The process of writing a paper

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In this document, I will discuss the process I recommend to develop a research paper. A first consideration is the sequence of steps to take to go from a paper idea to a fully-developed manuscript. A second consideration is the review process. I originally developed this document for my PhD advisees, to communicate how I coordinate the review process, but I have now decided to share it publicly. I think you will find this sequence of steps useful, even if your advisor don't use a process like this.

Stage 1: Paper scope and conclusions

This activity starts off the paper writing process. When we are talking over research, we will get to the point where we say, "This looks good, let's write it up." Questions to answer at this point are:

- What is the topic?
- Who is your audience? At first, figure out the domain of the audience (structural engineers, city planners, etc.) Next, list names of specific people you will want to read the paper. Visualizing specific people will help you think about whether your conclusions are relevant and valuable to them. It will also help you calibrate how much background information you need to provide. Related to this, pick a target journal to publish in.
- What do you want your audience to learn?

This is also the time to discuss authorship and (if appropriate) invite the other authors to join the effort. By establishing the authorship and roles of each author now, the later steps will be much smoother. Sometimes students want to wait on discussing this with potential coauthors, out of uncertainty, or a hope that it will work out naturally, but delaying usually creates complications. Waiting until the end to invite a coauthor may surprise them if they didn't know you were working on a paper, and you may feel weird adding them if they haven't contributed to the paper preparation. Conversely, you don't get the benefit of feedback and help from your coauthors if they haven't yet committed to helping coauthor the document.

Stage 2: Outline

This stage is like putting together a puzzle. There are lots of complicated ideas that need to be interwoven, and it can be a fun challenge to piece it all together. There is usually no single right way to put everything together, so try a few ideas and don't get caught up in careful writing at this point.

Some ideas and questions to keep in mind at this stage:

- Focus on the conclusions first. The rest of the paper is building towards your conclusions, so knowing the finish line will guide what needs to be included to reach these conclusions. I will look carefully for your conclusions and use them when commenting upon the appropriateness of other material in the paper.
- Identify the figures needed to explain your ideas and conclusions. Create rough-draft figures and place them in the outline. You will add, subtract and revise figures as you proceed, so don't spend much time at this point polishing your figures. Often, the figures you can use here are ones you have used in PowerPoint presentations.
- The best structure for your paper is usually *not* to describe the chronological order in which you performed your work. This is a tough one to overcome, because the chronological order in which you did the work is ingrained in your head. But when you try to build a story to support your conclusions, there are usually cleaner ways to summarize your analysis and key findings.
- Develop bullet points of critical concepts and observations to discuss in each section of the outline.
- Look at good papers by others on similar topics. How did they organize their material? How much time did they spend introducing key underlying concepts? It is much easier to consider your structure if you have some exemplar papers to compare your outline to.
- Think hard about what material you can leave. You will have more interesting things to discuss than you have room for, and trying to talk about everything you have ever worked on will obscure your primary results. The same goes for background information. There are lots of things that might be interesting to discuss, but are they necessary? You can always save extra results for other papers, appendices, etc., so it's not as if the material is lost forever.
- Don't worry much about the literature review at this point. It will be much easier to determine the important prior literature when writing your first draft in the next stage.

Your tasks at this point

- Rank the top two or three conclusions that you hope the reader takes away after reading your paper. Now look at the text and figures: have you focused sufficiently on these main points? Have you spent an excessive amount of time on anything that isn't a major point of emphasis?

My reviewing focus

1. Are you focusing on the most important contributions?
2. Are the concepts in the paper presented in a logical order?
3. Are the choices of figures and examples appropriate?

Stage 3: First draft

Write the text of the paper. After you have the outline, key concepts and figures prepared, it will be easier to decide what text is needed in each section. Write quickly, and don't worry about making your writing beautiful or grammatically perfect; if you are thinking about grammar, then you won't

be able to concentrate on the technical content and structure. And you may delete big chunks of text later, so don't waste time making it perfect yet.

Draft an abstract and focus extra attention on this. The abstract should summarize the topic of the paper, the key approaches used in the analysis, and key findings of the work. You may re-write the abstract later, but at this point, it is an excellent test to see if you have those concepts identified.

Your tasks at this point

- Review the structure of the paper. If you just read the headings without the text, is the outline of your paper clear and logical? Does all of the text beneath each heading fit within the stated topic?
- Check each paragraph—does it have a coherent topic? Is that topic apparent in the first sentence? Are the paragraph topics arranged in a logical manner? Do the transitions between paragraphs make sense? If you are answering no, that is a sign of incoherent writing.
- Show a copy of your draft to some fellow students—see if they find it interesting or understandable.
- Use my review comments as an opportunity to learn. How does the revision improve the paper? Are you making consistent mistakes that you can learn to avoid in future writing? Do not take corrections personally. There might be many corrections on the pages, but that is a natural part of the collaborative writing process and a result of an outside perspective bringing new ideas.

My reviewing focus

1. Are you providing appropriate detail in each section? Do any sections need substantial lengthening or shortening?
2. Are the conclusions supported by evidence?

