FINDING A RESEARCH TOPIC

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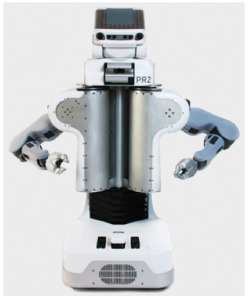
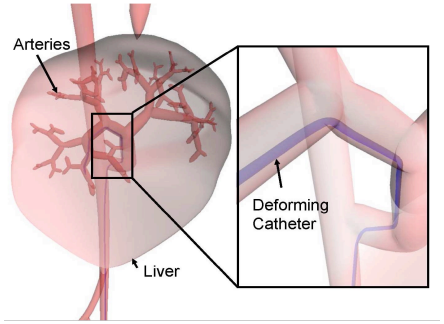
- B.S., M.S. Ph.D. In EECS, University of California, Berkeley
- J.R. & L.S. Parker Distinguished Professor Emeritus, UNC-CH
- Elizabeth Stevinson Iribe Chair, UMD, College Park
- Research:
  - ✓ ***Virtual Reality***
  - ✓ ***Robotics***
  - ✓ ***Human-Computer Interaction***
  - ✓ ***Physically-based Modelling, Simulation & Animation***





Sandhya Dwarkadas

Education

- Bachelor's degree in Electronics from Indian Institute of Technology, Madras, India
- Master's and Ph.D. in Electrical and Computer Engineering from Rice University, Houston, Texas

Research Area: Computer systems: architecture, parallel and distributed systems

Post-Ph.D.

- Research scientist at Rice for 4 years
- Faculty member at University of Rochester since
  - Currently the Albert Arendt Hopeman Professor and Chair of Computer Science with a secondary appointment in Electrical and Computer Engineering
- Sabbaticals at IBM Watson, HPCLinks/IISc India, EPFL Switzerland

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FINDING A RESEARCH TOPIC:
SOME BASICS

Things to Keep in Mind …

- The path to find a research topic will be a zigzag road
  - Don’t expect to find it in just one shot
- Often your research topic changes along your career
  - So no need to feel that you will be stuck with your Ph.D. topic for the rest of your life
- Ok to span two fields
  - Many breakthroughs are made this way

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Selecting a Topic

- Moving from coursework to picking a topic is often a low point
  - Even for the most successful students

- Why?
  - Going from what you know-coursework with answers, to something new-research that no one knows the answer and there can be many answers

The Thesis Equation

Topic + Advisor = Dissertation

Advisor vs. Research Areas

What if you like an advisor but are not passionate about his/her subfield, or vice versa?

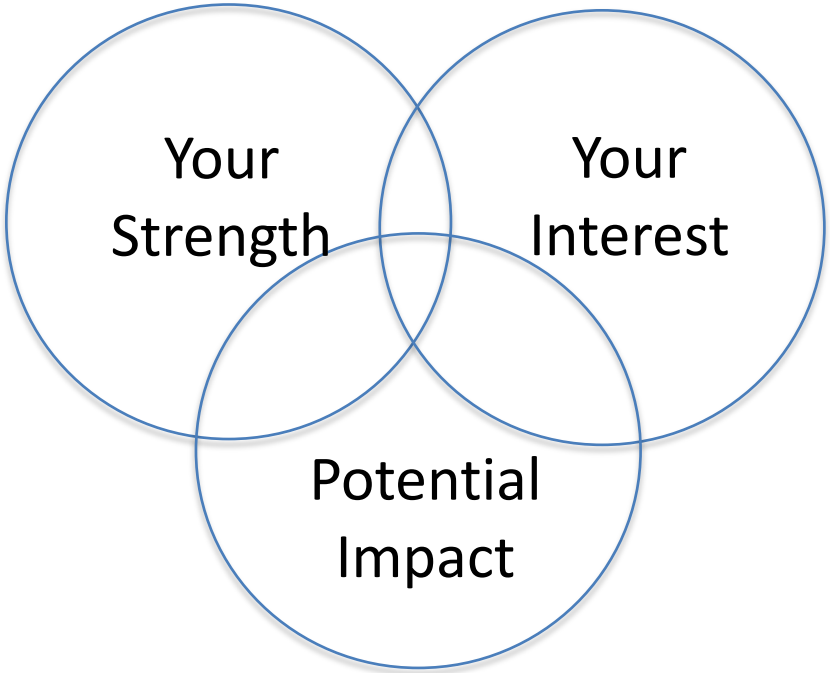
- Opinion: Picking a good match as an advisor is more important!
  - An adviser is for life
  - He/she can teach/mentor you in many things, not just research
  - You will be less stressed out
  - You can expand to adjacent subfield, with his/her help
  - You can get a co-advisor/committee to help with research

Selecting an Advisor

What should you consider when selecting an advisor?

