marking

The information provided here is *not* part of an official marking guide, and in particular not by the ANU. If there is some overlap – which there hopefully is – then it is "coincidental". In other words, the advice provided here is general advice on how your thesis can be improved and what often counts. This might be different between kinds of works (e.g., 6 pt vs. 12 pt research project vs. Honours thesis), different Universities, or even between program convenors! However, "in spirit", some of the following criteria might certainly play a role.

To re-emphasize:

The following list is far from comprehensive and is merely intended to get you started thinking about possible evaluation criteria. Please discuss your work and what is expected from you with your supervisor(s).

On top of this, for the students from the ANU reading this, I would like to be crystal clear that the following sections are by no means any sort of official criteria. They are literally just there to increase the chance that you write a better work, but they are not reflecting out official marking criteria.

7.1 Write-up Quality

There are several factors that play into account when judging the write-up. Here are some of them, though this list is clearly not exclusive.

- **Claims backed up?** Every claim must be backed up by a citation, unless your claims are your own. So don't make statements that you cannot prove by appropriate citations. Most of the time, only A^*-ranked works should be cited, though there are exceptions to this rule. If in doubt, discuss with your supervisor(s).

- **Citations new Enough?** You could check how "old" your citations are, to make sure you did not miss any new developments. If for example your newest citation is from more than 10 years ago, chances are high that you missed some relevant newer work – and some reviewers might be looking for that. It clearly depends on your precise research question which works are related and hence when they were published. So in some cases, the newest relevant work might indeed be more than 10 years old, so in such a case there is in principle nothing wrong with the newest citation being "older" as it might still be the newest one research-wise. However, it might still make a bad impression so some reviewer checking for this, in particular if he/she is not an expert in the field of your thesis. So to be on the save side it might be worth checking how old your citations are and discuss with your supervisor(s) whether there are some works from recent years that can be appropriately cited. Keep in mind, chances are high that you could indeed cite some works from recent years as your research question is more likely to be a current one than to be a dated one that didn't attract attention in many years.

- **Results appropriately stated?** Never oversell your achievements. Objectively report on your findings, even if they are bad. Don't claim that your small work will revolutionize the world or some field – that is very rarely true. Being humble is mostly likely closer to the truth – and this is what science is all about.

- **Level of formality adequate?** In particular when it's about HD vs. D it becomes important how formally adequate a work is reported. For high HD it should be on a level that could be published in an A^* venue, and the more informal/high-level everything is reported on, the worse for the mark.

- **Completeness and Self-Containedness.** Make sure that nothing important is missing. For example, not having a "Related Work" section isn't a good idea, but also check for completeness of the sections you have. For example, make sure your background section enables the reader to fully understand your work, without having to study any textbooks. For example, if your work builds on two subdisciplines of some field, providing background on only one of them would be a clear miss. Just make sure that your work is self-contained, i.e., that it can be understood with the material you provide.

- **General Form and Appearance.** This has many aspects, e.g., not having typos, not going over the border, using examples where helpful (graphically if possible), not having pages which are blank except a few lines, and many more. Just take care for the "general appearance".

  This is probably the least important point of all; but it still matters. Keep in mind that your reviewers don't have an intrinsic motivation to read your work – they *have* to. So make it *pleasant* and easy for them!

7.2 Factors Independent of Write-Up

For some works the supervisor might be consulted for further input, mostly for "scaling". The input provided is often not visible in the work but counts never the less.

- **Level of Independency.** It makes a huge difference whether the supervisor must explain every single bit, correct various parts multiple times to get all errors out, and even come up with the empirical design. Ideally, the supervisor only had to give the general topic/research idea and the student would do all the rest (and just ask for confirmation/feedback for the ideas he/she developed).
- **Amount of Contributions by the Student.** Whereas the main research question is always proposed by the supervisor, there is still often room for the student's won contributions, either on a technical level or more general regarding research ideas. Devising own ideas or approaches certainly improves the work/mark.
- **Level of Difficulty.** The harder the task or research question, the more valuable the work performed. Since the research question is given by the supervisor(s), the student barely has any influence on the hardness of the level of difficulty. However, if the work is conceptually easy (e.g., a simple application of existing techniques without any scientific or algorithmic challenges to be conquered by the student), then it becomes even more important that all the rest is of high quality, e.g., showing independency and high-quality write-up.

Chapter 8

Evaluation

Clearly not every project has empirical components (in particular in mathematics or theoretical topics) – though many do. So in case you were coding anything and conducted an empirical evaluation, this is where you should report the results.

