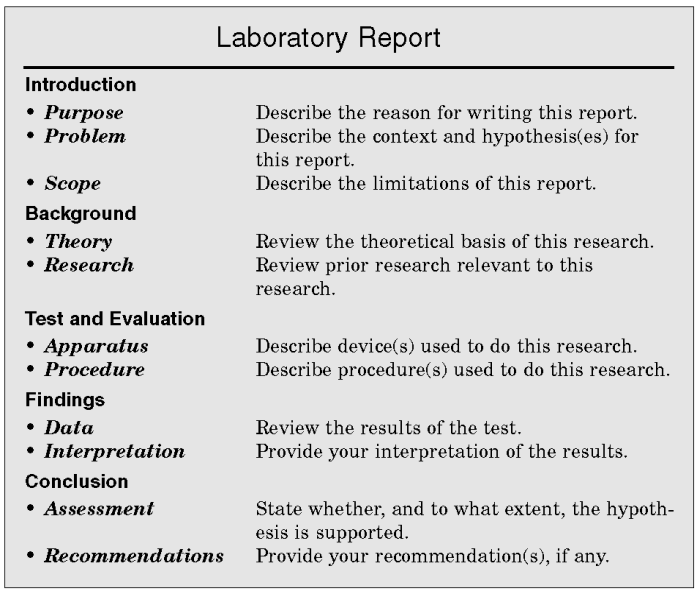
Standard Reports

Project reports are a specific type of report, which engineers and computer scientists are often required to write. Although often analytic in content, information can be integrated into the report in order to demonstrate understanding and insight into the wider subject of the Project.

The purpose of the report should be included in the abstract and **introduction**. First-year laboratory reports were between 4-6 pages long, third year up to 10pages.
The **introduction** also includes the problem and scope. Note that it is the work that is the subject of the report, e.g. to investigate the hardware of a personal computer, rather than the 'infrastructure' around the work, e.g. do not write that the purpose of the project was to pass Comp309!

Note that the **Problem investigation (background)** will require prior reading.



Laboratory Report

Introduction	
• ***Purpose***	Describe the reason for writing this report.
• ***Problem***	Describe the context and hypothesis(es) for this report.
• ***Scope***	Describe the limitations of this report.
Background	
• ***Theory***	Review the theoretical basis of this research.
• ***Research***	Review prior research relevant to this research.
Test and Evaluation	
• ***Apparatus***	Describe device(s) used to do this research.
• ***Procedure***	Describe procedure(s) used to do this research.
Findings	
• ***Data***	Review the results of the test.
• ***Interpretation***	Provide your interpretation of the results.
Conclusion	
• ***Assessment***	State whether, and to what extent, the hypothesis is supported.
• ***Recommendations***	Provide your recommendation(s), if any.

The **method** by which the tests and evaluations are conducted through the apparatus and procedure must be included in the report, but only include important detail that allows the experiment to be replicated. Importantly, do not simply copy from the project sheet.

The **results** present the findings, including the data and its interpretation. Discussion of any uncertainties, assumptions and debatable interpretation should be placed here for reports (often this will be a separate **'Discussion'** section in long formal reports).

Pocket Book of Technical Writing for Engineers and Scientists, Third Editon

Conclusions should state whether your initial hypothesis was supported. It should not state the mechanics of the laboratory, e.g. do not write 'we learned to put together a computer'. Recommendations are on the content of the laboratory, e.g. operating systems should be designed such that drivers cannot be installed prior to the kernel, rather than the laboratory itself, e.g. do not write 'projects should not start at 9 AM'.

Self reflection does not belong in the conclusion, e.g. do not write 'I realised that I had not previously known the difference between an 'GPU and a CPU'. This can be placed in a blog or in an appendix. Appendixes are also useful if you have a lot of data, such that only the most important data/results belong in the main body of the work and the remainder supporting evidence in the appendix.

Each assignment will be different based on the instructions given by the lecturer, so please read these carefully.

How to Structure and Write an Engineering Report:

Report writing is about communication. Hopefully, these hints and tips will provide a scaffold for successful communication between you as the writer and the reader.

Tip 1. Follow a standard layout - a reader can then concentrate on the message rather than worrying about the flow of the report.

A standard sequence of sections is as follows:

- Title Page
- Abstract
- Introduction
- Problem investigation (Background)
- Method
- Results & Discussion
- Conclusions & future work
- acknowledgements
- References
- appendices

[sections without capitals, i.e. future work, acknowledgements, appendices, may not be applicable to all reports]

Each of these sections will be explored in detail below (Tip 7)

Tip 2. Use a standard format - clear presentation and less time thinking about what style to use.
A consistent and common style makes the document easier for the audience to read. Many standard formatting schemes exist from Word templates to LaTeX style sheets, which will assist the writing.

