Networking Research, Education, Mentoring and Service: Ten Insights

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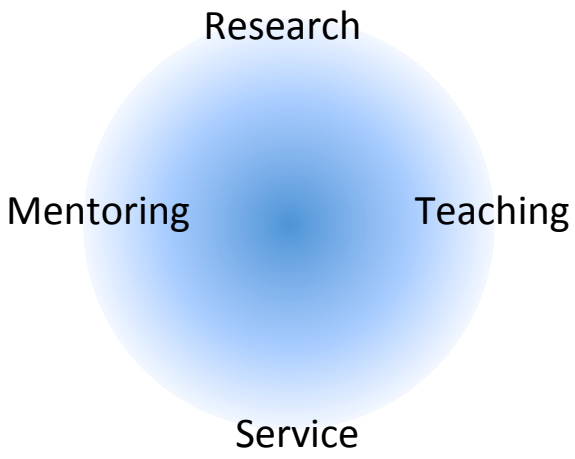
Overview



Top 10 lists: I *love* them

- "10 pieces of advice I wish my PhD advisor had given me", *CoNEXT, INFOCOM, N2Women student/workshops*
- "10 tips for writing a paper"
- "10 tips for writing a proposal," various workshops
- "Networking Education and the hands-on experience: 10 observations, insights, and advice that I wish someone had told me"
- "10 Networking Papers: Recommended Reading," ACM CCR 2006

Observations about past, future: tough!

Past

rose colored glasses

Future

crystal ball

Observations about past, future: tough!

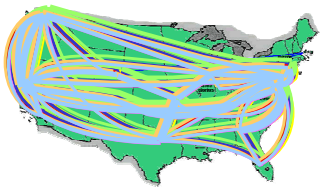
From SBRC tutorial (Florianopolis, 2001):

Future: information networks

intelligent game network

teleconferencing network

video distribution network



information retrieval network

Observations about past, future: tough!

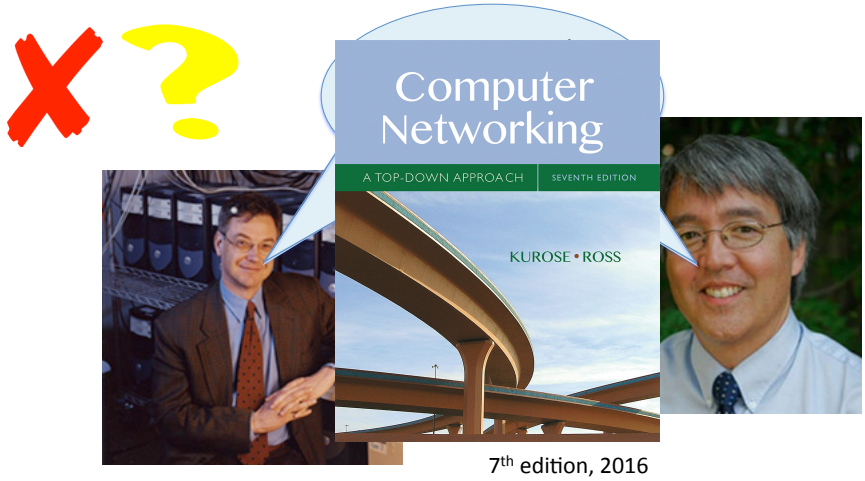
From 2006 Multimedia workshop

(two days after Google acquired YouTube)

Don't blink, because when you open your eyes, YouTube won't be around

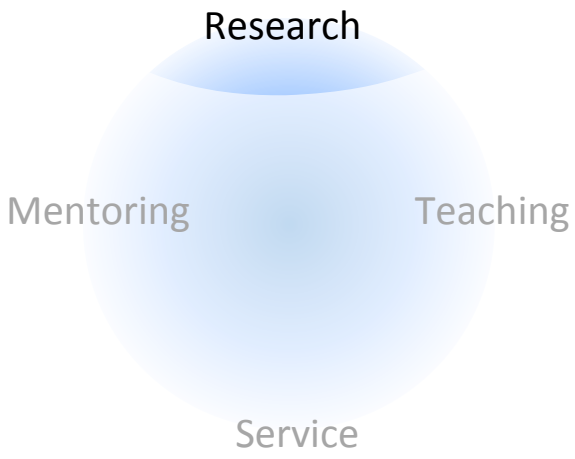
Observations about past, future: tough!

