Computer Architecture
Seminar/Proseminar
Lecture 1a: Introduction and Logistics

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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

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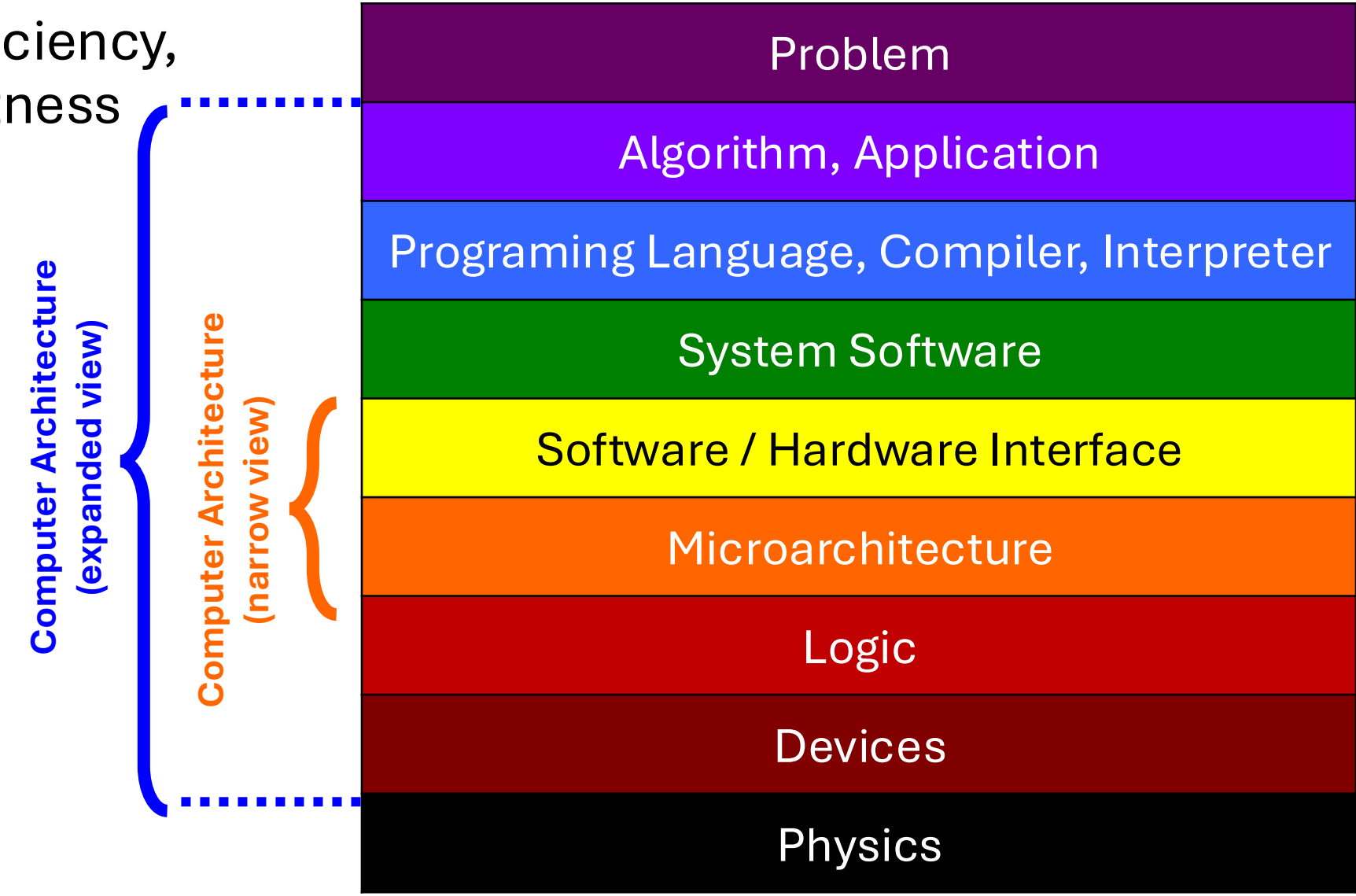
Computer Architecture