Tip 3. Imagine a prospective employer will read this work - the report will reflect your professionalism.
Care is needed with layout, content and proofreading. It also creates a good vibe about the content.

Tip 4. An computer science/engineering report is about the work - not the assignment, not the laboratory, not the report itself...
The report is on the work itself, the findings, what it all means and why it is important. The report should not be about the intangible infrastructure around it, e.g. it is not about the laboratory class or assignment or student or the document. All of these led to the important consideration that is the work, e.g. determining the effectiveness of recursion.

Tip 5. Write - start writing and keep writing.
Whether you enjoy/hate, good/bad, motivated/board, perfectionist/sloppy, at the task of writing: a very good place to start is just by writing without the fear of failure. Have fun and keep doing it whilst absorbing lots of different advice is the best way to improve. Balance the need to go back and revise/iterate, with the need to get your

thoughts down on paper. Polishing each sentence/word as it is written is too time-consuming, whilst no revision is often suboptimum, so a balance between the two extremes is needed. Tend towards simply writing thoughts down until the contents of whole document is complete in draft.

Tip 6. The order best suited to writing is not often that the order of reading, see figure 1.
Considering that the work and its findings are the most important element:
Firstly consider: what are the main findings that need communicating?
Then consider a thesis (thread) that supports this position. Then start writing the results & findings. This leads on to clear conclusions, with any doubts or arguments (for and against) placed in a discussion. This is all supported by the methods, background and finally the introduction. The important points in each section are then lifted out to form the abstract.

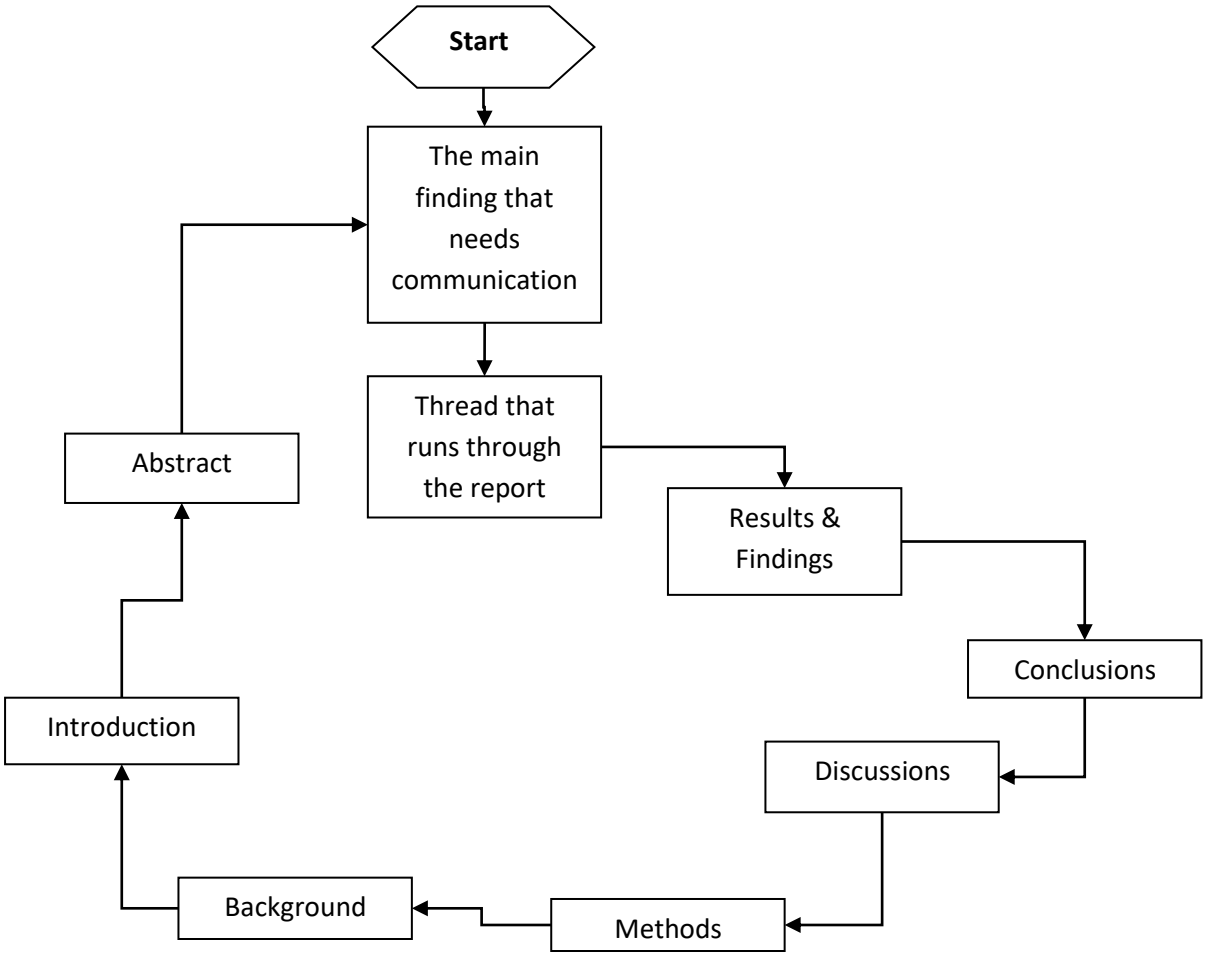


Figure 1 : Order of writing a report (note the difference to order of reading/presentation)

