1 Introduction

1.1 Professional Writing

Up until this point, most of your writing has probably been for well-defined class assignments or exams. Most likely, your objective has been to impress the reader with the amount that you know or the amount of work you have done.

In the real world, however, people are not generally interested in how much you know or how much you have done. Instead, they are interested in the useful information you have to communicate to them. Most readers are time poor, so your writing should have the following general goals:

- Help the reader to assess whether or not your report will be of interest.
- Help the reader who does not have time to read the whole thing to locate material of interest quickly.
- Write in such a way that the reader does not have to go over the material multiple times (or backtrack) in order to understand your report.
- Write concisely. That is, avoid the two offences of: 1) unnecessarily padding out your text; and 2) omitting key information. Both of these will waste the reader’s time; many students commit both offences in the same document. “Concise” means both “compact” and “complete.”

The importance of the above points has become dramatically elevated in recent times by the World-Wide-Web and email. These tools have greatly increased the amount of material presented (or pushed) to readers, while reducing the cost (time, effort, money) of generating and delivering written content. As a result, if you want your document to be read, you will have to put a lot more effort into tailoring it to the reader’s needs.

In ENGG1000, and in later design classes and your 4th year thesis, you are expected to take a real-world professional attitude to writing, bearing in mind
that not all of your document may be read and that its impact (reflected in your mark) depends upon getting your point across efficiently. If you fail to appropriately advertise an important piece of information and it does not get read, the fault lies with you, not the reader (or marker)!

1.2 Typical Forms of Communication

In your professional career, you will need to communicate effectively, in any or all of the following forms.

Technical reports: Here, the goal is to describe the motivation, technical details, experimental observations and important conclusions from a technical investigation. Only those people who have an interest in the technical investigation itself should read the document. The abstract plays a key role in helping people decide whether or not they belong to the target audience. You are not writing for the uneducated masses, so you should avoid filling the introduction with general overviews of the field.

Progress reports: Consulting engineers spend a lot of their time writing progress reports for clients; these often form part of the basis for payment! All practicing engineers working in a team or within a management structure must report their progress to different levels of management. Even academics must write regular progress reports to government and other funding agencies. The target audience for a progress report already knows who they are. For this reason, an abstract is not necessary. However, most progress reports should have an executive summary. Progress reports often contain material which might not be read immediately, but may prove important later on (the reports are filed). Thus, progress reports typically have a lot of appendices.

Project proposals: In this case, the goal is to provide the reader with a balanced perspective on the benefits and disadvantages associated with pursuing a proposed project. In many cases, the target audience should know who they are already, so there is little need for an abstract. On the other hand, if a large number of project proposals need to be sorted into different areas for further review by different individuals or groups, an abstract may well be required to assist in this process. Persuasive writing is important when making a proposal, but remember that you need to provide a balanced perspective. It is not helpful to hype up a doubtful project.

Grant applications: The main distinction here from a project proposal is the need for persuasive language. Money is up for grabs and you want to win it. You must stick to the truth, of course, but a balanced perspective is not usually expected.

Letters, memos and emails: As with all forms of writing, remember that the reader is time poor. The first few lines should make it clear what the
letter, memo or email is about or where it should be filed. Most busy people choose to read or discard letters or emails they receive, based on the first two or three lines. Use short paragraphs particularly for this type of communication, with bulleted or numbered lists for key points.

**Job applications:** These need to make an impact quickly. Only a small proportion of applications will be read thoroughly, except for highly specialized positions with few applicants.

**Reference letters:** Persuasive writing is a key skill here, assuming that you are wanting to support the person for whom you are writing a reference. Reference letters are usually read completely — and people *read between the lines* too. It is important for the reader to see that you have put a lot of effort into writing a thorough reference.

**Oral presentations:** We will look at this important form of communication more carefully in a separate handout, later in the course.

While the present document is focused primarily technical reports and progress reports, common principles apply to each of the above-mentioned forms of communication. For the ENGG1000 course, you should see your “Design Review” submission as a *progress report*, while your “Final Report” should be submitted as a *technical report*. Make sure that you understand the difference between the two and that you understand why this difference exists.

### 1.3 Why Write Well

You have probably heard it said that *in order to succeed in your career you will need to be able to communicate effectively*. This statement cannot be taken too lightly. No matter what career you intend to pursue, if you cannot communicate well, few people are likely to appreciate what you do. On the flip side, persuasive communicators often excel, even if their technical skills are below par. Of course, technical excellence coupled with strong communication skills is a killer combination.