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 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

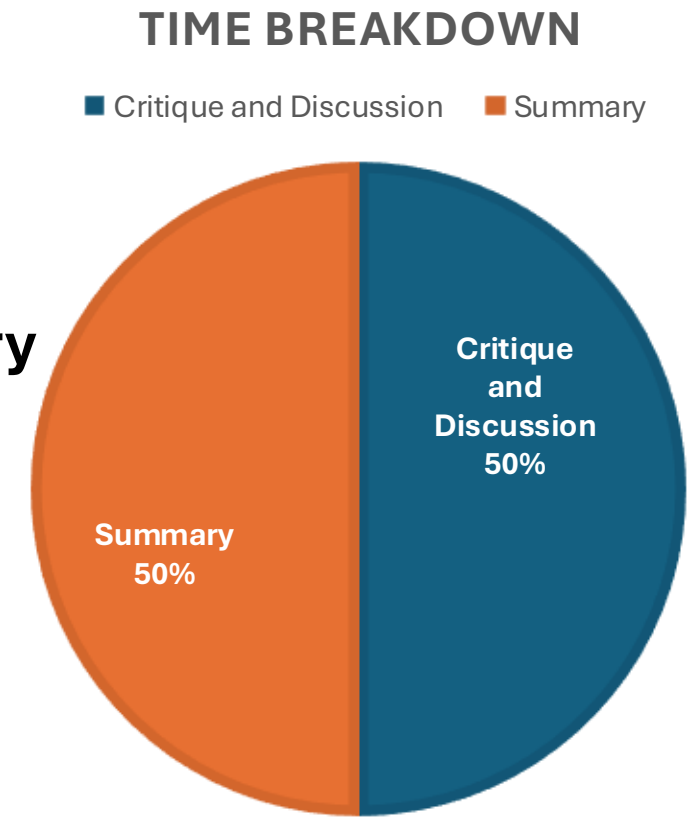
~20 min Summary

- Strengths
- Weaknesses

~5 min Critique

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

~15 min Discussion



More Advice on Paper Review/Talk

