Writing a Compelling Proposal

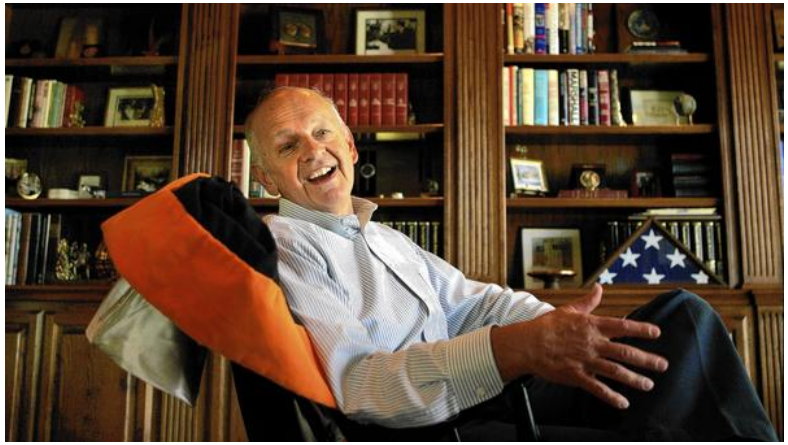
Susanne Hambrusch
Purdue University

Ed Lazowska
University of Washington

Thanks to Jim Kurose for sharing material

George Heilmeier

May 22 1936 – April 21 2014



- RCA Laboratories – invented LCDs
- Director of DARPA
- VP and CTO of Texas Instruments
- CEO of Bellcore

- IEEE David Sarnoff Award
- National Medal of Science
- National Academy of Engineering Founders Award
- IEEE Medal of Honor
- Kyoto Prize
- National Academy of Engineering Charles Stark Draper Prize

“Heilmeier Catechism”

- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today? What are the limits of current practice?
- What’s new in your approach? Why do you think it will be successful?
- Who cares? If you’re successful, what difference will it make? What impact will success have? How will it be measured?
- What are the risks? Why might you not succeed?
- How much will it cost?
- How long will it take?
- What are the midterm and final exams to check for success? How will progress be measured?

1: Pick good problem(s)

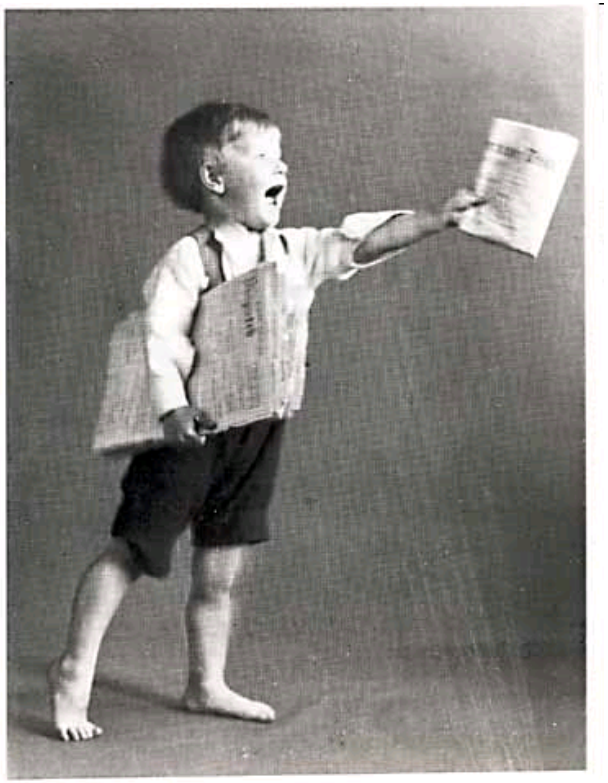
- why is the problem important?
  - what happens if you do not solve this problem?
  - why should anyone care?
- new fundamentals/principles involved?
  - universal truths (best) versus point solutions (not as good)
- a problem area with "legs"?
  - once you're done, is story over, or is this fundamental work leading to lots of future work?
  - are you setting a foundation?

A fool can ask more
questions in a minute
than a wise man/woman
(or a Yoda) can answer in a lifetime

2: Every proposal tells a story

- what is the "elevator pitch" of your proposal (reviewers, PDs)?