The following sections are, as for the rest of this template, just *suggestions*. They might fit to your work, or they don't. Discuss this with your supervisor(s).

8.1 Benchmark Set

This is where you describe the set of benchmarks that you use for testing your hypothesis empirically. Some ideas on what information you could convey:

- What's the origin of your benchmarks, where are they from?
- What benchmark set did you use *exactly*, i.e., can you explain what they are/mean?
- Why did you choose these benchmarks, and not others? I.e., why are they appropriate for your evaluation? Are they maybe some sort of "standard" and thus also used by others?
- Could you have chosen other benchmarks? If so, which? Why didn't you do so? (Could this maybe form future work?)

In nutshell, just tell everything interesting about the set of benchmarks selected.

8.2 Evaluated Software

This is where you would describe all software or algorithms etc. that you test. For example, if later you have tables or plots with some abbreviations to denote algorithms or specific configurations of your algorithm(s), then this would be the place to define

and explain them. So, all these abbreviations/acronyms or software names should be explained/introduced here, and explained in sufficient detail.

Furthermore, in most works you might not only test your own software/contributions, but you might compare it against software from the literature. If possible, then this is certainly good style, as you are usually not the first to tackle a certain problem: Others have attempted this before. So you should compare your performance against performance of the current/previous state of the art. Therefore, this software should be listed here as well. You might potentially have explained these other "competitors" before in the related work section, but there you focused on their scientific approach. Here you would list their software names and configurations, and otherwise reference back to the related work section. Explain why you compare against this software, and maybe mention other related software as well, explaining why you did not compare against it.

8.3 Hardware Setup

This section is supposed to explain all details on how to run the above-mentioned software, so that others could reproduce it, or at least can interpret your results appropriately. This is usually rather short.

On what computer was the experiment run? I.e.,

- What was the Operating System? (Name and version number.)
- What processor (CPU) was used, and how many? Single-core, or Multi-core? (In some disciplines, such as AI planning, only a single CPU is used, even if the processor has multiple cores.) Was GPU power used as well? If so, which?
- How much RAM was made available? (Note that this is typically different from the RAM the hardware has available, as we can reserve a specific amount to processes, which is lower than the total amount physically available.)
- How much runtime did you grant your processes? How did you measure it? Did you take "walltime" or "CPU time"? If you don't know what this means, google it! Explaining it might also be appropriate.
- Was your system a VM, running within another operating system (e.g., Linux within Windows), in a cluster, on a server, a personal laptop, etc.?

In a nutshell, you should simply report anything that will enable your reader to interpret your numbers that you are going to report later.

8.4 Empirical Results

This is the "core" of your section: Here you report all your findings.

A *very important* observations is that you will have to report on *two* things, where some might forget the second, although this is actually the more important item:

- Plain data. This is the raw data you obtained, reported in tables or plots or the like. E.g. which problems did you solve in the available time? How well did you classify the input correctly? (This is clearly content-specific.) Make sure to report your data in an appropriate way, enabling the reader to easily grasp what the data is supposed to show. It is important to discuss this early on with your supervisor, as he/she likely knows better how to appropriately report on your findings. (Also don't forget to look into important literature working on similar topics.)
- Interpretation. This is what you can infer from your results. Did the approach work well, or did it not? If it worked well, then to which extent? Does it *always* perform best (unlikely!), or is there a subset of benchmarks on which it worked well? If so, why? What's special about this subject making the approach work well there? Do your findings raise further questions and thus directions for future research/investigations? Please do not worry if your results are objectively bad. Certainly bad results can not be published, but you can still obtain very high marks. It is your job to evaluate how well (or how badly!) your approach worked, and it's (likely) not your fault if it did not. So making up ridiculous reasons why the results are great although they are clearly not is anti-scientific and will thus make an incredibly bad impression and penalized mark-wise. Simply objectively and truthfully report the findings – this is science. If the results are bad, can you explain or at least hypothesize why? (This would prove your high level of understanding.) Can you form future work based on your findings?

When reporting your results using graphs and plots, make sure to provide all information necessary to interpret the data, e.g., axis and graph labeling (cf. Figure 8.1).

