HOW TO WRITE A GOOD PROPOSAL: TIPS, INSIGHTS, AND PERSPECTIVE

ILLINOIS
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2020 CRA Career Mentoring Workshop

Thanks to Jim Kurose and Mary Hall for sharing earlier slides

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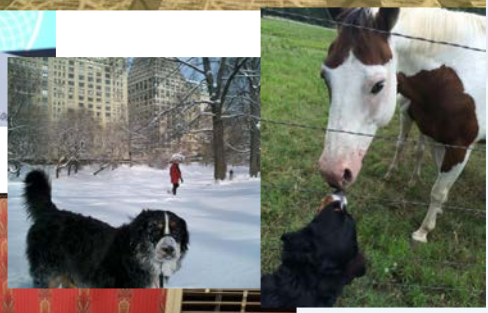
Computing Research Association

NANCY AMATO

- PhD @ UIUC; MS @ Berkeley; BS/AB @ Stanford
- Prof @ Texas A&M: 1995-2018
- Prof & Dept Head (back) @ UIUC: since 2019
- Research – Applied Algorithms
  - robotics, computational bio, parallel algorithms
  - 24 PhD Grads (11 profs, 9 research labs)
- Funding sources & reviewing
  - NSF, NIH, DOE, NATO, IBM, Samsung, Google
  - Reviewer for NSF, NIH, DOE, and "NSF-equivalent" for other countries (Canada, Sweden, Italy, Israel, Ireland, Hungary, EU, …)
- Professional Activities
  - CRA-WP: DREU Co-Director, 2000-present
  - CRA-E, CRA Board (Vice Chair)
  - IEEE Robotics & Automation, NCWIT, AAAS
- Other Stuff
  - Bernese Mountain Dogs – currently Fred & Wilma
  - Husband Lawrence Rauchwerger - also Stanford, UIUC, A&M, UIUC
  - Highlights: bucket trip to Machu Picchu & diving!








SUSANNE HAMBRUSCH

- Professor of CS at Purdue
- Department Head (2002-07,18-19)
  - Fundraising; new building
  - Set hiring goals; manage search committees and offers
  - mentoring junior faculty; promotions
- Division Director (CISE/CCF, 2010-13)
  - Developed new programs (XPS, AiF, CRII)
- Funding sources
  - NSF, ONR, Army, DARPA
  - Microsoft, Google, State Farm
- Research interests
  - Analysis of Algorithms, CS Education
- CRA Board member, CRA-E co-chair
- CS in undergrad education
  - CRA's Generation CS Report
  - NAS Report on Growth of CS Enrollments
  - CUE.NEXT

1: Pick good problem(s)

- why is the problem important?
  - is the problem timely?
  - what happens if you do not solve it?
- new fundamentals/principles involved?
  - universal truths (best) versus point solutions (not as good)
- a problem area with “legs”?
  - is this fundamental work leading to lots of future work?
- why is this the right problem for *you* to solve?
  - balance between experience and new directions

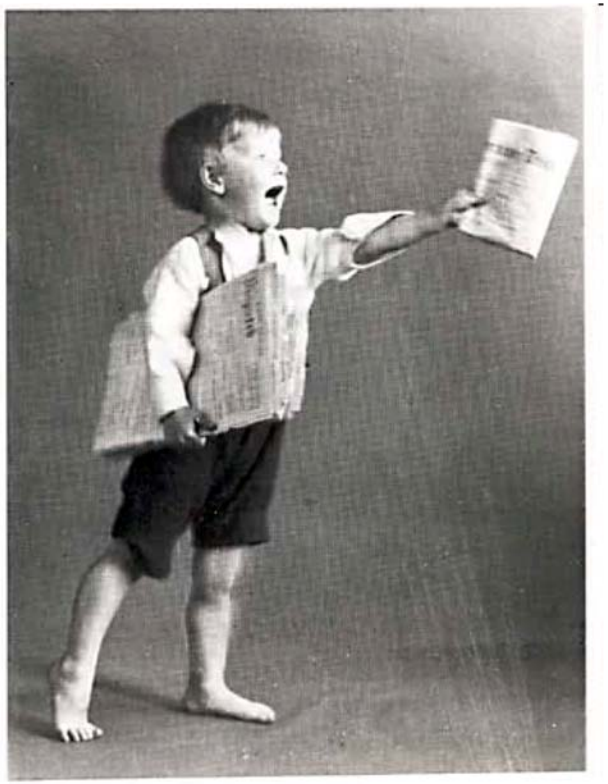
A fool can ask more
questions in a minute
than a wise man/woman
(or a Yoda) can answer in a lifetime

1b: When collaborating, be part of a strong team

- What expertise is needed to address the problem?
  - Make sure the team covers all the bases
- Top researchers strengthen the project
  - You will learn from them
- Be careful when collaborating with less successful colleagues
  - Guilt by association…

