CSE60321 Advanced Computer Architecture

Spring, 2020

Class: 356 Fitzpatrick Hall
Tues. & Thurs. 11:00am - 12:15pm

Instructor: **Dr. X. Sharon Hu**
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Office Hours: Mon. 1:00pm–2:00pm & Wed. 4:00pm–5:00pm or by appointment

TA: **Neil Butcher**
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Office Hours: Tues. 2:00pm–3:00pm & Thur. 9:30am–10:30am or by appointment

Required Texts:

1. J.L. Hennessy and D.A. Patterson, *Computer Architecture: A Quantitative Approach*, 6th edition, Morgan Kaufmann.
2. Papers selected from relevant journals and conferences in the relevant topic areas.

Course Overview and Objectives

This course introduces classical as well as state-of-art architectural approaches to designing high performance and power efficient computers. Topics include macro- and micro-architectural approaches to exploiting instruction level parallelism, thread level parallelism, data-level parallelism, multi-core architectures, memory hierarchy and storage, power-aware computing, etc. Emphasis is given to techniques for quantitative analysis and evaluation of modern computing systems, such as selection of appropriate benchmarks to evaluate and compare the performance of alternative design choices in system design.

At the end of this course, you are expected to be able to do the following:

- Measure and analyze computer performance to compare and contrast different computer architectures.
- Evaluate and compare the impacts of various architecture techniques on performance and power.
- Articulate the main architectural advances for improving computer performance/power and how they have impacted software development.
- Use knowledge about the underlying processor hardware (or "architecture") to write more efficient software.
- Summarize and explain research results from given journal/conference papers in the computer architecture area.

Grading Guidelines:

- Grade components:

Homework	30%
Midterm Exam	15%
Final Exam	25%
Final Project	25%
Class Participation and Others	5%

- The assignment of letter grades will follow the following scale: A: ≥ 90, A-: ≥ 85, B+: ≥ 80, B: ≥ 75, B-: ≥ 70, C+: ≥ 65, C: ≥ 60, C-: ≥ 55, D: ≥ 50 and F: < 50. Adjustments to the above scale may be made if deemed necessary by the instructor due to unforeseen circumstances.

Course Policies:

- Each lecture note will be made available the day of the intended lecture. Lecture notes are mainly for guiding in-class discussions and should not be used in place of the reading assignments.
- Reading assignments will be posted with the previous lecture notes. Students are expected to do the reading assignment **before the lecture**.
- There will be two exams (midterm and final), regular homework assignments, as well as a final project. Details of the exams and the project will be provided later. The midterm exam date is tentatively set to March 5th. The final exam is tentatively on May 8th, 10:30am-12:30pm.
- Only under unusual circumstances (medical excuse or prior instructor approval) may make-up exams be considered. Otherwise, a zero point will be counted towards one's grade.
- Homework should be submitted in the hardcopy form (unless specified otherwise) prior to the start of the class on the due date. Homework will be accepted up to three days after the due date. Late homework will receive a deduction of 20% of the total points received for each additional day. However, if a student abuses this privilege by routinely handing in homework late, the privilege will be withdrawn.
- For some homework assignments and the project, students may be asked to work in teams. Instructions on how to form a team will be given with the assignment. An evaluation form must be filled for each team-oriented assignment. More details will be given later.
- Inquiries about graded homework, lab reports, quizzes and tests will be accepted only if made **within one week** after they are handed back. Such inquiries should be made in writing, which clearly explains the complaints. Only after reviewing the written complaints, can the instructor make any grade adjustments.

Academic integrity:

According to the University of Notre Dame Undergraduate Academic Code of Honor, "members of the University community are expected to embrace and adhere to the following pledge:

> As a member of the Notre Dame community, I acknowledge that it is my responsibility to learn and abide by principles of intellectual honesty and academic integrity, and therefore I will not participate in or tolerate academic dishonesty."

No academic dishonesty in any form is tolerated. The University's Honor Code (http://honorcode.nd.edu/) reminds our community of our shared purpose both within the institute of academia and as members of a broader humanity; the statement also outlines policy violation procedures. Any questions regarding academic integrity, particularly regarding assignments in this course, should be directed to the instructor or TA.

Tentative Course Schedule:

Topics	*Number of Lectures*
Class overview and technology trends	1
Quantitative aspects of computer architecture	1
Review of Instruction Set Architectures and MIPS	1
Review of computer organization and pipelining	1
Memory hierarchy	5
Instruction-level parallelism and its exploitation	4
ILP limitations	1
Multithreading	2
Multicore and Multiprocessing	7
Emerging architectures for machine learning and other applications	3