Advanced Computer Architecture I
ECE 252 / CPS 220

Meeting Time & Location
TuTh 1:15 – 2:30PM
Teer 203

Teaching Team

Professor Benjamin Lee
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Webpage
http://www.duke.edu/~BCL15/class_ece252fall11.html

Synopsis
This course covers fundamental aspects of advanced computer architecture design and analysis. Topics include processor design, superscalar and out-of-order execution, caches and memory hierarchies, virtual memory, storage systems, simulation techniques, technology trends, and future challenges. Students will complete a collaborative research project.

After completing this course, students should be able to

- Understand modern processor architectures.
- Define and evaluate design metrics.
- Define and execute a research project.

Final project and paper required. Appropriate for graduate students, as well as advanced undergraduate students.

Prerequisites
Computer Science 104 or Electrical and Computer Engineering 152 or equivalent.

Grading
Homework: 30%
Midterm Exam: 15%
Final Exam: 25%
Project/Paper: 30%

Academic Policy
University policy as codified by the Duke Undergraduate Honor Code will be strictly enforced. Zero tolerance for cheating and/or plagiarism.

Late Policy
Late homework (except with Dean's excuses) will be penalized by 50% if less than a day late and receive zero credit if more than a day late. No late projects will be accepted.

Schedule

	Topic	**Hennessy & Patterson**
30 Aug 1 Sep	Introduction Early machines	1 B
6 Sep 8 Sep	Microcoding CISC to RISC Homework #1 Due	
13 Sep 15 Sep	Paper discussion I Pipelining I	 A.1-A.3
20 Sep 22 Sep	Pipelining II Instruction-level parallelism I	A.4 A.5-A.8
27 Sep 29 Sep	Instruction-level parallelism II Instruction-level parallelism III Homework #2 Due	2 3.1-3.4
4 Oct 6 Oct	Paper discussion II Midterm exam	
11 Oct 13 Oct	Fall break Memory I	 C.1-C.3
18 Oct 20 Oct	Memory II Virtual memory Homework #3 Due	 C.4-C.8
25 Oct 27 Oct	Paper discussion III VLIW	 G
1 Nov 3 Nov	Vectors Multi-threading	F 3.5-3.9
8 Nov 10 Nov	Multiprocessors Homework #4 Due Paper discussion IV	4
15 Nov 17 Nov	Advanced topics – technology Advanced topics – specialization	
22 Nov 24 Nov	Advanced topics – datacenters Thanksgiving	
29 Nov 1 Dec	Paper discussion IV Homework #5 Due Summary	

Research Readings

Paper Discussion I	• Hill et al. "Classic machines: Technology, implementation, and economics" • Moore. "Cramming more components onto integrated circuits" • Radin. "The 801 minicomputer" • Patterson et al. "The case for the Reduced Instruction Set Computer" • Colwell et al. "Instruction sets and beyond: Computers, complexity, controversy"
Paper Discussion II	• Srinivasan et al. "Optimizing pipelines for power and performance" • Mahlke et al. "A Comparison of Full and Partial Predicated Execution Support for ILP Processors" • Palacharla et al. "Complexity-Effective Superscalar Processors" • Yeh et al. "Two-Level Adaptive Training Branch Prediction"
Paper Discussion III	• Jouppi. "Improving direct-mapped cache performance by the addition of a small fully-associative cache and prefetch buffers" • Kim et al. "An adaptive, non-uniform cache structure for wire-delay dominated on-chip caches" • Fromm et al. "The Energy Efficiency of IRAM Architectures" • Lee et al. "Phase change memory architecture and the quest for scalability"
Paper Discussion IV	• Mudge, "Power: A first-class architectural design constraint" • Lamport. "How to make a multiprocessor computer that correctly executes multiprocess programs" • Lenoski et al. "The Stanford DASH Multiprocessor" • Tullsen et al. "Simultaneous multithreading: Maximizing on-chip parallelism"
Paper Discussion V	• Horowitz et al. "Scaling, power, and the future of CMOS" • Reddi et al. "Web search using mobile cores: Quantifying and mitigating the price of efficiency" • Dally et al. "Efficient Embedded Computing"