It is never too late to learn to communicate well, but it will require effort and practice!

### 2 The Importance of Questions

An excellent principle on which to found your writing is that

> “Technical writing is about answering questions.”

This statement can be understood in the following ways:

1. If the reader has no questions in mind, why would he/she be reading your report?
2. If there are non-obvious questions that you want the reader to be asking (because you are going to answer them), you must be sure to state those questions clearly and explain why they are important. This is usually done in the introduction to your document, but it may be necessary to do it even as early as the abstract or executive summary – see Section 4. **Bringing the right questions to the reader’s attention is central to effective written and oral communication.**

3. If you fail to answer an important question, the reader will be dissatisfied.

4. If statements or results presented in your document raise new questions which you do not answer, this will also leave the reader dissatisfied and perhaps annoyed. **This is one of the most common problems encountered in student reports** – a formula is given, a reference is cited, etc., in such a way that the reader is left with even more questions and no answers to them. It is worth reviewing your text, specifically with a view to checking whether there are obvious questions which have not been answered.

5. Each portion (paragraph, section, etc.) of your document should focus on a particular question (or set of related questions). What’s more, you should explicitly identify the question that you are answering before giving the answer. This is usually done in the first paragraph of a new section or sub-section, although in some cases the section heading might be sufficient. **Try to avoid jumping back and forth between different questions.** Finish one before moving on to the next. Many students fail to realize the importance of this.

In summary, the focus of your writing should not be _getting the facts down_. Instead, the focus should be to _provoke and answer questions_. This is the difference between writing for the reader and writing for yourself.

### 2.1 What about Questions you Cannot Answer?

No doubt you are now becoming concerned about questions to which you don’t know the answer. You could try to avoid raising such questions. More often than not, however, there will be obvious questions which arise out of your writing, to which you don’t know the answer. In these cases, by far the best approach is to **explicitly acknowledge** that you are aware of these questions, but that you cannot answer them at this time. No person can be expected to have all the answers, but acknowledging the fact has many beneficial effects:

1. It relieves any anxiety the reader may have, not knowing when or whether you will answer the question.

2. It establishes a kinship between you and the reader – the reader thinks: “I see that we have a common understanding of the important issues.”
3. It explicitly flags matters which may require ongoing investigation.

Here are some examples of questions which might come up that you cannot yet answer:

- Why did the author choose to do it this way (could apply to all kinds of things)?
  - If you don’t have an answer, acknowledge that there may be many ways of solving the problem and this is just the first one you have tried so far.

- Why do the results in Tables A and B appear inconsistent?
  - If you don’t have an answer, acknowledge that this is an unresolved issue, which may require further attention. Discuss how much of a priority it should be to resolve the inconsistency.

- Isn’t this assumption or approach a bit risky?
  - Don’t ignore this potential question. Acknowledge that there may be risk.

- How does this circuit work?
  - If you don’t know, acknowledge the fact and explain how you came up with it (e.g., trial and error, copied from a cited reference, etc.)

- Why doesn’t the theory agree with the observed outcome?
  - Acknowledge any disagreement; don’t invent wild unfounded explanations – e.g., “it might have been due to the phase of the moon;” if you don’t have a real answer, say so.

In summary, honesty is the best policy. If you sweep the bugs under the rug, they will breed. It does you no harm to be up front about what you do not yet know and it leaves the reader much more satisfied than if you just ignore gaping holes in your report.

3 A Strategy for Good Writing

3.1 Starting Out

Perhaps the best way to start your document is to create the heading structure. Start with major section headings and then jot down sub-section headings as they come to you. Revise your heading structure with the questions in mind. Ask yourself: “Will this structure enable me to address all the key questions?”
Underneath each heading, jot down brief points which you intend to make within the relevant section. I personally prefer to write at the computer. I leave the original list of points at the end of each section as it evolves, deleting a point only once it has been fully fleshed out in the text. In the course of writing, it commonly happens that I find the need to move points from one section to another, add new points to a section, or create a new section to contain new or existing points. All this is easily managed, freeing your mind from having to keep track of the things which have not yet been said.

Write the text underneath each section heading in whatever order seems easiest to you. The goal is to make the writing process as easy as possible, so that you don’t get too bogged down thinking about the entire document at once. Most people leave the introductory and conclusion sections until last.

