

How to Do Research

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What is research?

- Investigate and understand the known unknowns and unknown unknowns in the scientific world.
- In our lab, we are specifically interested in:
 - designing accurate, robust, and scalable **machine learning** algorithms;
 - advancing **natural language processing** models;
 - combining **learning and reasoning** for better AI.

How's research different from taking courses?

- Taking courses: instructor tells you **exactly** what to do.
- Research:
 - define an **open** research problem with your advisor;
 - you **(students) take the initiatives**;
 - discuss and refine the technical approaches;
 - you (students) implement the approach and perform experiments to verify the idea.

How to make good progress in research activities

- **Clearly define the problem / task** that you want to solve;
- Understand the **literature**: what other people have done, and what you can learn from them;
- Work out the algorithm first, find a suitable dataset, and put theories into practice: **write some code**;
- Start with **smaller subset of data** for debugging, and move on to larger datasets.
- **Document the results** carefully in spreadsheet / docs.

How to measure the effectiveness of ideas?

- Use **mathematical** tools to clearly define the problem and your solutions;
- Look at the theoretical properties of your **algorithms**;
- Define good **metric(s)**, and perform experiments on **multiple datasets**;
- Report results and compare with state-of-the-arts **baselines**.

Why is publication important?

- Publication is the most important formal method for **scholarly communications**.
- Presenting your research and attending leading conferences will create **impacts**, get **inspirations**, and facilitate the **exchange of thoughts** and good ideas.
- Peer-review is a good way to get **feedback** from top researchers in your field.
- And it is a *relatively* **objective** way to claim the effectiveness of your research.

What is in a good research (paper)?

- Is the problem **new**?
- Is your approach **new**?
- How good are the results **comparing to prior work**?
- Can you contribute any new **open-source** datasets/code?
- Is this paper well-structured and **well-written**?

Research is hard

- They are open problems that no one has a perfect solution!
- Implementing ideas and debugging code could be challenging.
- Performing good experiments are not easy.
- Writing papers against deadlines..

Research is rewarding

- You helped to advance science!
- When your first top conference full paper is accepted... (acceptance rates typically 10-30%);
- Other people attend your talk, read/cite your papers, and use your code/approaches;
- You are now the world's expert in this area.