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Technical Report Template

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Abstract

Every report should have an abstract. The abstract summarizes the report using between 100 and 200 words in a single paragraph. The purpose of an abstract is so that a reader can quickly get an idea of the main points and contributions of the paper. The author often writes the abstract last. This is because it is only *after* the body of the report is written that the writer gains a good perspective of the contents and results of the report. All reports submitted to me should follow the format shown in this template. Also, if you use this template for reports in your courses, you will be in good shape. However, be aware that CSU has a separate template for theses and dissertations. Note that the purpose of the abstract is *not* to provide an introduction to the problem, or a motivation for solving the problem, or a discussion of related work. Those discussions belong in the abstract. The purpose of the abstract is to summarize the report and the results.

1. Introduction

All reports should have an introduction. One purpose of the introduction is to introduce the problem. For instance, consider the background of this report template. I receive a lot of reports from students; a lot of them have common errors in writing, grammar, and organization; and all of them are in different formats. It looks more professional if all the reports that I collect are in the same format. This is especially true if the reports are distributed to other people, or if they are posted on the Internet.

Another purpose of the introduction is to provide a motivation for the work presented in the report. For instance, consider the motivation of this report template. If all of my students follow this template, then I won't have to provide individual guidance to hundreds of students. However, it is not only for selfish reasons that I provide this template. Students who follow this template can be sure that their reports will be more correct and more professional than they would be otherwise.

Another purpose of the introduction is to provide an overview of related work. The introduction should include at least five references to related papers and books. Internet

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references are strongly discouraged because they are not reliable. I could discuss many papers and books that are closely related to the topic of this report template. I use Markel's book [8] in my technical writing class. Strunk and White's book [9] is a classic that should be owned and used frequently by all writers. Many other excellent books have also been written to provide guidance for engineering communications [10–13]. There are also many papers that give more focused writing advice. One that I have found to be particularly helpful is Li [2]. Also, some papers that provide general research advice include sections that include writing advice [14].

The final purpose of the introduction is to summarize the paper one section at a time. In this report template, Section 2 discusses section headings, and Section 3 discusses fonts. Section 4 covers spelling and punctuation, and Section 5 discusses equations, which are often represented in a sloppy and inconsistent way in student reports. Section 6 shows how tables and figures should be properly presented. Section 7 discusses the importance and correct use of references and appendices. Finally, Section 8 contains some concluding remarks. Most reports will not have this many sections. A total of between four and six sections is more typical.

2. Section headings and report titles

The section headings are begun with numbers. The section headings begin with a capital letter, but all of the other letters in the section headings are lower case. In addition, make sure that the section heading (or subheading) and the first two lines of the following text are on the same page. The section heading at the bottom of this page is wrong because the section heading is on a different page than the first two lines of the section. You can enforce this in Microsoft Word 2007 by selecting the section heading and the first two lines of the section, right clicking, selecting the menu item Paragraph, selecting the tab Line and Page Breaks, and finally checking the check box "Keep with next."

2.1. Subheadings

Subheadings are numbered with an additional numeral such as 1.1, 1.2, and so on. If you have a 1.1 subsection, then you must also have a 1.2 subsection. It does not make sense to have a 1.1 subsection without a 1.2 subsection. This would be like trying to divide a pie into one piece. If you want the pie to be in one piece, then don't divide it. If you want to divide it, then you have to divide it into at least two pieces. Similarly, if you want to divide a section into subsections, you have to divide it into at least two subsections.

2.2. Report title

The first word of the report title is always capitalized. Every word in the title is capitalized except for prepositions, articles, and conjunctions (words like *of*, *or*, *and*, *the*, *with*, and so on). The title should be concise, typically 10 words or less, and should avoid acronyms unless they are commonly known. Include your name, affiliation (for example, Cleveland State University), and mailing address below the title. Include the date of the report below the title. If the work was done as part of your thesis research, include your advisor as your coauthor. If the work was done as part of a class project, do *not* include your advisor as your coauthor. Include the authors' email addresses as a footnote on the first page. The footnote should also acknowledge any financial support that helped you in your work. This is the only time you should use a footnote in the paper.

3. Fonts, justification, paragraphs, and spacing

Section headings and subheadings are 14-point font. The title is 16-point font. All the other text in the report is 12-point font. Never use all capital letters (this includes the report title and the section headings) unless you want to convey the impression of yelling. All fonts should be Times New Roman.