### 3.2 Going back over it

Once you have finished filling out all the sections, you are not finished. Now is the time to review your text from the reader’s perspective. Go over what you have written, asking yourself:

1. Are there any obvious questions here which I have not answered?
2. Should this material be reorganized so as to avoid jumping back and forth between different topics?
3. Is it clear what question I am answering? This is typically where you find the need to write a brief introduction to each section (anything from a sentence to a couple of paragraphs), explaining what specific questions it is addressing.
4. Is the text complete? You may have written the document out of order, yet the reader will most likely go through it linearly from start to finish. It commonly happens that you forget, during the first pass, to explain key concepts, terms or definitions before they are required. Remember, when the reader encounters a term or concept with which they are not familiar, they will look back (not forward) through the report to find the definition. If they can’t find it, they will be most annoyed with you for wasting their time looking.

Now you are ready to make a final pass through the document, looking for spelling, grammatical or typographical violations. It is a mistake to become overly concerned with spelling during the first or even the second pass through the document.

### 3.3 The Art of Persuasive Writing

Section 1.2 lists a number of different forms of communication, some of which call for the use of persuasive writing. Perhaps contrary to your suspicions, persuasive technical writing is not so much about being confident. Instead,
the principle tool for persuasive technical writing is anticipating objections.

You should think of the reader as an adversary, constantly challenging the statements you make – How can you be sure? What is your justification? Why isn’t the other approach just as good, or even better? etc., etc. Then, in the text, you should try to address all of the key potential objections. You do not necessarily need to state the potential objection, if the fact that you have addressed it is abundantly clear. You want the reader to be left with the impression that he/she cannot mount a reasonable argument against what you are proposing.

A secondary objective in persuasive writing is to pass your enthusiasm on to the reader. This is done primarily through careful choice of words. Note, however, that an unreserved ebullient writing style by itself will not be sufficient to persuade a technical reader. Indeed, unless you have anticipated and addressed the reader’s potential objections, an over-confident writing style could seriously backfire.

4 Elements of a Document

The purpose of this section is to explain the roles played by common elements encountered in technical documents. Many students have difficulty understanding the distinction between an abstract and an introduction, for example, whereas in fact these serve very different functions. You should read carefully through the various sub-sections below, to ensure that you have a good grasp of technical writing conventions.

4.1 The Abstract

The best way to understand abstracts is to note that abstracts are traditionally archived separately from the document itself, in lists of abstracts. In some cases, the document might not be publicly available (e.g., you have to pay for it), but the abstract is\(^1\). Abstracts of patents and academic articles are commonly treated in this way. The word “abstract” itself suggests that it can be read without reference to the original document.

Essentially, an abstract is a single paragraph (typically no more than 150 or 200 words) which can be read without reference to the document itself and provides sufficient information for the reader to determine whether or not they need to get the full document. It should not contain citations or references to sections within the document itself. It should not contain terms or definitions which cannot be understood without reference to the document. It should not be the least bit obscure; instead, it is essentially an “advertisement” for the document.

\(^1\)This is one reason why you can only expect to find a subset of the most useful information on the internet – along with a lot of rubbish, of course.
Not all documents need an abstract. In particular, if a document is addressed to a very specific audience who know already that it is relevant to them (e.g., a progress report) an abstract is not required. Abstracts might still appear on reports with a well-defined audience, for the purpose of archiving. In this case, the abstract may serve as a brief reminder of the document’s contents, to a future reader who is browsing back through past reports in the archive.

Since documents which need no abstract are commonly addressed to managers, they often have an executive summary instead. Note, however, that an executive summary serves a very different purpose to an abstract.

⇒ Which of your ENGG1000 reports requires an abstract?

4.2 The Executive Summary

Documents which are addressed to management usually contain an executive summary (ES). The ES should typically be between 3/4 and 1 page in length. It is intended to provide an executive with a concise overview of the main points in the document. Unlike an abstract, the ES is addressed to readers who already know that the document is relevant to them. Thus, it is not an advertisement. The ES should contain facts, rather than hype. An ES for a development proposal should summarize what is known about the market potential, expected profitability, strategic benefits, resource demands and potential risks. An ES will provide very little (if any) justification for the stated figures.

⇒ Which of your ENGG1000 reports requires an executive summary?

