



Technical Writing

Professor Fran Berman

bermaf@rpi.edu

Graduate Skills Seminar

October, 2016



Getting ahead entails good ideas communicated well

- **Success in research** = good results + good communication about your results
- **Success in business** = good ideas + good follow-through + good communication about your work
- **Good communication** =
 - “Elevator pitch” for professional conversations
 - Good presentations
 - Good writing
 - Conferences, journals, proposals, reports, opinion pieces, etc.



Writing Stuff

- Conference Papers
- Journal Papers
- “White Papers”
- Op-eds



Writing as a Creative Process

Writing advances your technical understanding. Many details and the overall story refined when you write things up. (Especially true for your thesis and grant proposals ...)

- **Writing can help organize the way you think about your results**
 - You probably will need to iterate ...
- **Writing can help put your work in context**
 - You'll discover a lot about your work by setting it in context with others
- **Writing may involve additional work**
 - Do you need to do more in order to present strong results?
- **It's important to have extended time periods to “get in the zone” when you're writing**



Writing as a Communications Vehicle

*Writing exists in a cultural context. Know your professional culture and how it communicates. Your writing should be in the same style as others in your group and be **optimized for your reader.***

- **Who is the audience?**
- **What is your story?**
 - Why is it worthy of your audience's attention?
 - Is your story compelling enough to keep your audience engaged?
- **Why does your story matter?**
- **How credible is your story?**
 - Building your credibility as an expert

Heilmeier's Catechism (from Wikipedia)

George Heilmeier was former Director of DARPA (Defense Advanced Research Projects Agency), former CTO of Texas Instruments, former President of Bellcore, and former CEO of SAIC. **Heilmeier's Catechism** is a set of questions credited to Heilmeier that anyone proposing a research project or product development effort should be able to answer:

- **What** are you trying to do? Articulate your objectives using absolutely no jargon.
- **How** is it done today, and what are the limits of current practice?
- **What's new** in your approach and why do you think it will be successful?
- **Who cares?**
- If you're successful, what difference will it make? (**value proposition**)
- What are the **risks and the payoffs?**
- How much will it **cost?**
- **How long** will it take?
- What are the midterm and final "exams" to check for success? (**milestones, metrics of success**)



Writing is a skill you can keep getting better at

- If you don't get accepted ... **DON'T GIVE UP**
- “Bounce”/improve the work!
 - Get over it, look at the reviews and improve the piece
 - Get more results if needed
 - Send it somewhere else (or for another round)
- **Not getting accepted doesn't necessarily mean that the work is bad** (original PageRank paper rejected from SIGIR in 1998 ...)

What should you write about?

- Choose a problem that is compelling to your audience and that you can articulate well.
- Make sure that your solution is credible and well-evidenced
 - You should have a sense of the “metric of success” for solutions – what does it mean to solve the problem?
- The problem statement should be persuasive (why should your audience care?). The solution “story” should be solid.

Where to find problems?

- Papers in the area
- Your advisor and other experts
- Extension of an approach to a richer setting or more applications
- Extension of an approach by changing the context / parameters
- Your own curiosity, Star Trek, etc.



Writing Conference Papers

- **Audience:** Specialists in your general area (e.g. programming languages, data mining, HPC)
- **Review committees:**
 - **Have a lot of papers to read in a short period of time -- You need to “sell them” early**
 - Make your results compelling and clear on the first page
 - Make your paper easy to skim (graphics, organization, line spacing, font)
 - **Are looking for new results that advance the state of the art**
 - Make the innovative aspects of your paper clear up front
 - **Are often looking for “hot” topics**
 - Can you relate your results to a community / national priority or new area?

Writing Conference Papers – Organization

- Organization of your paper is dependent on conference and area. **Read “best papers” from your target conference as a model.** (Best papers in many conferences at http://jeffhuang.com/best_paper_awards.html)

- **Generic format**

- Introduction
- Related work
- Approach
- Results
- (Future Work)
- Conclusion
- References

Current / next generation conference papers may expect you to **cite your data.**

Get in the habit of doing it now.



Writing Conference Papers – More Detail 1

1. Abstract

- 1-2 paragraphs summarizing the paper and results. Should be **well-written and broadly understandable**.

2. Introduction

- ~1 page – should tell reviewer everything they need to know about what you are doing and why it is important.
- **This is the time to catch the reader and make a positive first impression. Spend the extra time to make this compelling, exciting and interesting.**

3. Related work

- **Generously include work that's relevant, especially from likely reviewers**
- Diplomatically describe why their work doesn't solve your problem (“Berman's work focused on networks in which communication costs are zero. Our focuses on networks in which communications costs are positive and vary dynamically”)
- Related work is sometimes positioned later in the paper.

