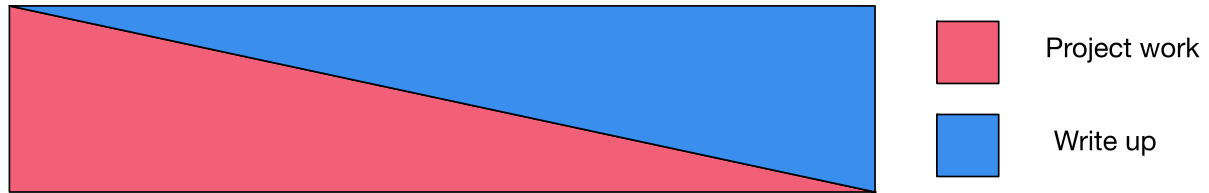


## Project Writing Cheat Sheet

### It's never too soon to start:

It's never too soon to start your dissertation. There's no best time to start, and it shouldn't be seen as one and then the other. Figure 1 illustrates a simple 'tapered' approach where, as time progresses the amount of effort on the project work is diminishes, the effort on the write up increases. **NOTE:** your project won't be a nice smooth transition like this, though you should aim for something like this.



**Figure 1:** A simple 'tapering of effort between project work and write-up

### Why would I want to start the write-up so soon:

Your write-up will help you order your thoughts and put your work into focus. Benefits include:

- Better understanding of the problem space, making thinking of a solution easier.
- Allows you to reflect on your solution. Spot better ways to do things. Which may lead to you re-doing your work.
- Help to manage workload.
- Your project marks come from your dissertation not your code. So, by working on your dissertation early helps to maximise your mark. **NOTE:** although your marks come from the dissertation you **MUST** have the code behind it to get marks.

### Structure of the document:

The hint here is the marking scheme. You should really have a section for each element in the marking scheme. This is normally something like:

- Introduction
- Background
- What was done and how
- Results
- Conclusions
- References

**NOTE:** There's often a marking section called 'Form' this is for how well you have written your dissertation and have you structured it well. Don't have a section for it!

### What goes where?

12-pager

Abstract

1. Introduction

- a. Motivation
  - b. What other approaches (have / are there?)
  - c. Main research question / aim
  - d. Sections of paper
- 2. Related work
  - a. Just the papers you've read – try to group and taxonomize
- 3. Methodology
  - a. Overview of the methodology
  - b. Succinct and only the bits about the technique used
  - c. The novel bits about what you did
- 4. Results
  - a. Results plan
  - b. Short (1 paragraph) outlining the main parts of the environment. Mostly just a list such as “We used Tensorflow 2.3 on a system with an 8-core intel CPU, NVIDIA Titan RTX GPU and 64GB of RAM”.
  - c. The most important / significant results
- 5. Conclusions
  - a. Short summary of the key findings of the work
  - b. Future work

#### Supplementary document

- 1. Introduction
  - a. Objectives
- 2. Related Work / Background
  - a. This should focus on the technical knowledge that you needed to gain in order to do the project
- 3. Methodology
  - a. How you prepped your data
  - b. Full details of the environment used the software and hardware
- 4. Results
  - a. Fully expanded set of results
- 5. Conclusions
  - a. Personal reflections

#### What you need to show:

Below is a list of things that you've been asked to show in your dissertation. Presented is where you can present evidence for this and what might make good evidence. It should, however, be noted that this is not an exhaustive list as evidence can come from anywhere in your dissertation.

