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Some guidelines for writing article-style reports in Computer Science

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Abstract This paper gives some guidelines for writing article-style reports in Computer Science. We focus on the typical structure of such papers and give some advice for writing the technical content. The paper is primarily intended for undergraduate students following various courses or doing their master's thesis. It may also be useful for graduate students writing papers or theses.

1 Introduction

Research in Computer Science (CS) is usually published in short reports called *articles* or *papers*. Conference papers are often somewhere between 10 and 20 pages long whereas journal papers are usually a bit longer. These papers often follow a particular structure that we will try to explain here. As a running example, we will use this paper itself. The intended audience of this paper is CS undergraduate or graduate students writing their first papers, for example, reports for course projects, master's theses, conference or journal papers.

As a first-time writer you have probably already read several or many papers and you probably have some idea of how they are typically structured and written. This paper tries to make these ways more explicit.

The rest of this paper is structured as follows. In section 2 we give an overview of the typical structure of computer science papers. Section 3 gives some practical advice on technical writing, formulated as simple patterns. Section 4 discusses related work. Finally, section 5 draws some conclusions and outlines directions for future work.

2 Structure of CS papers

A CS paper typically consists of a title, author information, abstract, introduction, substance, conclusions, acknowledgments, and references.

2.1 The title

The title of your paper might well appear in a list of other papers. Therefore, it is important that it is both precise and easy to understand. At the same time, it should not

be too long. As a reader, you want to quickly and easily judge from the title if this paper is interesting for you or not. The title of this paper is “Some guidelines for writing article-style reports in Computer Science”. This title is fairly precise while being reasonably brief. Just writing “Report Guidelines” would convey too little. The following would probably be too long and difficult for people to read quickly: “Some introductory guidelines for Computer Science students in writing research article-style reports”

When you make up your title, try to think carefully what you would like to say in the title. Can you be more brief? Is there anything important missing? Is the title easy to understand? Often, it is easier to formulate a good title *after* you have written the paper. Try to spend a few minutes after completing the rest of the paper to reflect on if you can improve your title.

2.2 The author information

The author information appears below the title and consists of author name, affiliation, and email. If you are several authors you normally list the names in alphabetical order (according to the last name). The affiliation is the organization that the author works for. What is the affiliation of an undergraduate student? If you are a student at the D programme at Lund Institute of Technology in Sweden, you might write as follows:

S. Tudent
D00, Lund Institute of Technology, Sweden
d00st@efd.lth.se

This would perhaps not say very much to a world-wide audience, but it would at least convey that you are somehow affiliated with Lund Institute of Technology, and how to reach you by email. For someone at this university it will be clear that you are an undergraduate at the D program, and that you started your studies in year 2000.

If you write your paper in Swedish, you could write as follows:

S. Tudent
D00, Lunds Tekniska Högskola
d00st@efd.lth.se

Here, you wouldn't have to write “Sverige” (“Sweden” in Swedish), since anyone who reads the paper would know that Lund is in Sweden.

2.3 The date

After the author information you write the date. The date is very important. For example, in a few years time, someone might find your paper on the web, and it is very interesting for them to know when it was written as this might influence their expectations on the paper. The date is also needed when you are writing drafts: people reading your drafts will want to know which version is newest.

2.4 The abstract

The abstract should be a summary of the report in a few lines (10-20). The goal is to inform the reader about what your paper is about and what is new in the paper, so that he/she can decide quickly if this is a paper of interest to him/her.

Just like for the title, it is a good idea to revisit your abstract *after* you have completed the paper, and make sure it accurately reflects what your paper is really about. This is because, as you write the paper, you will understand more about the problem you are writing about, and the focus of your paper might shift from what you originally intended.

2.5 The introduction

The Introduction is the first main section of the paper. Here you describe briefly the background and motivation for your work, the goals for your work, how you have gone about carrying out the work, and very briefly what your results are.

The background and motivation are intended to give the context for your work and explain the problem area that you are addressing and why it is important. Try to be precise, easy to understand, yet brief. Don't be too detailed. If you think you need a lot of detailed background information, save that for the next section. When reading the introduction, the reader wants to understand *why* your work is interesting and important in order to find it worthwhile to go on reading.

