

Checklist for writing papers

April 30, 2004

1 Introduction

Here we present a list of features to look for in a good scientific paper together with presentation. We'll divide up our list into several main categories.

Content: The information you are trying to convey.

Organization: The division of the information into logical phases to facilitate the reader's appreciation and understanding of that information.

Formatting: The actual laying out of text on the page.

Writing style: The composition of well formed sentences and paragraphs to deliver the information.

Oral Presentation: Boiling your paper down to a short oral presentation that conveys the essence of your research.

Some time ago, I read a very interesting tribute to Claude Shannon (inventor of Information Theory). He was described as someone who was unwilling to accept learning a part of mathematics well but insisted on constantly changing and rearranging it until he felt personally he could explain it to the man on the street. That truly expresses a basic goal of self-education, to take a subject and explain it in your own language and your own terms. That is the goal here, for you to acquire valuable information, think about it in your own terms, and convey it to the rest of us.

2 Content

This covers partly the actual researching and the decisions about what information to include in your paper. This can vary tremendously from topic to topic. For this course, I am looking for at least 2000 words of expository writing. At about 250 words a page, that would be about 8 pages of text. From teams of more than one person, I would hope for somewhat more text, but not double.

- Try to formulate a specific topic or question that you wish to investigate. Often this will be the basis of the introduction to your paper.

- Use the web, library, etc., to gather sources relevant to your topic. Often you'll have to evaluate how relevant parts of your sources are. Keep track of the sources you look at and what is contained in them. People commonly use index cards or a journal to do this.
- Keep track of explicit statements (theorems, formulas, etc.) about facts in your subject for recording in your paper.

Try to be a little creative in how you describe the material you uncover. Here are some suggestions.

- If there is something that is confusing you, try to write down a specific question about it in your notes. Come up with ideas for how you could make the concept less confusing: a model, a diagram, a calculation, etc.
- If the source says something in general is true, try to think of an example. For example, if the source gives a method for accomplishing some task, try to formulate an interesting example on which you can show how the method is carried out.
- If the source gives a collection of examples, see if you can find or express a general pattern for the examples.
- Sample calculations: work these out on scratch paper, but be sure to record them cleanly in your notes. Sample calculations can go a long way in learning how to explain a subject.

3 Organization

Before you start writing the details, break your subject into small digestible chunks which will form sections of your paper. Towards the end of your research, make as detailed as possible an **outline** of the topics you would like to write about. Each item in the outline may eventually turn into a section or a paragraph of your paper.

Here are some suggestions for types of sections.

Introduction: This should describe very briefly the subject of your report. A clean statement of the facts should be given. You should have a listing of all the sections in your report. The sections should have descriptive titles.

Definitions and clarification of terminology and basic facts: All notation and terminology must be explicitly defined or references to textbooks where the definitions may be found (with explicit page numbers) must be given. Expansion of the basic facts. For a historical paper, a timeline might be given.

Discussion: One or more sections discussing in depth your subject. Explain your algorithms in words, if a program. Prove a theorem if that's what your subject is about.

Examples: Example calculations, or output, or excerpts from texts.

Generalizations and variations: Anything you can think of, or possible subjects this paper leads into. Contemporary consequences of historical subjects. Projections about the future.

Description of other sources: Your observations on what's contained in the paper's references.

Bibliography: Should follow the format below. A good reference for writing organization and format is [1].

References

[1] Diana Hacker, *A writer's reference*, Bedford/St. Martins, Boston–New York, 1999.

4 Formatting

- Number your pages and sections, so that you may cross-reference parts of your paper by these numbers. If you refer to certain facts or equations in your discussion, you should name or number these facts or equations and refer to them by that name or number.
- Leave generous margins of about 1 inch around your text.
- Leave space between your technical equations or diagrams and the text.
- Make sure your notation is clearly chosen and clearly typed. Do not use the same letter to mean two different mathematical expressions.
- Check for spelling errors and grammar problems.

5 Writing style

Some advice on writing style:

- Write in short, clear sentences, as a journalist would. Go over your sentences and eliminate needless words. Each sentence should have a subject and verb and possibly one or two supporting phrases.
- Do not use any notation that you have not fully explained in words. Do not leave anything to the reader's imagination. For example, the sentence "Let x be an integer" or phrase "for all integers x " identifies the type of object x represents.

- Think about breaking your writing in paragraphs. Basically, a paragraph is a discussion of one idea, usually introduced in the first sentence. Sections should consist of paragraphs described a collection of related ideas.
- Be as precise as possible in your writing. Statements such as “This will work” leave it up to the reader to decide what “This” means. Explicitly state “This *program* ...” or “This *method* ...” or whatever else may be appropriate.
- It is usually clearer to organize technical arguments or calculations or data in “blocks” that are set off from the surrounding paragraphs. This includes large equations such as

$$\frac{1 + \sqrt{5}}{2} = 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \dots}}}}$$

If you have difficulty with equations in your word-processor, and you need them, it usually appears nicer to leave space for the equation and ink it in carefully in the final paper.

- Good english writing requires a little variety in how words are chosen and sentences are formed. Starting every sentence with “We” or the same sort of phrase is not good style.

6 Presentation

You will not be able to describe everything in your paper in a short presentation. Pick out the most interesting information and examples. Prepare good graphics and slides, so that you won’t have to spend a lot of time writing on the board. Alternatively, you can prepare a handout to give to the audience. That allows you to talk extensively about your subject and not spend a great deal of time writing on the board.

When you have a set of ideas to present, practice presenting it to yourself just for timing. If you like, feel free to consult with me any time about your presentation.