# How to Write an Academic Paper

Jianbang Xian (120037910056)

sinkinben@sjtu.edu.cn

### Abstract

This article mainly discusses two questions, that are how to choose a research topic and how to write an academic paper. Choosing a good topic is half the success of the paper. Some of my views on topic selection about Software Engineering are given in this article. Then, this article divides the problem of how to write an academic paper into five steps: (1) get the tools ready, (2) write a paper proposal, (3) write an outline for each chapter, (4) fill in each chapter and (5) revise the paper iteratively.

### 1 Introduction

Being able to write an academic paper is a critical skill for graduate students. It is also an important skill that continue to serve us if we intend to enter the PhD career, or any specific field that involves analytical writing [1]. However, academic writing is no way an easy task as it consists of lengthy procedures of conducting thorough research and the ability to write skillfully. Therefore, we should know some basic rules or skills of academic writing when we enter the master career. In this article, I will introduce some of my views on academic writing.

As we know, the premise of writing a great paper is to have a good idea. In the field of Computer Science or Software Engineering, the core of the paper is the software system we built or the algorithm(s) we implemented. Therefore, our ideas are all around the software or algorithm(s). Once we have a new insight into a problem, we can solve it by programming, and then record the solution and experimental results, which will become a paper.

The first thing we need to know is that, what is a paper? Olivia Valdes, a professor of Yale University, points out that, a paper describes the research work in the context of other related work. In particularly, it describes the problem we are solving, our solution, our experiments and results, our contribution to the general research area, related work in the area, and future directions for our work [2].

Now let's have a look at how to write an academic paper. I will divide this article into the following parts:

* **Introduction.** This section is the introduction, which introduces the main content of this article.
* **Choose a Topic to Research.** In this section, I will introduce some views on the topic selection of the paper.
* **Write the Paper Step by Step.** In this section, I'm going to share some ideas about how to write an academic paper step by step.
* **Summary.** This section is the summary of this article.

### 2 Choose a Topic to Research

As we know, a good topic is half the success of the paper. From my perspective, here are some things we should do when choosing research topics in Software Engineering.

**Look and think of ideas.** Search for ideas in paper or on websites related to the ideas generated. For example, if we are thought about learning Artificial Intelligence, we could browse through sites discuss Deep Learning or Machine Learning. As we read through these sites, we will begin to form several topics based on these ideas we already have. When we have some little ideas, we can read some classic review papers in related fields. The review papers can help us understand the development status of the topic we choose, and can also help us generate some great ideas.

**Avoid over used topics.** Be aware of overused ideas when deciding a topic. Some topics has been written on some many times, we may wish to avoid such topics unless we have a unique approach to the topic.

**Read general background books and papers.** Read articles, journals and papers on two or three topics related to our research. This will help us get an overview of the topic and provides a great source for finding words commonly used to describe the topic.

**Make a list of useful keywords.** Take note of all keywords related to our research. Look for words that best describe our topic when reading related works/topics in encyclopedias, articles and other research works.

Don't forget to follow the instructions of our mentors. If the topic requires writing applications (software) or constructing a hardware, make sure that choose an area we can afford to do or complete within the time limit.

### 3 Write the Paper Step by Step

In this chapter, I will share some of my ideas about how to write a paper step by step.

##### 3.1 Get the Tools Ready

The first step in writing a paper is to get the tools ready:

* The document editor, such as Office-Word and . These tools can help us format our papers and check spelling and grammar.
* Drawing software. Figures and tables are often the quickest way to communicate large amounts of complex information. To make exquisite figures and tables, a good drawing software is needed.
* Note management software. In the process of writing a paper, it is inevitable to produce a lot of notes. A good note management can help us improve our efficiency.
* Cloud backup service, e.g., OneDrive, Dropbox and Google Drive. We need to make a backup for everything related to our paper.
* Anything else that can help us write a paper.

It should be noted that before writing the paper, we should have a specific plan for how to write the program or algorithm to solve the problem we choose.

##### 3.2 Write a Paper Proposal

A good proposal is the first step to success. Merbouh Zouaoui, a professor of Université de Sidi Bel Abbés, says that a high quality proposal not only promises success for the project, but also impresses the Thesis Jury and professors about the student’s potential as a researcher [3]. The paper proposal provides a coherent and concise outline of the intended research, which allows us to assess the originality of the proposed topic [3].

Thus, writing a paper proposal is necessary for us before we write the paper.

Paper proposals will differ, but there are certain things that can be expected to be found in every one. From my perspective, the paper proposal needs:

* **The problem to be studied.** Give a statement in what research issues the study will address and in what ways.
* **Previous work on the problem.** By clearly describing previous work, we can better describe the current limitations and the need for new methodology. It also gives us an opportunity to demonstrate knowledge of the area and helps others relate our current work to other scientific areas.
* **Research methodology.** This section explains how we are going to conduct our research and the method we choose for our research question. Explain why the specific method is suitable for the research and how will it help us attain the research goals. The research methodology will give us an organized plan for the research.
* **The software requirements.** It should be noted that software (or algorithm) is the core of the paper. The software requirements define the boundaries of the problem. It can also prevent the paper from going off the topic we research on.
* **Significance of the Research.** The significance of the research will identify the importance of our work. It should be mainly stated in the introductory paragraph. We should highlight how the research is beneficial to the development of the related fields.
* **A schedule for tasks**. It will remind us finish the task on time, preventing us from missing the important deadline.

However, the paper proposal is just a plan. It does not mean that it must to contain these parts, nor does it mean that it contains only these parts. It can be adjusted, added, and deleted some sections according to our actual needs.