Although you should not be too detailed at this point, it is important to be concrete. Sweeping statements for motivating your work should be accompanied by (brief) concrete examples. It is also important to cite important related work at this point to put your work into context. For example, if your work builds on other work, cite that work. If your work is similar or different from other related work, cite that. However, you should still be very brief –detailed comparisons should be left for a section on related work towards the end of the paper.

The introduction should end with a short roadmap, explaining what to find in the remaining main sections the paper. In addition to explaining the structure of the paper, such a roadmap also works as a more detailed explanation of the goals of the paper. You can look at the roadmap at the end of section 1 of this paper as an example.

2.6 The substance of the paper

After the introduction there is usually two, three, or more main sections that contain the substance of the paper and explains what has actually been done and what the results are. The structure of this part will be different in every paper. It is good to start writing an outline of this part. However, you should be aware that you will often need to restructure it afterwards since it is difficult to know how much each section and sub-section will fill when you start writing. Maybe you will end up with a 15 page paper where one section is 10 pages and with a deep internal substructure, and a couple of other sections that are only half a page each. In that case you should restructure. For

example, break up the long section into two or three sections, and move the two half page sections into other sections.

2.7 The related work

It is often a good idea to include a section on related work after the substance sections. Usually, you have mentioned the existence of some of this work already in the introduction. But it is not until the end of the paper you can relate in a concrete way to it. In this section you should briefly explain alternative approaches to yours. Explain both how your approach is similar to and how it differs from these approaches. This is very useful for people who know some of the other work in detail. It helps them to understand how your work is different. It is also very useful for people new to the area and who want to know what more there is to read. It is also very useful for finding out what is new in the paper.

If your paper is a survey rather than presenting a new result, you will probably not have a Related Work section. Possibly you could have one if there are other similar surveys that you want to relate to.

2.8 The conclusions and future work

The last main section is a concluding section usually called “Conclusions” or “Summary”, or sometimes “Discussion”. In this section you pinpoint the contributions of your work. You pinpoint what is new and what the implications are (for example, what kind of new things can now be done). You also outline ways to continue your work. If you had more time to work on this problem, what could you do? This is interesting to the reader for several reasons. It helps explaining what you have done because it explicitly says what you have not done, but would have been relevant to do. It is also interesting because it shows in what directions the work could continue, and might inspire some of the readers to do such work, or to keep an eye open for your next publication.

2.9 The acknowledgements

After the conclusions you usually write a short unnumbered section called “Acknowledgements”. Here you thank everyone who has personally helped you with your work. This could be people that helped you implement something, that tried out your implementation and gave you feedback, people that you have discussed with and have given you new ideas, or feedback on your ideas. You should also thank people that have read and commented on your paper. If you are submitting your paper to a conference or journal you usually don’t know the names of your reviewers. However, if you think you have received some very important feedback from them, you may write something like “I am grateful to the anonymous reviewers for their suggestion to”

2.10 The reference list

After the acknowledgements you should have an unnumbered section called “References”. Here you list all papers, books, web-pages, etc., that you have cited in your text. There are various common styles for sorting the references, e.g., alphabetically or in the order of occurrence in the document. There are also various styles for citing.

Be precise in your references. Look at some example papers for how you typically cite things and how to write the references. For references to web-pages you need some more information than the URL. Try to find a title, maybe an author, and the organization hosting the web-page. It is likely that the URL will change in the future, and by giving this additional information, it might be easier to find the new location of the page.

2.11 Appendixes

Sometimes you find that you would like to include some information in your paper, but that it is too detailed to fit in the substance sections of your paper. In this case, it may be motivated to provide an appendix. For example, you might like to supply a complete example, a complete algorithm, a complete API, etc. If your appendix is long, an alternative is to put the information on the web, and give a reference to it in the paper.

2.12 Formatting advice

We do not give detailed formatting advice in this paper. Most papers use a formatting style similar to the one in this paper. If you use LaTeX, the standard “article” style is suitable. If you use some other word processing system and need to select or create your own styles, our advice is to try to mimic the styles used in this paper or in other article-style papers.

3 Patterns for technical writing

In CS it is common to try to capture good advice in the form of patterns [1]. Below we give a number of patterns for technical writing.

