Computer Architecture
Seminar/Proseminar
Lecture 1: Introduction and Logistics

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28 October 2026

S4L ROOTSEC CISPA HELMHOLTZ CENTER FOR INFORMATION SECURITY UNIVERSITÄT DES SAARLANDES

Goal of This Seminar/Proseminar

- Strengthen your understanding of computer architecture

- Teach/enable/empower you to:
  - Think critically
  - Think broadly
  - Learn how to understand, analyze, and present papers and ideas
  - Get familiar with key first steps in research
  - Get familiar with key research directions

Teaching Team



Giray Yaglikci



Michael Schwarz



Eduard Ebert



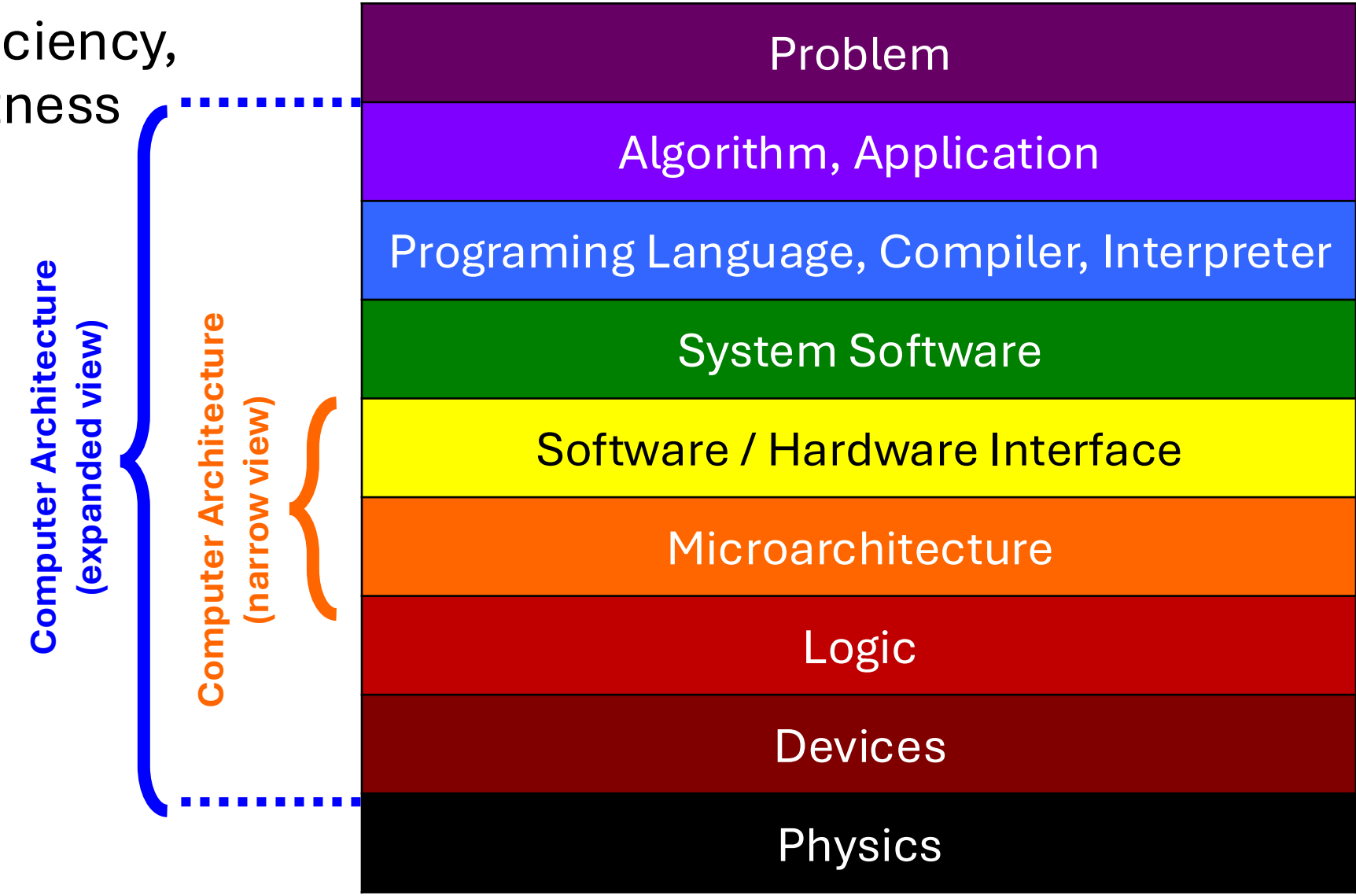
Namhun Kim

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Computer Architecture

Achieving the highest efficiency, performance, and robustness is possible via taking the expanded view



Computer Architecture

- science and art of designing computing platforms
  (hardware, interface, system SW, and programming model)

- to achieve a set of design goals, e.g.,
  - highest performance on earth on workloads X, Y, Z
  - longest battery life at a form factor that fits in your pocket with cost < €€€
  - the best performance/cost ratio
  - data integrity
  - confidentiality
  - …

- Designing a supercomputer is different from designing a smartphone
  → But, many fundamental principles are similar

Why Study Computer Architecture?

