CMPE 490
Design Principles in Engineering & Computer Engineering

Technical Report Writing

What is a Technical Report?

- A technical report is a formal report designed to convey technical information in a clear and easily accessible format. The report serves to <u>document</u> and <u>summarize</u> your work and also has an <u>archival</u> value.

- It is divided into sections which allow different readers to access different levels of information.

- The technical report will be one of the main materials on which your final grades for CMPE 491/492 will be based.

- This lecture will
    - explain the commonly accepted format for a technical report
    - explain the purposes of the individual sections
    - and give hints on how to go about drafting and refining a report in order to produce an accurate, professional document

Content of a Technical Report

A technical report should contain the following elements:

Section	Details
Title Page	Must include the title of the report. If word length has been specified, will often also require the summary word count and the main text word count.
Abstract	A short summary of the whole report including important features, results and conclusions.
Contents	Numbers and lists all section and subsection headings with page numbers.
Introduction	States the objectives of the report and comments on the way the topic of the report is to be treated. Leads straight into the report itself. (see follow-on slides)
The body of the report	Divided into numbered and headed sections. These sections separate the different main ideas in a logical order. (see follow-on slides)
Conclusions	A short, logical summing up of the theme(s) developed in the main text. (see follow-on slides)

Content of a Technical Report (cntd)

Section	Details
References	Details of published sources of material referred to or quoted in the text (including any lecture notes and URL addresses of any websites used).
Bibliography	Other published sources of material, including websites, not referred to in the text but useful for background or further reading.
Acknowledgements	List of people who helped you research or prepare the report, including your proofreaders.
Appendices (if appropriate)	Any further material which is essential for the full understanding of your report (e.g., large-scale diagrams, computer code, raw data, specifications) but not required by a casual reader.

Abstract (Summary)

- An abstract summarizes, usually in one paragraph of 300 words or less, the major aspects of the entire paper in a prescribed sequence that includes:

  1) the overall purpose of the study and the research problem(s) you investigated
  2) the basic design of the study
  3) major findings or trends found as a result of your analysis, and,
  4) a brief summary of your interpretations and conclusions

- The abstract allows you to elaborate upon each major aspect of the report and helps readers decide whether they want to read the rest of the report
  - Many people may read, and refer to, a report abstract but only a few may read the full report, as often happens in a professional organization
  - Therefore, enough key information [e.g., summary results, observations, trends, etc.] must be included to make the abstract useful to someone who may want to examine your work
  - It must be intelligible without the rest of the report

- How do you know when you have enough information in your abstract?
  - A simple guiding rule is to imagine that you are another researcher doing a similar study. Then ask yourself: if your abstract was the only part of the report you could access, would you be happy with the amount of information presented there? Does it tell the whole story about your study? If the answer is "no" then the abstract likely needs to be revised.

Introduction

- The introduction provides the <u>background information</u> needed for the rest of your report to be understood. It is usually at most one page in length.

  - The purpose of the introduction is to set the context for your report, provide sufficient background information for the reader to be able to follow the information presented, and inform the reader about how that information will be presented.

- The introduction includes:

  - the <u>background to the topic</u> of your report to set your work in its broad context
  - a clear statement of the <u>purpose of the report</u>, usually to present the results of your research, investigation, or design
  - a clear statement of the <u>aims of the project</u>
  - <u>technical background necessary</u> to understand the report; e.g., theory or assumptions
  - a <u>brief outline</u> of the structure of the report if appropriate (this would not be necessary in a short report)

Introduction (cntd)

Example: Introduction from a report entitled "A Review of Greenhouse Gas Reduction Actions and Opportunities: the Current Status of the Kyoto Protocol".

1. Introduction

The greenhouse effect is a natural phenomenon that keeps the earth's surface warm. Greenhouse gases trap heat from solar radiation, analogous to the way glass panes trap heat in a greenhouse. Due to increasing greenhouse gas emissions from human activities, the greenhouse effect has been significantly augmented, causing a rise in the earth's surface temperature. This temperature rise has led to climate change, causing frequent natural disasters. This has generated increasing awareness of the importance of reducing greenhouse gas emissions through international and domestic initiatives.