- story is *not* what you will do, but rather
  - what you will show, new ideas, new insights
  - why interesting, important
- why is story of interest to others?
  - universal truths, hot topic, impact, surprises or unexpected results
- know your story!



3: ***What*** will you do, and ***how*** will you do it?

- basic questions all reviewers will ask
- so ***ask and answer these questions*** for the reviewers in your proposal

what – questions to be addressed

how – methodology to address questions
how is it done today

4: Specific research questions

- clear problem statements: pose questions, show initial results, demonstrating methodology
  - questions alone aren't enough (anyone can pose questions – how will you address them)
- some near-term problems that you have an idea how to attack
- list longer term problems that you may only have vague idea of how to solve
  - showing longer term issues is important

5: Initial work: must be done before proposal

- initial results demonstrate feasibility
  - illustrative, explanatory to reviewer
  - provide intuition about what you will do
- but if the problems are basically solved already, then it's not proposed research
- illustrate approach(es) to solving problems
  - show you possess right skill set

6 Past work

- be specific about past related work, how proposed research differs
  - reviewers are knowledgeable, aware of past work
    (may have done the past work you are citing!)
  - what is the value added of proposed work (not just difference)

"*What Descartes did was a good step. You have added much …. If I have seen a little further it is by standing on the shoulders of Giants.*"

Sir Issac Newton, 1676

7 Introduction: crucial, formulaic

If the reviewer is not excited by intro, proposal is lost

- recipe:
  - *para. 1:* motivation: broadly, problem area, why important?
  - *para. 2:* narrow down: what is problem you specifically consider
  - *para. 3:* "In this proposal, we ….": most crucial paragraph, tell your elevator pitch
  - *para. 4:* how different/better/relates to other work, at high level
  - *para 5:* summarize contributions at higher level, long-term 10K ft view of contribution: change the world!
  - *para. 6:* … remainder of proposal structured as follows …

8 Broader impact

- important review criteria: will be explicitly addressed in proposal evaluation
- know what a broader impact *is:*
  - http://www.nsf.gov/pubs/policydocs/pappguide/nsf13001/index.jsp
  - http://cisebroaderimpacts.org/ - CISE-specific wisdom/examples of broader impacts
  - goes beyond your teaching responsibilities
- critical for large- (and medium-) sized proposals
  - poor broader impacts can sink a proposal
  - smaller proposals: BI impacts tend to be more formulaic
- leverage institutional resources/programs
  - you don't have to do it alone and it can be an idea/effort proven to work

9. Submit to a program funding the research you propose

- understand goals of program/solicitation
  - ask people who know, don't assume or guess
  - essential for cross/special programs
  - what/who has been funded recently
  - communicate with program directors
- if your research fits into more than one core program, communicate with relevant program directors before the submission
  - proposals don't always get moved or shared

10. Know the review process

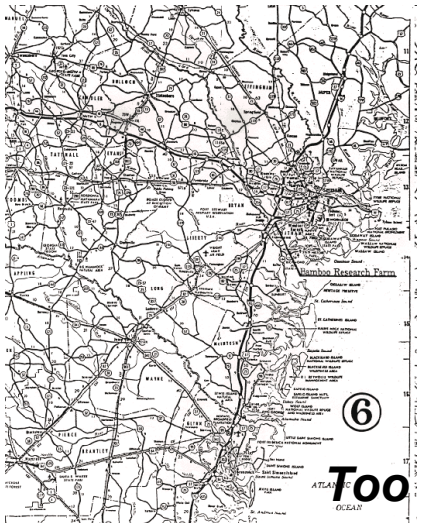
- proposals can get sorted and assigned to panels based on the information in the summary
- reviewers may read 10-15 proposals (lots of work, tiring)
  - interesting, fun/pleasant to read proposals a rarity
- reviewers will typically be panelists present at NSF (virtual panels as appropriate)
- rank proposals and bin: highly competitive, competitive, (low competitive), not competitive