- Enable better systems: faster, cheaper, smaller, more reliable, …
  By leveraging advances and changes in underlying technology/circuits

- Enable new applications and systems
  - Life-like 3D visualization 20 years ago? Virtual reality?
  - Self-driving cars?
  - Personalized genomics? Personalized medicine?

- Enable better solutions to problems
  - Software innovation is built on trends and changes in computer architecture
    > 50% performance improvement per year has enabled this innovation

- Understand why computers work the way they do

Computer Architecture Today

- Today is a very exciting time to study computer architecture

- Industry is in a large paradigm shift (to novel architectures) – many different potential system designs possible

- Many difficult problems *motivating* and *caused by* the shift
  - Huge hunger for data and new data-intensive applications
  - Power/energy/thermal constraints
  - Complexity of design
  - Difficulties in technology scaling
  - Memory bottleneck
  - Reliability problems
  - Programmability problems
  - Security and privacy issues

- No clear, definitive answers to these problems

Seminar/Proseminar in Computer Architecture

- **Fundamental** and **cutting-edge** research papers in computer architecture

- Multiple components that are aimed at improving students'
  - technical skills in computer architecture
  - critical thinking and analysis
  - technical presentation of concepts and papers
    - in both spoken and written forms
  - familiarity with major research directions

How to Make the Best Out of This?

- Come prepared → Read and critically evaluate the paper
- Think about new ideas
- Bring discussion points and questions; read other papers
- Be critical
- Brainstorm – be open to new ideas
- Pay attention and discuss + contribute
- Participate online after each meeting

Anatomy of a Good Paper Review (Talk)

- Title, Authors, Venue
- Summary
  - What is the problem the paper is trying to solve?
  - What are the key ideas of the paper? Key insights?
  - What are the key mechanisms? What is the implementation?
  - What are the key results? Key conclusions?
- Strengths (most important ones)
  - Does the paper solve the problem well? Is it well written? …
- Weaknesses (most important ones)
  - This is where you should think critically. Every paper/idea has a weakness. This does not mean the paper is bad. It means that there is room for improvement and future research can accomplish this.
- Thoughts/Ideas: Can you do better? Present your ideas.
- Takeaways: What you learned/enjoyed/disliked? Why?
- Discussion starters and questions

Paper Discussion Format

- Problem & Goal
- Key Ideas/Solution
- Novelty
- Mechanisms & Implementation
- Major Results
- Takeaways/Conclusions

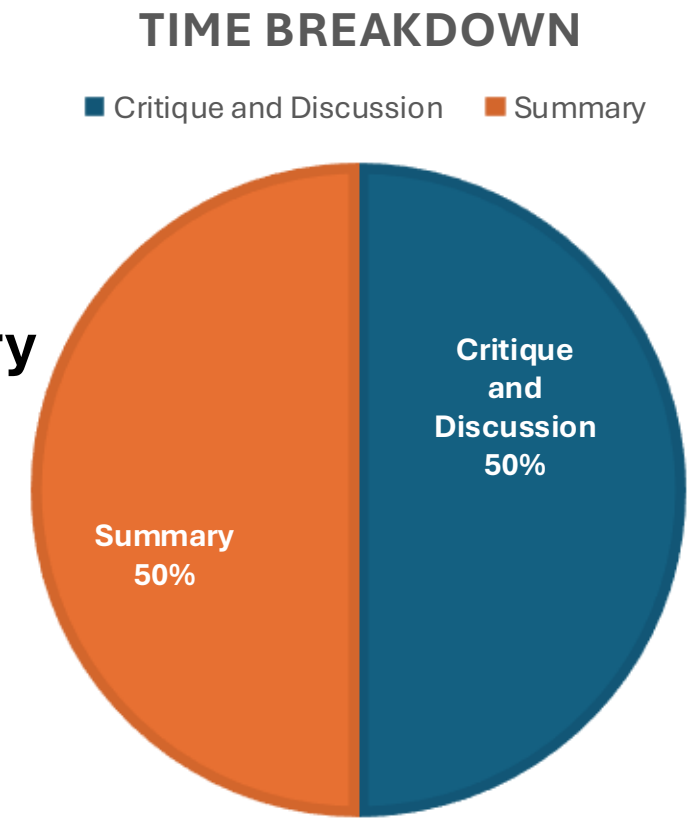
~20 min Summary

- Strengths
- Weaknesses

~5 min Critique

- The paper's significance in the literature
- New ideas/problems
- Brainstorming and Discussion

~15 min Discussion



Paper Summary

- Problem & Goal
- Key Ideas/Solution
- Novelty
- Mechanisms & Implementation
- Major Results
- Takeaways/Conclusions

Build and follow this order in

- reviewing papers
- building your ideas and projects
- presenting your new ideas
- presenting your finished projects
- elevator pitch

You can fit this flow into

- 1 hour lecture
- 20 mins of presentation
- 5 mins of short talk
- 2 mins of lightning talk
- <1 min elevator pitch

Some example bullet points for "strengths":