4.3 The Introduction

Most documents of significant size should have an introduction. Introductions serve the following purposes:

1. Identify the objectives of the document. For a development proposal, this would include a discussion of the motivation for the development activity, amongst other things. Where the document reports the outcomes of an investigative activity, the introduction should begin by explaining why the investigation was conducted. For a progress report, you should make it clear what aspects of the project are covered by the present report and in which areas you expect feedback to be most useful.

2. Provide contextual information. For a development proposal, the context should include information on other related products, relevant trends in the marketplace, recent technological advances, and so forth. For an investigative activity, the context includes information on what was already known, prior to this investigation. For a progress report, the context includes the relationship between this progress report and others which may have been written for the same project. You should identify the target audience and any assumptions about their knowledge and familiarity with the project.
3. Identify the questions which are addressed by this report – often with reference to specific sections in the remainder of the document. In doing this, you might give a brief summary of the significant outcomes described in the report. Because of this, it is easy to get confused between the introduction and the conclusion of a report. The key point to bear in mind is that the provision of summary information in an introduction serves primarily to draw attention to the questions which are answered by this report. This may help the reader to skip over less interesting sections, but it mostly serves to relieve uncertainty as to whether or not the report will answer a major question that the reader has in his/her mind. By contrast, the conclusion or summary section of a report serves to reinforce points which have previously been made.

In some cases, the introduction may finish with a brief description of the structure of the rest of the document. However, for documents whose structure is self-explanatory, or follows an expected pattern (e.g., a class report), this can be a waste of text. Similarly, if you know that the reader is going to read the entire document (e.g., class notes, as in the present document), there is no need to provide a document map.

4.4 Conclusions and Summaries

The terms “conclusion” and “summary” are used largely interchangeably for the final section in the main body of most documents. This section is all about the take home message. This is where you remind the reader of the three or four main points you want to stick in their mind. If you have seven or more points to make, or if the conclusion is running more than one page in length, your text may not have the desired effect. If you find the need to discuss conclusions from the body of the report at greater length or in more detail, consider adding a “Discussion” section, right before the conclusion.

4.5 The Bibliography and Citation

The key things to remember here are:

1. The bibliography is not a reading list; it is a collection of references that you have used in the body of the report. Each entry in the bibliography must be explicitly cited somewhere in the text.

2. There are two main reasons for citing references: a) to give credit where credit is due; and b) to point the reader to a more in-depth treatment of the subject in question. You do not need to provide references for results, circuits, theorems, etc., if they are common knowledge. Most things you learn in the first 3 years of an Engineering Program at university are common knowledge. On the other hand, things which you discover when researching problems specific to your design project might not be common knowledge.
4.5.1 Formatting Bibliography Entries

For technical writing, you should generally place the bibliography at the end of the main body of the report (but before any appendices), rather than embedding bibliographic references in footnotes. Bibliographic references should be as complete as possible. While numerous bibliography styles are in use, the following elements are common to virtually all:

1. Author names appear first.

2. If the reference is to an article within a published book, journal or magazine, the title of the article should appear next, often enclosed in quotes.

3. The name of the book, journal or magazine comes next, typically in italics.

4. The above information is followed by details such as publisher, year of publication, volume and page numbers (for serials), etc.

Here are two examples:

4.5.2 Citation Styles

Citations are unique identifiers which you embed in the text in order to reference an item in the bibliography. The two main styles are:

Harvard Style: Here, the names of up to two authors are used together with the year to form the citation key. Example: “The most common method (Jekyl and Hyde, 1902) involves substitution of ...”

IEEE Style: Here, you include the reference number, enclosed in square brackets. Example: “The most common method [1] involves the substitution of ...”

- This method is generally preferred for technical writing. It introduces less disruption to the flow of the text and has the benefit that the citation can be used either as a parenthetic remark or as a noun. Thus, for example, you could write: “The method of [1] involves substitution of ...”

- The only advantage of the Harvard style is that it is easier to add new bibliographic entries without changing the existing text, but this argument is largely irrelevant these days, now that word processing and typesetting programs can perform the renumbering automatically.
4.5.3 Referencing Web-Sites

There are two schools of thought with regard to web-sites. One is that web-sites are less authoritative and more transient than published articles or books, so they should not appear in the bibliography. In this case, you should identify relevant web-sites via footnotes in the main body of the document. The other school of thought is that web-sites can be included in the bibliography so long as reasonable steps have been taken to select URL’s which are likely to persist for some time.