11. Put yourself in place of reviewer

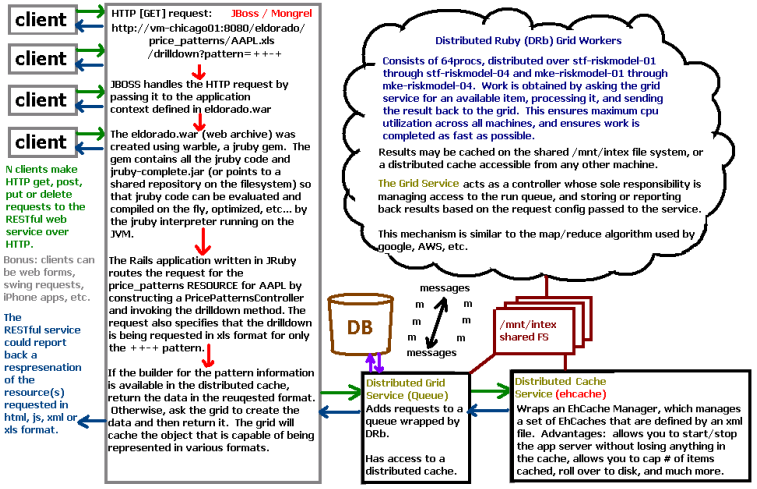
- less can be more
  - "I would have written less if I had had time"
- reviewers shouldn't have to work
  - won't "dig" to get story, understand context, results
  - need textual signposts to know where 'story" is going, context to know where they are
    - good: "e.g., Having seen that … let us next develop a model for …. Let Z be …."
    - bad: "Let Z be"
- what does reader know/not know, want/not want?
  - write for reader, not for yourself

12. Put yourself in place of reviewer

- page upon page of dense text: *no fun* to read
  - avoid cramped feeling of tiny fonts, small margins
  - create openness with white space: figures, lists
- provide enough context & information for reviewers to understand what you write
  - no one has as much background/ content as you
  - no one can read your mind
  - define all terms/notation



Too much detail!



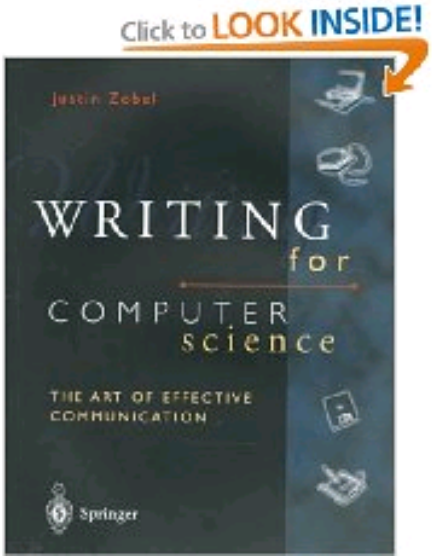
13. Master the basics of organized writing

- paragraph = ordered set of topically-related sentences
- lead sentence
  - sets context for paragraph
  - usually ties to previous paragraph
- sentences in paragraph should have logical narrative flow, relating to theme/topic
- don't mix tenses in descriptive text
- one sentence paragraph: warning!

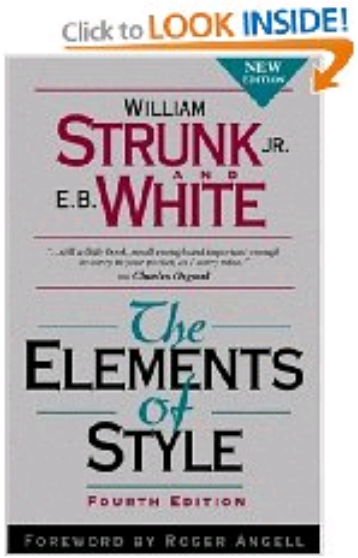
"No tale is so good that it can't be spoiled in the telling"
Proverb

14. Write top down

- computer scientists (and most human beings) think this way!
- state broad themes/ideas/ questions first, then go into detail
  - context, context, context
- even when going into detail … write top down!



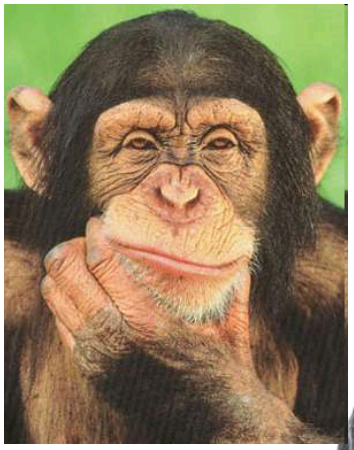
Writing for Computer Science
by Justin Zobel



The Elements of Style
by William Strunk E. B. White
(50 years old – and still a classic!)