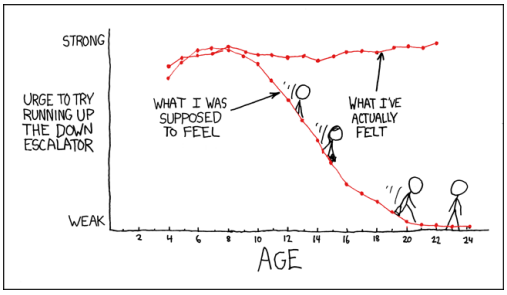

Figure 8.1: A graph illustrating the importance of axis and graph labeling. (Graphic taken from https://xkcd.com/252/.)

When you print tables, it's good style to highlight the best results in bold. Also use the BOOKTABS package for nicely formatted tables, as explained in the previous section on LaTeX advice. (That's not a must, but it will simply look much nicer!)

Chapter 9

Concluding Remarks

If you wish, you may also name that section *"Conclusion and Future Work"*, though it might not be a perfect choice to have a section named "A & B" if it has subsections "A" and "B". Also note that you don't necessarily have to use these subsections; that also depends on how much content you have in each. (E.g., having a section header might be odd if it contains just three lines.)

9.1 Conclusion

This section usually summarizes the entire paper including the conclusions drawn, e.g., did the developed techniques work? Maybe add why or why not. Also don't hold back on limitations of your work; it shows that you understood what you have done. And science isn't about claiming how great something is, but about objectively testing hypotheses. Also note that every single scientific paper has such a section, so you can check out many examples, preferably at top-tier venues, e.g., by your supervisor(s).

9.2 Future Work

On top of that, you could discuss future work (and make clear why that is future work, i.e., by which observations did they get justified?).

Note that future work in scientific papers is often not mentioned at all or just in a very few sentences within the conclusion. That should not stop you from putting some effort in. This will (also) show the examiner(s)/supervisor(s) how well you understood the topic or how engaged you are.

Appendix A

Appendix: Explanation on Appendices

You may use appendices to provide additional information that is in principle relevant to your work, though you don't want *every reader* to look at the entire material, but only those interested.

There are many cases where an appendix may make sense. For example:

- You developed various variants of some algorithm, but you only describe one of them in the main body, since the different variants are not that different.
- You may have conducted an extensive empirical analysis, yet you don't want to provide *all* results. So you focus on the most relevant results in the main body of your work to get the message across. Yet you present the remaining and complete results here for the more interested reader.
- You developed a model of some sort. In your work, you explained an excerpt of the model. You also used mathematical syntax for this. Here, you can (if you wish) provide the actual model as you provided it in probably some textfile. Note that you don't have to do this, as artifacts can be submitted separately. Consult your supervisor in such a case.
- You could also provide a list of figures and/or list of tables in here (via the commands `\listoffigures` and `\listoftables`, respectively). Do this only if you think that this is beneficial for your work. If you want to include it, you can of course also provide it right after the table of contents. You might want to make this dependent on how many people you think are interested in this.

Appendix B

Appendix: Explanation on Page Borders

What you find here is an explanation of why the border width keeps flipping from left to right – which you might have spotted and wondered why that's the case.

Firstly, that is *intended* and thus correct, so there is no reason to worry about this. The reason is that this document is configured as a two-sided book, which means:

- We assume the document will be printed out,
- that this will be done in a two-sided mode (i.e., the document will be printed on both sides of each page), and
- that the bookbinding will be in the middle, just like in every book.

When you open the book, there are three borders of equal size n. This however requires that even pages have a border of n on their left and $\frac{n}{2}$ on their right, and odd pages have a border of $\frac{n}{2}$ on their left and n on their right. This is illustrated in Figure B.1.

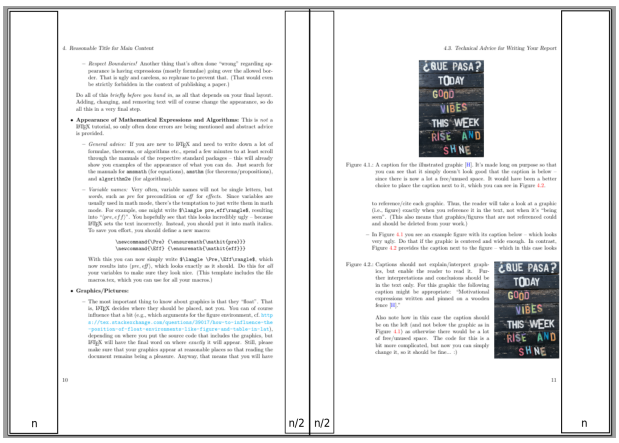

Figure B.1: Illustration showing why page borders flip.