1995: Jim and Keith approach a publisher, with book idea



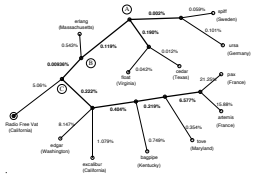
7th edition, 2016

Overview

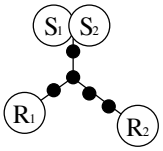


Research: what makes a problem interesting?

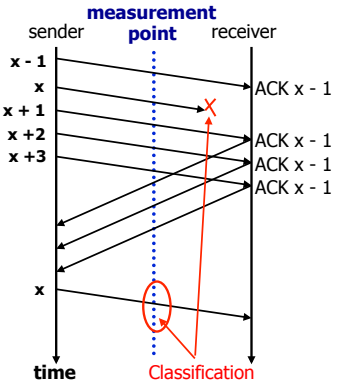
network measurement, inference: hands-on, rigorous



Packet Loss Correlation in the MBone Multicast Network



Detecting Shared Congestion of Flows Via End-to-end Measurement

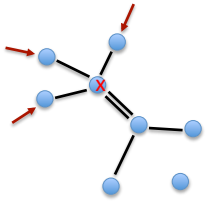


measurement in the middle

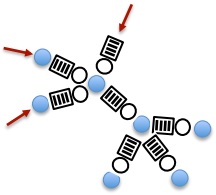
Research: what makes a problem interesting?

modeling: models provide and reflect insight

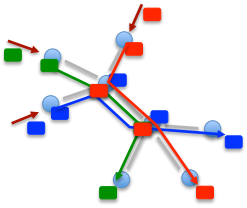
content-caching networks: bounding calculus, approximation algorithms



Circuit-switching:
blocking networks
(Erlang, 1917, Kelly 1986)



Packet-switching:
queueing networks
(Kleinrock, 1963)

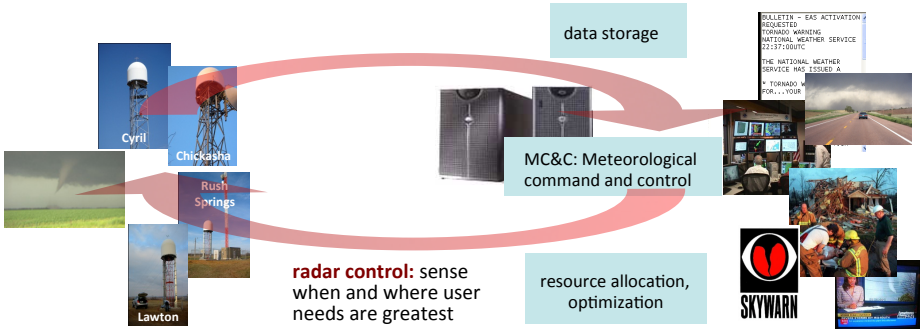


Content-caching:
cache networks

more: multicast, video, network calculus, …

Research: what makes a problem interesting?

sensor networks: deployment, architecture, impact, interdisciplinary



CASA: Collaborative **A**daptive **S**ensing of the **A**tmosphere

Research: what makes a problem interesting?

network architecture: "big picture" challenges for large scale systems

- Signaling: hard state versus soft state
  - "robustness" (non-fragility)
  - complexity of control
  - maintainability
  - evolvability
  - adaptability
  - reconfigurability
  - security
  - manageability
- MobilityFirst: logically-centralized control plane element for generalized mappings (e.g., name, location)
  - context-sensitive (attribute specific) services

#1

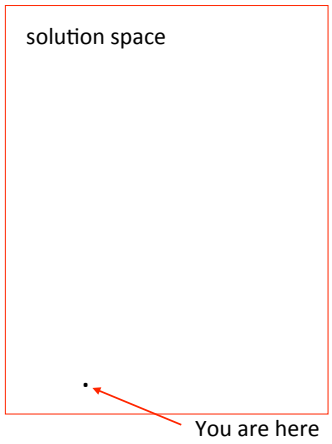
Picking Research Problems: carefully

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

- what's the fundamental issue you're solving?
- will the problem be of interest five, ten years from now?
- how "crowded" is the field?
  - lots of smart people!
  - what's your advantage?
- focus on fundamentals, solutions that cut across a solution space