What	Where	Good evidence
<b>The context</b>		
that the research question(s) have been placed in their academic and, where appropriate, industrial or commercial contexts	Introduction	You have clearly articulated why this is an important question, shown how the area will be improved by your work
that, in the case of a thesis undertaken as part of a team project, the relationship of the research to the overall project is set out along with the contribution of the candidate relative to that of other team members	Introduction	You clearly state what is your work and contribution and what is provided by others
<b>The literature</b>		
that the relevant literature or an appropriately justified section of it has been covered	Related work	Clear discussion of relevant papers – the exact number depends on the field, but think of at least 5
that the literature is reviewed in ways which are critical and analytical and not just descriptive	Related work	You have categorised (taxonomized) the literature into groups which share the same 'features'. That you have compared your work with that of others.
that the thesis demonstrates clear mastery of the literature	Related work and across document	Good use of the literature without significant gaps.
that explicit links are made between the literature and the topic of the thesis	Mostly introduction and related	You compare your work with that of others
that there are explicit links between the literature and the design of the study	Introduction and start of Methodology	You show that your aim/hypothesis is based on work that you have read – not just doing something
that there is a summary of the literature in so far as it relates to the thesis topic	Related work	The related work has a narrative which explains why the related work is there
<b>Methodology</b>		

that there is an awareness of the range of methodologies / methods which have been or might be used to tackle the topic	Methodology	You outline different approaches and explain why you have selected one (or more) of them
that there is adequate justification of the methodology(ies) / methods adopted for the research	Methodology	A clear justification is given for the methodology chosen
that the methodology/methods are related to the design of the research	Introduction / Methodology	There is a link between the design of the work and the methodology
that practical problems and issues are identified and discussed	Evaluation	You discuss issues that you have had during development and what you did about them
where applicable, that ethical considerations are outlined and discussed	Introduction / Methodology / Results	Consideration to ethical and other biases are given in the Introduction and Methodology. For the results a consideration of where bias could come from, how it can be minimised and how it can be measured
where applicable, that matters of reliability and validity are identified and discussed	Evaluation	Discussion about not only what is good about what you've done but what isn't good
<b>Design of the study</b>		
that the design of the study is appropriate to the topic	Introduction	You explain why you're using the approach you're using
	Methodology	<b>You show how the design matches the problem</b>
that there is awareness of the limitations of the design adopted	Methodology	The potential limitations are discussed as the design is put together
	Evaluation / conclusions	<b>You reflect on what is good / bad in your chosen design</b>
<b>Substantive research</b>		
that the research design has been properly implemented	Methodology	Clear discussion that shows the whole solution has been implemented
	Results	<b>A clear testing strategy which covers all of the solution and evidence of how it is functioning</b>

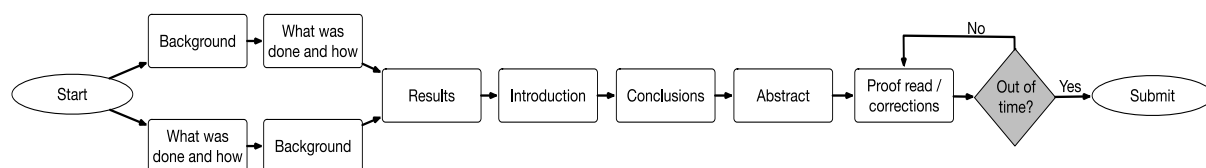
that the relevant sources of evidence have been explored		
Analysis		
that appropriate theoretical and, where applicable, empirical techniques are used to analyse evidence	Results	A clear results plan and the techniques (and metrics) which will be used for this
that the level and form of analysis is appropriate to the evidence	Results	Each table / graph is discussed and the important facts that you want the reader to take from these are highlighted – not just table / figure put in report without discussion
Outcomes / results		
that the outcomes/results identified relate to the topic	Results	Results plan should reflect on how the proposed relate to the original topic. And how the actual results relate.
that the outcomes/results are justified on the basis of the analysis of the evidence	Results	
that the outcomes/results are presented clearly	Results	Clear graphs / tables / etc. The most appropriate of these for highlighting the evidence to be presented.
where applicable, that patterns and trends in the outcomes / results are accurately identified and summarized	Results	Analysis of the presented results clearly highlighting the important things in the tables / graphs / etc...
Discussion		
that the main points emerging from the outcomes/results have been picked up for discussion	Results	Discussion of the figures / tables in the results section
that there is an awareness of the limitations of the outcomes / results	Results Conclusions	Reflection on what the results mean  <b>Summarise the significance and meaning of the results</b>
Conclusions		
that the conclusions relate to the initial focus of the study	Conclusions	You have reflected on the original goal of the project and addressed the hypothesis / aims

that the conclusions drawn are justified by the study	Conclusions	The conclusions should be clearly evidenced by material earlier in your dissertation – no new ideas in conclusions
that the implications of the conclusions for the field of knowledge have been identified	Conclusions	You have clearly summarised the main benefits / drawbacks of the work and how the work in the project will impact the field

