Seminar on Program Analysis

ECS 289C (Programming Languages and Compilers)

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Reading, Writing, and Presenting Research Papers

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How to Read a Research Paper

Based on:

How to Read an Engineering Research Paper by W. G. Griswold

How to Read a Paper by S. Keshav

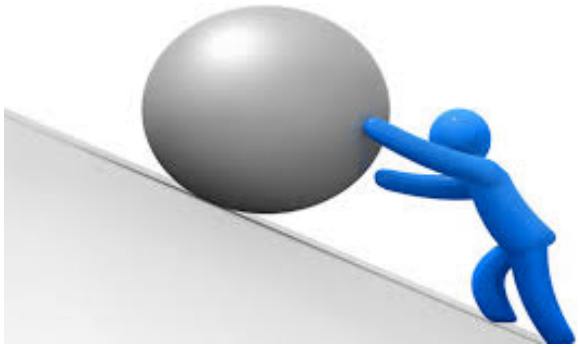
Why to Read Papers?

- Review them for a conference or class
- Keep current in your field of study
- As part of a literature survey of a new field

Learning to efficiently read a paper is *critical*
but a rarely taught skill

A Challenging Task

- Space limitation
- Specialized audience
- Time limitation



Useful to know what you should get out of the paper, and where to find that information!

Paper Structure

- Abstract (1-2 paragraphs)
- Introduction (1 page) → paper motivation + outline of solution
- Problem description (1 page)
- Proposed approach (2 pages)
- Technical details and evaluation (5 pages)

→ solution in detail

- Related work (1-2 pages)
- Conclusions and future work (0.5 pages) → recap

Lots of repetition at different levels of detail → can read "out of order" or skip certain sections

Questions to Keep in Mind

- What are *motivations* for this work?
  - Why doesn't the problem have a trivial solution?
  - What are the previous solutions and why are they inadequate?
- What is the proposed *solution*?
  - Why is it believed the solution will work and is better?
  - How is the solution achieved?
- What is the work's evaluation of the solution?
  - Argument, implementation and/or experiment

Questions to Keep in Mind

- What is your analysis of the identified problem, idea and evaluation?
  - Is this really going to work? Who would want it? Etc.
- What are the *contributions*?
  - Ideas, software, experimental techniques, area survey?
- What questions are you left with?
  - What do you find confusing or difficult to understand?

Questions to Keep in Mind

- What is your take-away message from this paper?
  - Sum up the main implication of the paper from your perspective
- What are the *future directions* of this research?
  - What ideas did you come up while reading the paper?

The Three-Pass Approach

PASS 1

Gives you a general idea about the paper

PASS 2

Let’s you grasp the paper’s content, but not its details

PASS 3

Helps you understand the paper in depth

First Pass

1. Carefully read the title, abstract, and introduction
2. Read the section and sub-section headings, but ignore everything else
3. Read the conclusions
4. Glance over the references, mentally ticking off the ones you have already read

Second Pass

- Look carefully at figures, diagrams and other illustrations
- Mark relevant unread references for further reading
- By the end of this pass, you should be able to summarize the main thrust of the paper

Third Pass

- Attempt to "virtually" re-implement the paper
- Identify and challenge every assumption in every statement
- By the end of this pass, you should be able to:
  - Identify its strong and weak points
  - Pinpoint implicit assumptions, missing related work, and potential issues with experimental or analytical techniques

Other Resources

- How to Read a Technical Paper by Jason Eisner
- How to Read a Paper by Michael Mitsenmacher
- Efficient Reading of Papers in Science and Technology by Michael J. Hanson

How to Write a Research Paper

Based on *Writing Good Software Engineering Research Papers*

By Mary Shaw

1. What is your contribution?

- Explain what problem you are set out to solve before reporting what you did

48% of Submissions

42% of Acceptances

Type of question	Characteristics
Method or means of development	One setting, but potential to be applied in other settings
Method for analysis or evaluation	One setting, but potential to be applied in other settings
Design, evaluation, or analysis of a particular instance	Particular instance with some broad appeal
Generalization or characterization	Beyond examples presented in paper
Feasibility study or exploration	Deal with an issue in new way

Questions about the contribution

- What is the question you are answering?
- Why does the answer matter?