The aims of this project are to examine the Kyoto Protocol and the effect it would have on participating countries. Another aim is to investigate actions already taken by three industrialized countries, namely Australia, the United States, and Canada.

The Body of the Report

- This is main part of the report, where you present your work. The introduction and conclusions act as a frame for the body only: therefore all the details of your work (including a summarized version of material in the appendices) must be included here in the appropriate section.

- You will need to put some thought into the ordering of the sections; the presentation of information should <u>flow logically</u> so that the reader can follow the development of your project. It is also essential that you choose concise but <u>informative headings and subheadings</u> so that the reader knows exactly what type of information to expect in each section.

- The body of the report:
    - presents the information from your research or your design
    - organizes information logically under appropriate headings
    - conveys information in the most effective way for communication:
        - uses figures and tables
        - can use bulleted or numbered lists
        - can use formatting to break up large groups of text

Conclusions

- The conclusions section provides an effective ending to your report. The content should relate directly to the aims of the project as stated in the introduction, and sum up the essential features of your work. This section:
  - states whether you have achieved your aims
  - gives a brief summary of the key findings or information in your report
  - highlights the major outcomes of your investigation and their significance
  - gives some future perspective

- The conclusions should relate to the aims of the work:
  - Example 1:
    Aim: The aim of this project is to design a mobile phone tower.
    Conclusions: In this report, a design for a mobile phone tower has been presented. The key features of the tower are... It was found that...

  - Example 2:
    Aim: The aim of this investigation is to analyze the shuttle delays between the Santral Campus and the new Ek Bina.
    Conclusions: In this report, shuttle delays were analyzed. It was found that... Based on these findings, it is recommended that...

Planning the Report

- Collect your information. – See CMPE 490 Lecture 3: Conducting a Literature Review

    Sources include laboratory handouts and lecture notes, the University Library, reference books and journals. Keep an accurate record of all the published references which you intend to use in your report, by noting down the following information:

    Journal article:
    author(s)
    title of article
    name of journal
    year of publication
    volume number
    issue number, if provided
    page numbers

    Book:
    author(s)
    title of book
    edition, if appropriate
    publisher
    year of publication

Planning the Report (cntd)

- Creative phase of planning
    - Write down topics and ideas from your researched material in random order
    - Next arrange them into logical groups
    - Keep note of topics that do not fit into groups in case they come in useful later
    - Put the groups into a logical sequence which covers the topic of your report

- Structuring the report
    - Using your logical sequence of grouped ideas, write out a rough outline of the report with headings and subheadings.

Writing the First Draft

- Who is going to read the report? For coursework assignments, the readers might be fellow students and/or faculty members. In professional contexts, the readers might be managers, clients, project team members. The answer will affect the content and technical level, and is a major consideration in the level of detail required in the introduction.

- Begin writing with the main text, not the introduction. Follow your outline in terms of headings and subheadings. Let the ideas flow; do not worry at this stage about style, spelling or word processing. If you get stuck, go back to your outline plan and make more detailed preparatory notes to get the writing flowing again.

- Make rough sketches of diagrams or graphs. Keep a numbered list of references as they are included in your writing and put any quoted material inside quotation marks.

- Write the Conclusion next, followed by the Introduction. Do not write the Abstract at this stage.

Revising the First Draft

- This is the stage at which your report will start to take shape as a professional, technical document. In revising what you have drafted you must bear in mind the following, important principle:

  The essence of a successful technical report lies in how <u>accurately and concisely</u> it conveys the intended information to the intended readership.

- Most importantly, when you read through what you have written, you must ask yourself these questions;

  - Does that sentence/paragraph/section say what I want and mean it to say? If not, write it in a different way.

  - Are there any words/sentences/paragraphs which could be removed without affecting the information which I am trying to convey? If so, remove them.

