Plan for this lecture

• Structure of a paper
• Reading papers for breadth/depth
  – How to maximize time efficiency
  – Three-pass approach
  – How to organize papers
• Homework (activities)
  – Read 1 iconic paper (questions at high/mid level)
  – Read 4-6 iconic papers (compare/contrast)
  – Google Scholar search for a topic of interest
Structure of a Paper
Structure of an 8-page, 2-col Paper

- Abstract
- Introduction
- Related Work
- Approach/Method
- Validation/Results/Experiments
- Conclusion
- Acknowledgements
- References
Abstract (1 paragraph)

• Purpose
  • Why is this paper interesting?
  • Why should I spend my time reading this?
  • What do you claim to do?
• Summarize problem being tackled, key innovations, main results
• One strategy: write it after rest of paper written
  – Caveat: some conferences might want an abstract earlier than the submission deadline
Introduction (1-1.5 page)

• Purpose: motivate work, inform reader what is to come
• First paragraph: describe problem and state current gap in science, including current methods’ deficiencies
  – Also briefly describe motivation: why addressing this particular gap is important, has applications
• Second paragraph: state the very high-level idea of your solution to address this gap
• Third paragraph: briefly introduce your method
• Fourth paragraph: briefly summarize experiments
• Fifth paragraph: summarize contributions
• Concept figure (Fig. 1): illustrate key idea of the work
• Important: sets initial expectations
Related Work (0.5-1 page)

• Note: This may also come before Conclusions—tradeoffs?
• Purpose: inform reader you are aware of prior results, and demonstrate the novelty of the work
• Summarize 15-50 most relevant papers
• Organize by rough topic or approach (use paragraph headings but no separate subsections, for space)
• Within each paragraph, can describe papers at a course level, e.g. “Some works approach the task by... [ref1, ref2, ref3].”
• End each paragraph or group of papers with how proposed method is different
Approach (2.5-3.5 pages)

• Purpose: describe novel approach, contribution
• Have an introductory paragraph describing an overview of the approach
• Make it clear which part of the approach is standard/from prior work, and which part is new/novel/innovative
• Common to have 2-5 subsections
• Should be detailed enough for others to replicate the work (in theory)—in ML, common to include a separate “implementation details” section
Experiments (2.5-3.5 pages)

• Purpose: prove stated contributions are meaningful
• Forms: performance measurements, simulation results, analysis of user study data, formal proofs...
• Include experimental setup (e.g. data and metrics used, methods tested with names, perhaps in special font setting)
• Include one or more results subsections (the outcomes from running the experiments)
• Show results in tables and/or figures, and describe/analyze these tables/figures in the text
• Explicitly make all the conclusions you want the reviewers to draw from them
• May or may not show statistical significance but be prepared to answer questions about it
Conclusion (1 paragraph)

• Summarize contributions and findings of the paper, briefly
• Acknowledge limitations and briefly suggest future work—no more than 1-2 sentences (may vary by research community)
Discussion

• May be part of experiments, potentially conclusion
• Purpose: papers do not often “close” a topic—this is where you reflect on what has been done, and what is still open
• May include: interpretation of results or evaluation, discussion of open problems, description of limitations, etc.
Acknowledgements (1 paragraph)

• Omit for review due to anonymity
• Ask your advisor which funding sources to acknowledge, any particular phrasing to use
• Can also thank the anonymous reviewers and area chairs
References

• Standard formats for this
• Can get bibtex citations for a paper from Google Scholar or DBLP, but may have to fix
• If a paper appeared in a conference/journal, don’t cite the arxiv version
• Use consistent formatting, e.g. the same conference should use the exact same string including abbreviation for the conference name
How to Read Papers
Why do we read papers?

• To know what others in our field are doing
• To get ideas for research projects
  – in terms of problems/tasks, as well as gaps and deficiencies in prior methods
• To know the relevant techniques
• To avoid reinventing the wheel
• To avoid having our papers rejected because we didn’t compare to relevant baselines
Why do we read papers?

There are many legitimate reasons for reading a paper

- I heard someone talking about this result
- The conference talk interested me
- It’s related to a problem I am working on
- My advisor told me to
- This provides context for another problem
- I think that I might want to explore this area
- ...

**Take-away point:** Why you plan to read a paper will—to some degree—dictate how you should go about reading it
Too many papers!

• CVPR, the top conference in my field, has over 1000 papers each year—and there are 5+ such conferences each year in my field
• Sometimes papers are organized by topic
• Last CVPR, I went through all titles and downloaded 300 papers, read the abstract and skimmed intro and figures
• Took notes on about half of them—otherwise I’d forget which papers did what
• Faculty often skim papers, and you will skim some, but have to read some in detail
Reading for breadth vs depth

• Breadth
  – Get a sense of the “pulse” of the field, what are open problems
  – Identify potential research directions
  – Get exposed to techniques—you never know when a seemingly unrelated technique may come in handy

• Depth
  – If your advisor sends you a paper, spend at least 30 min reading
  – You need to know papers in great detail, your advisor less so—the details are your responsibility
  – But if you do 5 hours of reading a week, you should spend 20 hours doing active work, i.e. developing your method and conducting your experiments
Maximizing Time Efficiency: Example

• Suppose you have 100 papers roughly relevant to your area
• Read abstracts+intros for all, look at concept/method figures (5-10 min per paper)
• Also skim approach and experiments for 20 (30 min per paper)
• Read 20 in great depth (2-4 hours per paper)
Multi-pass Approach

Keshav* has a nice paper on a three-pass reading approach

Pass 1: Basic comprehension
- What is the main topic of the paper?
- What are the authors’ claimed contributions?
- What do they cite?

