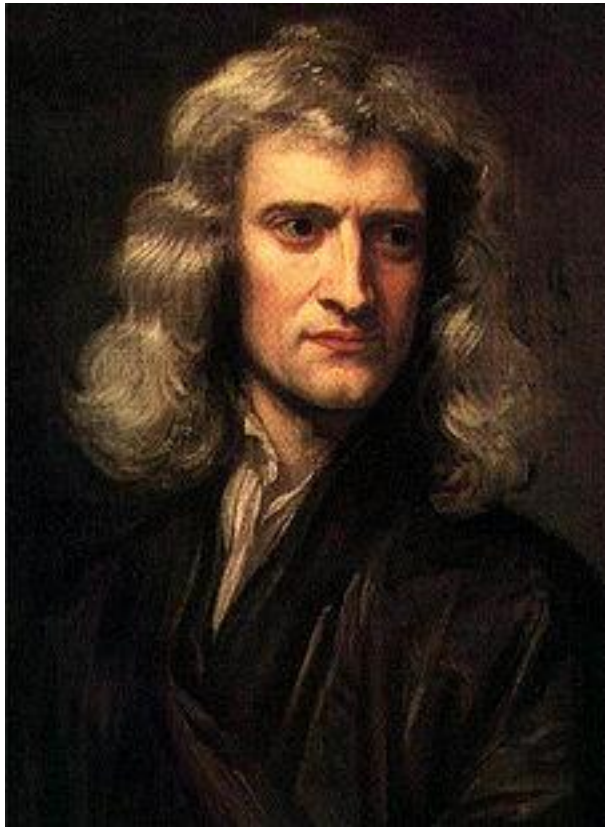

University of Pittsburgh
Paper Reading
CS 2001: Research Topics in Computer Science
Fall 2014
Dietrich School of Arts of and Sciences
Department of Computer Science

Research papers are the lifeblood of science



If I have seen further it is by standing on the shoulders of giants.

—Isaac Newton, 1676

Today, we'll cover

Typical paper structure

How to read

- Structuring your reading session
- What to look for
- Comprehension strategies

Filling in gaps in your knowledge

Papers in computer science often follow a somewhat predictable format

Abstract

- Introduction
- Related work*
- Proposed design/system/method
- Evaluation
- Discussion
- Related work*
- Conclusions & Future work

References

Content:

- Very short (~250 words)
- Brief description of purpose
- Highlight main results

Purpose:

- "Hook" the reader
  - Why is this paper interesting?
  - Why should I spend my time reading this?
  - What do you claim to do?
- Set the stage for the paper

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Content:

- Usually 1-1.5 pages
- Main elements
  - What is the problem?
  - Why is the state of the art insufficient?
  - Overview of the solution
  - Novel contributions of the work?
  - How is impact evaluated?
- Balance content and conciseness!

Purpose:

- Motivate the work
- Inform the reader of what is to come
- Many reviewers will make their initial decisions after reading only the intro!

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Content:

- Overview of past research/results
- Comparison to claimed contributions
- Not a book report!

Purpose:

- Motivate the work (How?)
- Inform the reader that you are aware of prior results
- Clearly demonstrate the novelty in your approach

Note: Related work may occur at the beginning or end of a paper

- Beginning: Prior work is necessary for understanding this paper
- End: Prior work is only tangentially related

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Content:

- Maybe more than one section…
  - Requirements, Design
  - Syntax, Semantics, Enforcement
  - Design, Implementation
  - …
- This is the novel content of a paper

Purpose:

- Proposal of original idea(s)
- This is the authors' contribution!
- Should be detailed enough for others to replicate the work (in theory)

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Content:

- Could be any number of things
  - Performance measurements
  - Simulation results
  - Analysis of user study data
  - Formal proofs
  - …

Purpose: "Prove" that the stated contributions are meaningful

Note: A incomplete/incorrect evaluation can kill an otherwise good paper!