A new paragraph is indicated by skipping a line. Indents should not be used. Paragraphs should almost always be at least three sentences long.

The justification is flush left and ragged right. Don't force all of the lines to end at the same point on the right margin. Some writers prefer right justification, but I think it forces unnatural spacing.

Use single spacing throughout the report, with blank lines inserted at appropriate places as shown in this template. Every main heading, including the abstract and section headings, should be preceded by two blank lines. Every subheading should be preceded by one blank line. Paragraphs should be separated with one blank line.

Set up your page settings using the Microsoft Word default, which includes one-inch top and bottom margins, and 1.25-inch left and right margins. Page margins can be set by selecting the Microsoft Word 2007 tab Page Layout.

Insert page headers and footers in your report by using Microsoft Word's Insert tab. The first page does not need a header or footer. The page header should contain the report title (left justified), and the report authors (right justified), both in 10-point italics. The page footer should contain the page number and the total number of pages, center justified in 10-point italics, as shown in this template.

4. Spelling and punctuation

Microsoft Word has a spell checker. Use it. There is no reason to have spelling errors in your report, as this simply indicates laziness. I do not expect your spelling to be perfect, but careful proofreading should eliminate 99% of spelling errors.

Microsoft Word also has a grammar checker, although it does not work so well. But it cannot hurt to use it. It might help you find errors in grammar.

Commas need special attention. There are two main rules to use with commas. First, commas should *never* be preceded with a space. For instance , the comma in this sentence is wrong because it has a space in front of it. Second, commas should *always* be followed with a space. For instance,the comma in this sentence is wrong because it does not have space after it.

Periods should always be following by exactly one space. For instance, this paragraph is wrong because the period at the end of the first sentence does not have space following it. Some people like to use two spaces after a period – this is an anachronism from the days of typewriters, but it is fine, as long as you are consistent. If a parenthetical phrase is at the end of a sentence, the period belongs outside the parenthesis (like this). However, if an entire sentence is parenthetical, the period belongs inside the parentheses. (Here is an example.)

Integers should usually be spelled out if they are less than 10, or if the number begins a sentence. Integers should be written with numerals if they are greater than nine. Nineteen out of 20 technical writers agree with this rule.

5. Equations

Mathematical variables should always be in italics. If you use Microsoft Equation Editor then it will format the equation for you. If you type the equation yourself in text mode, then make sure that you italicize the variables. Numbers should not be italicized. Also, every mathematical operator symbol should be preceded and followed with a space. For example, the equation

$$x^2 - 2x + 3 = 0 \tag{1}$$

was typed in text mode. It has a space before and after the minus sign, a space before and after the plus sign, and a space before and after the equal sign. The variable *x* is italicized. If you refer to any mathematical symbols in the text of your report, they should be italicized.

If you need to refer to equations by number, the equations should be numbered inside parentheses and aligned with the right margin, as shown above. (Insert a tab stop with a right alignment at the right margin.) If you need to refer to an equation later in the text,

refer to it without using the word “equation” – just refer to it by using the equation number in parentheses. For example, we can solve (1) using a genetic algorithm.

The minus sign is not the same as the hyphen on your keyboard. The hyphen is a short dash and looks like this: “-”. The minus sign is a long dash and looks like this: “−”. You can often get a minus sign by typing two consecutive hyphens in Microsoft Word. If that does not work, then go to the Microsoft Word menu item Insert → Symbol, choose the Symbol Font from the combo box, and find the minus sign.

If you need to use a multiplication symbol, don’t use “x” (ex) because it is a letter, not a multiplication sign. Neither should you use “*” (asterisk). Instead you should use “×”. This symbol can be found by selecting the Microsoft Word menu item Insert → Symbol, and choosing the Symbol Font.

All equations should be preceded and followed by a blank line. If you don’t have a blank line before and after an equation, it looks cluttered. If you have more than one blank line before or after an equation it looks too spread out.

6. Tables and figures

Tables and figures should be numbered and have a descriptive caption, as shown in Table 1. Tables should never appear before they are referenced in the text. They should appear as soon as possible after the paragraph where they are first referred to in the text. Each table must be referred to in the text by table number, along with some discussion of the data. For instance, Table 1 shows the average soybean price in Jamaica and Lebanon during the years 1999 and 2000. Note the judicious use of borders in Table 1 to make the table more readable. Note that the table, along with its caption, is center justified. Note that the caption is 10-point font.