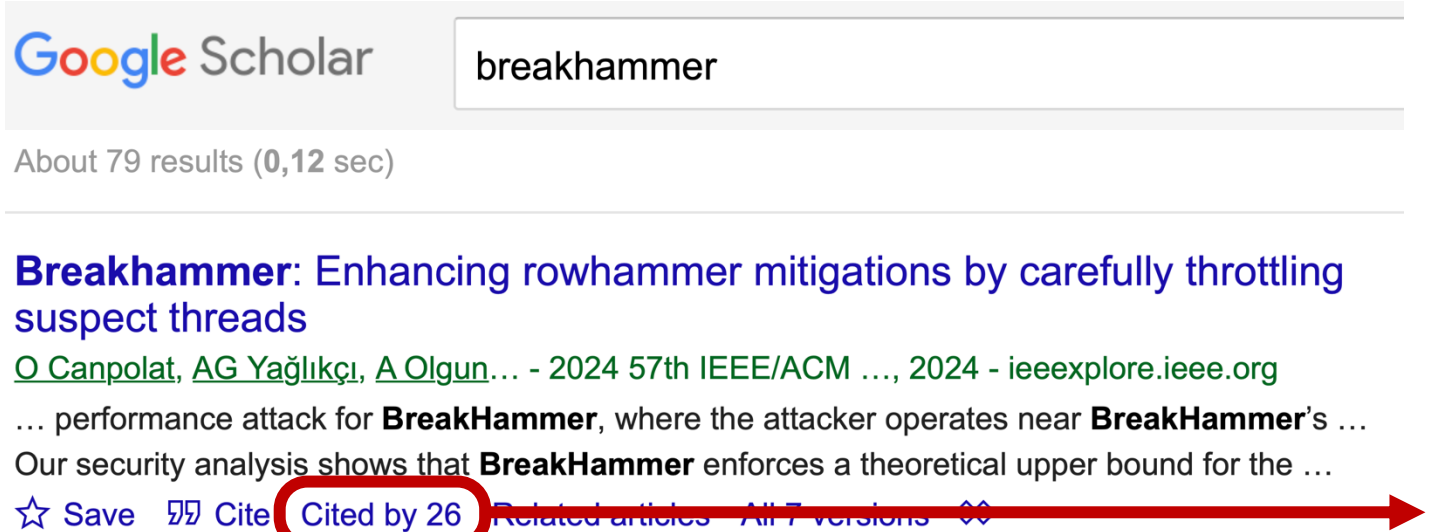
- The paper tackles an extremely important problem
- The idea of X is elegant and intuitive
- The paper provides a breakthrough in solving the important problem of X
- The paper brings many insights into a difficult problem
- The paper has invaluable experimental data that can open new research opportunities
- The paper exposes a new problem in the field X
- The proposed mechanism is simple and effective
- Extremely thorough and insightful comparisons to prior works
- The analysis of Y is very insightful in the paper
- Nice collection of small ideas that make good headway in solving the important problem of X
- Excellent explanation of related works
- The mechanism is technically sound
- The mechanism is very low cost and practical
- Well written paper
- Wonderful explanations of X, Y, Z,…

Some example bullet points for "weaknesses":

- Very incremental contribution
- Very weak novelty compared to prior work X
- The paper ignores critical works that solved the same problem (e.g., X et al., MICRO YYY; see below for more works)
- The paper lacks insight in its mechanisms. They are shown to work in the evaluation section. But why do they work?
- Too much data, little insight. Why does the mechanism work?
- The paper has a critical flaw in its assumptions of how modern caches are designed: …
- The problem is not motivated well
- The evaluation does not compare to the state-of-the-art
- Uses a very outdated baseline that is not the state-of-the-art
- Key overheads of the mechanism are not modeled
- The proposed technique seems extremely complex, and the complexity is not evaluated
- The paper is impossible to penetrate due to the poor writing
- The key mechanism is not explained well
- It is unclear how the parameters of the algorithm is determined
- The solution relies on static profiling
- Too many typos and spelling/grammar errors, getting in the way of understanding
- The experiments seem flawed

Every work has strengths and weaknesses

- Papers are filtered into our class as they have merit
- They should already emphasize their strengths: start with their major contributions
- There is always room for improvement, so there are weaknesses
- Some papers acknowledge some of their weaknesses
- Many weaknesses are not obvious, but you have a brain and many others' brains
- Check the arguments in papers that improve the paper you present
- Important! You should be skeptical about those claims too. Practice caution!



fenses. BreakHammer identifies potentially malicious threads by tracking the number of triggered RH mitigations per hardware thread and throttles their memory requests. However, it depends on prior RH solutions for mitigation and requires microarchitectural modifications, such as changes to caches, to propagate thread information to the throttling logic in the memory controller. In contrast, DAPPER provides standalone *Perf-Attack* resilience with minimal overhead without requiring additional microarchitectural changes. Furthermore, DAPPER can be combined with BreakHammer to enhance protection against *Perf-Attacks*. Another concurrent

Jeonghyun Woo and Prashant J. Nair, "Dapper: A Performance-Attack-Resilient Tracker for RowHammer Defense," in HPCA, 2025.