#1

Picking Research Problems: carefully



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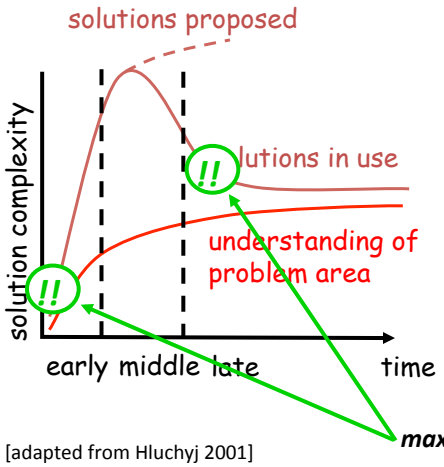
(but maybe shouldn't be)

Choosing, defining a research problem

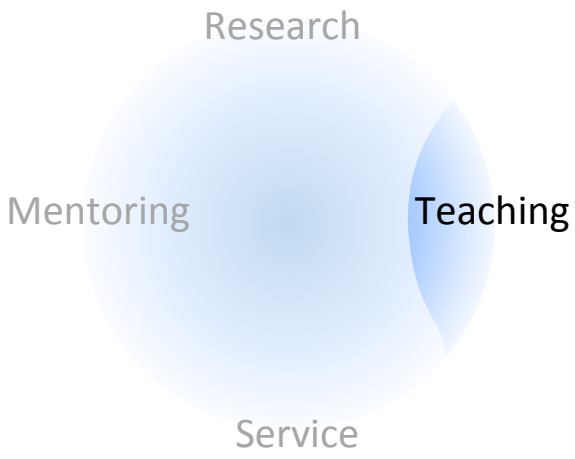


- complexity, sophistication are themselves not of interest
- simple is sometimes harder!

maximum impact / mindshare

[adapted from Hluchyj 2001]

Overview



Teaching

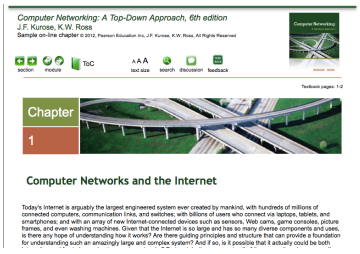
#3

- 50% an acquired art: *can be studied, and learned*
- 50% connecting with students, caring
- Question: what is the value of of "being there"
  - *active learning:* research shows: better learning outcomes
  - you can learn, try it!

Teaching: a prediction

- tomorrow "textbooks": high quality, highly interactive, high production value
- interactive, with video, interactive animations, problems, reviews, question/answering
- *teaching challenge:* what will be the "value added" by in-class participation?

As teachers, we will need to become increasingly aware of the value we add over technology-based education



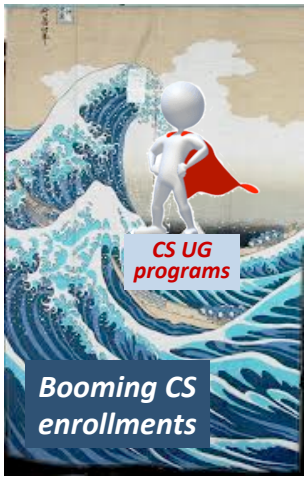
Computer Science for All (CS for All)

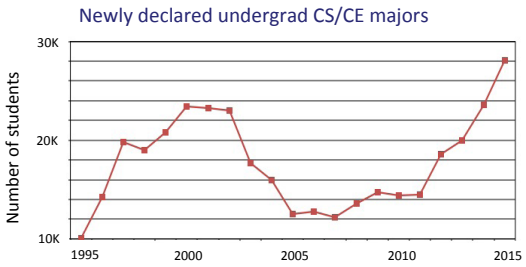
- Enable *all* students to have access to high-quality CS education in K-12:
  - Knowledge base, capacity for rigorous, engaging CS education
  - foundation in NSF CS10K investments
  - Professional development for educators
- Collaboration: NSF, Dept. Ed., industry, non-profits
- CISE and EHR to provide $120 million over five years

"In the new economy, computer science isn't an optional skill – it's a basic skill…"