Stage 4: Refined drafts

Once the paper's structure is in place, you can turn your attention to details in the paper. Below are items to check as your writing is getting more polished. Don't try to do these while you are writing your first draft; they will distract you from writing down your ideas. Instead, finish your draft and then go back later to see how you can "tighten up" what you've written.

1. Focus extra attention on the abstract, conclusions, and introduction in that order. Many readers will only read those sections, so they should clearly explain what you have done and why it is important.
2. Check that you are getting to the point quickly. For example, if you have a section called "Objectives," do you state an objective in the first sentence or two of the section? Taking a long time to get to the point frustrates readers and obscures your key points.
3. Avoid emotional or judging words in technical writing. Saying that an issue is "of utmost importance," is "obvious," or is "trivial," may seem reasonable to you, but not everyone will agree with your conclusions. By using those words, you tell readers how they should react, instead

of guiding them to draw their own conclusions. It is more professional to be dispassionate in your writing and let the results speak for themselves.

4. Use fewer words and simple words, when possible. Consise writing is pleasant to read and easier to understand.

   -Bad: *It can be seen that in Figure 1, the dependence between the X variable and the Y variable can be approximated by a linear relationship.*

   -Good: *X and Y have an approximately linear relationship, as seen in Figure 1.*

5. When you are proofreading, focus on a single issue during each of your passes through the document. If you multitask, you will miss problematic items. Some items to check during individual passes:

   (a) Your numerical data and equations are correct.
   (b) You have defined all of your acronyms and symbols.
   (c) You have used consistent terminology to refer to key ideas.
   (d) You have included accurate references for all of your citations (use a reference manager like Zotero).

My reviewing focus (I will take multiple passes on versions at this stage)

1. Can sections or paragraphs or sentences be shortened?
2. Are figures clear? Can anything be added or subtracted to make them better serve their purpose?
3. Can phrases be re-written to be clearer?
4. Did you follow all of the above rules?

Stage 5: Submit the paper for review

Once we both agree that the paper is ready for review by the journal, send it in. A few notes on items that often come up as you submit your paper:

- By default, you should submit the paper yourself and be the corresponding author on the paper. It's a good chance for you to learn how the publication process works.
- If there is a field for you to upload a cover letter, you can include something very simple the one below.

  Dear Editor,

  Please find attached our manuscript entitled "...", which we request that you consider for publication in [journal name]. We confirm that this is original work and has not been submitted elsewhere for publication.

  [You can re-use material from theses, proceedings, or reports that are not widely distributed, but if this is the case, then declare it in the cover letter and explain the degree of overlap. We can discuss this.]

  Sincerely,

  [your name]

- When you submit your paper to a journal, the editor will typically send it to two or three reviewers, each of whom will provide their opinion on what changes are needed before the paper can be published (assuming they recommend that it be published). The Editor or Associate Editor at the journal is responsible for picking and inviting knowledgeable reviewers. Some journals ask you for a few suggested reviewers to help the Editor in making their choices.

- When suggesting reviewers, try to identify other researchers in the field who are knowledgeable about the topic of the paper. I generally look at the reference list for some initial inspiration for names. I also tend towards younger people if possible as they tend to be less burdened with other administrative duties, and more timely with their reviews. The potential audience people that you identified in Stage 1 are also good choices.

Stage 6: Respond to review comments and resubmit

It usually takes one to four months for a journal to complete its review and provide you a conclusion. Most likely, you will receive a list of comments and questions from the reviewers, which you will have to respond to when submitting a revised paper.

Here are some things to keep in mind when preparing your responses and revised paper:

- First just read all the reviews a couple times, and take a day to think about them. Do you think responses will require re-analysis, or just clarification and elaboration of existing results? Will the revisions ultimately improve the paper? It can be a bit shocking when you first read a list of concerns about a paper that you thought was perfect, but after you've had some time to reflect and think about a path forward, you should feel better.

- Make a document that as a numbered list of all the comments, and make some notes after each one about what you might do in response. Don't worry yet about detailed responses, and don't change anything in your paper. This step is somewhat like outlining your paper–you are just trying to figure out your plan. This stage is a good time to talk your plans over with your advisor and co-authors, and once you agree on the plan then you can start responding and making revision.

- Be humble and polite in your tone when you respond, even if you think the reviewer is wrong or misunderstood your paper. First, if the reviewer misunderstood your point, then there is a good chance that future readers of your paper will misunderstand as well, so this is a chance to fix your paper and clarify your point. Second, if you annoy the reviewer by being argumentative in your response, then you are only likely to cause yourself trouble when the reviewer has to decide whether the revised paper is worthy of publication. Keep in mind that the reviewer has volunteered their time to offer constructive feedback, and it is tremendously annoying as a reviewer to feel like the author is not receptive to feedback.

- By default, your response to a review comment should be to change something in the paper, and not just to explain the issue to the reviewer. If you only explain to the reviewer in a response, then future readers do not benefit from the clarification. If you revise the paper, then all readers will better understand the issue.

- Be specific in your responses. If you reply "we changed the paper to clarify our concept," then the reviewer will have to expend a lot of effort to determine how to evaluate your revised paper and see if you have fixed the problem. Instead, write something like "Following Equation 8, we

added the following text to clarify our concept: xxxxx." Then it will be easy for the reviewer to identify and evaluate that change.