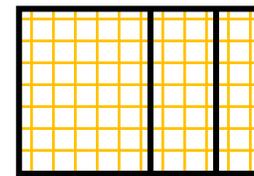
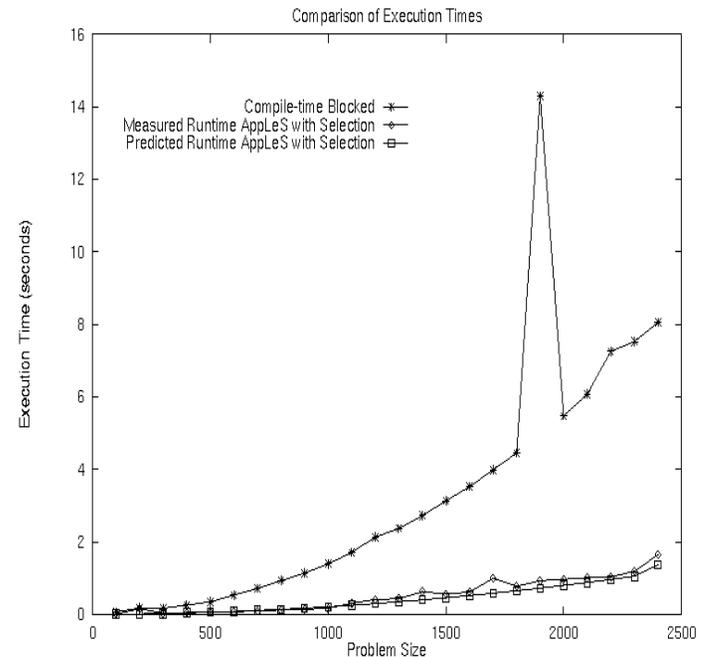
Writing Conference Papers – More Detail 2

4. Approach

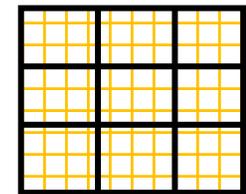
- Clearly describe the problem you're solving and your approach to solve it: methods, experiments, theorems, etc.
- Provide enough detail to make your approach credible and reproducible

5. Results

- Make the work visually accessible and interesting. Graphs and visuals (tables, etc.) can be great additions
- Be able to discuss the trends in your data and what they imply with respect to the problem and the area.



Run-time
AppLeS
Partitioning



Compile-time
Blocked
Partitioning

Writing Conference Papers – More Detail 3

6. (Future Work)

- What needs to be done next?
- This can help increase the interest and motivation for the work you've already done.
- Sometimes not included.

7. Conclusion

- .5 page? Should be as self-contained as possible, compelling, and less than a page: What did you do, how did you do it, what are the results, why should we care.
- **After the introduction, this will likely be the second most read section.**

8. Acknowledgements

- People who helped who are not authors. Be generous.

9. References

- Be relevant and generous. Use the standardized reference formats for your community.



Writing Journal Papers

- **Journal papers are the archival record of your work. This is the place for comprehensive detail and thorough description of what you have done.**
- **Audience:** Specialists in your specific area (e.g. exascale programming environments) and in the general area (e.g. HPC)
- **Journal papers**
 - Should include enough details so that results can be reproduced when possible
 - Should provide detailed methodology and charts and graphs of results
 - Should include data citations so paper is “self-contained”
 - Should stand up if read “with a fine toothed comb”

Writing Journal Papers – Organization

- Organization of the paper is dependent on journal and area. **Read other papers from the journal as a guide.**

- **Generic format**

- Introduction
- Related work
- Approach
- Results
- Future Work
- Conclusion
- References





Writing Journal Papers – More Detail 1

- Use the same basic organization for journal and conference papers. All guidelines about clear and compelling writing in conference papers apply.
- **In a Journal paper, you have more room and are expected to go into greater detail.**
 - **Reviewers expect to spend more time on these and provide detailed feedback to you.**
 - Write the paper assuming that every detail will be gone through with a fine-toothed comb.
- **Differences between Journal and Conference Papers**
 - **Introduction** -- you have a bit more room than a page. In a 20 page paper, you can spend **2+ pages** motivating the problem and your solution.
 - **Related work** – You can go more into detail about what other people have done and where your work fits in. Remember that you need to **both show that your work is different and not put down other's research**