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<<<This rest of this paper is only in a rudimentary draft form>>>
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3.1 Reader interest

The most important thing to think about when writing a report is the reader. You should present your material in a way which allows the reader to understand it with as little effort as possible. Try to present things in the interest order of the reader. Before you explain how something is done, be sure that you have been very clear about why it is done, and how it fits in the big picture. Your goal should be that the reader can stop

reading at any section, and still have learned something useful. You should make it easy for your reader to grasp the important things you have done without having to read all details.

This style of writing is suitable for technical writing and is almost opposite to the style of writing used in fiction, e.g. thrillers, where the reader will not understand the story until the last few pages.

3.2 Stand-alone paper

... it should be possible to read and understand your paper without having to read specific other papers... don't use terms without explaining them. However, you don't have to give all the details – you can't repeat other papers within your own. Often it is sufficient to give a very brief explanation and a reference. ..

3.3 One-pass reading

... it should be possible to read through the paper in one pass... don't use terms before they are explained...

3.4 Shallow structure

... avoid deep substructures within sections... this is often the result from trying to do a logical outline of the paper ... the goal of the structuring is to chunk the information in the paper into suitable pieces, and arranging them in an overall structure that is easy to follow ...

3.5 Don't use jargon

... you are writing an article-style paper. Avoid buzzwords and unscientific jargon. Your reader will not take you seriously. Avoid “cuteness”, irony, etc. Your reader may not have the same background as you and might misunderstand or become irritated. Avoid the spoken language that you often find in magazines and on the web.

3.6 Abbreviations

Use abbreviations sparingly. If you use them, be sure to explain what they mean before you start using them. For example:

“the program is represented by an Abstract Syntax Tree (AST). The AST nodes are decorated with attributes computed by the static-semantic evaluator...”

3.7 Exemplify by concrete examples

General statements are often possible to interpret in a lot of different ways. Whenever you state something in general it is a good idea to back it up with a concrete example.

You might think that it is obvious what you mean by your general statement. But it is very nice for the reader to see your example so they are sure they understood you right. And if the reader does not understand your general statement, the example will naturally help.

3.8 Motivate

Whenever you claim something, it is recommended to motivate why. The reader might guess why, but reading your motivation helps reassure the reader that he/she understands what you mean.

Instead of claiming that something is “good”, “invaluable”, or using some other subjective term, it is better to say that it is “useful”, and preferably give an example of such use. “This is useful in order to ...”

3.9 Use consistent terminology

In technical writing, it is important to use consistent terminology. Try to find precise terms and explain them if needed. It is not a good idea to use synonyms since the reader might think there is a subtle difference that is not explained. This is opposite to fiction writing where you want to vary your language.

3.10 Beware of “I”

When you read technical papers you want to focus on the technical content and not on the person who wrote the paper. For this reason, it is irritating when people use the term “I” in their papers. An exception is in the acknowledgment section where it is appropriate to be personal and write “I”.

It is not completely forbidden to write “I”, but you should be aware of its effect, and try to avoid it when there are better solutions.

Instead of writing “I” you can often write “we”. This may feel odd if you are not co-writing the paper with anyone else. However, the “we” could also mean the writer and the reader, like in “Let us now see what happens when n approaches infinity...”. It could also mean “me and my supervisor” or “me and my students” or “me and my colleagues”. If you feel odd about using “we” anyway, you can often rewrite the sentences to avoid personal pronouns altogether.

3.11 Never copy

It may be tempting to copy phrases, ideas, or complete works from other sources. Never do this. It is strictly forbidden and may lead to disciplinary measures. However, it is perfectly fine to cite others. Use citation marks and give a reference to the source. If you reuse a fact, an idea or an example, give a reference to the source, even if you have used your own wording. Read more about plagiarism at, e.g., <http://www.princeton.edu/pr/pub/integrity/pages/plagiarism.html>. When in doubt, consult your teacher.

4 Related work

This paper is only intended as a quick introduction to writing papers in computer science. There are other papers and notes addressing writing within the field of computer science. For example, how to get your paper accepted at specific conferences, how to review CS papers, etc. In comparison, this paper gives more basic introductory advice like how to structure the paper into sections. For more advice, see, e.g., the links on the web page by Mark Leone [2].

5 Conclusions

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Acknowledgements

I would like to thank bla bla bla for bla bla bla...

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2. M. Leone. Advice on Research and Writing. Carnegie-Mellon University. <http://www-2.cs.cmu.edu/afs/cs.cmu.edu/user/mleone/web/how-to.html>