Pass 2: First look at real details
- Focus on details: evaluation, figures, methods
- Ignore proofs

Pass 3: Depth!
- Fully understand all details

First Pass: Decide How Much Time to Invest

Focus your attention on:
- Title and Abstract
- Full details of the Introduction
- Section and Sub-Section headings in the body
- Full details in the Conclusion
- Skim references, note what you’ve read

After this, you should know about the “5 Cs”
- **Category**: Experimental paper? Theory? Measurement?
- **Context**: What does this paper cite?
- **Correctness**: Do any assumptions seem reasonable?
- **Contributions**: What do the authors (claim) to contribute?
- **Clarity**: Can you follow the paper?

You can probably accomplish this for most papers in ~10 minutes
Activity 1 (10+10 min)

• Pick a paper from the iconic papers list
• Answer 5C’s (take notes)
• Share with class
Second Pass: Breadth of Knowledge

General idea: Read the whole paper, but skip super-intricate details like proofs, some equations (if many).

Focus on:
- Understanding methodology, evaluation, figures, etc.
- Mark relevant references for later reading (more breadth!)
- Being able to explain the main ideas of the paper to someone else

This process can take up to an hour for a 10-page paper

Why so long?
- Perhaps you’re new to the subject area
- Authors use methodologies or techniques that are unfamiliar
- Paper is just badly written...

Slide adapted from: Adam Lee
Second Pass: Breadth of Knowledge

Important questions include:

- What are the motivations for this work?
- What is the proposed solution? Is it novel?
- How is this solution evaluated?
- What do you think about the problem, solution, and evaluation?
- What are the contributions of this work?
- Des this paper close an area of research? Open a new one? Lead to interesting future work?
- What questions do you still have?

Griswold has a nice template for answering these questions—linked on the course page.
Activity 2 (60 min, HW)

• Pick another paper from the iconic papers list
• Answer questions from previous slide (take notes)
• Share with class next time
Third Pass: Develop Intricate Understanding

**Main focus:** Everything you’ve glossed over so far
- Thorough scrutiny of assumptions
- What alternative solutions might have been possible?
- Does the evaluation cover enough meaningful cases?
- Detailed examination of proofs and proof techniques

After a thorough pass, you should (ideally) be able to replicate the results presented in the paper

This is a **time-intensive** process
- 4-5 hours for beginners
- Around an hour for more experienced readers
Note-Taking

Note-taking can help build your understanding of a paper and manage the many papers that you’ll eventually read.

Note taking while you read helps capture the context of your reading session for later reference.

Use a highlighter to mark major points, definitions, and theorems for quick reference later.

Make notes in the margin:
- Write down questions as they pop into your head.
- Answer previous questions as you find answers.
- Summarize tables, graphs, etc.
- Add details to incomplete/unclear examples.

Note - Taking Slide credit: Adam Lee
Note-Taking

Note taking after you read can also help

- Ensure complete understanding of relevant papers
- Manage large collections of papers as your progress in your studies

Consider making a document per research area

For each paper, write up:

- A technical summary of the work
- A brief description of the paper’s relation to other works
- Relationships to your ongoing/planned research
- Resources you can use in your work (e.g. data)
- Any cool ideas for future work that come to mind

Slide adapted from: Adam Lee
Initially, you will have an incomplete knowledge of a research area. How can you fix this problem?

**Step 1:** Read up on prior work!

**Step 2:** Understand how this paper fits into more recent research

There are research tools to help aid these processes

- ACM portal: [http://portal.acm.org](http://portal.acm.org)
- Google scholar: [http://scholar.google.com](http://scholar.google.com)
- Citeseer: [http://citeseerx.ist.psu.edu/](http://citeseerx.ist.psu.edu/)
- DBLP: [https://dblp.uni-trier.de/](https://dblp.uni-trier.de/)
How to Organize Papers

• I used to keep folders with printed and annotated papers, labeled by topic/subarea
• I still annotate papers, and keep a separate document with notes (for easier searching)
• Reference management software support exists:
  – Mendeley
  – EndNote
  – Zotero
  – ReadCube Papers
Activity 3 (HW)

• Read 2-3 iconic papers in one area, and 2-3 in another
• Compare and contrast: Summarize and present writing strategies—how papers in this area are typically written
• Highlight any differences between areas, any similarities (share)
Activity 4 (HW)

• Pick a topic or a research project idea (should be fairly specific, not a whole research area)
• Do a Google Scholar search to determine what others have worked on in this area
• Share with us what you found
Activities 2, 3, 4