Thesis Tips & Paper Writing

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1   How to write a (conference/journal) paper [2013]

Well, actually this is not a how to. Just some comments. And the most important one is this:

1.1   Who do you write the paper for?

In zero-th order, you write the paper to be accepted! That's perhaps disillusioning because you thought you'll write a great piece of literature, different in all respects to anything before, a seminal paper, one that the world will talk about. That's fine, but first it needs to be accepted. Now, in that view, who do you write the paper for?

(i) For the reviewer that is looking for reasons to reject and, sometimes, for reasons to accept.

(ii) For the 'senior researcher' that, due to his strong preconceptions (prior, I should say), will decide after 2-5 minutes to know what the paper is *all* about. And in doing so he will skip and jump to precise locations in the document where he, due to his strong preconceptions (...), knows that things must be explained. And he will be annoyed if he does not immediately find information at the places he expects (as humans are naturally annoyed if someone dares to violate their preconceptions). Often, reader (i) and (ii) coincide.

(iii) For the actually interested and experienced reader that knows what the paper is roughly about, has already decided that it is interesting and well motivated, and now wants to learn about the technical details. He will expect the details to be given concisely, without all the motivations/philosophy/discussion crap, at exactly the right place.

(iv) And at the very last, for the young unexperienced reader, that still believes papers are read from front to back and should be a joy to read.

In my experience, many unexperienced writers tend to write for the 4th audience, which, when it's about getting the paper accepted, is a bugger. If you accepted the above, writing a paper is not an artistic skill that would require you to develop your own style. Instead it is a rather well-defined chore, where the right things should be written at the right places. And it is a bit a game of theory of mind, where the writer needs to think a lot about the expectations of the reader.

Disclaimer: Yes, ideally, papers should be a joy to read. And some of you are really good writers and should exploit this. But this, in my opinion, is secondary to the goal of writing a paper that will be accepted and is truly *functional* (also in the positive sense) for readers (i), (ii) and (iii).

1.2 What do annoying readers/reviewers expect at which place?

1.2.1 Abstract

1.2.2 Introduction

Dedicate this to readers (i) and (ii)!

Briefly motivate your area of research as a whole, pointing to the future goals the field aims to achieve. Then mention limitations of the state-of-the-art, bottlenecks that explain why the field didn't manage to achieve its goals yet. Then state that your approach addresses exactly such bottlenecks, remedies some limitations. All this still non-technical but referring already to some key references.

Then state the contributions explicitly, almost enumerate them. This is like setting up a contract with the reviewers, shouting at them THESE ARE MY CLAIMED CONTRIBUTIONS, AND PLEASE JUDGE ME ON THESE. Sounds crazy, but I think it is really necessary to give a reviewer a clear 'hint' on what basis he should actually evaluate the contributions of the paper. Otherwise you might end up with a review that states "the paper's contributions

in saving the moon were insignificant" – only because he discovered the word 'mooning' somewhere in your paper.

Then briefly outline the structure of the paper.

1.2.3 Related Work

Dedicate this to reader (i)!

Several paragraphs (say 3-4), each of which concerns a certain related area, briefly mentiones the achievements of several papers (say 6), and then draws a conclusion from this. There are the following options for a possible conclusion:

- the existing papers address exactly the same problem as we do; our work outperforms the existing algorithms as we shown in the experimental section

- the existing papers all share a certain limitation; our work generalizes this and gets rid of exactly this limitation, the experimental section demonstrates that our method can solve problems that others fail due to their limitations

- the existing papers are good and provide good algorithms but do not address the integrated problem; our work employs and combines these existing algorithms to solve a greater, higher-level problem

This section needs to anticipate what you will compare with in the experimental section. Again, this is like setting up a contract with the reviewer, telling him on what basis to evaluate the paper. In case the reviewer knows the previous work in more detail this will also enable him (or bias him) to compare the problem formalization to exactly the papers that you chose to discuss.

1.2.4 Method sections (named differently)

Dedicate this to reader (iii)!

- Clearly discriminate between known background (also when not explicitly naming a section 'background') and own models/formalisms

- Use a technical writing style, trying to convey the method as concisely as possible (think of reader (iii)), without too much motivation/discussion/fuss

If in these sections you still think that you need to motivate your goals/aims/approach, then you did something seriously wrong in the intro and related work section!

Yes, you may motivate and discuss specific choices of formalization, technical details, draw in detail relations to other formalisms or algorithms. But this is not anymore the battleground to make readers interested in your methods or iterate over and over again how cool it is. Just explain.