### In what order should I write the sections?:

It might sound odd, but you don't write a thesis from front to back in one go. For example your abstract should be a high-level overview of your thesis, you can't really write this before you have written your thesis. Figure 2 illustrates some common outlines of how you might choose to write your dissertation.

It's sensible to start by writing either your background or what was done and how sections as these are the ones that you probably know the most about at the point where you start writing. The order of these two sections depends on which you feel you can do first. The results normally come next as this is a big and important section. When this is done you should now have enough in place to write your introduction (you need to know what you're introducing people to before you can write the introduction). Conclusions are next as you've now pretty much finished the dissertation and you want to highlight your conclusions. In essence your **introduction** says what you're going to do, and your **conclusions** say what you've done, so to make sure that they match they should be written one after the other. The last bit of real writing is your **abstract** as this is a short overview of everything it really needs to come at the end (of the writing phase) to make sure it **summarises what you did** not what you plan to do. Finally, as you've planned well and have loads of time left you can now proof read and correct your dissertation until you need to submit.



**Figure 2:** Suggested orders for writing your dissertation.

### How much to write for each section:

There's no hard and fixed rule for this, however, as a good rule of thumb you can't go massively wrong by using the mark allocation for each section with the page limit. An example here is:

Assuming dissertation length is 40 pages. Use the formulae  $\text{pages} = 40 * \text{mark allocation}$

Section	Mark allocation	Pages
Introduction	10%	4
Background	10%	4
What was done and how Called Methodology for short	40%	16
Results	25%	10

Conclusions	5%	2
References	5%	2
Form	5%	0

### Writing Styles:

You're not writing a 'Who done it':

A dissertation is not a murder mystery book where you have a big reveal on the last page and no-one expects the culprit to be who they turn out to be. Your dissertation should be the complete opposite. From the abstract onwards you should be making it clear to the reader what they should expect to know by the end.

You're not writing pop-science:

Pop science (the sort of textbooks your parents buy you for Christmas) are those where they sensationalise thing (The advent of Data Science was a pivotal point in human history) and tend to be low on providing evidence to support the claims made. You should not be sensationalising your work and you should be providing evidence to support your claims. It's very tempting to make bold statements such as 'Machine Learning is changing how we see the world', but although this may be true, it needs evidence to back it up. Without the evidence you're bordering on (dare I say it) fake news. Also make sure what you're writing is relevant for your project. If your project is about how AI can be used to identify cats from dogs is it relevant to spend a page talking about how great AlphaGO is?

You are writing an academic document:

The things that distinguish academic writing are: i) the document is written in an a neutral tone (you're not adding emotion to the text), ii) any claims you make are backed up with supporting evidence (in most cases this will be citing work others have done already, but may be to evidence of things you've discovered), and iii) you are not hiding things as you're going – all ideas are presented up-front with no shocking reveals at the end.

DO NOT's for your project:

- **DO NOT** put code fragments into your document. There are very few cases when this is valid. It's always better to describe what your code does and include pseudocode.
- **DO NOT** put screen grabs into your 'What was done and how' / section. Again, there are very few cases when this is valid.
- **DO NOT** forwards reference (i.e. say that you will tell people something in a later section). In general, this indicates that you haven't structured your document well.
- If you start a list of items with "such as", "for example", or "these include" **DO NOT** finish the list with "etc.", "and so on". This is implied by the first part.

Do's for your project:

- **MAKE SURE** every figure is labelled and it is discussed properly in the text. The adage may be that a picture says a thousand words, but without a description of the figure the reader won't know what they are looking for. **MAKE SURE** that the label for the figure appears on the same page as the figure!
- Avoid large diagrams from leaving huge gaps at the bottom of pages (i.e. half a blank page and then a figure at the start of the next page). Make it look like you're trying

to waste space. Pull text from after the figure to before the figure so you don't have a huge gap.