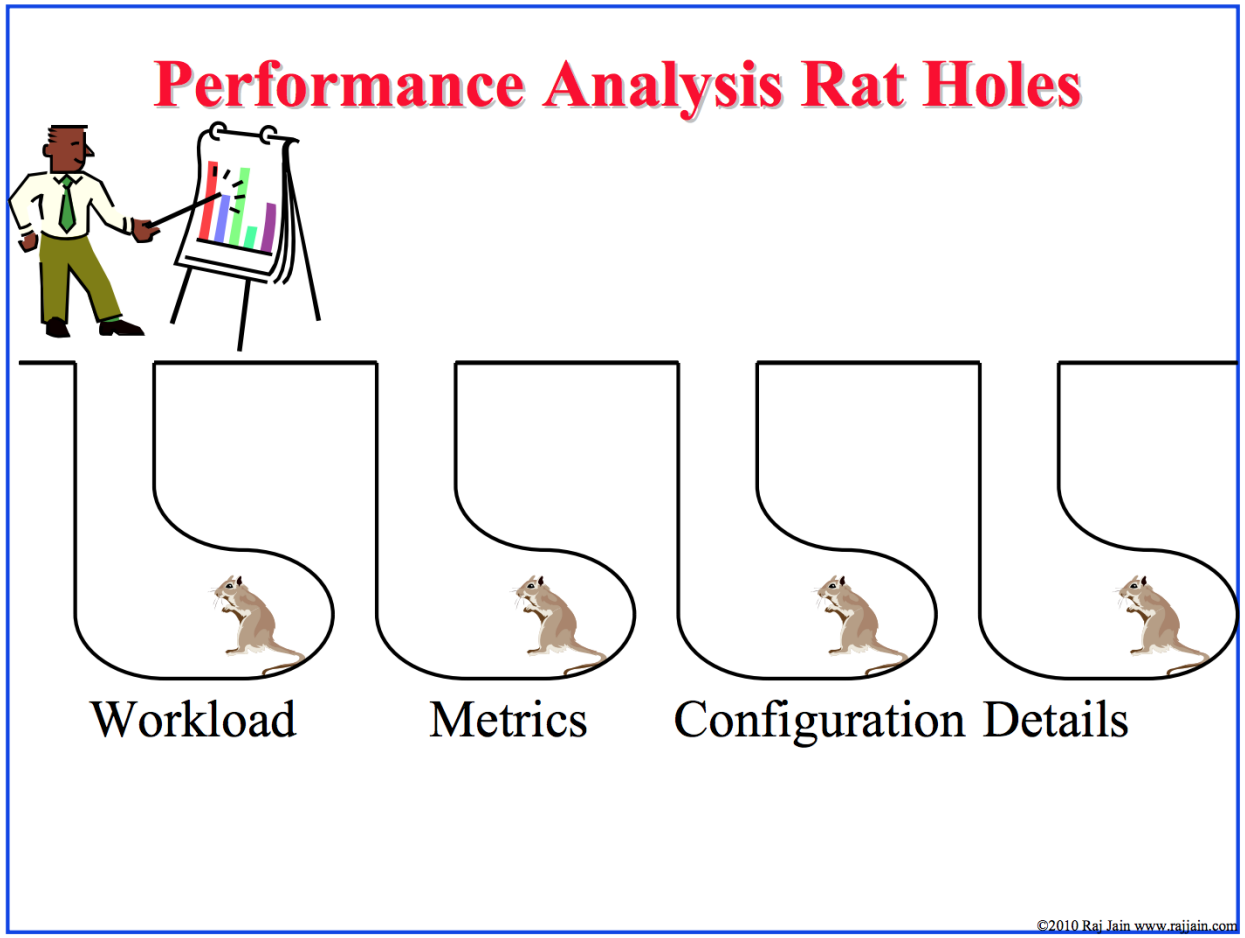
- When doing the paper reviews and analyses, be very critical

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

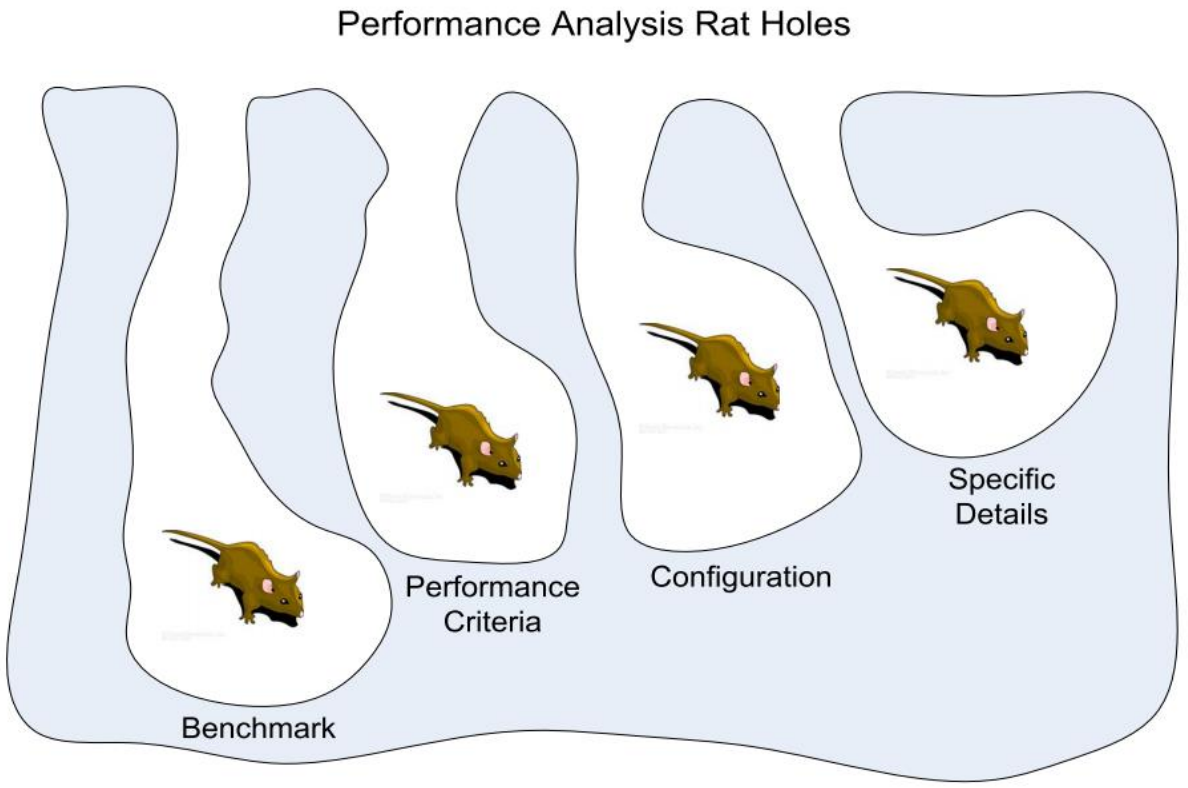
- Critical thinking & analysis: This is how things progress in science and engineering (or anywhere), and how you can make big leaps