Year	Jamaica	Lebanon
1999	1.98	3.14
2000	2.45	3.03

Table 1 – Average soybean prices (dollars per bushel).

When you refer to a specific table in the text (for instance, “We see that Table 1 shows such and such”), always capitalize the first letter in the word “Table.” On the other hand, if you are referring to a table without using a number, then the first letter in the word “table” is not capitalized. For instance, “The above table shows the average soybean prices in Jamaica and Lebanon during the years 1999 and 2000.” The same rule applies to designators like “figure” and “section.” If you want to refer to a specific section, then always capitalize the word “section” – for example, “In Section 6 we discuss tables and figures.” If you use the word “section” in a more generic manner, then do not capitalize it – for example, “In this section we discuss tables and figures.” This is like the use of personal titles. For instance, if you are using a title with a specific person you capitalize

their title, but if you are not using the title with a specific person's name then you do not capitalize the title. "The history books tell us that President Washington was the first president of the United States." Or, "One of the pickiest professors I've ever seen is Professor Simon."

Always insert a blank line before and after each table. This is just like the use of blank lines around equations.

The same general rules that apply to tables also apply to figures. Note that figure captions do not have to be short. In fact, the more descriptive a figure caption is, the better. The reader should not have to delve into the text to understand a figure. The reader should be able to understand the figure by looking at the figure along with the caption. Also, figures should always have a white background. MATLAB® often creates figures with a gray background, but you need to change it to white (using MATLAB options) before you put it in a report. The figure axes should always be labeled, legible, and include units if applicable. You can use color, but make sure the lines will be distinguishable if the report is printed in black and white.

Figure 1 is a bad figure. Although it uses different colors for the lines, which is nice, both lines are solid. So when the report is printed on a black and white printer the two lines will not be distinguishable from one another. Also, part of the background is gray, which is bad. Conserve toner! Also, the numbers on the axes are too small. Finally, the axes are not labeled.

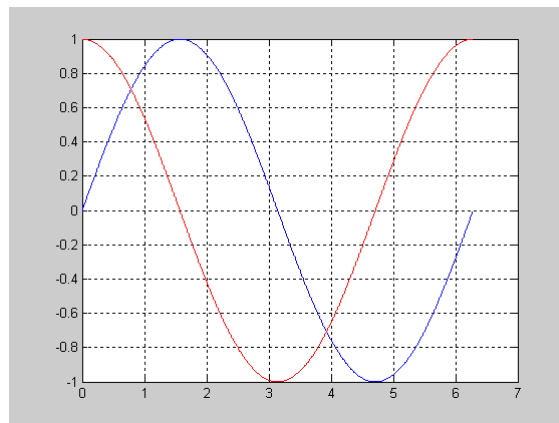


Figure 1 – Bad figure. The reason this figure is bad is because the font is too small, the axes are not labeled, the traces are not labeled, and the background is gray instead of white.

Figure 2, on the other hand, is a much better figure. The entire background is white. The lines are different styles (one is solid and one is dashed) so they will be distinguishable when printed on a black and white printer. The axes are labeled (including units) and the two traces are labeled with a legend. Finally, the axis labels and numbers are large enough to read. All of this formatting can be done within MATLAB. Notice that Figure 2 has gridlines, which generally provides a more professional appearance to a graph.

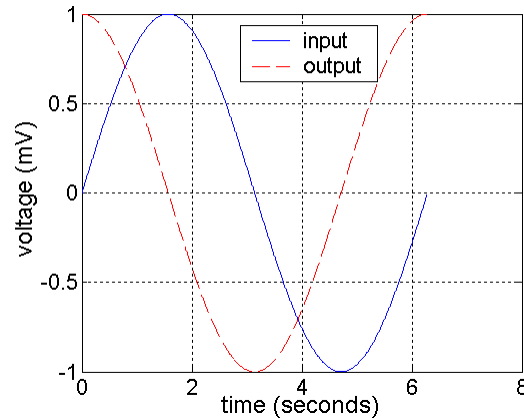


Figure 2 – Good figure. The font is nice and big, the axes are labeled (including units), the traces are labeled (input and output), and the background is white. Also, the caption is long enough to be descriptive.

Speaking of units, when referring to some quantity and its units, separate the quantity from the units with a space. For instance, the minimum voltage in Figure 2 is -1 mV . Note the space between the “ -1 ” and “ mV .” You would never write, “Today for lunch I had 10bananas.” Instead you write, “Today for lunch I had 10 bananas.” Your microcontroller voltage supply is not “ 5V .” It is “ 5 V .”