- Make sure sentences are clear and can be interpreted. A bad example (of what you shouldn't do) is: "Different sections of the system performed different actions". What are the sections? What are the actions?
- Avoid personal reflections apart from in the conclusions.
- Be careful not to 'state the obvious' this can be sentences such as "computers make less mistakes than humans".

### Writing and proofing:

Everyone writes with mistakes. It's a human frailty compounded by the fact that when we read our own writing we read what we thought we wrote, rather than what we actually wrote. There's also the case of poor English. We don't enter computing because we're experts at English writing – normally the contrary. As such we need to minimise the chances of producing poor writing. Some techniques to help with this are (you should use as many as you can):

- Get someone else to read your dissertation who is not from computing. They will read the document for the purpose of clarity of writing.
- Get someone else from computing to read the dissertation – pair up. If you read someone else's dissertation and they read yours then you both benefit. You each gain a different perspective on writing a dissertation (I'd never thought about writing about that) and you can each check each other's for understandability from a computing science point of view.
- Use the English support unit. Anyone can use them to proof documents.
- Put your document aside for at least a week then re-read. You'll spot a lot more mistakes.
- Read it out loud. This engages different parts of your brain and can help you spot where things aren't clear or too long.

A Note on Marking and writing quality: Examiners are told not to mark down work for bad English / writing apart from the mark for the Form section. However, if your work is so bad that they can't understand it then you're bound to lose more marks.

### Grammar:

Be aware of tautologies - saying the same thing twice. Remove the duplicate. This can happen within a sentence e.g. "In order to solve the problem the authors used machine learning to solve the problem". Or between sentences e.g. "In the work by Markas et al. [4] the authors adopted a machine learning approach. The authors used a machine learning approach to solve their problem."

### Writing tense and personage:

When writing about work you are referencing you should use the past tense. When writing about your work you should use the present tense and when writing about future work you should use the future tense.



When writing for academic purposes we never write using “I”, even if we are the sole author. It is acceptable to use “we” but keep this to a minimum. You can always re-phrase a sentence to avoid using “I” or “we”.

#### Overview, summary and conclusions:

In a section the overview comes at the start, a summary at the end. Conclusions are normally presented in their own section at the end.

#### What is the difference between Abstract and introduction?:

The introduction can be thought of as a (several page) executive summary of your dissertation. It should summarise the whole dissertation. An abstract is a short description of the project – not normally more than half a page. You may be wondering what is the difference? Think of it this way – the introduction should be more detailed than the abstract. Hence the two do talk about the same information but progressively in more detail. The purpose of an abstract is to allow people to quickly decide if your dissertation is worth reading. Once someone has decided it's worth taking a look then they will read the introduction – which will provide more details (but not all). On finishing reading the introduction they should then know if they want to read the rest of the dissertation. So, each gives progressively more details about what you've done.

#### Abstract:

What is an abstract?

Abstracts are a fairly recent addition to academic documents. They were introduced to allow the reader to quickly identify if the document is actually of interest to them and what are the main aspects of the work.

As such they're your way of selling your work to make people want to read it. So, make it interesting clear and above all honest - there's nothing worse than being disappointed by over-selling.

Your abstract should be a complete description of your project. Think of it as a mini dissertation in just one paragraph. A good way to do this is to write it as a structured abstract, though as Newcastle doesn't ask you to produce a structured abstract you should delete the titles and merge into one paragraph before submitting.

**Structured abstract:** is an abstract which contains headings and text for each heading. The headings can be anything, though a good set of headings can be: Context, Objective, Method, Results, Conclusion. Write a couple of sentences on each of these.

- Context: is setting the scene for your work. You should be answering such questions as: What area is this work in? What is the big problem here? Why is it important to solve this problem?
- Objective: is the main thing you are intending to do / solve in your work here.
- Method: a quick overview of the technique / method that you are going to use. Just enough so that the reader can get a feeling for your work.