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Content:

- Not all papers have this
- If included, typically contains
  - An interpretation of results/evaluation
  - Discussion of open problems
  - Description of limitations

Purpose:

- Papers do not often "close" a topic
- This is where you reflect on what has been done, and what is still open

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- Conclusions & Future work

References

Content:

- Far too often: Rehash of the paper
- Ideally: Reflection on contributions

Purpose:

- One last summary of contributions given the whole context of the work
- Identification of promising future research directions

Preparing to read

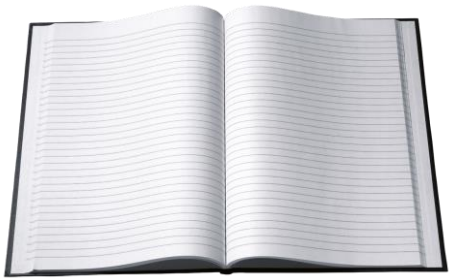
Reading a research paper is different than other reading!

- 10 pages of news: < 10 minutes
- 10 pages of fiction: < 20 minutes
- 10 pages in a textbook: < 30 minutes
- 10 page research paper: 20 minutes – several hours!

Prior to reading, make sure you gather the appropriate supplies

Quiet Environment

Appropriate Time
(How much?)

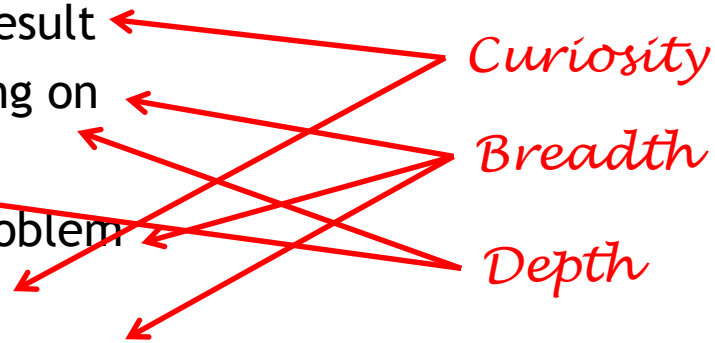


Note-Taking Supplies (?!)

Why are you planning to read that paper?

There are many legitimate reasons for reading a paper

- I heard someone talking about this result
- It's related to a problem I am working on
- My advisor told me to
- This provides context for another problem
- The conference talk interested me
- 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

A multi-pass approach to reading is generally good

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?

Curiosity

Pass 2: First look at real details

- Focus on details: evaluation, figures, methods
- Ignore proofs

Breadth

Pass 3: Depth!

- Fully understand all details

Depth

* S. Keshav, "How to Read a Paper," ACM SIGCOMM Computer Communication Review 37(3) : 83-84, July 2007.

Your first pass over the paper should help you decide how much time you need to invest in it

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

Audience Participation!

Finding Deceptive Opinion Spam by Any Stretch of the Imagination. Myle Ott, Yejin Choi, Claire Cardie, and Jeffrey Hancock. *Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics: Human Language Technologies (ACL HLT)*, 2011. http://myleott.com/

Let's talk a little bit…

- 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?

The second pass over a paper is all about breadth of knowledge

General idea: Read the whole paper, but skip super-intricate details like proofs.

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 standard 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…

After breadth reading, you should be able to answer many questions about a paper

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?
- What does 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. I've linked to it on the course page.

Audience Participation!

Adi Shamir, "How to Share a Secret," Communications of the ACM 22(11) : 612-613, November 1979.

Let's talk a little bit…

- 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?
- Does this paper close an area of research? Open a new one? Lead to interesting future work?
- What questions do you still have?

Your third pass over a paper should focus on developing an intricate understanding of the subject matter

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 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 can help build your understanding of a paper and manage the *many* papers that you'll eventually read

Note taking after you read can 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
- Any cool ideas for future work that come to mind

A few examples…

Filling in the gaps…

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
- IEEEXplore: http://ieeexplore.ieee.org/Xplore
- Google scholar: http://scholar.google.com
- Citeseer: http://citeseerx.ist.psu.edu/

Let’s do a little tracing…

Conclusions

Paper reading is an essential skill for PhD students (and researchers in general!)

At first, this is a slow process, but gets easier with practice

Multi-pass reading can help aid comprehension

- Pass 1: Overview
- Pass 2: General understanding, expand breadth of knowledge
- Pass 3: Details, details, details

Next time: Writing paper reviews