2. What is your new result?

- Explain precisely how you have advanced the state of the art, and how this is useful beyond your project

Type of result	Example(s)
Procedure or technique	New or better way to do some task
Qualitative or descriptive	Structure or taxonomy for a problem area
Empirical model	Empirical predictive model based on observed data
Formal model	Structural model that permits formal analysis
Tool or notation	Implemented tool that embodies a technique
Specific solution, prototype	Solution to application problem
Report	Interesting observations not general enough to lead to a descriptive model

44% of Submissions

28% of Acceptances

Questions about the result

- What, precisely, do you claim to contribute?
- What's new here?
- What has been done before? How is your work different or better?
- What, precisely, is the result?

3. Why should the reader believe your result?

- Show evidence that your result is valid – i.e., it actually helps solve the problem

	Type of result	Example(s)
16% of Submissions 26% of Acceptances	Analysis	Rigorous analysis
	Evaluation	Includes feasibility studies, pilot projects
	Experience	Used on real examples by someone else
27% of Submissions 37% of Acceptances	Example	Example with explanation of why it retains the essence of problem being solved
	Persuasion	Rarely sufficient for a research paper
	Blatant assertion	Highly unlikely to be acceptable

Questions about credibility

- Is there solid evidence to support your result?
- Is the your evaluation described clearly and accurately?
- Is the validation related to the claim?

Summary

- There is *no recipe* to write a good research paper
- Clarity of explanation is necessary but no sufficient
- This study may reveal different results for other conferences, and even ICSE today
- Nevertheless, interesting to see what the trends are/were, and what conference committees look for

Video: How to Write a Great Research Paper

Simon Peyton Jones
Microsoft Research

https://www.youtube.com/watch?v=g3dkRsTqdDA

How to Give a Presentation

How to give a great research talk

Simon Peyton Jones
Microsoft Research, Cambridge

1993 paper joint with
John Hughes (Chalmers),
John Launchbury (Galois)

Giving a good talk

This presentation is about how to give a good research talk

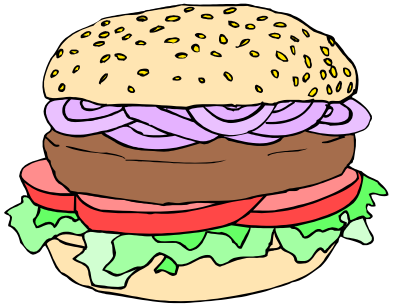
- What your talk is for
- What to put in it (and what not to)
- How to present it

Why you should listen to this talk

- Because many research talks are poor…
- …and quite simple things can make *your* talks much better
- Because everyone benefits from good talks
  - Your audience is happier
  - You get promoted
- Because a research talk gives you access to the world's most priceless commodity: the time and attention of other people. Don't waste it!

What your talk is for

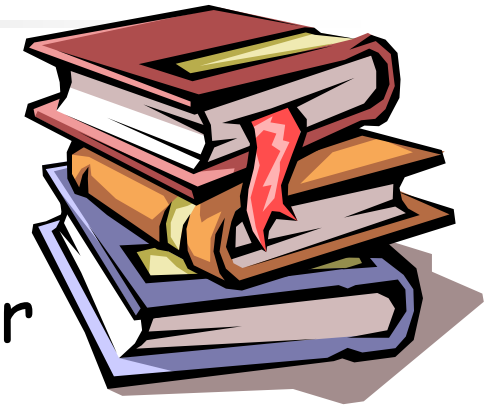
Your paper = **The beef**



Your talk = **The beef advertisment**

Do not confuse the two

The purpose of your talk…

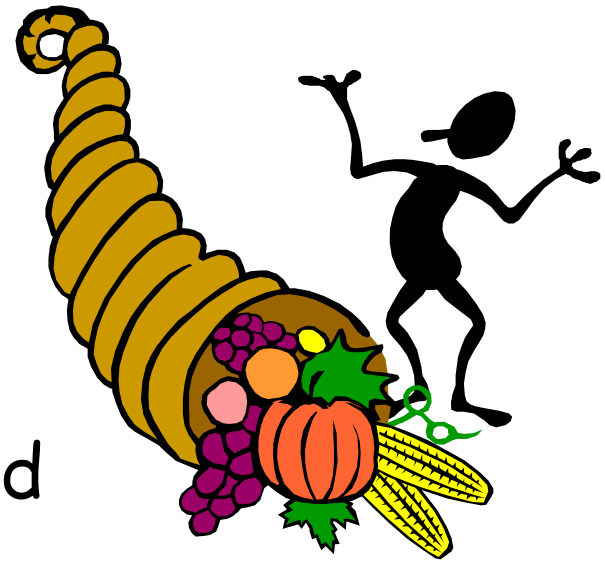


The purpose of your talk **is not**:

- To impress your audience with your brainpower
- To tell them all you know about your topic
- To present all the technical details

The purpose of your talk…

The purpose of your talk **is**:



- To give your audience an intuitive feel for your idea
- To make them foam at the mouth with eagerness to read your paper
- To engage, excite, provoke them
- To make them glad they came

Your audience…

The **audience** you would like

- Have read all your earlier papers
- Thoroughly understand all the relevant theory of cartesian closed endomorphic bifunctors
- Are all agog to hear about the latest developments in your work
- Are fresh, alert, and ready for action

Your actual audience…

The audience you get

- Have never heard of you
- Have heard of bifunctors, but wish they hadn't
- Have just had lunch and are ready for a doze

Your mission is to

WAKE THEM UP

And make them glad they did

What to put in

What to put in

1. Motivation (20%)
2. Your key idea (80%)
3. There is no 3

Motivation

You have 2 minutes to engage your audience before they start to doze

- Why should I tune into this talk?
- What is the problem?
- Why is it an interesting problem?

Example: Java class files are large (brief figures), and get sent over the network. Can we use language-aware compression to shrink them?

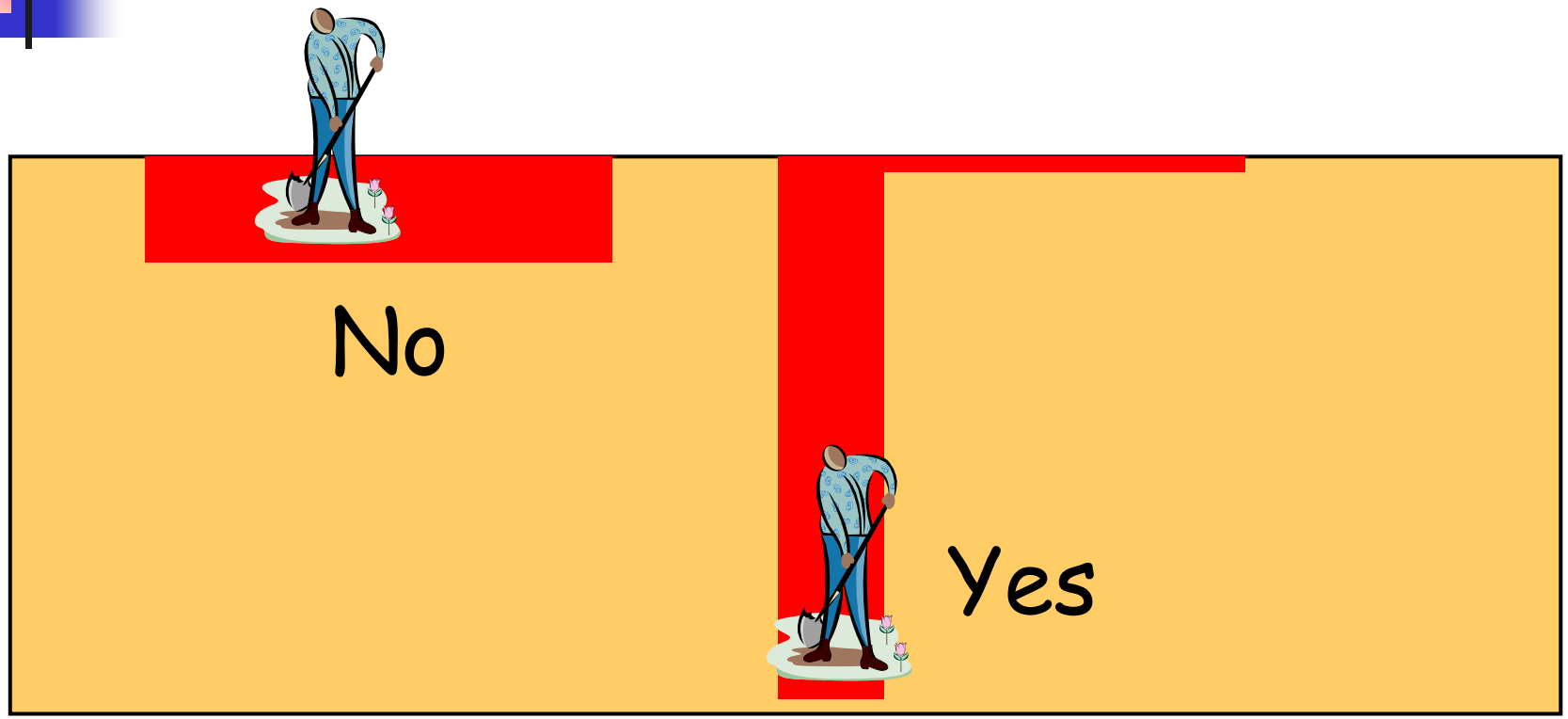
Example: synchronisation errors in concurrent programs are a nightmare to find. I'm going to show you a type system that finds many such errors at compile time.