Tip 7. Guidelines for what each section should include:

Title page: identifies the report to the reader

Title, name, student number, course code, lecturer, assignment number/description and date (including year) should be included.

Abstract: abstracts out all of the report.

Scope, motivation, succinct method if vital, results, meaning of the results, conclusions and benefits.
It is highly unusual to include equations and exceptionally rare to include figures and references.

It is not a summary or a synopsis. A summary says what was done. An abstract says why it was done and what was important about it. An executive summary also says what needs to happen i.e., recommendation for actions to take (e.g. improve the simulation by taking into account fiction at the bearings - *this example is not a good recommendation*!)

[Hint: throughout the report concentrate on the why, not the what. Demonstrate insight and mastery of the subject rather than repeat the story of what happened.]

Introduction (start section numbering here at '1').

Think of the introduction as a funnel. Go from a broad scope to the focus of the work. This assists in leading the reader to a clear picture of the work.

The introduction can be also a standard sequence of sub-sections:

- Scope - what is and what is not being included in the study
- Motivation - problem to be sold, subject to be investigated, missing piece of theory and so forth. Not the laboratory, told to do it, gain a degree...
- Aim - higher level of what is to be achieved
- Objective - SMART outcomes that build together to meet the aim [Specific, Measurable, Attainable, Relevant and Timely]
- Anticipated Benefits - include if not covered by motivation

Roadmap - occasionally included if a long report and adds something other than repeating the standard sequence.

[Hint: concentrate on the work itself, not the infrastructure. The readers are interested in the work, rather than the fact it was an assignment during a degree]

Problem investigation (Background)

This places your work in the context of previous related work. There is no need to show off the breadth and depth of your literature research if it is not relevant (unless you wish to specifically say why a standard approach is not relevant here).

It can also provide instruction on the subjects that the reader needs to know in order to understand the current work.
It can give contrast and alternatives to the approach being adopted, either highlighting similarities or explaining differences.

It only covers the area of work associated with the results, discussion and conclusion - it does not have to include the whole field!

Methodology

The work must be reproducible. The method section should provide sufficient detail of the independent researchers to verify the results (cf. cold fusion in a test-tube).

All assumptions need to be stated.

Clear diagrams, pseudocode, details of datasets, equipment and so forth are often included.

Results

This is sometimes 'Results and Discussion' when the initial results motivate further experiments. However, it is good practice to write discussions separately as this is the section way you can really demonstrate your abilities.

This section presents the evidence for the position that was created by the work. The 'position' that you take on the work is critical, i.e. what did the work show? For example, "simulated and theoretical modelling techniques show good agreement and both contribute to the design of controllers".

Described the important details of what occurred. Tables are useful for summary and comparison, whilst figures display relevant trends.

If comparing technique A with B, then please use mathematical significance testing, e.g. Students T-Test, to show that the results were not a fluke.
[Hint: good students will now be typing 'Students T-Test' into wikipedia and then following up the links]

Think about what you want to show. If comparing simulated/theoretical results with real life/empirical results, then plot the trends on the same axis.
[Hint: label, units, keys, captions, figure/table number, citation in text - are all necessary]

Identify any anomalous results, both supporting or contradictory to your position, stating why they are interesting. Results are a statement of fact, which includes identifying any uncertainty. Consider the difference between accuracy and precision when presenting the results.

Discussion

This is the intellectual argument of the work.
Here is where you explore the position taken based on the results and the background information from past studies. Alternatives and uncertainty are described, but where possible a single position should be taken, which can include the null result (there was no improvement due to the novel technique compared with the existing technique).

It has similarities to a debate where both sides of the argument of presented, e.g. why might the position taken be incorrect?
It is the best place to demonstrate understanding, mastery and insight into the subject.

Conclusion (generally not 'discussion and conclusion' unless a very short report)

The statement of the position the work takes.

What was found,
Why it is important and its meaning.
Benefits (may be included)

It is not:

A pure summary, e.g. we did this and then that and this.
An argument (this was the discussion) although it can be stated that the results were inconclusive.
A place for new information
Self Reflection (e.g. "I learned how to use Matlab and really enjoyed it..."), which may belong in an appendix, but much better on a blog.

