

CS/ECE 4504 Computer Organization

Instructor

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Office Hours: Tuesday 3:30-5:00pm, Thursday 12:30-2:00pm
or by appointment

Course Information

Lectures: RAND 220, Tuesday and Thursday 2:00-3:15pm

Course Website

<https://canvas.vt.edu/>

Prerequisites

A grade of C or better in ECE 2504 (Intro to Computer Engineering) or CS 3214 (Computer Systems)

Course Topics

Topic	Percent of Course
1. Evaluation Metrics	20%
2. Recent Commercial Computer Architectures	20%
3. Levels of Computer Parallelism	20%
4. Processor - Memory Relationships	15%
5. Trends in Computer Architecture	15%
6. Storage	10%
	<hr/> 100%

Course Outcomes

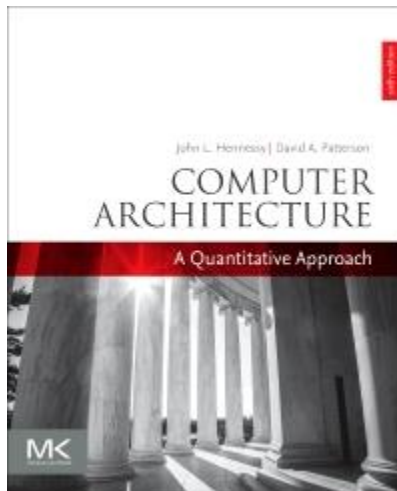
Having successfully completed this course, students will be able to:

- Compare several recent commercial computer architectures.
- Distinguish different categories of parallelism in computer architecture.
- Analyze computer systems using Amdahl's Law.
- Describe how processors and memory interact to affect performance.
- Use metrics to evaluate architectural features.

Textbooks

Required (H&P, 6th Edition)

J.L. Hennessy and D.A. Patterson,
Computer Architecture: A Quantitative Approach, 6th Edition,
Morgan Kaufmann, 2017, ISBN 9780128119051/9780128119068



Supplementary textbooks

D.A. Patterson, and J.L. Hennessy, Computer Organization & Design – The Hardware/Software Interface, 5th Edition, Morgan Kaufmann, 2014, ISBN 978-0124077263

Weekly Schedule

As with any plan, this schedule is subject to change.

Week	Lecture
1 (Aug 20)	Intro, Trends
2 (Aug 27)	Quantifying Computer Arch (H&P Chapter 1)
3 (Sep 3)	Quantifying Computer Arch (H&P Chapter 1)
4 (Sep 10)	Pipelining, Harzards (H&P Appendix C, Chapter 3)
5 (Sep 17)	ILP, Loops (H&P Appendix C, Chapter 3)
6 (Sept 24)	Branch Prediction (H&P Appendix C, Chapter 3)
7 (Oct 1)	Dynamic Scheduling (H&P Appendix C, Chapter 3)
8 (Oct 8)	Speculation (H&P Appendix C, Chapter 3)
9 (Oct 15)	Multi-Issue (H&P Appendix C, Chapter 3)
10 (Oct 22)	Cache (H&P Appendix B)
11 (Oct 29)	Cache Optimization (H&P Appendix B)
12 (Nov 5)	VM, ILP limits (H&P Appendix B)
13 (Nov 12)	SMT, Multiprocessor (H&P Chapter 5)
14 (Nov 19)	Thanksgiving
15 (Nov 26)	Coherence (H&P Chapter 5)
16 (Dec 3)	Final Review

Evaluation

Distribution of Marks

The marks in this course will be recorded as letter grades. There are 5 assignments, a midterm exam, and a final exam. The breakdown of marks is as follows:

- Assignments (15%)
- Project (40%)
- Quizzes (15%)
- Final Exam (30%)

Assignments (15% of final grade)

The assignments will consist of written problems only. Students may discuss general approaches to solving homework problems among themselves, but **the actual solutions that are turned in for grading are expected to be the original work of the individual student.**

Assignments will be handed out by posting them on the course website. Assignments should be handed in by uploading them onto the course website, on the due time and date specified. **No credit will be given for late work without prior permission.**

Date (**estimated**) when assignments will be available and dates when assignments will be due are as follows unless otherwise stated by instructor:

Available	Topic	Date Due (by 11:00 PM)
Sept. 4	Performance evaluation (H&P Chapter 1)	Sept. 18
Sept. 18	Pipelining +ILP (H&P Appendix C, Chapter 3)	Oct. 2
Oct. 2	More on ILP (H&P Chapter 3)	Oct. 16
Oct. 16	Memory Hierarchy (H&P Appendix B)	Nov. 6
Nov. 6	Advanced Topics (H&P Chapter 5)	Nov. 20

Project (40% of final grade)

The project is to develop, simulate and evaluate an architectural element discussed in or related to material in the class. This project will require you work in pairs to modify a large program (a processor simulator), and run experiments with the purpose of measuring the performance effect of architectural changes.

Quizzes (15% of final grade)

I may assign classes during class, as I deem appropriate. You must be present to complete in-class quizzes.

Quizzes will cover recent lecture material, required reading, topics relevant to projects, and problems assigned as part of the homework. You may use your book and your notes on quizzes. I do not give make-up quizzes. If you miss a quiz, you will receive a grade of zero for that quiz.

Final Exam (30% of final grade)

The final exam will cover the material for the entire course and will be held during the exam period. You are allowed to bring two-pages of notes.

Re-grading Requests

If you find a problem with the grading (i.e., homework, project, or exam), you must e-mail a formal write-up to the professor, stating the issue that you have with the grading of a particular problem(s) and the rationale for requesting the re-grade. For example,

7(c) My answer is equivalent to the answer that was given. It was just provided in a further simplified form. Therefore, I believe I should receive full credit for the problem.

Note: We will re-grade entire problems rather than just the portion specified, i.e., in the above case, the entire problem 7 will be re-graded. Also, there is no guarantee that the new grade is higher, i.e. regarding request may result in a lower grade.

DEADLINE for Re-grading

You must e-mail the above information within two weeks after the grade is given back to you. After two weeks, the grade becomes final and will not be changed.

Honor Code

I fully expect that you will adhere to the Virginia Tech Honor Code in all phases of this course. When you submit work, you are agreeing to be bound by the Honor Code, even if you do not sign or write a pledge on your work.

I encourage discussion and cooperative learning for general course-related concepts. However, any work that you submit for a grade must be your own or that of your team if an assignment allows for it. I will enforce the Honor Code strictly to the best of my ability and may report suspected violations to the Office of the Undergraduate Honor System. For your convenience, below is a copy of the honor code from the university (in **bold**)

The Undergraduate Honor Code pledge that each member of the university community agrees to abide by states:

“As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do.”

Students enrolled in this course are responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any assignment is responsible for obtaining specific guidance from the course instructor before submitting the assignment for evaluation. Ignorance of the rules does not exclude any member of the University community from the requirements and expectations of the Honor Code.

For additional information about the Honor Code, please visit:

<https://www.honorsystem.vt.edu/>

Student Perceptions of Teaching

You are strongly encouraged to complete the Student Perceptions of Teaching (SPOT) questionnaire. Constructive student feedback is important for enhancing the learning experience in this course. Changes to the class and instruction may result from suggestions that are shared with me. Comments about specific aspects of the course or instruction are most helpful. For example, past comments indicated that real-world examples were important for helping students to understand key concepts, and so more of these examples were added to the course materials.

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