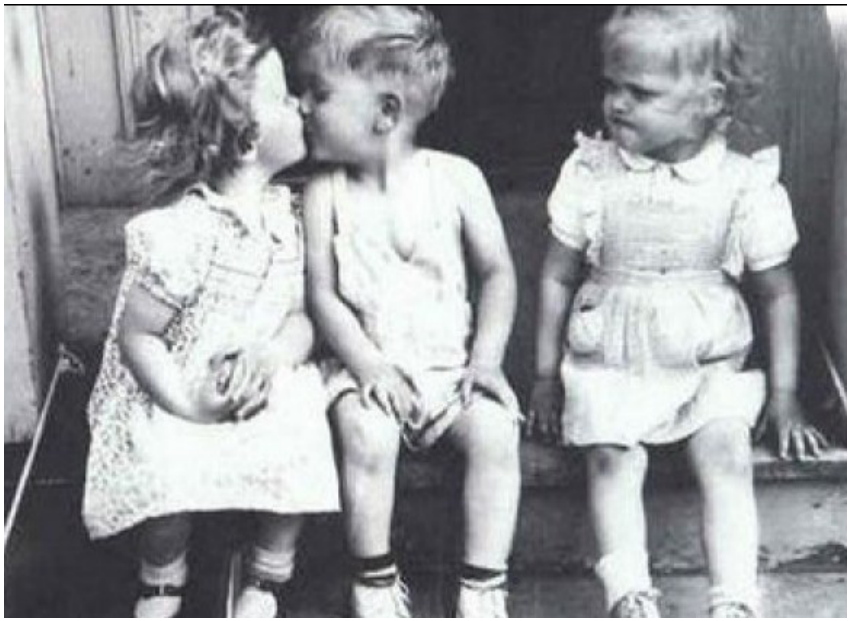
15. Good proposal writing takes time

- give yourself time to reflect, write, review, refine
- give others a chance to read/ review and provide feedback
  - get a reader's point of view
  - find a good writer/editor to critique your writing
  - you may get contradictory advice
- starting proposal two weeks before deadline, while ideas/ results still being generated: non-starter
- get a "red team" review a week before it's due



16. Learn from Declinations

- it'll happen now and then, for the rest of your professional life
- learn from a declination
  - *Why* was paper/proposal rejected?
  - *What* did/didn't reviewers see/like?
  - talk to the program director



- ….. but don't write assuming the same reviewers will review your proposal (paper). They won't!

Perspective of an NSF DD on junior PIs

- successful PIs:
  - choose a good problem related to their expertise but not continuing the PhD research
  - get mentoring and help in preparing a proposal
  - are enthusiastic about research
- junior PIs: likely to get benefit of the doubt in core programs
  - in larger efforts, a junior PI is generally not a good idea
- if a proposal is declined
  - getting verbal feedback from the program director is crucial: helps understand the reviews
  - don't take a declination personally: many good proposals don't get funded
- submit a career or a small core proposal?

More words of wisdom …

- process of writing a proposal improves the research!
- read the solicitation, know the proper home for your proposal
  - know special preparation and evaluation criteria
  - talk to cognizant program manager
- have a really good (required) one-page summary upfront (intellectual merit, broader impacts)
  - all reviewers will be asked to answer these questions
- use an example that shows *richness* (but simple enough for reader to understand), *threads through proposal to provide unity/common thread*

More words of wisdom …

- volunteer to be a proposal reviewer
  - better yet: have someone send your name to the right person
  - you learn by seeing the process
- teaming up with a more experienced researcher on a first proposal can be good start
- generating proposals
  - great idea (great) versus “there’s deadline” (harder)

Take home messages

- choose your problems and program carefully
- be bold and remember the big picture
- demonstrate proficiency, vision
- present a clear plan for research, with preliminary work
- write *extremely* well
- advice/feedback from mentors, experienced faculty in your research area
- put yourself in the place of a reviewer
- get feedback from program manager if declined
- remember Heilmeier's Catechism

“Heilmeier Catechism”

- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today? What are the limits of current practice?
- What’s new in your approach? Why do you think it will be successful?
- Who cares? If you’re successful, what difference will it make? What impact will success have? How will it be measured?
- What are the risks? Why might you not succeed?
- How much will it cost?
- How long will it take?
- What are the midterm and final exams to check for success? How will progress be measured?