Writing Journal Papers – More Detail 2

- Differences between Journal and Conference Papers:
 - **Approach** – Provide a detailed methodology that could be reproduced. Provide enough detail about parameters, hardware, software, data, versions **so that someone else could reproduce your results** with the same setup if possible.
 - **Results** – **Explain your results and their significance thoroughly.** Why did the graph spike? Under what circumstances was one method better than another?
 - **Future Work** – Include future approaches and problems that this work could support. Spend **< 1 page** on this.
 - **Conclusion** – Make this self-contained and clear. Spend **< 1 page** on this.
 - **References** – **Be generous and thorough.**



Optimizing your chances of success 1

- **“Red-team” reviewers:**
 - Pick knowledgeable and trustworthy colleagues to read and critique your paper.
 - **Revise the paper** based on their reactions and their comments on strengths and weaknesses.
- **Cite your data:**
 - **Provide a publicly accessible place for your data** – ingesting your data in a public or institutional repository is best if the Journal does not provide repository services.
 - **Give your data a DOI** and create a citation for your data.
 - Use community practice / standards to refer to your data. (<https://www.rd-alliance.org/group/data-citation-wg/outcomes/data-citation-recommendation.html> provides a community approach that includes dynamically changing data sets). Include relevant metadata.



Optimizing your chances of success 2

- **Be careful about correlation vs. causality:**
 - Many phenomena happen together without a causal relationship
- **Strive to make your work reproducible:**
 - Include enough detail about methods, hardware, software, parameters, etc. so that someone could conceivably reproduce your results.
 - Share code and data when possible. Issues about what to share and what is competitive advantage still under discussion
<https://web.stanford.edu/~vcs/papers/RoundtableDeclaration2010.pdf>
- **Don't "thumb your nose at the giant"**
 - Pay attention to page length. If there are page limits (e.g. in conferences), don't just make things smaller to fit in.
 - Be generous with related work – include relevant potential reviewers



Optimizing your chances of success 3

- **Make the paper easy / fun to read**
 - **Use graphics** to compellingly convey the message
 - Use font / spacing / italics and bolding / section organization / color to make the paper fun to read
 - **Don't jam every possible space and use super-small font**
 - **Do multiple drafts** until you get it to a level that will promote your success
- **Present your work professionally**
 - **Use “we”** vs. “I”, even if there is only one of you
 - **Neither oversell nor undersell.** Study how other authors subtly promote the importance of their work without sounding arrogant.
 - **Look at “Best Paper” recipients** in your conference or highly ranked journal articles for good examples of writing and results
 - **Do not plagiarize** – if you want to refer to something explicitly or implicitly, cite the work and give credit to the authors.

Writing “White Papers”

- “A **white paper** is an authoritative report or guide that informs readers concisely about a complex issue and presents the issuing body's philosophy on the matter. It is meant to help readers understand an issue, solve a problem, or make a decision.” [Wikipedia]
- **Audience:** Non-specialists
 - **Writing a “white paper” about your point of view is often the first step to pitching an idea to a funder or stakeholder**
- **White papers are usually**
 - Short (1-3 pages)
 - Aimed at non-specialists
 - Written to provide compelling evidence to go in a particular direction
- **Make it short, clear, compelling, self-contained and easily readable.**
 - Use Heilmeier’s Catechism to help clarify your own thinking.



Writing op-eds

- An **Op-ed** is a short written piece that expresses your opinion.
- **Audience:** General public
- **Publication venue:** Newspaper, magazine, etc.
- **Purpose:** Persuasively get your point of view across
- **Op-eds can have tremendous influence on community and stakeholders**
 - Can establish you as an expert
 - Can get your point of view into the national discourse
 - Can be useful to your company, project or community
- **Writing Op-eds can help train you as a persuasive communicator**

Op-Eds give your opinions a voice

SEARCH

The New York Times

EDITORIAL Promises, Promises From AT&T

DAVID BROOKS The Epidemic of Worry

DAVID LEONHARDT Dear Republican Voters

The Opinion Pages

Struggling to Serve at the Nation's Richest University

Rosa Ines Rivera
ON CAMPUS OCT. 24, 2016



Karyn Lee/Pratt Institute

Cambridge, Mass. — I've been at [Harvard University](#) for 17 years, but I've never been in a classroom here. I'm a cook in the dining halls. I work in the cafeteria at the T.H. Chan School of Public Health, where every day I serve

More News | Today's Paper | Video | Most Popular | U.S. Edition

Try a Digital Subscription | Log In | Register Now | Help

The New York Times Science Search All NYTimes.com

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPINION ARTS STYLE TRAVEL JOBS REAL ESTATE AUTOS

ENVIRONMENT SPACE & COSMOS

I Had My DNA Picture Taken, With Varying Results

Log in to see what your friends are sharing. Log in with Facebook on.nytimes.com. Privacy Policy | What's This?