4.6 Appendices

Use appendices to include supplementary material, lengthy derivations, or other text which need not be read to appreciate the main points. Appendices allow you to move potentially distracting details out of the main body of the document, while still retaining them for the record. Appendices should generally follow the bibliography and be enumerated via letters rather than numbers, so as to distinguish them from the body sections.

4.7 Figures, Tables and Equations

Figures and tables must have descriptive captions. One reason for this is that they are often floating objects, meaning that they might appear at a different position on the page or on a different page to the location where they are first referenced. Another reason is that figures and tables are often read quite separately from the text. Some people prefer to read through a section and then review the relevant figures and tables. Others prefer to do it the other way around. Finally, you will often want to reference figures and tables from multiple locations in the body of the text. The bottom line is that regardless of where you choose to position your figures and tables, they should each have a unique number and a descriptive caption.

Figure captions should be placed below the figure, while table captions should appear above the table. When referencing figures and tables from the text you should use expressions like “Figure 3”, “Fig. 3” or “Table 2.” Remember to capitalize the “F” in “Figure” and the “T” in “Table.”

Displayed equations should be consistently justified: either all left justified; or all centre-justified. Centre justified looks a lot better in my opinion. Equations should be numbered (with numbers in parentheses) if you need to refer to them from the text. See your other lecture notes for examples of this. When referencing a numbered equation from the body of the text, use expressions like “equation (3)”. Remember to include the equation number in parentheses and do not capitalize the “e” in “equation,” unless it is the first word in the sentence.

Be very careful to define all of the symbols which are used in an equation, either before you write the equation or in the sentence which immediately follows
it. Otherwise, the reader might waste time hunting through the document to see if they have missed something.

As for the equations themselves, make an effort to typeset them properly. If you are using a word processor like Microsoft Word™, make a habit of using the equation editor to create all equations (not just those which involve non-roman symbols). If you are using a typesetting system like Latex, the equations will always look beautiful.

5 Thinking of the Reader

The purpose of this section is to provide some additional suggestions which will help you to take the reader’s perspective when writing.

5.1 What is the Right Length?

Think of how long you expect the reader to spend reading your document. For a class assignment, a reasonable expectation might be 15 minutes. The time taken to mark your final ENGG1000 report, is unlikely to exceed one hour. For your ENGG1000 progress report, 30 minutes would be a reasonable expectation. For your 4th year thesis, you could expect anything up to 4 hours. Now work back from this to estimate the number of pages which could appear in the body of the text, if you want them to be read carefully. In order to make the maximum impact, you want to be quite certain that your key points are actually read, so the easier you make it for the reader to notice them, the more successful you will be.

Use appendices to include material which is a distraction from the main flow of the text. They will probably only be skimmed by most readers, but someone else who needs to build on your work may find them invaluable.

5.2 What Annoys the Reader?

Here are some of the things which I personally find most annoying:

1. Missing key facts – I can’t understand what has been written because there is a key piece of knowledge which is either omitted or placed somewhere else in the document.

2. Not answering any particular question. You have probably had the experience of getting to the middle of a section and realizing that you have no idea what the writer is trying to say.

3. Unexplained notation or definitions. These prevent the reader from being able to immediately understand what is being written.
5.3 Helping the Reader

In addition to what has already been said, remember that most people read your document linearly, from start to finish. By contrast, you have the whole thing in your mind at once when you come to start writing. As a result, there is a great temptation to describe things from the perspective of someone who already knows it all, rather than from the perspective of the reader who only knows what you have said already in addition to general background knowledge. A common mistake is to make tangential reference to something in the introduction, which will not make sense until the reader has finished reading the report.

If you are writing a long document, do not assume that the reader will remember something which was mentioned only once, much closer to the start of the document. Good practice is to remind the reader of definitions and notation that you are using, if the previous definition appeared quite some pages ago.

In summary, if you write in such a way as to reduce the level of effort on the part of the reader, you will be more successful in making an impact.

6 Grammatical Issues

6.1 Active vs. Passive Voice

Most sentences can be expressed either in the active or the passive voice. For example, you could say, “We assume a market size of 300,000 people,” or you could say, “A market size of 300,000 people is assumed.” The former statement uses the active voice, while the latter uses the passive voice.

As a general rule, passive constructions require more effort on the part of the reader, because they are less natural in everyday speech and because the key verb appears later in the sentence. For effective technical writing, therefore, you are strongly encouraged to use the active voice, no matter what you may have been taught at school.