When you use the word Table, Figure, Section, Chapter, or some other designator, along with a number, the designator must always be on the same line as the number. Table 1 shows soybean prices, but this sentence is not correct because the word “Table” and the number “1” are on separate lines. In Microsoft Word you can insert a space that does not allow a line break by typing Ctrl-Shift-Space. So instead of typing T-a-b-l-e-`<space>`-1, you should type T-a-b-l-e-`<Ctrl-Shift-Space>`-1.

7. References and appendices

Almost all reports should include references. It is hard to imagine a report without references. References should be arranged either alphabetically or in order of appearance in the text. I prefer alphabetical, but many journals and authors prefer order of appearance. Every reference that is listed should be referred to in the text, but the abstract should not contain any references. References should be referred to with the reference number in square brackets. When the reference list is finally presented at the end of the report, the word “References” is not preceded by a number; that is, the references section is an unnumbered section.

The purpose of including references is so that the reader can look up those references. Make sure the reference has enough information so that the reader can obtain the references. Reference [1] shows how to refer to a thesis or dissertation. Note that at the beginning of a sentence, a reference must be preceded by the word “Reference.” However, in the middle of a sentence, the reference is never preceded by the word “Reference.” For example, [1] shows how to refer to a thesis or dissertation. Reference [2] shows how to refer to a journal publication. Reference [3] shows how to refer to a

web page, but Internet references are strongly discouraged because they are not reliable, and because links get broken so quickly. Wikipedia references should *never* be included in a formal report. Wikipedia is a good source of information, but any information gathered from Wikipedia needs to be double-checked with a more formal publication (conference, book, or journal) before that information is included in a report, and then it is the refereed source (*not* Wikipedia) that needs to be listed in the reference list. Reference [4] shows how to refer to a conference publication, and [5] has a template that can be used for writing a thesis at Cleveland State University. Reference [6] shows how to refer to a book, and [7] shows how to refer to a contributed chapter in an edited volume (that is, the chapter author is different than the book editor).

Be consistent in the formatting of your references. Look on the Internet for American Psychological Association (APA) style guidelines. Or you can use the style shown in the reference list of this report template. For example, if you use the first initial and last name of the authors for one reference, then you should use the first initial and last name of the authors for all references. If you list the issue number for one journal reference, then you should list the issue number for all journal references. If you italicize the name of one conference, then you should italicize the name of all conferences. All of your reference formatting needs to be consistent.

Appendices are included after the references and are labeled Appendix 1, Appendix 2, and so on. Appendices are sections that contain material that is not essential to understanding the report, but that an interested reader can refer to for the sake of completeness. For instance, detailed mathematical proofs, schematics, flow charts, and program listings could all be included in appendices.

8. Conclusion

All papers should have a conclusion. One purpose of a conclusion is to summarize the report. For example, this template has discussed various aspects of report writing. The student who attempts to follow these guidelines will see a marked improvement in his or her written communication skills. Like anything else, good writing takes practice. Don't get discouraged if you don't get it right the first time. Just keep practicing. We discussed how sections should be numbered, and how the report title should be formatted. We also discussed what types of fonts should be used at various points of the report. We talked about spelling, punctuation, and equation formatting. We talked about the proper use of tables and figures, and finally we provided information about how references should be formatted.

Another purpose of the conclusion is to summarize the benefits and drawbacks of the material that was presented. For instance, I could say that the benefit of this report template is that students now have a guideline that will improve their writing skills. However, a drawback of this template is that students may feel that they are spending more time on writing and report formatting rather than technical research. Each student

needs to strike a balance between time spent on technical work, and time spent on writing and other communication skills.

The final purpose of the conclusion is to present ideas or proposals for future work that could be conducted either by the author or by someone else. For example, this report could be expanded in the future by including additional grammatical rules and guidelines.

Finally, it should be noted that a paper could violate a lot of the rules discussed here and still be an excellent paper. For instance, you could use different margins, right justification instead of ragged right margins, different font sizes or styles, different capitalization rules, and many other choices. The important thing is to be consistent. It does not matter too much if you capitalize the first letter of every word of your figure captions, or just the first letter of the first word, as long as you are consistent. It does not matter if you use a different font size, as long as you are consistent. Inconsistency in these matters is a sure way to produce a paper with a sloppy look.

References

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