President's Weekly Address 1/30/2016

CS Education



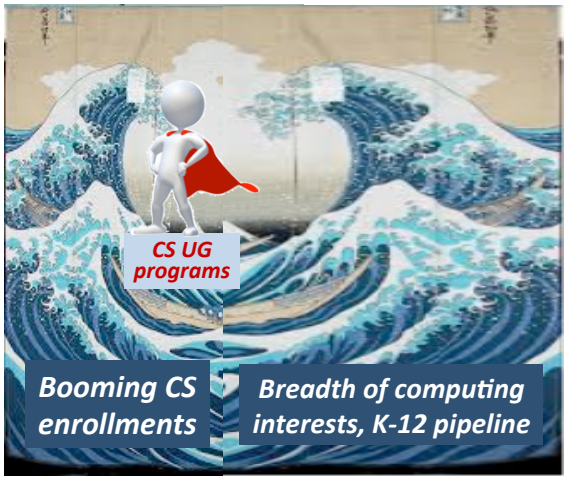


Explosion of interest seems different this time around

- broader interests
- minors, other disciplines

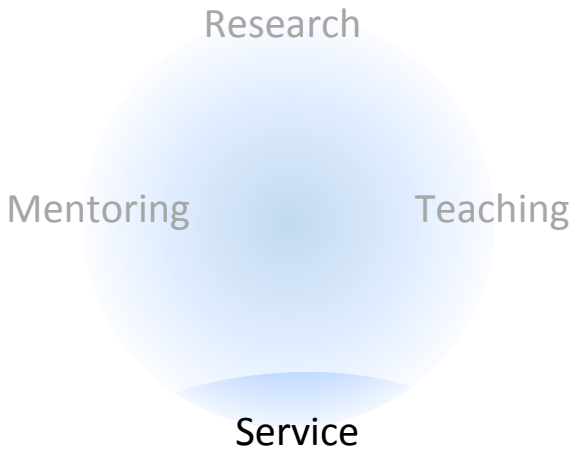
#6

CS Education



- *second sea change (tsunami):* broadening interest in computing among incoming students
- success of CS10K, CS4All
- CS+X

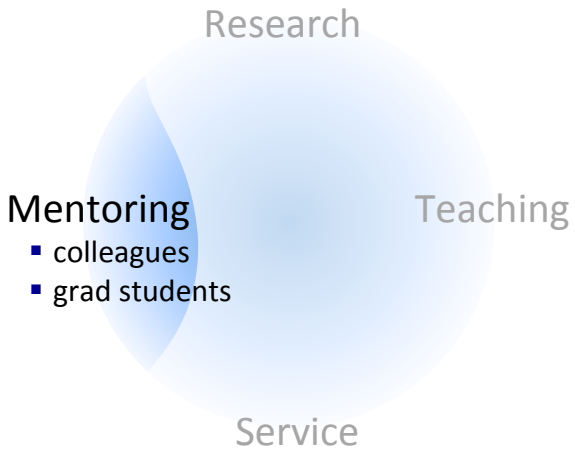
Overview



Service

- do it because you love it, and you think it needs to be done
  - 1st Infocom student workshop (2005) (with Edmundo de Sousa e Silva)
  - Sigcomm education workshops (2002,2003,20011)
  - journal EIC positions, PC positions
- service to larger community: your institution, CS community, gov't:
  - good leaders are needed from (and for) our community
- if you do it, do a *jrex* (a.k.a. amazing) job

Overview



Mentoring: the *process* of doing research #7

apprenticeship

- research is still a guild
  - grad student = apprentice
  - early career faculty nred mentoring also!
- what my former students tell me 1-25 years later:
  - learn research process, how to define/frame problems
  - communication: writing, speaking
- early career faculty, researchers: learning the "ropes"

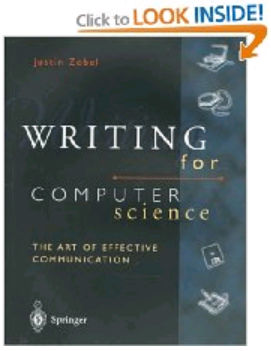
Learn how to write *really* well #8

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

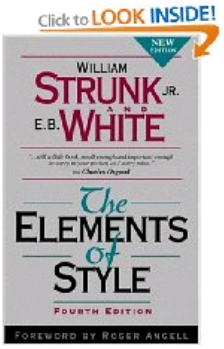
- can *not* overstress importance of good writing
  - the most important course?
- "unfair advantage" in paper selection, proposal
- best investment of your time
- study role models

http://www-net.cs.umass.edu/kurose/writing/

Recommended reading:



Writing for Computer Science
by Justin Zobel



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

Learn how to speak *really* well #9

image of a public speaker remove

- Can't overstress importance of good speaking
  - important course to teach/ take?
- "unfair advantage" in mindshare
- convey exciting story/message
  - thoughtful
  - engaging
  - clear, concise
- practice, practice practice
  - videotape, critique yourself
  - study role models