The dilemma with the active voice is choosing an appropriate actor – i.e., a subject for your verbs. In the above example, the subject was “We,” as in “We assume...” This is a widely accepted actor for technical writing. Where there is only one author, it is still preferable to use “we” rather than “I” as the subject of your sentences. The thinking here is that the use of “we” draws the reader in to feel like they are part of what is going on. It comes across as less arrogant, more authoritative and leaves room for adding authors to the document later on.

6.2 Tenses

Although general writing may make full use of the many tenses available in the language, technical writing should use the present tense wherever possible. Thus, for example, you would say “We select the LM318 opamp for our circuit,” rather than “We selected the LM318 opamp for our circuit.” The thinking here is that a technical document describes something that is repeatable and
still relevant, rather than just an activity in the past. If the present tense is completely inappropriate, choose another tense which is as close to the present as possible. Here is a list to help you if you are not used to thinking of tenses:

**Present:** “We select ...” – this is good.

**Perfect past:** “We have selected ...” – this is as close to the present as you can get.

**Imperfect:** “We selected ...” – this is further in the past; don’t use it unless you want to report something which is no longer useful or relevant. For example, you could say “Originally, we selected an OP04 opamp, but found it too expensive. Currently, we recommend the use of the LM318.”

**Plu-perfect:** “We had selected ...” – this is even further in the past again. You should never need it in technical writing.

**Future:** “We will select ...” – try to avoid using the future tense in your document. There is a temptation to use it to refer to what you plan to write in later sections of the report. From the reader’s perspective, however, the entire report has already been written.

### 6.3 Non-Native Language Writers

For many of you, English is not your first language. However, it is useful to remember that good technical writing is a skill which even native speakers must learn. Amongst the skills which have nothing to do with the language itself are:

1. carefully structuring the document;
2. focusing on the raising and answering of questions;
3. taking care to explain symbols and definitions;
4. appropriate referencing; and many more.

If your native language is not English, you may find it useful to write an initial draft of the document, or at least the list of points for each section, using your first language.

It is also worth noting that technical writing is simpler than general writing, from a language perspective. Only a subset of the tenses and vocabulary are used and much of the vocabulary is dictated by the technical context of your document, with which you are necessarily familiar.

### 7 Expectations and Tips for ENGG1000

The purpose of this section is to provide specific suggestions for writing your ENGG1000 reports.
7.1 Audience and Objective

The purpose of the ENGG1000 project is to experience the process of design within your chosen discipline. For this reason, you should spend some effort describing aspects of the process by which your design proceeded, in addition to the final design. Thus, for example, it would be remiss of you to describe only the design concept which was finally selected, without some discussion of other options and your reasons for ruling them out.

The principle audience for both reports in this subject consists of your academic mentors. However, you should write your final report in such a way as to be accessible to a much wider audience. This is because the final reports will be kept by the school and might be used as examples for future students, course coordinators or industry auditors. Apart from your mentors, the only other individuals who are likely to refer to your progress report are the members of your own project team.

7.2 Word Processors vs. Typesetting

Most of you will probably select Microsoft Word\textsuperscript{TM} to write your ENGG1000 reports. There is no problem with this, although it is worth noting that Word\textsuperscript{TM} is not well adjusted to technical writing. The main market for Microsoft Word\textsuperscript{TM} is interested in writing letters, memos and the like. The two most significant drawbacks of Word\textsuperscript{TM} from the perspective of writing a lengthy technical document are:

1. Equation handling is not that great. Of course, you should use the equation editor, but it treats equations as opaque objects, so you cannot search on them, globally replace symbols, and so forth. Also, in-text equations do not work all that well – they typeset badly and cannot be broken across lines.

2. Word\textsuperscript{TM} does not handle internal cross-references well. A long technical document typically has lots of references to figures, tables, equations and so forth. Word\textsuperscript{TM} can be used to create such references, but they are easily broken by moving things around, do not port properly to documents which are split across multiple files, and do not have semantically meaningful names. Most people encounter enormous frustration with references in Word\textsuperscript{TM} when writing longer technical documents.