Your key idea

If the audience remembers only one thing from your talk, what should it be?

- You must identify a key idea. "What I did this summer" is No Good.
- Be specific. Don't leave your audience to figure it out for themselves.
- Be absolutely specific. Say "If you remember nothing else, remember this."
- Organise your talk around this specific goal. Ruthlessly prune material that is irrelevant to this goal.

Narrow, deep beats wide, shallow



Avoid shallow overviews at all costs

Cut to the chase: the technical "meat"

Examples are your main weapon

- To motivate the work
- To convey the basic intuition
- To illustrate The Idea in action
- To show extreme cases
- To highlight shortcomings

When time is short, omit the general case, not the example

Exceptions in Haskell?

Exceptions are to do with control flow
There is no control flow in a lazy functional program

Solution 1: use data values to carry exceptions

```
data Maybe a = Nothing
             | Just a

lookup :: Name -> Dictionary -> Maybe Address
```

Often this is Just The Right Thing
[Spivey 1990, Wadler “list of successes”]

What to leave out

Outline of my talk

- Background
- The FLUGOL system
- Shortcomings of FLUGOL
- Overview of synthetic epimorphisms
- π-reducible decidability of the pseudo-curried fragment under the Snezkovwski invariant in FLUGOL
- Benchmark results
- Related work
- Conclusions and further work

No outline!

"Outline of my talk": conveys near zero information at the start of your talk

- But maybe put up an outline for orientation after your motivation
- …and signposts at pause points during the talk

Related work

[PMW83]	The seminal paper
[SPZ88]	First use of epimorphisms
[PN93]	Application of epimorphisms to wibblification
[BXX98]	Lacks full abstraction
[XXB99]	Only runs on Sparc, no integration with GUI

Do not present related work

But

- You absolutely must know the related work; respond readily to questions
- Acknowledge co-authors (title slide), and pre-cursors (as you go along)
- Praise the opposition

  "X's very interesting work does Y; I have extended it to do Z"

Technical detail

$$\frac{}{\Gamma \vdash k : \tau_k} \qquad \frac{\Gamma \cup \{x : \tau\} \vdash e : \tau'}{\Gamma \vdash \lambda x.e : \tau \to \tau'} \qquad \frac{\Gamma \vdash e_1 : \texttt{ST}\ \tau^\circ\ \tau \qquad \Gamma \vdash e_2 : \tau \to \texttt{ST}\ \tau^\circ\ \tau'}{\Gamma \vdash e_1\ \texttt{>>=}\ e_2 : \texttt{ST}\ \tau^\circ\ \tau'}$$

$$\frac{\Gamma \vdash e : \tau}{\Gamma \vdash \texttt{returnST}\ e : \texttt{ST}\ \tau^\circ\ \tau} \qquad \frac{\Gamma \vdash e : \tau}{\Gamma \vdash \texttt{newVar}\ e : \texttt{ST}\ \tau^\circ\ (\texttt{MutVar}\ \tau^\circ\ \tau)} \qquad \frac{\Gamma \vdash e : \texttt{MutVar}\ \tau^\circ\ \tau}{\Gamma \vdash \texttt{readVar}\ e : \texttt{ST}\ \tau^\circ\ \tau}$$