Sorting is important

Strengths and weaknesses should be sorted in decreasing priority order

(Say the more critical point first)

Novelty ≥ Idea ≥ Mechanism ≥ Implementation ≥ Evaluation methodology ≥ Writing Quality

Thoughts/Ideas and Looking into the Future

- What you learned/enjoyed/disliked? Why?
- What was the state-of-the-art before this paper?
- How does this paper advance the state-of-the-art?
- What is the state-of-the-art now?
- What are the open research questions today in this field?
- Can you do better? Present your ideas.
- How to eliminate the weaknesses you identified?
- Do you have a fundamentally different solution to the same problem? What would you do differently?
- Does this work advance the state-of-the-art? If so,
  - Does it bring new problems?
  - How can you solve or avoid those problems?

More Advice on Paper Review/Talk

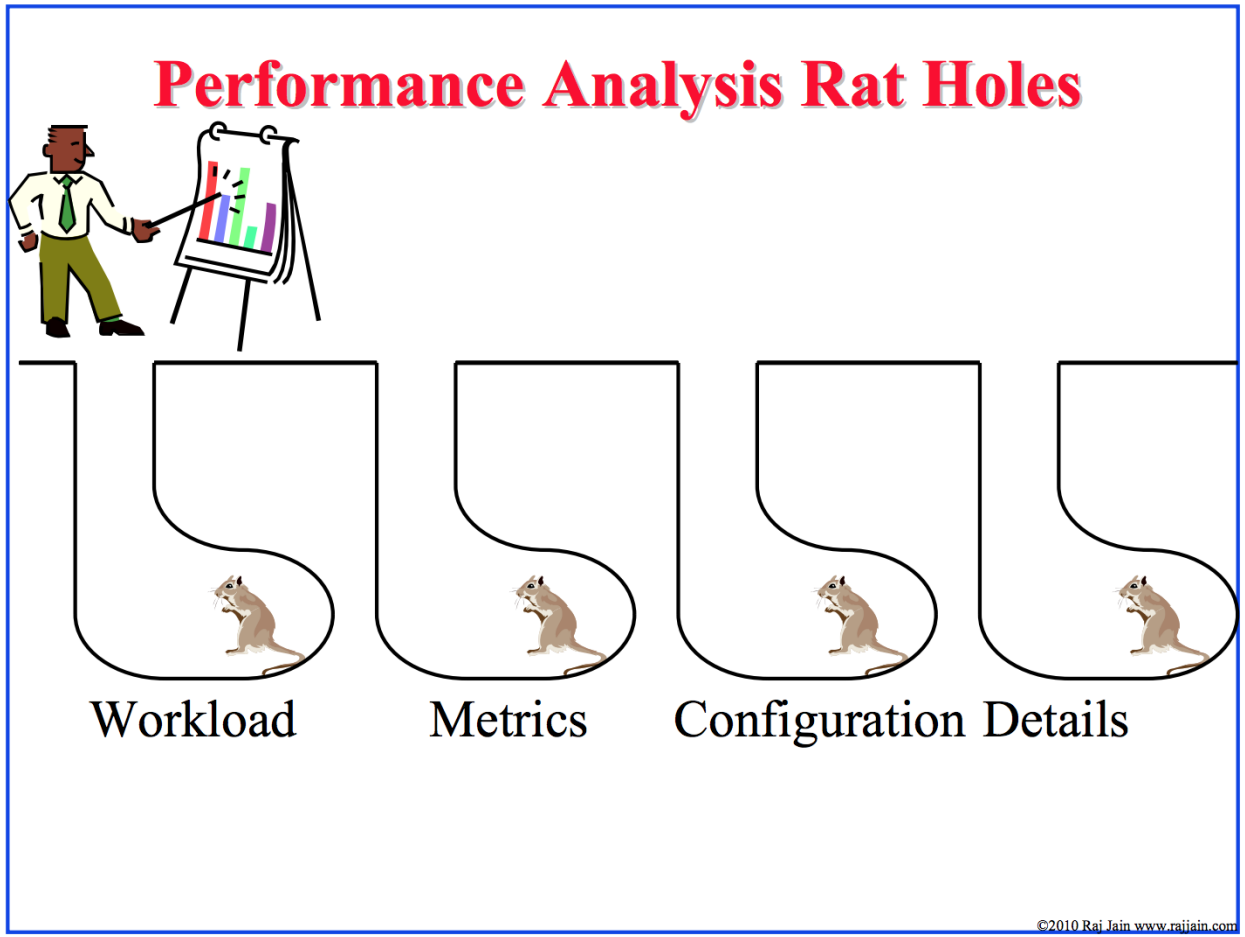
- When doing the paper reviews and analyses, be very critical

- Always think about better ways of solving the problem or related problems
  - Question the problem as well
  - Read background papers (both past and future)