- Working style is very important
  - Do some background reading about faculty research
  - Talk with current graduate students to find out working style
  - Talk with current graduate students about expectations
  - Get to know your working style; be honest with yourself

Now the harder part: Find a Research Topic



The path to success consists of three simple elements. Find what interests you that you can do well and would have potential impact.

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Find your own strength

Understand others is intelligence.
Understand yourself is wisdom.
--- Lao Tze

- What is easier for you?
  - Writing and modifying a complex software and debugging it?
  - Prove theorem?
  - Analyzing data?
- How to find it if you don't know?
  - Try various projects/classes

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Topic Scale and Scope

- Scale
  - Should be big enough to have more than one open problem, or solving one should lead to another
- Scope
  - Too narrow, e.g., just analysis no experiment, not leave enough room
  - Too broad, open ended e.g., data mining, for what? why? too

More Things to Consider

What drives you? bores you?

- Technology, puzzles, applications, interdisciplinary

- Do you (i.e., your advisor) have funding for you to work in the area?
  - Working as a TA
  - Working as an RA
  - Having university/college, government, industry, etc… fellowship/scholarship/grant
- Don't chase hot topics unless you are truly interested
  - Hot topics can change by the time you graduate and are in the job market

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More Detailed Considerations

Whose interests besides yours may also be important?

- Your advisor
- Your research community
  - E.g. architecture and OS fields' interests may not be the same

- Love your topic!
  - Sets the course for your next 2-3 years
  - Determines, in part, opportunities offered to you upon graduation
  - May work in same/related area for years

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Interdisciplinary Research Topic

These days, many top faculty candidates have interdisciplinary thesis topics

- Examples: AI + Systems, HCI + Software engineering, AI + Biology/Medicine, HCI + Psychology, database + architecture, HCI+ education.

- Benefits
  - May leverage your interest/strength in the other areas
  - You can find jobs in other areas/departments
  - You can easily find coadvisers and collaborators
  - It might be easier to bring "fresh air" to an old area or problem
  - **There is so much to learn, so you won't get bored**

Think “Out of the Box”

- Great things are not incremental advances
- Examples:
  - Our field thought ***X*** but in fact ***Y*** is true
  - No one thought we could do X ***but in fact we can***
  - No one thought of doing X but here are ***reasons why it is crucial***

Q & A

- How many of you have topics you're happy with?
  - How did you find them?
- How many have topics you are not so happy with?
  - How did you find them?
  - What are you going to do about it?

IDENTIFYING A GOOD RESEARCH PROBLEM

Inspiration vs. Perspiration

“There are two main ways to find a topic: inspiration and scut work. Inspiration is great, but unpredictable. Scut work is a lot more dependable. In other words, join a project, build something, and see what’s hard about it. There’s a good chance that whatever caused you difficulty has a thesis topic in it.”

Flash of Brilliance

- You wake up in the middle of the night with a wonderful idea or a new approach to solve an open problem
- Warnings:
  - It may not seem so wonderful in the morning
  - Even if it does, you may not be able to convince others

A Talk Inspires You

- You hear a talk in your area and think “I could do that better!” or “Why didn’t they think of X?”
- You start a discussion with the speaker…
- Warnings:
  - Your idea may have already been done
  - Your idea may not work

Data Needs Answers

- You participate in a data collection/analysis effort with another student or in industry
- You become fascinated with the potential to answer questions no one is asking
- Warning:
  - If industry, make sure you can access the data and publish
  - There may be a question of who gets to answer those questions

The Apprentice

- Your advisor has a list of topics/funded projects that need to be worked on
- A fairly common, easy method
- Warnings:
  - Several people may be working on the project: you have to find your own angle
  - Don’t work long on something that isn’t really exciting to you

