

research area,  
problems

# Finding a Research Topic (including interdisciplinary)

***Soha Hassoun***

Department of Computer Science  
Tufts University

***Carole-Jean Wu***

Meta – AI Research  
(Former Professor at ASU)



**CRA-WP**

Computing Research Association  
Widening Participation

# Research Area vs. Research Problems

- Research **area** is broad (e.g., machine learning; systems)
- Research **problems** are specific questions to answer within a research area (e.g., combining supervised and unsupervised learning for image recognition; designing efficient data prefetchers for chip-multiprocessors)
- A **thesis** advances the field by addressing several (3) important research problems



**CRA-WP**

Computing Research Association  
Widening Participation

# Poll

- Did you already find your research area?
- Are you working on a research problem?
- Have you solved one or more research problem?



**CRA-WP**

Computing Research Association  
Widening Participation

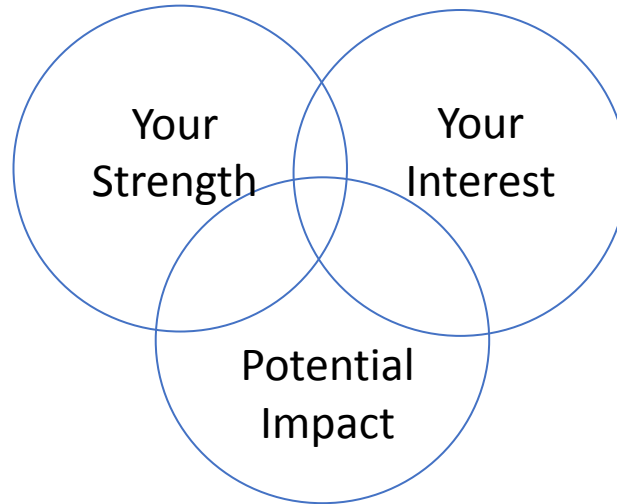
**You + Advisor = Research**



**CRA-WP**

Computing Research Association  
Widening Participation

# Finding a Research Area: You



Find what interests you that you can do well and where you can have potential impact.



**CRA-WP**

Computing Research Association  
Widening Participation

# Finding Your Strength

- What drives you?  
Technology, puzzles, applications, interdisciplinary work?
- What is easier for you?
  - Building things?
  - Proving theorems?
  - Analyzing data?
- How to find it if you don't know?
  - Try various projects/classes



**CRA-WP**

Computing Research Association  
Widening Participation

# Finding Your Passion

Love your topic!

- Sets the course for your next 5+ years
- May work in same/related area for years
- Determines, in part, opportunities offered to you upon graduation

Balance passion with practical issues, such as funding:

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



**CRA-WP**

Computing Research Association  
Widening Participation

# Identifying Potential Impact

- What kind of impact will the work have?
- What will you become an expert in?
- Where will this area take you next?



**CRA-WP**

Computing Research Association  
Widening Participation



# A **good match** with an advisor is important!

## *What's the advisor's role?*

- mentor (research/career); nurture; connect you to a research community

## *What makes for a **good match** ?*

- Research subfield: do some background reading; talk with advisor
- Flexibility: potentially expand to an adjacent subfield; work with co-advisor
- Working style: Talk with current graduate students; know your own style
- Agreeable funding situation



**CRA-WP**

Computing Research Association  
Widening Participation

# From a Research Area to Finding Research Problems



**CRA-WP**

Computing Research Association  
Widening Participation

# How Do You Identify Good Research Problems?

- Apprentice
- The Extended Course Project
- An Inspiring Talk
- Data Needs Answers
- Flash of Brilliance
- The Interdisciplinary
- The Stapler



**CRA-WP**

Computing Research Association  
Widening Participation

# The Apprentice

- Your advisor has a list of topics/funded projects that need to be worked on
- A fairly common, easy method
- **Pay attention to:**
  - 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



**CRA-WP**

Computing Research Association  
Widening Participation

# 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 to seed interdisciplinary research topics
- **Pay attention to:**
  - Check with your advisor
  - The project may not be extensible to a PhD thesis



**CRA-WP**

Computing Research Association  
Widening Participation

# 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...
- **Pay attention to:**
  - Your idea may have already been done
  - Your idea may not work



**CRA-WP**

Computing Research Association  
Widening Participation

# Data Needs Answers

- You participate in a data collection/analysis effort with another student or in industry
- You become fascinated with the potential of newly released data sets to answer questions no one is asking
- **Pay attention to:**
  - Data ownership and purpose of use
    - If industry, make sure you can access the data and publish



**CRA-WP**

Computing Research Association  
Widening Participation

# Flash of Brilliance

- Looking at the research problem space *holistically*
- Finding novelty from your knowledge and results
- **Pay attention to:**
  - The potential impact by focusing on your proposed ideas, results and state-of-the-art prior works



**CRA-WP**

Computing Research Association  
Widening Participation



# The Interdisciplinary

You learn about a problem in another field that you think you can help with (e.g. history and computer science)

- **Pay attention to:**
  - You will need real collaboration with experts in the other field
  - You'll need to make the case that this really is a contribution to both fields (especially to your own).
  - Consider publication venues, which impacts future job prospects



**CRA-WP**

Computing Research Association  
Widening Participation

# 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?
- **Pay attention to:**
  - It could be impossible to find a common theme that makes sense – your imagination is the limit!



**CRA-WP**

Computing Research Association  
Widening Participation

# Tips & Suggestions



**CRA-WP**

Computing Research Association  
Widening Participation

# When you're stuck at the start

Read/present papers regularly to find open research issues

- Practice summarizing, synthesizing & comparing sets of papers
- Be skeptical: 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***



**CRA-WP**

Computing Research Association  
Widening Participation

# When you're still stuck...

- Do internships in industry
  - They have many problems but may 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?



**CRA-WP**

Computing Research Association  
Widening Participation

# When you're really really stuck

- Change research advisor?  
Check department policies; check funding
- Change research areas?
  - 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)
- Sometimes taking a few months break can relax you and freshen up your mind!



**CRA-WP**

Computing Research Association  
Widening Participation

# Things to Keep in Mind ...

- The path to finding a research area / problem is iterative
  - Don't expect to find it in just one shot
- Your research area can change with your career
  - No need to feel that you will be stuck with your PhD area for the rest of your life
- Ok to span two fields
  - Many breakthroughs are made this way



**CRA-WP**

Computing Research Association  
Widening Participation

# Recap

*You* + *Advisor* = Research

- Driven by *strengths, passions, and potential impact*
- **Good match** with advisor is a must

Many ways to identify good research problems

If stuck, try different strategies to get unstuck



**CRA-WP**

Computing Research Association  
Widening Participation



# Thank you for prior presenters

***Sandhya Dwarkadas***

Department of Computer Science  
University of Virginia

***Carol Espy-Wilson***

Department of Electrical and Computer Engineering  
University of Maryland

**Kathryn McKinley & Ellen Zegura**

o



**CRA-WP**

Computing Research Association  
Widening Participation

# Finding a Research Area and Research Problems:

## *Open Discussion!!*



**CRA-WP**

Computing Research Association  
Widening Participation