CS 2001: Research Topics
Formulating and Pitching Your Ideas

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September 22, 2021

Plan for this lecture

- What makes a good idea?
- DARPA's Heilmeier Catechism
- NSF Merit Review Criteria
- Good/bad idea examples
- How to come up with ideas?
- Formulating ideas activity
- Pitching ideas activity

What makes a good idea for a PhD student?

- Is it worth doing?
  - Will it improve how we do work in the field?
  - Will it be useful for the world?
- Is it interesting enough?
  - Has it been done before?
  - Will the community learn something from it?
- Can it be done?
  - Is it too ambitious?
  - Do you and your team have the skills to do it?
  - (Are you uniquely qualified to do it?)
- Will it fit well in a good PhD thesis?
- Is your advisor interested in this?
- Does your advisor have funding, or might they be able to acquire it, for this type of idea?

The Heilmeier Catechism

- "DARPA operates on the principle that generating big rewards requires taking big risks. But how does the Agency determine what risks are worth taking?

- George H. Heilmeier, a former DARPA director (1975-1977), crafted a set of questions known as the "Heilmeier Catechism" to help Agency officials think through and evaluate proposed research programs.

- What are you trying to do? Articulate your objectives using absolutely no jargon.

- How is it done today, and what are the limits of current practice?

- What is new in your approach and why do you think it will be successful?

- Who cares? If you are successful, what difference will it make?

- What are the risks?

- How much will it cost?

- How long will it take?

- What are the mid-term and final "exams" to check for success?"

National Science Foundation Merit Review Criteria

- "Intellectual Merit: The Intellectual Merit criterion encompasses the potential to advance knowledge; and

- Broader Impacts: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes."

- How might these be formulated for some of our iconic papers?

https://www.nsf.gov/pubs/policydocs/pappg18_1/pappg_3.jsp

National Science Foundation Merit Review Criteria

"The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to:

    a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and

    b. Benefit society or advance desired societal outcomes (Broader Impacts)?

2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?

3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?

4. How well qualified is the individual, team, or organization to conduct the proposed activities?

5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?"

https://www.nsf.gov/pubs/policydocs/pappg18_1/pappg_3.jsp

Are these good or bad ideas?

- Develop a dataset for a new problem
- Replace the neural architecture in one system with another architecture
- Develop a more efficient way to accomplish the same task
- Make AI think like a human
- Compare how two methods work
- Make the outputs of a method more interpretable

How to come up with ideas?

- Come up with a new problem
  - What makes this easy?
  - What makes this challenging?
- Twist on an existing problem, with somewhat new approach
- Solution for an existing problem but under new resource constraints–e.g. limited supervision, computational resources

How to come up with ideas?

- Blend problems/solutions—apply techniques from one area to another area

- Compare methods in a way that hasn't been compared

- Existing problem, propose dramatically new and improved method, or an incremental, but well-performant twist

- What else?

Environments for new ideas

- Places/settings in which I've come up with new ideas that ended up being published:
  - While observing my child
  - While watching ads during NFL games
  - While riding in a cab
  - While going for walks
  - While reading papers

Activity 1 (30 min)

- Think of a project you have done, a paper you have read, an app you have seen, etc.
- Describe what was already done, where you would like to take it further, and how (hypothetically)
- Write down answers to the Heilmeier questions (10 min)
- Present your answers to the class (in 5-7 min)
- The class will then ask further questions based on your answers—be prepared to defend your idea!

Activity 2 (20 min)

- Choose from the set of iconic papers
- Write down some relatively low-level ideas of future work– what are small changes you can make to the work to improve it?
- Then write down mid-level and high-level changes– if you have 1 year, what will you do to improve the solution? What about if you have 3-5 years?
- Also write down related, but different research directions that might also be worth pursuing
- Present ideas to class and discuss (5-10 min)