Research Methods

CSCI 8901:
What we've learned so far…

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GWU
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Almost done!

Today

- Summary of topics we have discussed
- Poster
- Final Report
- 1-on-1 meetings: Xiaosu, Jie, Maorui, Cuidi, Ellie, David, Cat, Lingsheng
  - In person first, then online

Next class: Poster Session

Dec 19th: Final report due

Topics so far…

Reading Papers

Selecting Projects

Why Science is Hard

Papers and Conferences

Productivity

Writing

Presenting

Visualizing / Graphing

Grants

Creativity

Jobs

Last chance for questions or discussion on any of these topics!

Reading

"Black boxing"

- abstract away the parts that you don't need right now

Don't read linearly

- Read intro/conclusion (figure out theme and where to focus)

Look for "Figure 1"

- Use pictures to help understand the paper

Write out mental model / questions

- Have a way to keep notes about a paper

Tool to organize

- Zotero

Recipe: Skimming

1) Read the abstract and introduction
- Highlight each contribution they claim

2) Look at the title of each section/subsection
- Guess what it will be about, but don't read it carefully

3) Examine the figures and tables
- Understand what metrics they will evaluate

4) Read the conclusion and any parts that stand out

You now know:
- Paper type: theoretical, modeling, implementation, measurement
- The main goals of the paper
- What evaluation the authors think is important
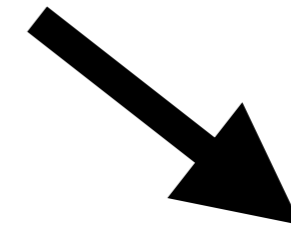
Writing

Start by outlining Methods
- You know this so it will be easier to do
- Writing it down makes you understand it better and recognize areas that are not complete

Look at relevant papers to see how to structure the paper
- Having a template

Recipe: Introduction

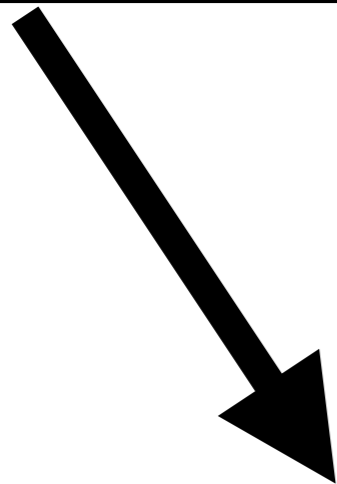But imagine how wonderful it could be if we could figure out how to do X!

My work helps us get one step closer to the magical dream world!
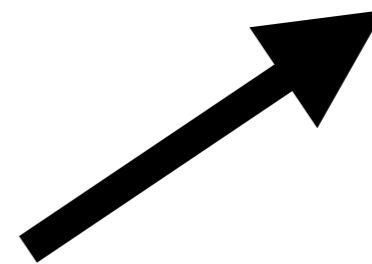
The world is a terrible, terrible place.

Recipe: Introduction v2

There is something new and wonderful!

But everything is hard and terrible!

My work helps us get one step closer to the magical dream world!

Recipe: Starting a Paper

1. Write a 2 paragraph abstract
   - High level brain dump of problem and goals
   - Plan to rewrite this all later

2. Add titles for all sections and subsections

3. Outline key sections
   - One bullet point per paragraph

4. Sketch key figures
   - System design, algorithm flow
   - Predicted experimental results

Experiments

Reproducibility (for yourself and others)
- Run at least 3 times to check consistency

Pilot runs / Microbenchmarks
- Initial simpler experiments that let you see if results match expectations

Environment - choose it carefully
- Affects results so specify details

Environment, Task, System = Behavior

Hypothesis - must be testable
- Predict what results will be (draw a sketch)

Parameter exploration
- Only change one parameter at a time
- Be aware of "parameter explosion", carefully searching space

Recipe: Experimental Design

1. Have something to compare against

2. Consider and isolate the most important variables

3. Plan experiments to show:
   - How well your system does **compared** to a baseline
   - **Why** your system does well

4. Predict results and sketch graphs before starting

5. Run experiments

6. Ensure results are repeatable and significant
   - Think about threats to internal and external validity

(Throughout) Iterate and feedback as needed

Presenting

Make **3** key points clear

Speak loudly, avoid bad words, gestures, enthusiasm, eye contact

Don't overdo animations
- Use to emphasize most important points, but don't let them be a distraction

Not too many words
- Bullet points or pictures

Use pauses, repetition for emphasis of key points

Proper types of graphs for results

Outline and summary to show audience what to expect and what was important

Give background / motivation to set context
- First few minutes of the talk are the most important

7 points per slide, 7 words per point, super large font

Recipe: Presentation Structure

1. Motivate your problem with an introduction
   - Analogies and stories are great!

2. Limit yourself to three key points
   - Use repetition and consistency to reinforce key ideas

3. Have ups and downs
   - Use pacing and delivery to draw the audience's attention

Bonus tip: have a conclusion/summary to wrap things up!

Recipe: Presentation skills

Speak clearly

Volume, Bad Words

Position your body

Gestures, Posture

Engage the audience

Voice Modulation, Smiles, Eye Contact

Poster

Prepare a poster about your project
- Make a single 24x36 inch slide in a tool like Powerpoint
- Landscape format for easier display on screen

Give a 3-5 minute research pitch
- Overview the problem - why is it important? what is hard?
- High level description of solution / approach
- Preliminary results or experimental plans (can be fake)
- Conclusion that emphasizes key points
- 3-5 min Q&A (must be at least 3 questions per poster)

Can use poster slide directly, or break it into smaller zoomed in slides
- Don't make a separate set of slides, pretend that you are standing next to a physical poster and directing our attention to it

Final Report

Combination of all material so far:

1. Project Overview (~1 page)

2. Literature Survey (~1-3 pages) *(or can be after Eval)*
   - Modify based on my feedback if necessary

3. Proposed Approach (~1-2 pages)
   - New text to explain your visual (~1 page)

4. Experimental Design/Results (1-2 pages)

5. Conclusion (0.5 pages)
   - Emphasize a few key points about your results or your design

Prepare this in a format fitting for your end goal
   - Latex conference template, Python Notebook, etc

Class Survey

https://forms.gle/aNdUiSJLgHYvpPe58