CS 6354 Computer Architecture
Spring 2016 Syllabus

COURSE CONTACT AND LOGISTICS

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Course Webpage: https://www.cs.virginia.edu/ smk9u/CS6354S16/home.html
Review Submission: Collab
Piazza: https://piazza.com/virginia/spring2016/cs6354

COURSE OVERVIEW

Computer architecture is the science and art of designing, selecting, and interconnecting hardware components and co-designing the hardware/software interface to create a computer that meets functional, performance, energy consumption, cost, and other specific goals. This course examines the fundamental computer design trade-offs, and provides an extensive knowledge of state-of-the-art research proposals with the goal of developing an understanding that will enable students to perform cutting-edge research in computer architecture. We will learn, for example, how uniprocessors execute many instructions concurrently, how state-of-the-art memory systems deliver data into the processor, and how heterogeneity in multi-core processors can improve performance and save energy in the future computer systems. Examining the trade-offs of different designs requires that you already know how to correctly design a computer, as is taught in CS 3330. **The concept and content of this course is adapted from the CMU Computer Architecture course ECE 18-740.**

COURSE GOALS

- Goal 1: To familiarize with both fundamental design tradeoffs and recent research issues/trends in processor, memory, and platform architectures in todays and future systems. A strong emphasis will be given on fundamental principles and design tradeoffs.
- Goal 2: To provide the necessary background and experience to advance the state-of-the-art in computer architecture by performing cutting-edge research. A strong emphasis will be given on critical analysis of research papers (through reading and literature review assignments), and developing new mechanisms that advance the state of the art (through the course research project).

TEXTBOOKS AND RESEARCH MATERIAL

No textbook is required for this course. Lectures will serve as the main source of information and they will provide the required references to reading material (such as research articles). A good source of information on all covered topics is the research articles that introduced or built upon the covered topic. These articles are usually published in top conferences (such as ISCA, MICRO, ASPLOS, HPCA) or journals (such as IEEE or ACM Transactions). I strongly encourage you to dig out the original source of the covered topics as well as the research that builds upon it. This will help you become a successful and well-read researcher in computer architecture/systems. I encourage you to do your own research, consult multiple sources, question assumptions and statements, and talk with me and the TA whenever you have questions.

The following textbooks could be useful as supplements to lectures:

- Computer Architecture: A Quantitative Approach, Fourth Edition by Hennessy and Patterson, Morgan Kaufmann/Elsevier
- Structured Computer Organization by Andrew Tanenbaum, Prentice Hall
- Parallel Computer Organization and Design by Michel Dubois, Murali Annavaram, Per Stenstrom, Cambridge University Press
- Readings in Computer Architecture by Mark Hill, Norman Jouppi, and Gurindar Sohi, Morgan Kaufmann

Reading material will be distributed in class and/or will be available on the website electronically.

GRADING

The course will be graded on a curve scale. The tentative breakdown of grades is given below:

Homework and Class Participation	5%
Reviews	25%
Research Project	50%
Exam I	10%
Exam II	10%

REVIEWS

One of the goal of this course is to learn the design principles from precedents. you will learn from examples by reading and evaluating strong and seminal papers, as well as recent state-of-the-art research papers. The primary purpose of reviewing papers is to be able to critically analyze ideas and internalize and summarize the problem, key ideas, mechanisms, key strengths and weaknesses of the work. There will be 1-3 papers assigned every week for reviews. Yours reviews should be concise, clear, and short (half a page).

RESEARCH PROJECT

This course is a hands-on research oriented course. You (in groups of two or three) are expected to propose, conduct, and experimentally evaluate a 2-3-month long research project whose goal is to advance the state-of-the-art and/or current understanding in computer architecture or a related subject. The topic of the project is flexible, but it must be approved by me. This is your chance to explore in depth a computer architecture topic that interests you and perhaps even publish your innovation in a top computer architecture conference. I strongly encourage you to start thinking about your project topic as early as possible and interacting with me to crystallize it over time.

SCHEDULE

Subject to change.

1 **1/21/2016**
Lecture 1: Introduction, Basic of Research, and Paper Review

2 **1/26/2016**
Lecture 2: Fundamental Concepts I

3 **1/28/2016**
Lecture 3: Fundamental Concepts II

4 **2/2/2016**
Lecture 4: Fundamental Concepts III

5 **2/4/2016**
Lecture 5: Pipelining and Precise Exceptions I

6 **2/9/2016**
Lecture 6: Pipelining and Precise Exceptions II

7 **2/11/2016**
Lecture 7: Out-of-Order Execution I

8 **2/16/2016**
Lecture 8: Out-of-Order Execution II

9 **2/18/2016**
Lecture 9: Multi-Core, Asymmetry, and Specialization I

10 **2/23/2016**
Review Session

11 **2/25/2016**
Lecture 10: Multi-Core, Asymmetry, and Specialization II

12 **3/1/2016**
Lecture 11: Multi-Core, Asymmetry, and Specialization III

13 **3/3/2016**
Lecture 12: Memory I

14 **3/8/2016**
Spring Break

15 **3/10/2016**
Spring Break

16 **3/15/2016**
Lecture 13: Memory II

17 **3/17/2016**
Exam I

18 **3/22/2016**
Milestone 1 Presentations

19 **3/24/2016**
Milestone 1 Presentations

20 **3/29/2016**
Lecture 14: Emerging Non-Volatile Memory Technologies

21 **3/31/2016**
Lecture 15: Branch Prediction I

22 **4/5/2016**
Lecture 16: Branch Prediction II

23 **4/7/2016**
Lecture 17: Caches I

24 **4/12/2016**
Lecture 18: Caches II

25 **4/14/2016**
Lecture 19: Prefetching I

25 **4/19/2016**
Lecture 20: Prefetching II

26 **4/21/2016**
Lecture 21: Prefetching II

27 **4/26/2016**
Final Project Presentation

28 **4/28/2016**
Final Project Presentation

29 **5/3/2016**
Review Session

30 **5/X/2016**
Exam II