2: Every proposal tells a story

- story is *not* what you will do, but rather
  - what you will show, new ideas, new insights
  - story pitch may differ between programs and agency
- why is the story of interest to others?
  - universal truths, hot topic, surprises or unexpected results
- practice your “elevator speech”
  - reflect in summary and intro



3: ***What*** will you do? ***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

4: Specific research questions

- clear problem statements
  - pose questions, show initial results, demonstrate methodology
  - questions alone aren't enough; 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 for multi-year efforts (e.g., CAREER)

5: Initial work

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

6: Past work

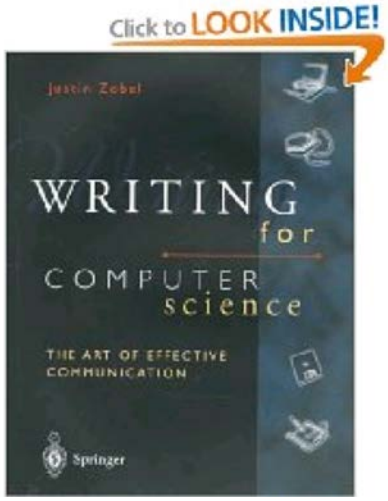
- be specific about past related work, how proposed research differs
  - reviewers are knowledgeable
  - be aware of past work [sometimes they did the past work you are citing!]
  - establish current state of the art
  - what is the *value added* of proposed work, not just difference

"*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.*"

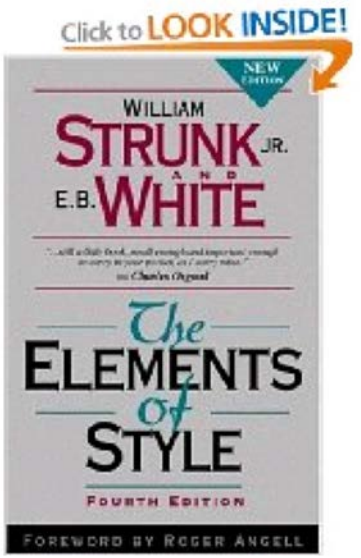
Sir Issac Newton, 1676

7: Write top down

- computer scientists (and most humans) 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
William Strunk E. B. White
(50+ years old – still a classic!)

8: Introduction

- **If reviewer is not excited by intro, proposal is lost**
- Recipe to follow:
  - *para. 1:* **motivation:** broadly, problem area, why important?
  - *para. 2:* **narrow down**: what is problem considered? what is the current state of the art for solving problem? why is it insufficient?
  - *para. 3:* "**In this proposal, we** ….": most crucial paragraph, tell your elevator pitch; make it easy to read
  - *para. 4:* **how different**/better/relates to other work; brief
  - *para. 5:* **summarize** your contributions at higher level and a long-term view: change the world! Brief summary of high level research plan
  - *para. 6:* … **remainder of proposal** structured as follows …
  - figure: a **high-level figure** that establishes a mental framework for proposed research

9: Good proposal writing takes time

- give yourself time to reflect, write, review, refine
- give others a chance to read/review and provide feedback
  - find a good writer/editor to critique your writing
  - understand a reader's point of view
  - participate in workshops at your institution
  - you may get contradictory advice
- starting a proposal two or four weeks before deadline?
  - won't generate great ideas
  - difficult to tell a cohesive story without iteration

10: 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 program, communicate with relevant program directors before the submission
  - proposals don't always get moved or shared

11: Know the review process

- **NSF** proposals sorted and assigned to panels based on the summary
- a reviewer may read 10-15 proposals; lots of work, tiring
- reviewers will either be panelists at NSF, participating in a virtual panels, or be ad-hoc

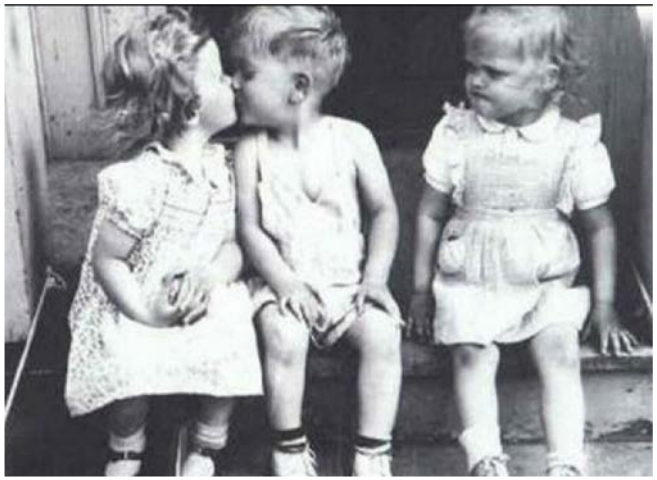
Other agencies

- peer review vs. internal review
- may be less transparent

12: Put yourself in place of reviewer

- **less is more**
  - don't overwhelm with details and redundancy
  - "*I would have sent you less if I had had time*"
- **reviewers shouldn't have to do extra work**
  - they won't "dig" to get story and understand context
  - need textual signposts to know where "story" is going
    - good: "e.g., Having seen that … let us next develop a model for …. Let Z be …."
    - bad: "Let Z be"
  - easy to read formatting
- **write for the reader**
  - not for yourself