- 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

An Example Presentation and Discussion

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

Course Logistics and Grading

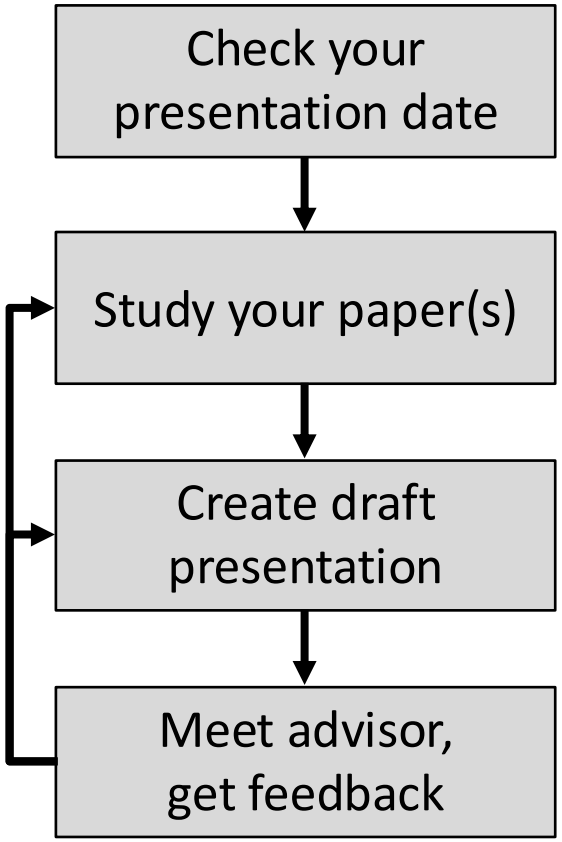
Three Deliverables

- **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

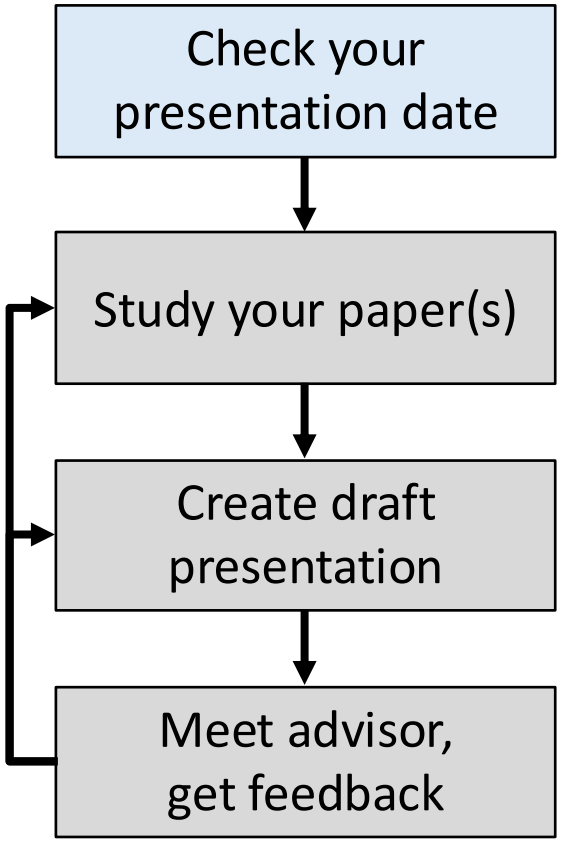
- **Literature Survey**
  This focuses on a paper that is assigned exclusively to another classmate, but contains *all major related works* relevant to the paper and *your projection* to the future

