Finding a Research Topic (including interdisciplinary)

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Link to captions

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 knowledge by addressing important research problem(s)
Poll

- Did you already find your research area?
- Are you working on a research problem?
- Have you solved one or more research problems?
You + Advisor = Research
Finding a Research Area: You

Find what interests you that you can do well and where you can have potential impact.
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
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
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?
A good match with an advisor is important!

What’s the advisor’s role?
- research mentor
- career mentor
- your connection to a research community

What makes for a good match?
- Research sub-area: do some background reading; talk with advisor
- Flexibility: potentially expand to an adjacent sub-area; work with co-advisor
- Working style: talk with current graduate students; know your own style
- Agreeable funding situation
From a Research Area to Finding Research Problems
How Do You Identify Good Research Problems?

- Apprentice
- The Extended Course Project
- An Inspiring Talk
- Data Needs Answers
- Flash of Brilliance
- The Interdisciplinarian
- The Stapler
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
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
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
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
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
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
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!
Tips & Suggestions
Topic 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?
Useful Things to Consider

- Is your problem solvable?
  - 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 problem/solution is new?
  - Why my problem is scientifically exciting?
  - Why solving my problem will help the world?
Getting *started*?

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*
When you’re 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?
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!
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
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
Thank you for prior presenters

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**Kathryn McKinley & Ellen Zegura**
Finding a Research Area and Research Problems: 
*Open Discussion!!*