How to read papers

What is a scientific paper?

- Scientists communicate their research findings by writing papers.
- Papers (in CS) are usually published in:
  - Journals: periodicals on a particular subarea of CS
  - Conference proceedings: a collection of papers presented at a meeting of people in a subarea.
- Peer review
  - Papers are vetted by experts in your subarea before publication.

Why bother reading papers?

- All the newest research is in papers.
  - You'll learn what's been figured out and what's left to discover.
- Papers often suggest new avenues of research ("future work").
- Contain information about how experiments were conducted, methodology used, tools and equipment needed.
  - Can give you ideas on how to conduct your own research.

Two types of papers

- Primary research paper
  - These are the "new findings" in research.
  - Contain *original* data, experiments, discoveries, findings, conclusions.
  - (Hopefully) should contain enough information to
    - verify the authors' claims
    - replicate the findings

Two types of papers

- Review paper
  - Give an overview of a subarea.
  - Summarize many different papers.
  - Often contain more background information than primary research articles.

Sections of a primary research paper

- Abstract
  - Summary highlighting the main research questions, provides key results of experiments, and usually some short conclusions.
  - Read to figure out if the whole paper is worth reading.
  - If the article is behind a paywall, the abstracts are usually free.

Sections of a primary research paper

- Introduction
  - Gives background information and introduces the research questions to be studied.
  - Usually includes lots of citations to other articles in order to position the new research in the field.
  - Often includes motivation for why this research is important.
  - If intro makes no sense, rest of the article may not either. Consult a review paper, textbook, or citations in the paper.

Sections of a primary research paper

- "Materials and Methods"
  - Rarely called that.
  - One or more sections that illustrate what the researchers did.
    - Created a new algorithm? Give the algorithm.
    - Ran experiments? Explain them.
- Results
  - "Did it work?"
  - Often numerical data from experiments.
  - Often includes charts and graphs.

Sections of a primary research paper

- Evaluation
  - If there's a new system/algorithm/technique, how well does it perform?
  - Are these results significant compared to other results?
- Discussion and conclusions
  - Opinions about what the research means, how it can be used, further hypotheses or experiments to run, future work.
  - Stuff here is author's interpretations, not necessarily factual.
- References

How to read it: two passes

- First pass:
  - Read title, abstract, introduction. Skim heart of the paper. Read conclusions.
  - Goal: be able to state the research question and major conclusions.
- Might stop here
- Second pass:
  - Read everything more carefully.
  - Only skim technical details like proofs.
  - Pay special attention to figures, graphs, and charts.
  - Goal: be able to summarize to another person the content of the paper.