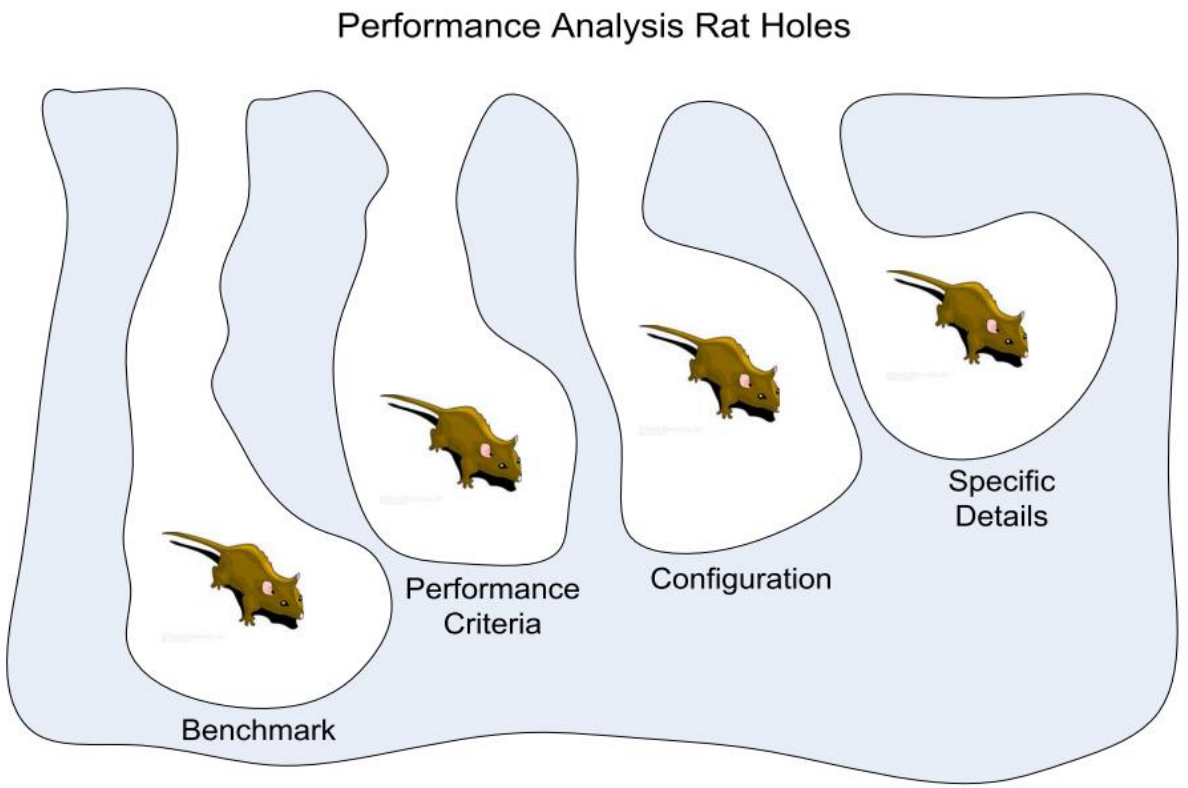
- Critical thinking & analysis: This is how things progress in science and engineering (or anywhere), and how you can make big leaps

- Sample text reviews will be provided online

Avoid Rat Hole Discussions



Source: https://www.cse.wustl.edu/~jain/iucee/ftp/k_10adp.pdf



Source: P. Jarupunphol, “Using Buddhist Insights to Analyse the Cause of System Project Failures,” Ph.D. Thesis, 2013

More Advice on Talks

- Kayvon Fatahalian, “Tips for Giving Clear Talks”
  - http://graphics.stanford.edu/~kayvonf/misc/cleartalktips.pdf
  - Many useful and simple principles here

“Every sentence matters”

“The audience prefers not to think” (about things you can just tell them)

“Surprises are bad”: say why before what
(indicate why you are saying something before you say it)

Explain every figure, graph, or equation

When improving the talk, the audience is always right

More Advice on Talks



Salvador Dali (age 22)



Salvador Dali (age 53)

Learn the basic principles before you consciously choose to break them

Some advices

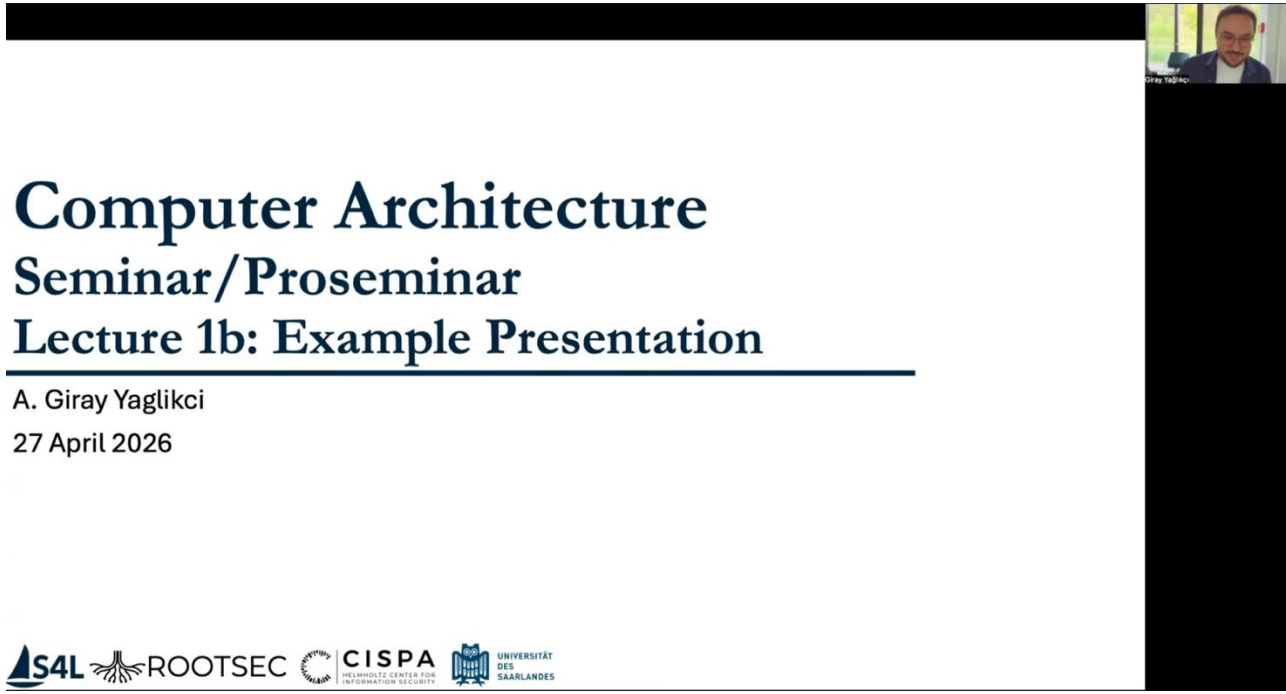
- Never trust the projector: Use white background and high contrast
- Use page numbers
- Speak **LOUDLY**
- Make logical line breaks
  in your text
- Install a Zoom client on your computer and allow permissions
  for screen sharing, microphone, and camera