13: Learn from Declinations



- declinations happen to *everyone*; get used to them
- learn from a declination
  - *why* was paper/proposal declined?
  - *what* did/didn't reviewers see/like?
  - contact the Program Director and set up a time to call (prepare questions)
  - realize that the revised proposal will go to different reviewers
- at NSF, a declined proposal may get funded for one year as an EAGER (talk to the PD)

ABOUT NSF PROPOSALS

INTELLECTUAL MERIT AND BROADER IMPACT CRITERIA

All NSF proposals are reviewed according to:

- **Intellectual Merit** encompasses the potential to advance knowledge
- **Broader Impacts** encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes. Examples of weak BI:
  - *"My research results will be my broader impact."*
  - *"I will train my graduate students to be like me."*
  - *"I am teaching a new seminar course."*

  Impact on diversity and inclusion, mentoring, K-12 outreach, community outreach

Read the proposal guide NSF 19-1: PAPPG

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HOW IMPORTANT IS THE BUDGET?

- Read guidelines carefully.
  Communicate with your grant/business office
- Special programs can have different budget requirements
- Stated limits are strictly enforced
  - $505K on a $500K limit: expect return without review
- Overhead and RA costs differ by institution
  - You don't have to meet the upper limit
- NSF reviewers are not asked to evaluate the budget

WAYS TO JUMP-START PROPOSAL WRITING

- **Be a proposal reviewer**
  - have someone send your CV to the right PD
  - you learn by seeing the process
- **Team up** with a more experienced researcher on a first proposal
  - don't lead a big proposal effort
- **Read proposals** others in your area have written
  - *ask:* many people will give you a copy
- **Attend** a proposal-writing workshop
  - your institution may offer some (with general advise)
  - NSF's Career Proposal Workshop, April 6
    - apply by March 2

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WAYS TO JUMP-START PROPOSAL WRITING

- **Talk to a PD**
  - especially if not sure what program to submit to
  - email a PD a 1-pager and set up time for a call
    - Don't contact multiple PDs in one e-mail
  - what questions can you ask?
    - Is the proposed research in scope?
    - Budget related (e.g., include a post-doc or programmer, course buy-out)
    - how does NSF handle a proposal matching two programs?
    - my research community is very small. How does this work on a panel?

CRII

"Intended to support research independence among early-career academicians who specifically lack access to adequate organizational or other resources."

- Cannot have received grants or contracts as PI
- Provides essential resources for early-career PIs

Note: Combination of organizational support and requested support cannot exceed two RAs for two years (confirmed by chair).

CAREER

"*NSF's most prestigious awards in support of early-career faculty who have the potential to serve as academic role models in research and education.*"

- Well-argued and specific activities that will build - over 5 years - a foundation for a lifetime of contributions to research and education.
- At most three submissions made by an untenured, assistant professor.
- CAREER awardees are eligible to be nominated by their funding agency for a PECASE award.

Some reasons why CAREER proposals with great potential don't get funded ...

incremental, not visionary

no advocate on the panel

reviewers didn't see the big picture

unaware of related work

hard to read

sloppy writing

needed expertise not evident

boasting tone

competition from stronger proposals

the best part is buried on page 10

lacking relevant references

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ADVICE FROM SUCCESSFUL RESEARCHERS

Mechanics….

- READ THE SOLICITATION! Read the FAQ's.
- Send your proposal to the appropriate program.
- Put effort into writing a few good proposals.
- Collaborate with experienced and successful researchers; it can be a great learning experience.
- Be open and responsive to negative comments and reviews. Turn them into concrete actions for the next submission.
- Never give up, never surrender: if you believe in your proposal, it will (eventually ...) get funded.
- Top researchers get proposals rejected. Good proposals get declined. Don't be discouraged when it happens to you.
- Talking to the Program Director can be informative.

ADVICE FROM SUCCESSFUL RESEARCHERS

The Story!

- Tell a good and convincing story.
- Find an interesting and important direction; identify a unique perspective that relates to your expertise.
- Be bold and ambitious! Choose research problems that can have broad impact outside your research community.
- A creative idea with high potential impact is always preferable to a dressed-up incremental idea - even if the former is not as guaranteed to succeed.
- Be excited about your idea
- Don’t propose something you aren’t passionate about just because you think it will “sell” better.

QUESTIONS?