For your 4th year thesis in particular, I would encourage you to consider \LaTeX\textsuperscript{} [1]. This is a public domain typesetting package, based on the \TeX\ language [2], created by the famous computer scientist Donald Knuth. 5% to 10% of students typically opt to use \LaTeX\ for their thesis, and I have never met any student who regretted the choice. \LaTeX\ uses a small set of well thought-out paradigms, as opposed to Word\textsuperscript{TM} ’s tangle of features. \LaTeX\ also implements official typesetting rules for you. With Word\textsuperscript{TM}, on the other hand, it is your responsibility to apply good consistent typesetting conventions to your document.
As a simple example, those of you who are not typists might not realize that the full stop (or period) which finishes a sentence should be followed by 2 spaces (officially closer to 1.5 spaces), whereas commas, colons and other punctuation marks should be followed by only 1 space. When working with Word™, you are left to apply such conventions yourself. Most importantly, equations and cross references are easy, highly portable and typeset beautifully in \LaTeX. Most technical journals expect the author to have written their document in \LaTeX, although they often tolerate word processors. The learning curve for \LaTeX is also remarkably small for technically oriented writers, mainly by virtue of its thoughtful design.

7.3 Writing your ENGG1000 Design Review (a.k.a. “Design Proposal”)

A separate design review must be submitted by each sub-group (not just one from the entire project team). Sub-group SG-A must submit a report covering their proposed design approach (or approaches) for the rotating platform and “exterminate” message. Sub-group SG-B must submit a report covering their proposed design approach (or approaches) for the signal detection sub-system.

A suitable structure for your ENGG1000 Design Review is:

1. Executive summary
   - Provide an overview of the key features of your design, the expected benefits and disadvantages of the selected approach, the foreseeable risks and the resource requirements. You should write this last, so that you have all the information from which to generate an informative summary.

2. Table of contents

3. Introduction
   - Include a compact statement of the problem.
   - Draw attention to the questions which you have found central in coming up with a design concept.
   - Explain what the reader can expect to be answered in your document, and what questions still remain to be answered.

4. Explanation of the Design Concept
   - You need at least to have a section devoted to describing the design concept you intend to pursue. You may include a discussion of other plausible concepts here, or you might choose to document these in another section or an appendix. You decide what is best. Be sure to include block diagrams to efficiently communicate your concept(s).
5. Relevant Knowledge

- For this report, it is probably a good idea to have a separate section devoted to knowledge acquisition in relation to your design concept. Identify what useful information you already have in hand, and what remains to be learned in order to develop the concept further.

6. Risk Management

- Explain the foreseeable risks to your project and the contingencies plans you have come up with to minimize these risks.

7. Project plan

- You must have a solid set of tasks, each with its own description, a responsible individual and a well-defined scope with deliverables. A typical project will involve well over 10 tasks, although these might be organized as sub-tasks of a few larger tasks. You should try to finish your report a few days before the deadline and then have a group session in which you read over it and deliberately question the rationale behind each of your decisions/statements. In seeking to find answers to these questions, you will most likely uncover tasks which you did not previously think of when writing the initial plan.
- You must include a Gantt chart – i.e., a chart in which each task is presented with a graphical timeline, showing any relevant deadlines.
- All plans should be forward looking, so we are most interested in the tasks which are not yet complete. Tasks which have been completed already might be included for reference, particularly where the completion of these tasks has helped to give you a better idea of how long (and how much resources) things take. In any event, be sure to indicate on your Gantt chart, the percentage of each task which has already been completed.

8. Summary

- small number of key take home messages

9. Bibliography

- remember that references must be cited in the text

10. Appendices (if any)
7.4 Writing your ENGG1000 Final Report

Each project team, including both sub-groups, produces only one final report. A suitable structure for your ENGG1000 final report is:

1. Abstract
2. Table of Contents
3. Introduction
4. Design Concept
5. Technical specifications and detailed design
   - Specifications answer questions like:
     - How much power does it consume?
     - How fast and under what conditions can it operate?
     - Over what range can it operate, including any dependence on environmental conditions?
   - Detailed design includes:
     - circuit diagram;
     - mechanical drawings and physical dimensions, as appropriate;
     - reasons for choosing particular components, sub-circuits, mechanical arrangements, etc.
6. Performance Testing
   - How did it go?
   - What went wrong?
   - What could you do better with the benefit of hindsight, more time or more knowledge?
7. Reflection on the Team’s Performance
   - What did you do well as a team (or as a sub-group)?
   - What mistakes did you make as a team (or as a sub-group)?
   - How well did the team (or sub-group) work together?
8. Summary
   - small number of key take home messages
9. Bibliography
   - remember that references must be cited in the text
10. Appendices (as required)
References