Two Example Paper Review Presentations

- Understanding RowHammer Under Reduced Wordline Voltage, DSN 2022
- **L7a: Seminar in Computer Architecture – Spring 2024** [Talk Video] (60') [Slides (pptx) (pdf)]



- BreakHammer: Enhancing RowHammer Mitigations by Carefully Throttling Suspect Threads, MICRO 2024
- **L1b: Seminar/Proseminar in Computer Architecture, Summer 2026** [Talk Video](Last 50') [Slides (pptx) (pdf)]



Course Logistics and Grading

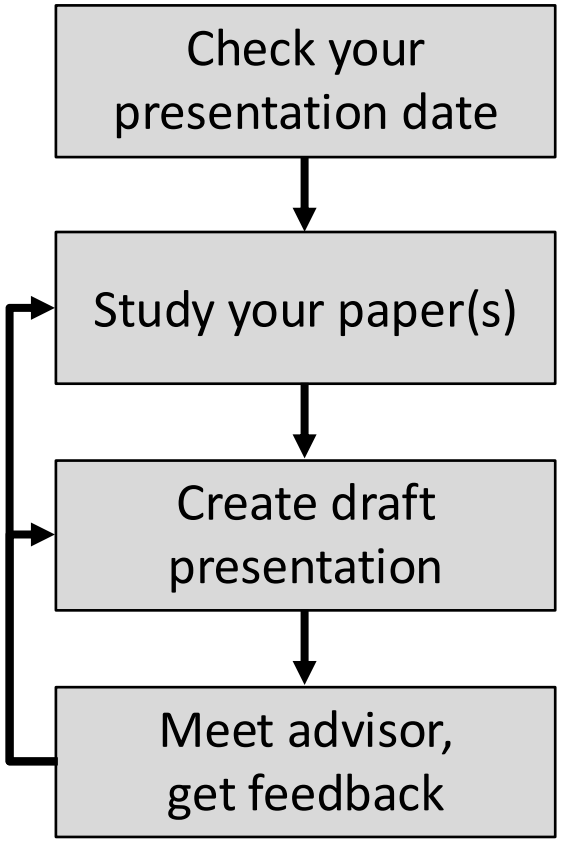
Three Deliverables

- **Critical Paper Review Talk**
  This is the paper that is assigned exclusively to you

- **Critical Paper Review Report**
  This is the paper that is assigned exclusively to you

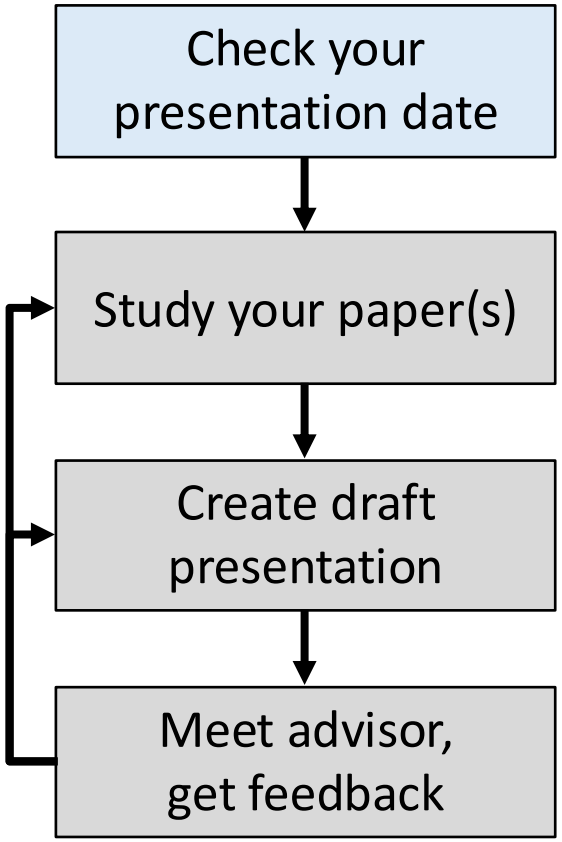
- **Literature Survey**
  This focuses on a paper that is assigned exclusively to another classmate, but contains *all major related works* relevant to the paper and *your projection* to the future