The Extended Course Project

- You do a project in a course that turns out to be great – you want to do much more
- Another pretty good method
- Warnings:
  - Check with your advisor
  - The project may not be extensible to a PhD thesis

The Stapler

- You work on multiple topics and publish papers that are good and interesting to you
- Can you somehow put it all together into a dissertation?
- Warning:
  - It could be impossible to find a common theme that makes sense

The Interdisciplinarian

- You learn about a problem in another field that you think you can help with (e.g. history and computer science)
- Warning:
  - You will need real collaboration with someone in the other field
  - You'll need to make the case that this really is a contribution to both fields (especially to your own)

Some advice ...

“Start with the questions, not the answers”

“Don’t lose the forest for the trees”

“Shoot for the moon but have something tangible and defensible if you fall short”

FINAL TAKEAWAYS

Useful Things to Consider

- Is your topic doable?
  - Do you have the tools? data? equipment?
  - Do you have/can you acquire the skills?
  - What is your metric of success?
  - What will you compare against?
- Do you have a story to tell?
  - Why my topic is new
  - Why my topic is scientifically exciting
  - Why solving my topic will help the world

Now for the practical side

- Is it doable in the amount of time (5-7 years total for the PhD) you have?
  - Partition work into publishable units
  - Set a goal/deadline, e.g., conference submission
  - Chart a roadmap
  - Periodically regroup and reevaluate to make sure that your roadmap is realistic and your goals are being reached
- Is it fundable?
- Is it something you can get a job you like with?

Tips and Suggestions

- Topic + advisor are both important

- Follow your interests and passion
  - Key driver for success and impact
    - Are you eager to get to work, continue working?

- If not really interested, adapt
  - Tedium or actual lack of interest and motivation?

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When you're stuck at the start

Read/present papers regularly to find open research issues

- Practice summarizing, synthesizing & comparing sets of papers
- Write your own slides for presentations
- Don't 100% believe what a paper says

Work with a senior PhD student on their research

Get feedback and ideas from others: conferences, research internships, advisor's idea

Sometimes you need to take a leap of faith!

- Be open to trial – and - error

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When you're still stuck…

Do internships in industry

- They have many problems but have no time to solve them

- Attend PhD oral exams, thesis defenses, faculty candidate talks
  - Understand how to formulate problems
  - Understand what constitutes a problem solution
- Assess your progress, with your advisor
  - Set goals per semester
  - Have you ruled out an area? converged on an area?
  - Chosen a topic for an exploratory research project?

When you're really really stuck

- Change research topics?
  - May move you out of your advisor's comfort zone of expertise
  - Starting from "scratch" (e.g., need to learn the related work in a new area)
- Change research advisor?
  - May go through 'shakedown' period again
  - May or may not be better off
- Sometimes taking a few months break can relax you and freshen up your mind!

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Great Articles for Every Grad Student (and Advisor)

- "How to Succeed in Graduate School: A Guide for Students and Advisors," ACM Digital Library
- http://pgbovine.net/PhD-memoir.htm : The Ph.D. Grind (a memoir by Asst. Professor Philip Guo documenting his Ph.D. years)

Resources

CRA-W Career Mentoring Workshops:

- http://www.cra-w.org/ArticleDetails/tabid/77/ArticleID/50/Career-Mentoring-Workshop-CMW.aspx

On Academic Life:

- http://blogs.scientificamerican.com/guest-blog/2013/07/21/the-awesomest-7-year-postdoc-or-how-i-learned-to-stop-worrying-and-love-the-tenure-track-faculty-life/
- http://dynamicecology.wordpress.com/2014/02/04/you-do-not-need-to-work-80-hours-a-week-to-succeed-in-academia/

On Post-Docs:

- http://cra.org/resources/bp-view/best_practices_memo_computer_science_postdocs_best_practices/

Tips on doing an academic job search:

- http://matt.might.net/articles/advice-for-academic-job-hunt/
- http://people.mills.edu/spertus/job-search/job.html
- https://homes.cs.washington.edu/~mernst/advice/academic-job.html

Job Ads:

- http://cra.org/ads/

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FINDING A RESEARCH TOPIC:
OPEN DISCUSSION!!

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