Preparing Your Critical Paper Review Talk



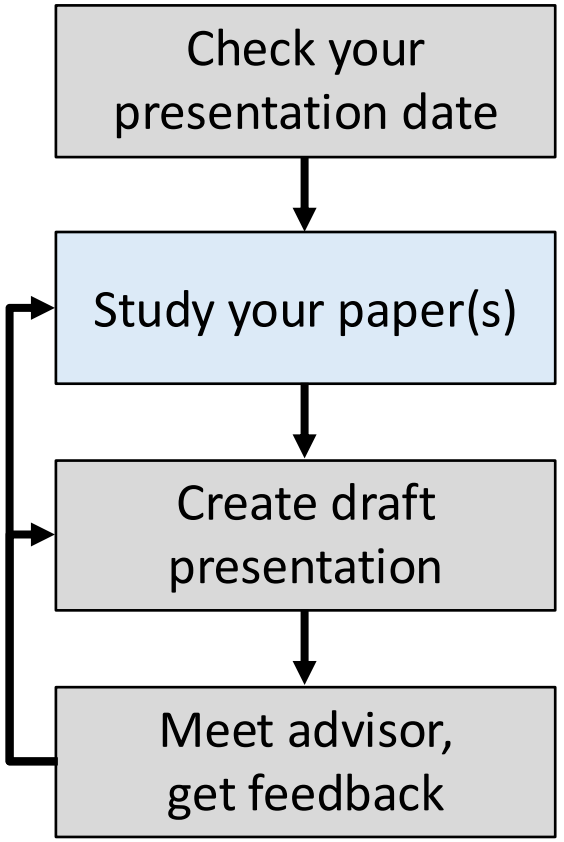
Preparing Your Critical Paper Review Talk: Start Early

- Preparing a good presentation takes time
- Start early!



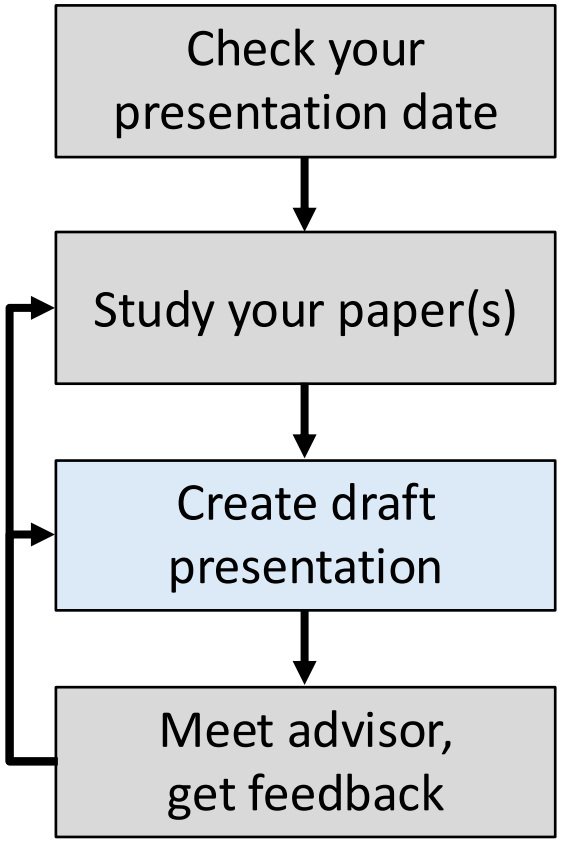
Preparing Your Critical Paper Review Talk: Study the Paper