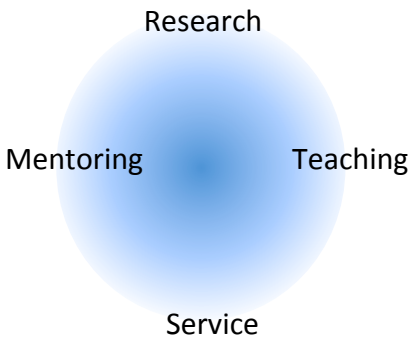
Identify role models

#10

- who does something you care about *really* well?
  - how do they do it?
- many role models:
  - no one does everything
  - find your balance
- get a mentor
- be a mentor

from "10 things I wish my advisor had told me," circa 2009

Overview



… a few final observations….

Final observations

networking research community: vibrant!

- SDN, NFV: solving management and control plane challenges; bringing computation to the edge
- mobility
- cybersecurity
- data
- cyberphysical systems, IoT
- ….

more generally: evolving human-technology frontier

- networking's key role when computing is embedded on, around, and in us

Final observations

- constant need to "prove" yourself
  - being out of your comfort zone can be hard but …
  - the need to keep learning
- privileged to be doing what we do
  - working in a discipline that has, and will continue to, profoundly change the world
  - meaningful work, well paid
  - our roles as teachers and mentors are *impactful*
- work we do is great; people matter

… to the *amazing* PhD students and postdocs I've worked with at UMass:

Supratik Bhattacharyya
Michael Bradshaw
Claudio Casetti
Vasanta Chaganti
Yu-CHih Chen
Shenze Chen
Mostafa Dehghan
Jayanta Dey
Daniel Figueiredo
Victor Firoiu
Timur Friedman
Zihui Ge
Majid Ghaderi
Kurt Gordon
Yu Gu
Yang Guo
Dan Gyllstrom
Simon Heimlicher
Ren Hung Hwang
Sharad Jaiswal
Ping Ji
Sneha Kasera
Ramin Khalili
Benyuan Liu
Yong Liu
Victoria Manfredi
Daniel Menasche
Sue Moon
Ramesh Nagarajan
Erich Nahum
Giovanni Neglia
Jitu Padhye
Jim Partan
Sridhar Pingali
Ram Ramjee
Bruno Ribeiro
Elisha Rosensweig
Dan Rubenstein
Sambit Sahu
Jim Salehi
Henning Schulzrinne
Shubho Sen
Jonathan Shapiro
Rahul Simha
Suresh Singh
Jennie Steshenko
Kyoungwon Suh
Suddu Vasudevan
Bing Wang
Wei Wei
Maya Yajnik
David Yates
Ellen Zhang
Chun Zhang
ZhiLi Zhang
Mike Zink

… to all of my research collaborators and postdocs over the years

scrolling list of co-authors not reproduced in PDF

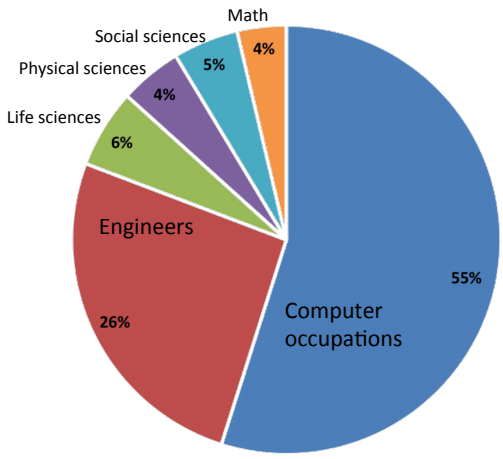
What have others added (1)?

- learn how to deal with rejection
  - it'll happen now and then, for the rest of your professional life (hopefully not with your partner)
  - learn from rejection: Why was paper/proposal rejected? What did/didn't reviewers see/like?
- know your "secret weapon"
  - what "unfair advantage" do you have over everyone else?
- learn how to change topics
  - boring to do same thing for 30 years!

What have others added (2)?

- learn how to deal with stress
  - life balance, life changes, too much work
  - learn how to multiplex - you'll be doing it the rest of your life
- learn how to read/review/write fast, but well
  - and follow the 90/10 rule

Many STEM jobs are in computing



Job Openings 2014 – 2024 (growth and replacement)

US Bureau of Labor Statistics

Data from the spreadsheet linked at http://www.bls.gov/emp/ind-occ-matrix/occupation.xlsx