Preparing Your Critical Paper Review Talk



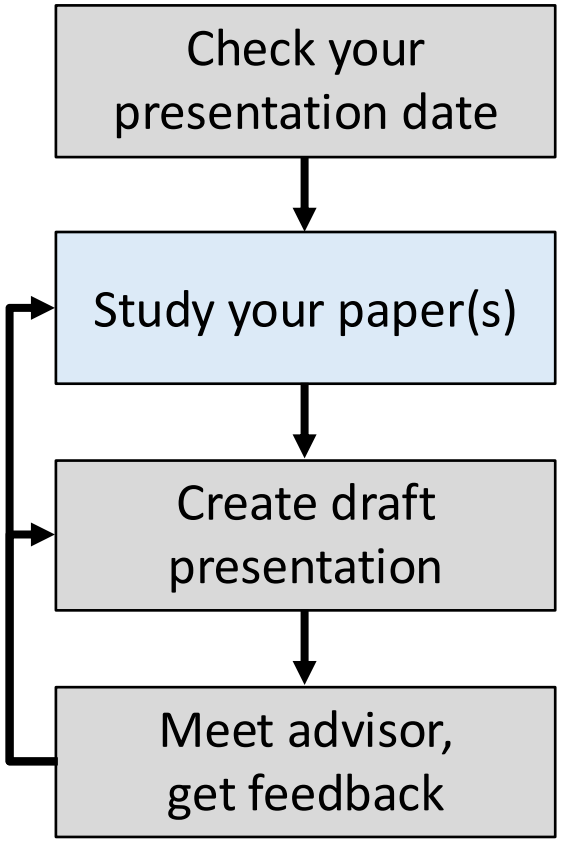
Preparing Your Critical Paper Review Talk: Start Early

- Preparing a good presentation takes time
- Start early!



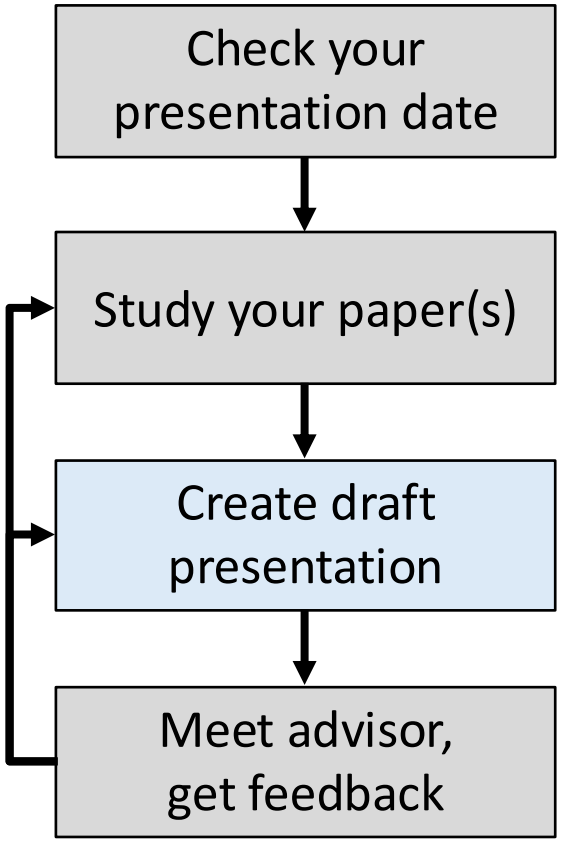
Preparing Your Critical Paper Review Talk: Study the Paper

- 3 ‘C’s of reading
  - *Carefully:* look up terms, read cited papers
  - *Critically:* find limitations, flaws
  - *Creatively:* think of improvements
- Try examples by hand and try tools if available
- Study follow up works
- Consult with mentors if questions



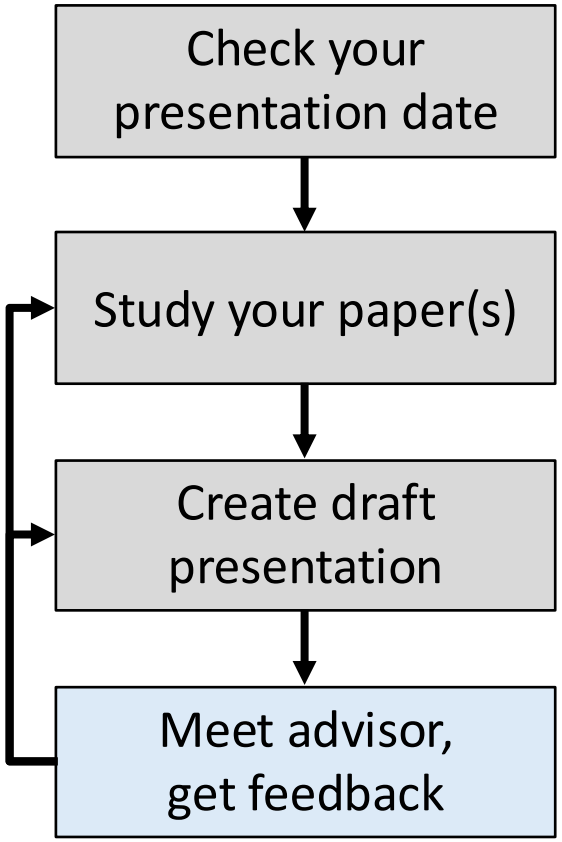
Preparing Your Critical Paper Review Talk: Prepare a Draft