- Results: These are the headline results for your work. What is it that you've actually achieved, but not the whole results.
- Conclusions and novelty: of your work - what makes it stand out from the rest.

### Introduction:

**Motivation:** When writing your abstract think about the following items which the reader will want to know answers to:

- In what area is your project?
- Why is it important to do this work?
- Who will benefit from this work being done?
- Why has no-one done this work already? Note: your work may not be fully unique so it might just be the particular take on your work that hasn't been done before.

**Hypothesis:** Your project needs a clear hypothesis. This will be a constant element throughout your dissertation. You will pick up on this in the background section to justify choices. You will use this in the methodology (implicitly) when explaining things – such as why you choose a particular approach. You will need this in the results to show you have (or haven't) achieved what you set out to do. You will reflect on it in your conclusions.

**Aims and objectives:** The aim for your project should be a clear statement of where you wish to reach by the end of your project. This should be clearly broken down into **SMART** objectives.

### Background:

The background section can contain two elements:

- Background material that the reader should be aware of in order to understand the rest of the dissertation. This could be libraries that you used, languages used or programming approaches used. **NOTE:** you should assume that the reader has the same background you did at the start of your project – so there's no need to discuss things that you were taught as part of your degree.
- Related work. In the form of other (academic) work which solved the same or related problems. This should also explain **why** the other solutions can't be applied to your problem here or in what way is your approach different. If you can cluster the related work into things that are doing the same sort of things. Such as 'all works which use a Reinforcement Learning approach' and 'all works which use a Genetic Algorithm approach'. If you can then relate your work to these other works and clusters then that's even better.

As a general rule, good dissertations contain both of these parts, bad ones contain only background material.

A third element exists for dissertations which use a large dataset or an environment you're building on:

- A clear discussion of any data or environment relevant to your project (e.g. the dataset of images you are going to use, their size, the number of images and other relevant characteristics).

### Tools, techniques and software used

In all projects you will need to use techniques, tools and software which are not part of what you would expect others to know about. As a rule of thumb this is anything you didn't know about before starting your project or anything the majority of the rest of the people on your course would not know about. So for example you can assume that people would know what Java is but it is unlikely that they would know what TensorFlow was.

Each of these things should be described in enough detail so that someone reading the dissertation can understand things without having to go off and read up on these things beforehand.

### What was done and how:

This section is easy to get wrong. It's not a blow-by-blow account of what you did in the order you did it in, it's an academic discussion of your solution. **DO NOT** write things like "First I chose my programming language. Then I wrote the header files for the code." Write something more like "The programming language chosen for this project was C++. This choice was made as it allowed for the development of a clearly defined API, as represented through the C++ header file, which could be made available to users of this tool." In fact this should come towards the end of your methodology – when talking about environment.

You should define what development model you used. But don't waste more than a few lines on this.

**A big note of caution here:** You've been working on your project for many months and know it in intimate detail. This often means that you forget the overall picture of what you're doing and the context where it is placed. For example, if all I write "We substituted a ReLU activation function within the fourth layer of the network" you don't have a context. However, if I first describe the architecture the activation function which is normally used then talk about substituting ReLU then things will make more sense. A good way to assess if you've described your project effectively is to find a fellow student (not working in the same area) and see if they understand what you've written. The below will help you out:

**The 50,000-foot view:** Remember the person reading your dissertation hasn't been sat beside you all the time you've been doing it. As such they don't have an idea of what you've done. So help them out:

- Start out with a high-level (50,000-foot) view of your project. Explain the key aspects of the solution in abstract terms – a good figure will help here. Once they've read this they should have as full idea of what you have done and how (though lacking all the details).
- Now go back to each of the parts you talked about in the high-level view and fill in the details.

