Research Methods in computer science

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Lecture 2

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Agenda

PhD Goals and Skills

PhD Milestones and Template

Research Topic Formulation

PhD Goals

What are they?

Push the field forward.

Practical Goals of CS Ph.D.

- Generate papers?
  - Need N papers to graduate??
- Create new technology that will change the way we do things
  - Describe your technology in a paper
  - Paper is not the goal. It is a vehicle for communication and dissemination.

Research Skills vs Technical Knowledge

Research skills are different from discipline-specific knowledge

Research skills are somewhat general

- Could even extend to other sciences

We can improve proficiency by practice

- Need iterations and pattern matching

Research Skills

What skills do we need to do research?

How to create knowledge?

(Practical) How to produce output such as: paper/presentations/software?

Related Skills

- Research Skills
- Soft Skills
- Skills for Entrepreneurs
- Leadership Skills

Systematic Practice

Vs

Try harder

Deliberate Practice

Observe

- Find good papers and presentations
- Study the content and style

Identify Skills

- Compare with your habits/skills/outputs
- Details (not high level like “writing”)

Practice

- Drills to challenge and improve
- Iterate with feedback

PhD Milestones

What are they?

PhD Template

Work on a project or two, often assisting a senior student; write a little

Work on a major project; write one or two papers on that topic

Write a dissertation

Discussion on variations in the “PhD template”

Think about your post-PhD objectives

Recap…

- What do you need to know/learn?
- What do you already know/learn?
- What do you want to work on?

- Practice, observe, adapt, seek feedback, iterate

Finding a Topic

Different from working on a topic

Didn’t get a chance to practice this much until now

An Observation About Ideas…

Rarely do we see an idea with no relation to the existing body of knowledge.

How to Find a Topic?

Read, read, read, discuss, go to talks

Listen to your advisor: sometimes you may not have a choice, but you can still bring small ideas

Lets say you are convinced you found a topic. You are excited.

How to know if we should pursue the topic?

Why do (PhD) research?

Do not work on ideas before evaluating them. Learn how to evaluate them.

Finding a research topic - 1

A hard problem

– but some heuristics may help:

Subject candidate topics to four basic questions [Herb Simon]:

1. Will anybody care about the answer?
Is there any utility in answer? Sometimes we care about the answer even without utility (e.g., DNA structure, structure of the Universe).

2. Solvable within the given amount of time?
Is this the right time to start with it? Can I finish it in 2-4 years?

3. Will I be the first to answer this question?
Need to look at past and ongoing work around the world. Are other people working on it now?

4. Do I have good tools to address this question?

Adapted from slides by Marek J. Druzdzel

Finding a research topic - 2

Why will I be successful in my research?

"Because I'm smarter than others"

bad answer ...

There are scores of smart people around.

"Because I'm a hard worker"

better ...

But everybody who wants to succeed works hard.

"Because I have a secret weapon"

Much better!

Adapted from slides by Marek J. Druzdzel

Finding a research topic - 3

What is a secret weapon?

A comparative advantage over your competitors to glory:

A good problem that nobody has thought about before.

- First to think about this problem because of personal or professional experiences?
  - Should we look for research ideas in journal articles?
- Resources I can access – people, computation resources, software, tools
- My background beyond technical: hobbies, music, interests in other fields, or life situations e.g., diseases common in my family, business links

Adapted from slides by Marek J. Druzdzel

We will see how there are parallels between finding good research topic vs finding good topics for startups.

We will discuss other ways of evaluating ideas next time. E.g., Heilmeier's ideas.

Do not work on ideas before evaluating them. Learn how to evaluate them.