Writing a Research Paper in Mathematics

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Postgraduate Away Day
13th May 2010
I do not claim that I am particularly good at or have a lot of experience with writing papers!
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A personal review

Over the last 8 years I have perhaps read about 300 research papers; less than maybe 30 of them were well-written.
Sins of authors of mathematical papers

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There is a virtually inexhaustible supply of badly written papers.
Massively parallel computers (MPCs), characterized by their scalable architectures, are a viable platform on which to solve the so-called grand-challenge problems. These distributed-memory systems are expandable and can achieve a proportional performance increase without changing the basic architecture. In order to take full advantage of scalable hardware, the application software must also be scalable to exploit the increased computing capacity."

Get to the point!
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Many papers have no key message.
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- In many papers the sentences are too long. Use short sentences.
Sins of authors of mathematical papers

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- Do not plagiarise.
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Get to the point!

- Many papers have no key message.
- In many papers the sentences are too long. Use short sentences.
- Do not plagiarise.
- Try not to write the paper so only you know what you are talking about, and the reader does not have a clue!
Outline

1 Before you write

2 Structure and Organisation

3 Presentation and writing process

4 The reviewing process
The Audience

Who are you writing this particular paper for?
Who are you writing this particular paper for?

Everybody wants their paper to be read by someone.
The Audience

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Mathematical papers are read by specialists in a given domain.
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Think of a specific reader

- Interest your reader.
- Leave out trivial results.
Who are you writing this particular paper for?

- Publish on your website?
The Audience

Who are you writing this particular paper for?

- Publish on your website?
- A journal paper?
Writing your thesis
Melina Freitag

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Journal requirements

- Think about which journal you want to submit your article to (more theoretical? practical? ...).
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- Most journals provide style files/templates.
Outline

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4. The reviewing process
First Draft

The first draft is the hardest part

- A paper should tell a story, if possible.
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An example outline
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An example outline

1. Introduction (describe the problem clearly; put it into context).
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1. **Introduction** (describe the problem clearly; put it into context).
2. **Section(s)** on your main results/analysis (what is new/original in your paper?).
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3. Examples/Experiments/Numerical results/Computations/Comparisons and interpretations.
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Fill the gaps

■ What do you want to be in the sections?
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- What do you want to be in the sections?
- Bullet point strategy.
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- **Bullet point strategy.**
- Add the main theorems and proofs/approaches/mathematical analysis/numerical examples (those are your main results).
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Now you have a "skeleton" to work with!
From the first draft to a first paper version

- Form sentences from the bullet points.
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- Form sentences from the bullet points.
- Fill in all the gaps.
From the first draft to a first paper version

- Form sentences from the bullet points.
- Fill in all the gaps.
- Write an abstract.
Writing process

From the first draft to a first paper version

- Form sentences from the bullet points.
- Fill in all the gaps.
- Write an abstract.
- Add keywords.
More details

Title

- Should not be too long.
- Should not be too general.
- No abbreviations or complicated symbols.
- Verbal element (gerund or participle).
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Abstract

- Present the main results of the paper.
- Should be short and crisp.
- Avoid empty phrases like ”In this article we prove, among other results, that ...”. Just write ”We prove that ..”
- No complicated formulae.
- As independent from the article as possible.
Writing an abstract

Abstract MadLibs!!

This paper presents a ________ method for ________ (synonym for new) (sciencey verb) the _____________. Using ____________, the (noun few people have heard of) (something you didn’t invent) _________ was measured to be _____ +/- ______ (property) (number) (number) _________. Results show _________ agreement with (units) (sexy adjective) theoretical predictions and significant improvement over previous efforts by __________, et al. The work presented here has profound implications for future studies of _________ and may one day help solve the problem of (buzzword)

______________________.
(supreme sociological concern)

Keywords: __________________, __________________, __________________ (buzzword) (buzzword) (buzzword)
Introduction

1. Abstract and introduction are your main "selling points".
2. Interest your reader in the first paragraph!
3. States the problem, history of work and related problems/pointers to relevant work.
4. Your main results/theorems.
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Main Sections

- The body of the paper.
- Contains theorems/proofs/definitions/algorithms/numerical approaches.
- Choose section titles carefully!
- Not more than 5-7 sections, use subsections for better organisation.
Proofs

- The formulation of theorems and proofs is particularly important.
- Be precise.
- Especially, when proofing theorems think about your reader.
- Think about the "logic flow".
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References

- Add the references (most of them will be needed in the introduction).
- Use BibTeX, MathSciNet, Google Scholar etc.
- Make sure your reference list is accurate and up-to-date.
- A narrow bibliography, particularly restricted to the author, is suspicious.
- A long bibliography is only really appropriate for survey papers.
Outline

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3 Presentation and writing process
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Presentation and style

Make your paper clear and enjoyable to read!

Do not waffle!

You do not want the reader to get angry or bored.
Writing process

From the first version to a final version.

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- Read your paper several times.
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  - label for equations/figures/Theorems etc. (\LaTeX).
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7. The whole process usually takes about a year, but often longer.
Addressing referee’s comments

**Reviewer comment:**
“The method/device/paradigm the authors propose is clearly wrong.”

**How NOT to respond:**
× “Yes, we know. We thought we could still get a paper out of it. Sorry.”

**Correct response:**
✓ “The reviewer raises an interesting concern. However, as the focus of this work is exploratory and not performance-based, validation was not found to be of critical importance to the contribution of the paper.”

**Reviewer comment:**
“The authors fail to reference the work of Smith et al., who solved the same problem 20 years ago.”

**How NOT to respond:**
× “Huh. We didn’t think anybody had read that. Actually, their solution is better than ours.”

**Correct response:**
✓ “The reviewer raises an interesting concern. However, our work is based on completely different first principles (we use different variable names), and has a much more attractive graphical user interface.”

**Reviewer comment:**
“This paper is poorly written and scientifically unsound. I do not recommend it for publication.”

**How NOT to respond:**
× “You #&**% reviewer! I know who you are! I’m gonna get you when it’s my turn to review!”

**Correct response:**
✓ “The reviewer raises an interesting concern. However, we feel the reviewer did not fully comprehend the scope of the work, and misjudged the results based on incorrect assumptions.”

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