Finding a Research Topic

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Carol Espy-Wilson

- BS, EECS, Stanford University, Palo Alto, CA
- MS, EE, and PhD, EECS, Massachusetts Institute of Technology, Cambridge, MA

- Professor, ECE and ISR, University of Maryland, College Park
- Research:
  - Digital Speech Processing
  - Speech Segregation
  - Detection of Speech Biomarkers for Emotion Recognition and Mental Health Assessment
  - Speech Inversion for Speech Therapy, Accent Reduction, Speech Recognition

Sandhya Dwarkadas

Education

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

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

Post-PhD

- Research scientist at Rice for 4 years
- Faculty member in Computer Science at University of Rochester
  - Albert Arendt Hopeman Professor of Engineering
  - Former Chair of Computer Science at UofR, current co-chair of CRA-WP
  - Secondary appointment in Electrical and Computer Engineering
- Sabbaticals at IBM Watson, HPCLinks/IISc India, EPFL Switzerland

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Poll

Are you a first/second/third/fourth year PhD student?

Have you already identified a thesis topic?

Are you currently working on a research problem/project (or have you worked on one in the past)?

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Finding a Research topic:
Some BaSICS

The Thesis Equation

Topic + Advisor = Dissertation

Selecting an Advisor

- Picking a good match as an advisor is important!
  - An advisor 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

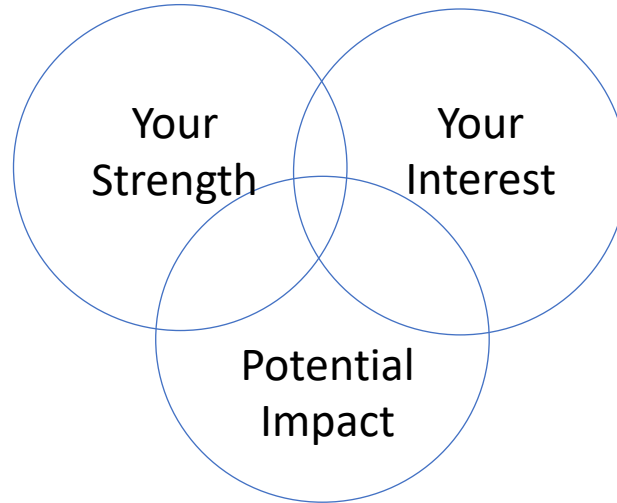***What should you consider when selecting an advisor?***

- 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

Finding 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.

Find Your Own Strength

- What drives you? bores you?
  - Technology, puzzles, applications, interdisciplinary work?

- What is easier for you?
  - Writing and modifying a complex software and debugging it?
  - Building things?
  - Proving theorems?
  - Analyzing data?

- How to find it if you don't know?
  - Try various projects/classes

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Follow Your Heart (and Head)

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

Is there funding for you to work in the area?

- Working as a TA
- Working as an RA
- Having a university/government/industry/… scholarship/grant

Topic Scale and Scope

Scope

- Is the topic of sufficient depth to qualify as a challenging research problem?
- Is the problem too big for you to handle in the time-frame of a PhD?

Scale

- What kind of impact will the work have?
- What will you become an expert in?

Identifying a Good Research Problem

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

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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

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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)

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."

TIPS & Suggestions

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

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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?

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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!

Things to Keep in Mind ...

- The path to finding a research topic will be a zigzag road
  - Don't expect to find it in just one shot

- Your topic of research can change along your career
  - No need to feel that you will be stuck with your PhD topic for the rest of your life

- Ok to span two fields
  - Many breakthroughs are made this way

Recap

- ***Topic*** + ***advisor*** are both important

- Follow your ***interests*** and ***passion***

- Learn your ***strengths***

- Make a ***plan*** and continually ***reevaluate***
  - Make sure you have the right ***tools, data, equipment***

Finding a Research Topic:
Open Discussion!!