1.2.5 Evaluations

Sometimes it is helpful to clearly state at the beginning of this section what claims the experiments investigate.

Do them solidly. Not much to say otherwise.

1.2.6 Conclusions

Do not literally reiterate the whole abstract or introductions. But yes, usually you start with a few sentences that recap what has been developed, contributed and how well it performed (which naturally have overlap with the abstract). But keep this short.

Actually, you can leave the conclusion very short (say, just a few lines). A very sympathetic thing is if you openly discuss the limitations of your approach, which you can if you have enough confidence that the positive aspects are strong anyway.

Sometimes people append opportunities for future research, or some wider discussions. But I think this gets less and less popular and I also don't like it much: It is too cheap and arbitrary to make statements about what one could do in the future. An open discussion about limitations and how one could remedy them is more sympathetic, I think.

2 How to write a (Bachelor/Master) Thesis

A couple of points:

- The purpose of a Bachelor/Master project and thesis is *not* just to do something and provide a report on what you did! A Master thesis is *not* a lab book or protocol (Versuchsprotokoll) of your work that reports "I did this. Then that. And the results were this." Instead, the Master thesis should (aim to) provide a scientific statement, just like a conference paper, motivating the work as a whole, pinpointing the limitations of existing methods and why the approach is promising in progressing the state-of-the-art, etc.

- The major contribution of a Master project is *not* only an implemented algorithm or method. The discussion of the novel approach *relative* to the state-of-the-art is at least an equally weighted contribution! In other words: The outcome is not only a "thing", but an understanding of why/how/when that "thing" is better than previous existing things.

- Both points require that you really know and understand the state-of-the-art in the respective field! Achieving this is a major part of the work and desired outcome of the project. Your insight in the field will be reflected in the sections 'Intro' (motivating the work), 'Related Work', and 'Discussion'.

Therefore, write the theses exactly structured the same way as a conference paper! Plus the following additional sections:

2.0.7 Background

'Background' refers to standard notation, knowledge & techniques used in the work, but which might not be familiar to the reader. This is like extracts from text books or lectures that a reader might already know anyway, but you provide for completeness (or because you can present the material more beautifully).

Insert this between 'Related Work' and your 'Method sections'.

2.0.8 Discussions (of Insights & Alternatives)

For a thesis, the conclusion should be replaced by a much broader discussion of what has been learned from the whole work. This discussion should include the following subsections:

– Results: First discuss the evaluation results: Have we achieved what we wanted to show? How do we compare to existing methods/approaches?

– Alternatives: What would have been (potentially better) alternative approaches to the whole project? Consider the whole range of possibilities of the state-of-the-art again! Even if you have not empirically evaluated them, can you guess how existing methods X or Y would have performed on the evaluations? If you'd start the project over again, how would you approach it now?

– Insights: What insights have been gained generally? During the work, have you tried methods and abandoned them? Why? Has there been an insight of what are new core research problems for the future?

– Brief Conclusion: As for a conference paper

Unlike for a conference paper, the discussion should definitly also give space to negative results, because they are really insights.

3 How we evaluate Bachelor/Master theses

These are the five points we eventually write brief evaluations about:

1) Scientific discussion (Thorough discussion of the motivation, related problem settings, related work, alternative approaches, benefits and limitations of alternative and own approaches)

2) Method development (solid problem definition, clean derivation of methods, originality and ingenuity of own ideas and solution approaches, formal analysis (equivalences/complexity/theory))

3) Implementation & Results (methodologically clean evaluation of own methods, solid comparison to alternatives, final discussion of results and methods)

4) Presentation (written and oral)

5) Autonomy, prerequisites (formal knowledge, implementation skills), supervision aspects, initiative and motivation

In Deutsch:

1) Wissenschaftliche Diskussion (Gründliche Diskussion der Motivation, verwandter Problemstellungen, verwandter Arbeiten, alternativer Ansätze, Vor- und Nachteile des eigenen Ansatzes und der Alternativen)

2) Methoden-Entwicklung (Formal klare Problemdefinition, methodisch saubere Ableitung, Originalität und Einfallsreichtum der eigenen methodischen Ideen und Lösungsansätze, formale Beiträge (Äquivalenzen/Komplexität/Theorie))

3) Realisierung und Resultate (Implementierung und Evaluation von Methoden, methodisch sauberer Vergleich mit alternativen Algorithmen, abschließende Diskussion der Resultate und Ansätze)

4) Präsentation (Aufschrieb und Vortrag)

5) Eigenständigkeit, Vorwissen und Fähigkeiten (formales Wissen und Implementierung), Aspekte der Betreuung, Motivation und Initiative