### Writing up your project or writing about your project:

This is a bit of a subtle difference until you see the difference in action. It's very easy to 'write about your project'. By this I mean that you describe what was done without

explaining to the reader the useful information they need to know. It's very quick and easy to write about your project. An example could be something like:

'a Python code was developed which read in the CSV data and then produced the desired figure'

Although this describes what you did it fails on the 'and how' part. If you think of a document as being information that someone else could use to reproduce your work, then the statement above would not help. However, writing something like this would be much better:

'in order to produce a figure of average cost against year the third to tenth columns of the CSV files were averaged for each row and plotted together with the first column value. This was developed in Python.'

Avoid focusing on the tools rather than the work the tools perform. Think more about the abstract task the tool is performing. Someone else might want to use a different tool to do the same thing. What they want to know is the underlying thing you have to do rather than the specifics on how to do this in tool X. A good way to do this is to write almost the entire methodology without referring to the specific tools at all and then have a sub-section on implementation where you discuss the tools you actually used.

### Results:

This section should really be called "Results plan, Results, and Evaluation" as these elements are all needed.

**A BIG NOTE OF CAUTION:** Most people leave this section till the last minute and then suddenly realise that they don't have enough time to do justice to it. A good results section can take weeks to do. Therefore, start thinking about it early and plan it out well.

### Results plan:

This should define what you want to test about your work, the metrics you are going to use, how you're going to conduct the experiments and how you are going to assess that the results you get.

### Results:

Clear tables, carts, graphs of your collected results. You should highlight key features in your results here (e.g. the maximum value observed was X.XX). Keep the summary findings for your evaluation.

**DO NOT:** Just put screen shots of your program running in here. That's a sure way to get low marks.

### Evaluation:

This is where you draw out things from your results **AND** from aspects of your project. For your results this should be interesting analysis on the figures and tables which you pull together to bring out pertinent points. For the evaluation of your project this should be a reflective analysis of what you did. For example, was the assumptions you made at the start good? Should you (in hindsight) has used a particular approach?

## Conclusions:

### Structure of the conclusion:

- An overview of the work which was done in the project
- A summary of the main findings from the results / evaluation
- A personal reflection on how the project went
- Future work ideas (think of this as 6+ months of effort not just 'tidy up things').

Conclusions should highlight the project and draw out the main findings. Assume the reader hasn't read the rest of your project (often true) and give an overview of the whole project. Draw out the main discoveries from the project and put them in a context appropriate for the area.

The conclusions **SHOULD NOT** just be a set of statements showing that you have achieved (or not) your objectives. You should discuss whether you have achieved your objectives. But this should not be the only thing and it should not be the first thing you discuss.

Future work: This is more difficult than you might think. Think about future work in the sense of "What would you do if we gave you another six months?" The future work should be substantial items and not just "What I didn't get done because I didn't work hard enough in the first place." It can be something different to the work you did do – though it does need to be related. For example, "Although we solved X in this project a good future work task would be Y as this is now seen as the biggest problem in this area."

## References:

Make sure all references in your text are correct and point to the right item in the references section.

Make sure all references are complete. There should **NEVER** be an et al. Journal papers should have a title, authors, Journal name, issue, page numbers and year. Conference papers should have title, authors, conference title, location, pages and year.

A good dissertation will have few references to web pages, a bad one often has lots.

Use a reference style. Nothing looks worse than just a list of poorly formatted text. And be consistent – adopt one style and stick with it.

## Saving Space

If page count is significant then here are some tricks to help you out.

## General help

Look for paragraphs which end with a line with just one or two words. By doing a little editing of the text in the paragraph you can save a whole line.

### Avoiding flowery English

It's very easy to write flowery English - English where when three words would do you write ten.

1. Is your list really necessary? It's easy to write "There are two problems with this approach. The first problem is ..., whilst the second problem is ....". This could be said more succinctly with "The problems with this approach are ... and ...".
2. Remove the unneeded linking words. For example "In another work, Markas et al. [4] ...". This can be shortened to "Markas et al. [4] ...".

### Squeezing LaTeX

- There's some good help on the [Cambridge Engineering page](#).
- If you're using inline equations don't have blank line between the equation and the text. Otherwise LaTeX will assume they are separate paragraphs and put a large gap in there.
- More information in Canvas under "Typesetting your [Thesis](#)".