Diagrams, Graphs, Tables, and Math

- It is often the case that technical information is most concisely and clearly conveyed by means other than words. Imagine how you would describe an electrical circuit layout using words rather than a circuit diagram.
  Here are some simple guidelines:

Section	Details
Diagrams	Keep them simple. Draw them specifically for the report. Put small diagrams after the text reference and as close as possible to it. Think about where to place large diagrams
Graphs	They must not be overcrowded. They must be easily readable.
Tables	Is a table the best way to present your information? Consider graphs, bar charts or pie charts. Dependent tables (small) can be placed within the text, even as part of a sentence. Independent tables (larger) are separated from the text with table numbers and captions. Position them as close as possible to the text reference. Complicated tables should go in an appendix.
Mathematics	Use mathematics where it is the most efficient way to convey the information. Longer mathematical arguments, if they are really necessary, should go into an appendix.

The Report Layout

- The appearance of a report is no less important than its content. An attractive, clearly organized report stands a better chance of being read. Use of a standard 12pt font, such as Times New Roman, for the main text is usually recommended.

- Use different font sizes, bold, italic and underline where appropriate but not to excess. Too many changes of type style can look very fussy.

- Use heading and sub-headings to break up the text and to guide the reader. They should be based on the logical sequence which you identified at the planning stage but with enough sub-headings to break up the material into manageable chunks.

References to diagrams, graphs, tables, equations, & source material

- In the main text you must always refer to any diagram, graph or table which you use.

- Label diagrams and graphs as follows:

  Figure 1.2: Graph of energy output as a function of energy input.

  In this example, the second figure of section 1 might be referred to as "....see Figure 1.2..."

- Label tables in a similar fashion:

  Table 3.1: Performance specifications of commercially available batteries.

  In this example, the first table in section 3 might be referred to by "...with reference to the performance specifications provided in Table 3.1..."

- Number equations as follows:

  $$F\ (dB) = 10 \log_{10} F \qquad (3.6)$$

  In this example, the sixth equation in section 3 might be referred to as   "...noise figure in decibels as given by eqn (3.6)..."

- References should be given in the text in square brackets [3], and provided at the end of the text body

Originality and Plagiarism

- Whenever you make use of other people's facts or ideas, you must indicate this in the text with a number which refers to an item in the list of references

    - Any phrases, sentences or paragraphs which are copied unaltered must be enclosed in quotation marks and referenced by a number

    - Material which is not reproduced unaltered should not be in quotation marks but must still be referenced

    - It is not sufficient to list the sources of information at the end of the report; you must indicate the sources of information individually within the report using the reference numbering system.

Originality and Plagiarism (cntd)

- Information that is not referenced is assumed to be either common knowledge or your own work or ideas; if it is not, then it is assumed to be plagiarized, i.e., you have knowingly copied someone else's words, facts or ideas without reference, passing them off as your own.

  - Plagiarism can have serious consequences, even legal.

- This warning applies equally to information obtained from the Internet. It is very easy for markers to identify words and images that have been copied directly from web sites.

Finalizing the Report and Proofreading

- Your report should now be nearly complete with an
  - Introduction
  - Main text in sections
  - Conclusion
  - Properly formatted references and bibliography and any appendices.

- At this point, you must add the contents and title pages and write the abstract.

Proofreading

- This refers to the checking of every aspect of a piece of written work from the content to the layout and is an absolutely necessary part of the writing process.

- Note: Never send or submit any piece of written work, from email to course work, without at least one and preferably several processes of proofreading.

- In addition, it is not possible for you, as the author of a long piece of writing, to proofread accurately yourself; you are too familiar with what you have written and will not spot all the mistakes.

- It is then a good idea to give your report to someone else to read carefully and check for any errors in content, style, structure and layout. If so, you should record the name of this person in your acknowledgements.

A Few Words on Word Processing

Advantages	Disadvantages
Word processing and desktop publishing packages offer great scope for endless revision of a document. This includes words, word order, style and layout.	Word processing and desktop publishing packages never make up for poor or inaccurate content.
They allow for the incremental production of a long document in portions which are stored and combined later.	They can waste a lot of time by slowing down writing and distracting the writer with the mechanics of text and graphics manipulation.
They can be used to make a document look stylish and professional.	Excessive use of 'cut & paste' leads to tedious repetition and sloppy writing.
They make the process of proofreading and revision extremely straightforward.	If the first draft is word processed, it can look so stylish that the writer is fooled into thinking that it does not need proofreading and revision!