##### 3.3 Write an Outline for Each Chapter

An outline can help us organize our thoughts and ideas which we think are important. It is considered the skeleton of backbone of any paper. Outlining before writing the rough draft will help us identify which topics are important and which information is considered supporting ideas. Besides, it involves writing quick summary sentences or phrases for every point we will cover in each paragraph, giving us a picture of how our argument will unfold [4].

A standard academic paper in Software Engineering consists of the following parts.

1. **Abstract.** An abstract is a short summary of the research paper, usually about a paragraph long (but it shouldn't be very long). It contains most of the following kinds of information in brief form. The body of the paper will develop and explain these ideas much more fully.
2. **Introduction.** The introduction is the big picture of our work: what, why, and how. A good introduction should lead the readers from a generalized topic to a particular aspect. It helps to establish the main idea, context, research importance and summarizes background data on the topic, providing the main goal of the work. The introduction should include the thesis statement and any background information that we might have gathered. A thesis statement is the main topic and explains to the readers what ours views are on this topic.
3. **Relative work.** This is an essential part of a paper, discussing related work is a good way to put our work in context with other similar work and to provide a way for us to compare our work to other work. It is not enough to just site related work, we need to explain to the readers in what way it is related to our work in the paper.
4. **Our work and contribution.** In this section we can describe the actual details of our work. We should explain clearly what questions the paper is trying to answer, as well as how we decide to go about finding the answers, and we should describe in detail the solution and how it answers these questions.
5. **Experiment or evaluation.** This section should thoroughly describe the results we obtained. Whenever possible or appropriate, we should try to present the results pictorially using graphs or histograms. In addition, we must explain the results and tell the reader what all these data mean.
6. **Conclusion, summary, and the future work.** In this chapter, we should conclude with the main ideas and results of our work. Discuss ways in which our project could be extended..., what's the next? what are the left problems that resulted from the current work? These questions need to be considered carefully.
7. **Acknowledgment.** A great work must be the crystallization of the wisdom of many people, don't forget to thank them at this section.
8. **References.** At the end of the paper is a Reference section listing all the papers that we cited in the paper.

##### 3.4 Fill in Each Chapter

After the outline is established, we can fill in the skeleton of the paper. An important principle is that we don't have to write the chapters in order. If we are short of ideas about a chapter, we can skip it over and finish the following chapters first. Another important principle we need to keep in mind is that completion is more important than perfection.

For the abstract, introduction and related work, the writing of these chapters are relatively fixed. We can expand the details of each chapter according to the description or requirements of the outline.

The most important chapters are the chapter about **our work and contribution** and the chapter about **experiment or evaluation**.

We can express our work and contribution in the following aspects.

* Details of the problem we are solving
* Details of the program's architecture
* Details of the solution and the project's implementation
* Details of the core algorithm(s) in the program
* Discussion of how our solution solves the problem

Even though we may have spent most of our time on writing code, a paper does not contain a copy of the source code. Instead, we can use pseudo code to describe our ideas.

As for the chapter about experiment and evaluation, we can try to express in these ways.

* Explain the tests we designed and performed, e.g., how and why we design these test cases.
* Explain how we gathered the data and results
* Present the experiment results by charts. It should be noted that quality is more important than quantity. The readers will be tired of pages and pages of graphs and tables, instead they want to be convinced that the how, experiments support the conclusions.
* Discuss the results. Explain and interpret the results, and compare them to related work if possible. This can help readers understand the significance of our work.

It should be noted that including large pieces of source code in the paper is not permitted. Even though we may have spent a long time on writing code for the project, and even though we may be very proud of the simple and efficient code we wrote. The code may be appropriate to include a description of the implementation at a higher-level by pseudo code.

##### 3.5 Revise the Paper Iteratively

The completion of the first draft does not mean that the paper is finished. We need to make further revisions to the draft.

No one can write a perfect first draft, it’s impossible. Revising is critical if we want to impress the reviewers (or professors) and get a high grade for our paper. Revising doesn't mean revise only spelling mistakes and grammatical errors, we need to revise individual paragraphs like when we wrote them for the first time. Once the paper is drafted, make sure hand in the best possible work by checking it over thoroughly and making any necessary edits.

In my opinion, we can do the revising operation in a number of ways, such as:

* Eliminate irrelevant ideas and unnecessary information
* Add new explanations, details, points to ensure additional support for our argument
* Rewrite paragraphs and sentences to present our ideas better
* Re-organize paragraphs and sentences to make our paper logical

A good paper needs to be polished carefully, we should be ready that we may need to write more than one draft or revise our paper several times.

### 4 Summary

This article mainly discusses two questions, how to choose a research topic and how to write a paper step by step.

Below is a quick list of the procedures that shows how to finish a complete research project in CS or SE.

* Choose a topic to research.
* Get the tools ready.
* Write the program according to the problem.
* Start writing paper early. Don't wait until the program is finished.
* Write a proposal that includes a statement of the problem under study, the software requirements, an indication of how the problem will be solved.
* Write an outline for each chapter before we write the paper.
* Write the first draft of the paper as soon as possible. Completion is more important than perfection.
* Polish the first draft of the paper.

A very important issue has not been mentioned above, it is that we should never plagiarize. Academic integrity is the most important quality that we must maintain in our research career. As the saying goes, nobody wants a doctor who cheated to get his medical degree to perform a life or death surgery on them or a bad engineer to build bridges.

That's all. Thanks for reading.

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