$$\frac{\Gamma \vdash e_1 : \texttt{MutVar}\ \tau^\circ\ \tau \qquad \Gamma \vdash e_2 : \tau}{\Gamma \vdash \texttt{writeVar}\ e_1\ e_2 : \texttt{ST}\ \tau^\circ\ \texttt{Unit}} \qquad \frac{}{\Gamma \cup \{x : \forall \alpha_i.\tau\} \vdash x : \tau[\tau_i/\alpha_i]}$$

$$\frac{\Gamma \vdash e : \tau' \to \tau \qquad \Gamma \vdash e' : \tau'}{\Gamma \vdash e\ e' : \tau} \qquad \frac{\Gamma \vdash e : \texttt{ST}\ \alpha^\circ\ \tau}{\Gamma \vdash \texttt{runST}\ e : \tau}\ \alpha^\circ \notin FV(\Gamma, \tau)$$

$$\frac{\forall j.\Gamma \cup \{x_i : \tau_i\}_i \vdash e_j : \tau_j \qquad \Gamma \cup \{x_i : \forall \alpha_{j_i}.\tau_i\}_i \vdash e' : \tau'}{\Gamma \vdash \texttt{let}\ \{x_i = e_i\}_i\ \texttt{in}\ e' : \tau'}\ \alpha_{j_i} \in FV(\tau_i) - FV(\Gamma)$$

Figure 1. Typing Rules

Omit technical details

- Even though every line is drenched in your blood and sweat, dense clouds of notation will send your audience to sleep

- Present specific aspects only; refer to the paper for the details
- By all means have backup slides to use in response to questions

Presenting your talk

How to present your talk

Your most potent weapon, by far, is your

enthusiasm

Enthusiasm

- If you do not seem excited by your idea, why should the audience be?
- It wakes 'em up
- Enthusiasm makes people dramatically more receptive
- It gets you loosened up, breathing, moving around

Write your slides the night before

(…or at least, polish it then)

- Your talk absolutely must be fresh in your mind
- Ideas will occur to you during the conference, as you obsess on your talk during other people's presentations

Technology

- Borrow a laser pointer, but avoid using it
- Consider borrowing a wireless slide changer
- Test that your laptop works with the projector, in advance
- Laptops break: leave a backup copy on the web; bring a backup copy on a disk or USB key

Do not apologise

- "I didn't have time to prepare this talk properly"
- "My computer broke down, so I don't have the results I expected"
- "I don't have time to tell you about this"
- "I don't feel qualified to address this audience"

The jelly effect

If you are anything like me, you will experience apparently-severe pre-talk symptoms

- Inability to breathe
- Inability to stand up (legs give way)
- Inability to operate brain

What to do about it

- Deep breathing during previous talk
- *Script your first few sentences precisely* (=> no brain required)
- Move around a lot, use large gestures, wave your arms, stand on chairs
- Go to the loo first

You are not a wimp.
Everyone feels this way.

Being seen, being heard

- Point at the screen, not at the overhead projector
- Speak to someone at the back of the room, even if you have a microphone on
- Make eye contact; identify a nodder, and speak to him or her (better still, more than one)
- Watch audience for questions…

Questions

- Questions are not a problem

Questions are a golden golden golden opportunity to connect with your audience

- Specifically encourage questions during your talk: pause briefly now and then, ask for questions
- Be prepared to truncate your talk if you run out of time. Better to connect, and not to present all your material

Presenting your slides

A very annoying technique

- is to reveal
- your points
- one
- by one
- by one, unless…
- there is a punch line

Presenting your slides

Use animation effects

very very very very very very

sparingly

Finishing

Absolutely without fail, finish on time

- Audiences get restive and essentially stop listening when your time is up. Continuing is very counter productive
- Simply truncate and conclude
- Do not say "would you like me to go on?" (it's hard to say "no thanks")

Conclusion: there is hope

The general standard is often low. You don't have to be outstanding to stand out

You will attend 50x as many talks as you give. Watch other people's talks intelligently, and pick up ideas for what to do and what to avoid.

http://research.microsoft.com/~simonpj

Do it! Do it! Do it!

Good papers and talks are a fundamental part of research excellence

- Invest time
- Learn skills
- Practice

Write a paper, and give a talk, about
any idea,
no matter how weedy and insignificant it may seem to you

Research is communication

The greatest ideas are worthless if you keep them to yourself

Your papers and talks

- Crystalise your ideas
- Communicate them to others
- Get feedback
- Build relationships
- (And garner research brownie points)