What's Popular Now

Surgeons Who Took on F.B.I. Abandon Shadow

Run Ren Shao, Movie Mogul Beta as Creator of King of the Game, Dies at 106

MOST EMAILED RECOMMENDED FOR YOU

- In Defense of DNA Testing (2 Letters)
- Praying for Carp in Great Lakes, but Debating Their Presence
- A New Test for Malaria, No Blood Required
- LETTERS Weighing the Value of Mammograms
- OBSERVATORY Mutant Petunias Sing the Blues
- NEWS ANALYSIS Why Everyone Seems to Have Cancer
- DOT EARTH! Food, Genes and the Feeling of Risk

Kira Peilart, 28, had her DNA tested by three direct-to-consumer companies, and the results don't agree.

By KIRA PEILART
Published: December 30, 2013 | 421 Comments

I like to plan ahead; that much I know about myself before I plunged into exploring my genetic code. I'm a healthy 28-year-old woman, but some nasty diseases run in my family: [sarcotendinitis](#), [rheumatoid arthritis](#), [Alzheimer's](#) and [breast cancer](#).

FACEBOOK TWITTER GOOGLE+

POLICYFORUM

SCIENCE PRIORITIES

Who Will Pay for Public Access to Research Data?

Francine Berman and Vint Cerf²

When economic models and infrastructure are not in place to ensure access and preservation, federally funded research data are "at risk."

On 22 February, the U.S. Office of Science and Technology Policy (OSTP) released a memo calling for public access for publications and data resulting from federally sponsored research grants (1). The memo directed federal agencies with more than \$100 million R&D expenditures to "develop a plan to support increased public access to the results of research funded by the Federal Government." Perhaps even more succinctly, a subsequent *New York Times* opinion page sported the headline "We Paid for the Research, So Let's See It" (2). So who pays for data infrastructure?

The OSTP memo requested agencies to provide plans by September 2013 that describe their strategies for providing public access to both research publications and research data. Plans are expected to be implemented using "resources within the existing agency budget," i.e., no new money should be expected. Currently, federal R&D agencies are working hard to foster approaches to public access, to assess needs for supporting partnerships and enabling infrastructure, and to develop timetables and approaches for implementation. We focus here on the research data portion of the OSTP memo.

Research data of community value are supported today in a variety of ways. Some of them, like those in the Protein Data Bank (PDB) (3)—a database of protein structure information used heavily by the life sciences community—are supported by the public sector. (In particular, U.S. funding from the National Science Foundation (NSF), the National Institutes of Health (NIH), and the U.S. Department of Energy for the Research Collaboratory for Structural Bioinformatics (RCSB) PDB is \$6.3 million annually.) Other data, as from the Longitudinal Study

What happens to valuable data when project funding ends? Consider, for example, a 3-year research project in which valuable sensor data are collected from an environmentally sensitive area. Those data may be useful not just for the duration of the project but for the next decade or more to collaborators and a broader community of researchers. For the first 3 years, the costs of stewardship (including development of a database that supports analysis, access to the data for the community through a portal, adequate storage and management of the data collection, and so on) may be paid for by the grant. But who pays for subsequent support? In such cases, research data may become more valuable just as the economics of stewardship become less viable.

Up to this point, no one sector has stepped up to take on the problem alone, and it is unrealistic to expect as much. In the public sector, federal R&D agencies are unlikely to allocate enough resources to support all federally funded research data. The costs of



Op-Eds provide evidenced opinions

Not all Op-Eds are like this, but many good Op-Eds have this structure:

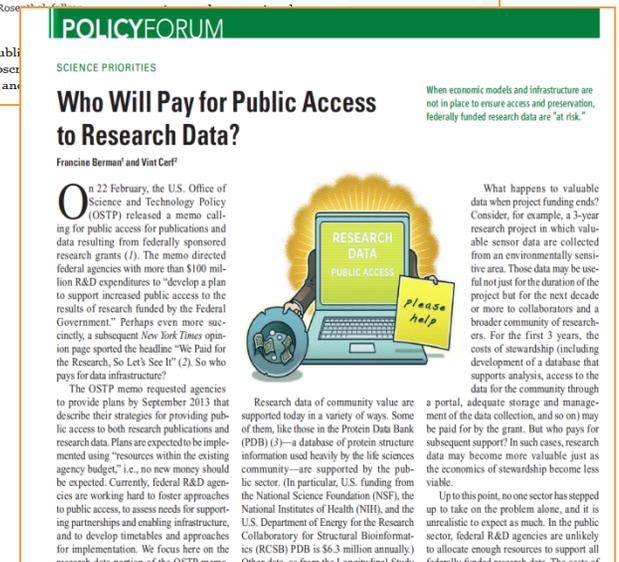
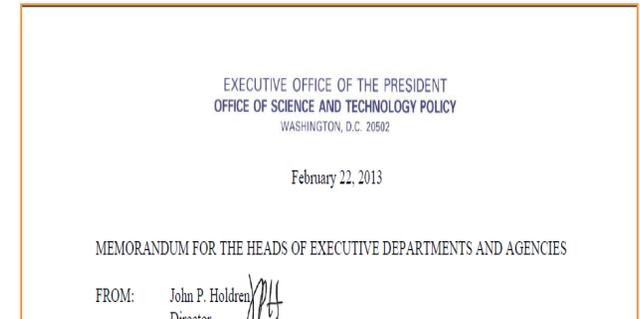
- **Lede** – *Lead-in around a news hook or personal experience*
- **Thesis** – *your position (explicit or implied)*
- **Argument** – *should be based on evidence (stats, news, reports, expert quotes, scholarship, history, experience). Arguments often presented as a series of points.*
- **Criticism pre-emption** – *take the lead in acknowledging the flaws in your argument and address potential counter-arguments*
- **Conclusion** – *circle back to lede?*

Lede Options

- Current news
- Dramatic or personal anecdote
- Reference to popular culture or twist on conventional wisdom
- Anniversary of an event
- Major new study

Fran's Op-Ed Story

- February 2013 OSTP Memo: Called on federal agencies (NSF, NIH, DOE, NASA, NOAA, etc.) for new policies for **public access to research data and publications** but **no new money** for infrastructure.

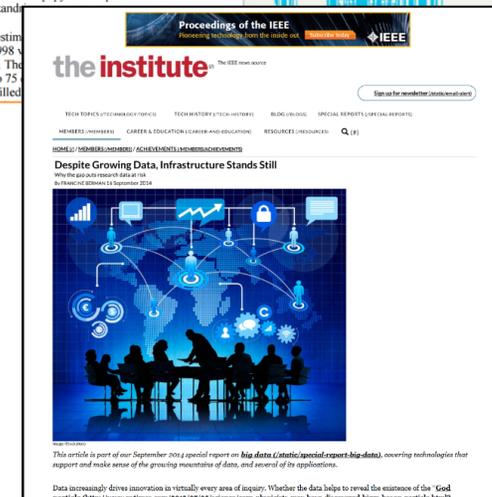
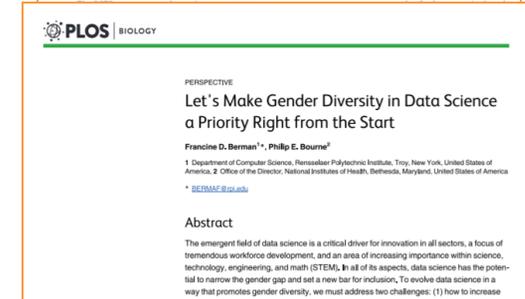
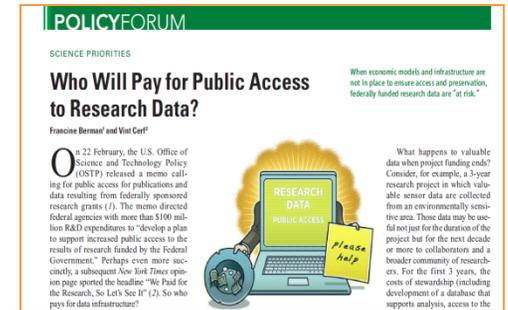


Research
with the fewest
the direct results of
public, industry, and
digital data.

Op-Ed Tips

- **Write in a way that generic smart people can relate to; don't assume they know your discipline.**
- **Don't use buzzwords or talk "inside baseball" without explaining things.**
- **Pay attention to publication word count** – op-eds are usually quite short, often less than 1500 words
- **The final version may be reviewed and/or edited** – what you send in may not be the final draft
- **Do your homework** – everyone will read this

All articles available at <http://www.cs.rpi.edu/~bermaf/>





Reprise: Writing is a skill you keep getting better at

- If you don't get accepted ... **Don't give up**
- **“Bounce”/improve the work!**
 - Get over it, look at the reviews and improve the piece
 - Get more results if needed
 - Send it somewhere else (or for another round)
- Good writing takes **effort**. Better writing takes **practice**. You will keep improving your writing throughout your career.