Networking Research, Education, Mentoring and Service: Ten Insights

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ACM SIGCOMM Conference
August 2016

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

Future

rose colored glasses
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

We want to write a book, but there will be no printed books by 2000, so ….
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

Research: what makes a problem interesting?

modeling: models provide and reflect insight

content-caching networks: bounding calculus, approximation algorithms


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

- radars (sensors)
  - data storage
  - resource allocation, optimization
  - computation, communication

- end users: NWS, emergency response

- radar control: sense when and where user needs are greatest
- MC&C: Meteorological command and control
- CASA: Collaborative Adaptive Sensing of the Atmosphere

**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
Picking Research Problems: carefully

- 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

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

#1

solution space

You are here (but maybe shouldn’t be)
Choosing, defining a research problem

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

[adapted from Hluchyj 2001]

maximum impact / mindshare

Overview

Research

Mentoring

Teaching

Service
Teaching

- 50% an acquired art: *can be studied, and learned*
- 50% connecting with students, caring
- Question: what is the value 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
CS Education

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

Overview

- Research
- Teaching
- Mentoring
- Service
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)
  - 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
- colleagues
- grad students

Research
Teaching
Service
Mentoring: the process of doing research

- research is still a guild
  - grad student = apprentice
  - early career faculty need 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

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

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

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

- 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

- 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

- Research
- Mentoring
- Teaching
- Service

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

... 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