

research area,
problems

Finding a Research Topic (including interdisciplinary)

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Link to captions

<https://bit.ly/3PYcqIB>



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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)



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Poll

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



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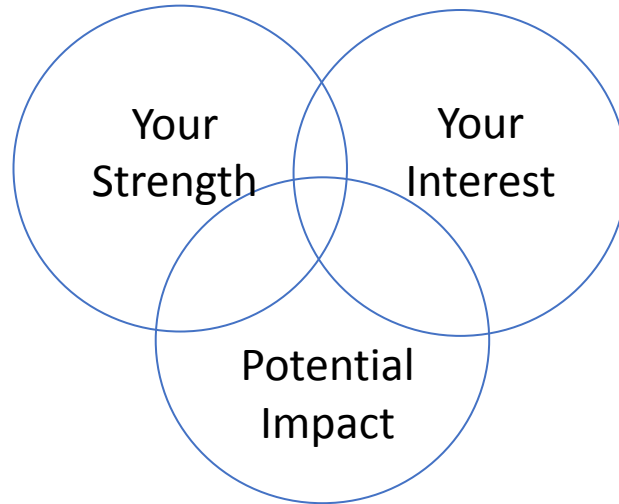
You + Advisor = Research



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Finding a Research Area: You



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



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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



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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



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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?



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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



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From a Research Area to Finding Research Problems



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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



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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
- **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



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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



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



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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



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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



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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



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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!



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Tips & Suggestions



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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?



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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?



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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



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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?



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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!



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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



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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



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Thank you for prior presenters

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Finding a Research Area and Research Problems:

Open Discussion!!



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