- 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



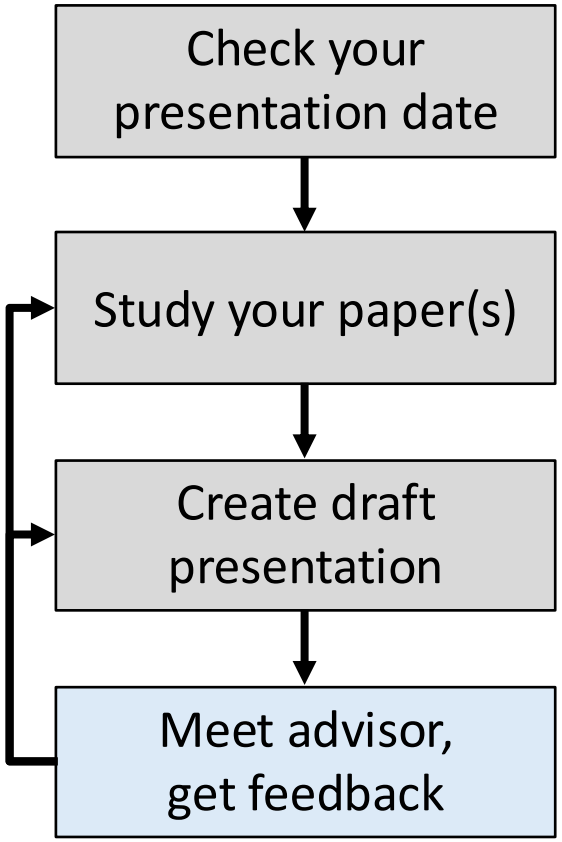
Preparing Your Critical Paper Review Talk: Prepare a Draft

- 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
- Keep it concise
- v1: Paper's summary, your critique, and the discussion points.
  Due: Mid-semester
- v2: Built on v1 and elaborates on the discussion in and after the session

Literature Survey

- This is the critical review report of a paper, presented by your classmate
- Follows the same structure as your talk
- Contains two more sections, each summarizing a number of other papers
  - State-of-the-art before the presented paper
  - State-of-the-art today and your projection into the future
- Due: Two weeks before the last day of grade submission
- 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: Mondays 15:00 – 16:30
  → Starts at 15:00 sharp
- Paper assignment
  - Study the list of papers (https://cms.cispa.saarland/comparch_s26/2/Paper_List)
  - All papers are uploaded (https://cms.cispa.saarland/comparch_s26/materials)
  - Feel free to find and suggest a paper outside of this list
  - Bid papers online (https://cms.cispa.saarland/comparch_s26/exams)
  - Check your email and be responsive
  - Assignment policy: First-Come-First-Served
  - Due was May 4, but let's pull it earlier to April 30 for early paper assignment and scheduling
    → 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
April 22, 2026	Release of the Paper List		Paper List	
April 27, 2026	Intro, Logistics, and Example Presentation	May 1: Labor Day		
May 4-8, 2026	Prep Week		Schedule of Sessions	Apr 30: Preferences
May 11, 2026	Student Sessions	May 14: Ascension Day		
May 18, 2026	Student Sessions			
May 25, 2026	No class	May 25: Whit Monday		Report v1
June 1, 2026	Student Sessions	Jun 4: Corpus Christi		
June 8, 2026	Student Sessions			
June 15, 2026	Student Sessions			
June 22, 2026	Student Sessions			
June 29, 2026	Student Sessions	ISCA Week		
July 6, 2026	Student Sessions	Euro S&P Week		
July 13, 2026				Report v2
	Two weeks before the last day of grades			Literature Surveys

* All dates are subject to change

Policy for Using Artificial Intelligence (AI)

- Rule of thumb: AI at your disposal is a tool and does *not* 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

- 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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