- Explain the motivation for the work
- Clearly present the technical solution and results
  - Include a demo if appropriate
- Outline limitations or improvements
- Focus on the key concepts
  - Do not present all of the details



Preparing Your Critical Paper Review Talk: Get Feedback

- Prepare for the meeting
  - Schedule early
  - Send slides in advance
  - Write down questions
- Make sure you address feedback
  - Take notes
- Meetings are mandatory!
  - Latest: the week before the talk
  - At least one meeting



Critical Paper Review Report

- This is the critical review report of the paper you presented
- Follows the same structure as your talk
- We will provide a latex template (A double column conference template)
- Keep it concise (max 4 pages + unlimited pages for references)
- Due: Jan 8, 2027

Literature Survey

- This is the critical review report of a paper, presented by your classmate
- Follows the same structure as your talk
- Contains three additional sections, each summarizing several other papers
  - State-of-the-art before the presented paper
  - State-of-the-art today
  - Your projection into the future
- Keep it concise (max 5 pages + unlimited pages for references)
- Due: Feb 5, 2027
- This is compulsory *only* for the seminar students and *bonus* for everyone

Grading Rubric

	Seminar	Proseminar
Presentation of the Critical Review	40%	50%
Active Participation in Discussion	20%	30%
Critical Paper Review Report	10%	20%
Literature Survey	30%	0%
Bonus: Literature Survey*	10%	10%

* Collecting BONUS points is possible only if the student satisfactorily, participates in discussions and delivers the compulsory materials (anything above the BONUS line in this table)

Tentative Schedule

- We will meet once a week (except some weeks)
- Two presentations per session (40 min. each)
- Meeting time: Fridays 14:00 – 16:00
  → Starts at 14:00 sharp
- Paper assignment
  - Study the list of papers (https://cms.cispa.saarland/comparch_w26/2/Paper_List)
  - All papers are uploaded (https://cms.cispa.saarland/comparch_w26/materials)
  - Feel free to find and suggest a paper outside of this list
  - Bid papers online (https://cms.cispa.saarland/comparch_w26/exams)
  - Check your email and be responsive
  - Assignment policy: First-Come-First-Served
  - **Due is Oct 30** → More time for you to get prepared

Topics	2003	2007	2011	2012	2014	2015	2016	2018	2019	2020	2021	2022	2023	2024	2025
CPU fuzzing														2	
DRAM Interface														1	
Memory Security		1						1		1			2		3
Memory Reliability						1	1								
Processing near Memory						1									
Processing in Storage												1			
Processing Using Memory														2	1
Secure caches									1				1		
Storage, privacy											1				
TEE							1			1					
uARch Energy			1	1											
uArch Security					1			1	2		1				1
Speculative Execution	1											1			

Tentative Schedule

Week	Schedule	Important Dates	We will release	You will submit
Oct 28, 2026	Release of the Paper List		Paper List	
	Intro, Logistics, and Example Presentation			
Nov 2-6, 2026	Prep Week		Schedule of Sessions	Apr 30: Preferences
Nov 13, 2026	Student Sessions			
Nov 20, 2026	CCS Week (No meeting)			
Nov 27, 2026	Student Sessions			
Dec 4, 2026	Student Sessions			
Dec 11, 2026	Student Sessions			
Dec 17, 2026	Student Sessions			
...	No meetings	Christmas Break		
Jan 7, 2027				Critical Paper Review Report
Feb 5, 2027				Literature Survey

* All dates are subject to change

11 students are assigned but 8 registered. The last four student sessions are enough for 8 students.
We can cancel Nov 13 and give you more prep time based on the paper preference poll returns on Friday

Policy for Using Artificial Intelligence (AI)

- Rule of thumb: AI at your disposal is a tool and does *not* replace you, and you do *not* want it to replace you

- You are the sole author of the submitted and presented material
  - You are responsible of every single word
  - Hallucinations will not be tolerated
  - You can be invited for an oral examination to test your knowledge of the submitted material
  - You should be able to answer all reasonable questions during your talk

- Using AI is ok
  - for fixing your grammar and polishing your text
  - for brainstorming if you fact-check every idea/statement/claim

- When you use AI,
  - Do not trust! Fact-check everything!
  - Make sure that the terminology is correct

- AI is great, but you are (*should be*) greater!
  Technical depth of the final material should be more than what AI can generate by itself

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