Future work (not always necessary)

This is not a place for what should have been done already, but ran out of time. Instead, it identifies interesting follow on work.
Either - breadth more comparison or experiments, depth more analysis or preferably opportunities (how does this work provide a platform for the research community).

References (vital!)

Even a short laboratory report should have three-five references!
No work is completely devoid of context or past work in the field and this must be referenced.

1. Journal papers are preferable as these have been thoroughly peer reviewed
2. Conference papers and books - finally,
3. Lecture notes and Internet resources are the last resort and should be only a small percentage of the references presented.

There are many standard formats of reference, so please pick one and be consistent
[Hint: the Harvard system is good to start off with as if you rearrange the text you do not need to rearrange the order of citation, cf. http://en.wikipedia.org/wiki/Parenthetical_referencing]

Appendices

Repository for additional and supporting work that is not central to the argument or positions taken.
For example, tables of values that are summarised in a graph in the main sections.
Details of experimental setup where an overview is given in the method section.

Data sheets of important components.
Self-reflection

[Hint: personally, it is good to take a step back from any task and analyse your interaction with it. It helps you identify what you learned and how you could improve for the next similar task. However, this belongs in a blog rather than an academic report as it is not central to the work. Some academics like self reflection as it helps them adapt the set work next year, so please check individual requirements. If you are unsure, then it is highly unlikely that any academic would mark down a student for having self reflection in an appendix, but you may be mark down for having self reflection in a conclusion]

[Hint: do not use first person in your writing, i.e. 'I' or ' the author'. Increasingly, it is becoming acceptable to use 'we', but ~~I would recommend~~ it is recommended to practise writing without the use of even this 'second person'. Thus, a sentence such as 'I thought the experiments were good as the results were as intended' becomes 'it was considered that the experimental results supported the position taken on the effectiveness of recursion in AI techniques as an initially unstable system was stabilised'. Academic English is very formal as it seeks to avoid ambiguities.]

Summary:
The ease of communication successfully for both the writer and reader is important. These guidelines seek to help a writer to achieve this goal, but they are not perfect, omniscient or the only method of report writing. Please use this and alternative guides to help scaffold the writing process.

Have some fun with this exercise!

"
Jack and Jill went up the hill
to fetch a pail of water
Jack fell down and broke his crown
and Jill came tumbling after.
"

Try writing an academic report on the incident described above!

The result should not read like a nursery rhyme or simply repeat what happened.

Don't turn the page! Spend 10 minutes sketching the outline of the report based on the Hints and tips contained above. Write an abstract and see how it compares to a suggestion below...

1. Take a position:
   e.g. lack of health and safety causes accidents, forced child labour should be outlawed to protect children, mains water is taken for granted by the Western world ... and so on

   once a position is determined, consider the thread that needs to run throughout the document.

2. Identify important results:
   The male had serious head injuries and the female had an uncontrolled descent of the incline that could have caused further injury

3. Discuss the results
   assume that it was in England; Jack and Jill are common English names
   assume that it was a couple of centuries ago prior to mains water as the pail had to be fetched
   assume that there was a well at the top of the hill in order to supply the water
   consider that the ground might have been slippery from well water or that inadequate footwear was being used
   assume that the weight of the water could cause balance problems, especially as it was a single pail.

   Summarise that better health and safety would have recommended a tap instead of the well, two smaller balanced pails, proper foot wear and a stepped path up the hill.

   Relate this to alternative situations, e.g. African children fetching water from wells.

4. Conclude that better health and safety would have identified the risks and helped to eliminate them

5. Method is a bit different to the usual engineering experiments in this case as it is second-hand reporting of observations. However, the quality and consistency of the sources used may be investigated. Try investigating the origins of this nursery rhyme.

6. Background is very important as references to support the assumptions in the discussion need to be provided. Similarly, health and safety codes need to be cited.

7. Introduction. Set the scope to investigate a report of an accident. The motivation would be to suggest the cause as this had not been reported previously. The aim is to identify the probable causes of the accident. The objectives would be to investigate probable causes, identify the time period, identify the likely place of incidence and suggest possible causes of the accident. The benefit would be to prevent similar accidents happening in the future.

8. Abstract:
   A widely reported accident that led to one serious head injury and potential for further serious injury had not previously been investigated. It was considered that although the accident was likely to have occurred over 200 years ago in England, there are many lessons that can be learnt in modern situations where fetching water from wells is required. Health and safety, including risk assessment, was inadequate and led to many failings, such as failing to use a tap instead of a well and unbalanced loads. Risk assessment and education of children is recommended to mitigate accidents when transporting water.

   Good luck and have fun with writing. Enjoy the creative process and trust that you have something worthwhile to communicate to the audience! Will Browne, VUW, v1 2010, updated October 2019