How to write a paper

Anil Damle (some slides adapted from Joe Halpern)

Writing papers

One of the major activities in academia

Success in academia is closely linked to being able to write papers well

We will talk about the main issues of doing so here

- Won’t cover mechanics of writing papers for specific areas (ask questions or talk to your advisor)

Writing clearly helps clarify and sharpen your thoughts

Writing strategies

Good writing is good writing. Reading examples of good writing helps build the ability to write well

- Identify authors who write well and read there papers—why does the paper clearly and effectively convey ideas.

- This can be broader than just technical papers in your area

There is no single “formula” for good writing, but it can often be easier starting with a more constrained approach and then building your personal “style,” bending and breaking rules (somewhat).

Tell a story

- Arguably the most important part of a paper (in getting it read and accepted) is the introduction
- Identify who you are telling the story to (know your audience)
- Before you write the intro, figure out the short “elevator pitch”
  - Why should someone else think your paper is exciting? The introduction should expand on this.
- I often write a draft of the intro first
- Suggests theorems to should prove, and directions to go

An excerpt

From “Writing Science: How to write papers that get cited and proposals that get funded” by Joshua Schimel

“A paper tells a story about nature and how it works; it builds the story from the data but the data are not the story. The papers that get cited the most and the proposals that get funded are those that tell the most compelling stories.”

An example

“‘Lagrangian interpolation is praised for analytic utility and beauty but deplored for numerical practice.’ This heading, from the extended table of contents of one of the most enjoyable textbooks of numerical analysis [1], expresses a widespread view.

In the present work we shall show that, on the contrary, the Lagrange approach is in most cases the method of choice for dealing with polynomial interpolants. The key is that the Lagrange polynomial must be manipulated through the formulas of barycentric interpolation. Barycentric interpolation is not new, but most students, most mathematical scientists, and even many numerical analysts do not know about it. This simple and powerful idea deserves a place at the heart of introductory courses and textbooks in numerical analysis.[1]”

Excerpt from “Barycentric Lagrange Interpolation” by Berrut and Trefethen

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What makes an idea “sticky?” Why do some ideas stay with you? Heath and Heath [2007] identify six factors, the first four:

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- Unexpected
- Concrete
- Credible

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- Concrete: ground your idea in effective examples
- Credible: Convince the reader that your results are believable (outline in the intro, details later)

A rough structure for an intro

Start with the big picture and key ideas: What are you trying to do and why?

Don’t bury the lead

Write the most important thing first

Can then flesh out the main idea for those interested in reading further; don’t wait till paragraph five to get to the key idea

What are the challenges, why is what you have done not obvious / interesting

Roughly outline at a high level what you did (I like to weave this through the intro)

Summarize and pull it all together.

That said, all rules are made to be broken . . .

Everything else

- Typically, Section 2 gives definitions and relevant background
- The main results are in the following sections
    - The results should emphasize the story. For example, for a theory paper, the goal isn't to prove a bunch of theorems; the theorems are in service of the story.
- Where does related work go? It depends.
    - If your main story is extending/improving prior work, then the work must be discussed in the intro. You should also mention particularly relevant papers and how they relate to your work, at a high level, in the intro.
    - You can do a more careful comparison later in the paper. If there's a lot of other work that you think is worth mentioning, it's useful to have a "Related work" section.
    - Often, the related work section goes towards the end of the paper, after you've stated your results, so you can compare to the work, but this is not a rule
- Conclusion: "Tell them what you're going to tell them, tell them, and tell them what you've told them," also can/should have a discussion and draw conclusions

Revising and editing

The first draft is never perfect. Taking the time to edit and revise is also important to good writing.

Being a good critic helps the editing process (though it can be difficult for your own work).

Getting others to read your work will also help in this regard. Especially those not already familiar with the work.

Typographical errors and grammatical mistakes can be distracting to the reader. It is important to work diligently to minimize them.

Resources

Handbook of Writing for the Mathematical Sciences, Third Edition by Nicholas J. Higham

https://www.maths.manchester.ac.uk/~higham/hwms/

Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded by Joshua Schimel

Questions and discussion