ECE 462/562: Computer Architecture and Design – Spring 2022

Time: Monday, Wednesday, Friday, 9am – 9.50am; Credits: 3
Location: Psychology Rm 306
Online Students Time: AOE (Videos will be posted to Panopto by 5pm on each class day.)

Instructor
Tosiron Adegbija (https://tosiron.com), tosiron@arizona.edu
Office Hours: Fridays, 4.30 – 5.30 pm; ZOOM link on D2L welcome page/Piazza.

Course Websites
We will use Piazza (also accessible via D2L -> Piazza) for class resources, lecture notes, assignments, and discussion. The system is highly catered to getting you help fast and efficiently from classmates and myself. Unless you have questions specifically related to your grade, personal matters, or similar, you should post your questions to Piazza. Sign up link and access code are on D2L. All enrolled students must sign up on Piazza (The sign-up code is given in the D2L class welcome message).

If possible, I encourage you to post questions on Piazza before classes so that we can discuss the questions during class if necessary.

We will use D2L (https://d2l.arizona.edu) for Grades (via D2L -> Grades), assignment submission (via D2L -> Assignments), and class videos (posted after every class via D2L -> Panopto).

Course Overview
This course focuses on the techniques of quantitative analysis and evaluation of modern computing systems and is appropriate for both advanced undergraduate and graduate students. We will build on introductory classes that showed how a basic computer functions, and examine different techniques for improving computer performance, energy consumption, and usability. Emphasis will be placed on the major component subsystems of high-performance computers. We will discuss several topics, including pipelining, instruction-level parallelism, virtual memory, caches (memory hierarchies), multiprocessors, and advanced storage systems. Students will undertake a major computing system analysis and/or design project on topics of interest to the students. Hopefully, you will also have a lot of fun learning in this class. The course schedule can be found here.

Topics include, but are not limited to:

- Fundamentals of computer design (Week 1)
- Pipelining overview (Week 2)
- Memory hierarchy design (Week 3 – 4)
- Instruction-level parallelism (Week 5 – 7)
- Thread-level parallelism/multiprocessor systems (Week 8 – 9)
- Heterogeneous multiprocessing (Week 10)
- Data-level parallelism (Week 11)
- Storage systems (Week 12 – 13)
- Warehouse-scale computers (Week 14)
- Emerging computer architectures (Week 15)
Learning Outcomes
By the end of this course, students will:

- Understand the fundamentals of computer architecture and system design
- Be able to appreciate and understand the various design issues and tradeoffs of computer design
- Be able to apply this knowledge to new computer architecture design problems with the context of balancing application requirements against technology constraints
- Be able to understand current trends and future directions of computer architecture

Prerequisites
It is assumed that you are familiar with material covered in ECE 274 (Digital Logic Design) and ECE 369 (Computer Organization). Alternatively, you must be ready to do any additional studies required to catch up on the prerequisites. If you have any questions about the prerequisites, feel free to ask me. Other skills and background that may be required for this course include:

- Basic UNIX/Linux OS and compiler knowledge
- High-level programming languages (e.g., C, C++) and data structures
- Verilog
- Basic assembly language
- You should be willing to take extra time on your own to catch up on the necessary background and skills if you do not already have them. Google is a great resource for this!

Textbooks
The recommended textbook is “Computer Architecture: A Quantitative Approach” (Sixth Edition) by John Hennessy and David Patterson. However, you are not required to purchase this textbook to get the most out of the class. Given the rapidly evolving nature of computer architecture, a lot of the class contents will also be based on freely accessible research papers.

Communication with the Instructor
In general, questions about class contents should be posted on Piazza. That way, responses can be helpful to other students and other students (or the grader) may also be able to provide quicker responses to questions. Please be respectful in all your posts on Piazza, especially when answering other students’ questions, even if the answers are obvious to you.

For questions related to grades and personal matters, please email me. In your emails to me, please include the course number in brackets in your subject (i.e., [ECE 562] or [ECE 462] or [ECE 562-201] if you’re an online student) so that I can sort my email. You are more likely to get a quicker response with this in your subject.

Grading
The grading for the class will be performed on an individual basis. You will not be competing with other students for your grade. Your grade is only dependent on the effort you put into the class. Letter grades will be assigned using a 10% scale:

- 90 – 100%: A
- 80 – 89%: B
70 – 79% C
60 – 69% D

All grades will be posted on D2L. The grading will be based on a weighted sum as follows:

- 30% - Class project (from March until the end of the semester)
  - The project description will be posted on Piazza.
    - Project proposal: Due on Friday, March 4
    - Final project report: Due on Friday, April 29
- 20% - Midterm 1 (tentatively on Friday, March 4)
- 20% - Midterm 2 (not cumulative) (tentatively on Friday, April 29)
  - All midterms will be open book/open notes, administered online via the D2L Quiz function, and will last approximately 50 minutes.
- 10% - Homework
  - 2 – 3 homework assignments based on the gem5 simulator
- 20% - Quizzes
  - Approximately 8 quizzes will be administered online via the D2L Quiz function.

Policies

- In accordance with the University's policy on face coverings, surgical or higher-grade face coverings are required for all in-person class activities. This will be strictly enforced. For more information, please visit https://covid19.arizona.edu/face-coverings.
- No academic dishonesty will be tolerated. Unless otherwise instructed, all course work should be done on your own. Please consult the UA Code of Academic Integrity.
- Students are expected to read any assigned material before lecture.
- No late work will be accepted, unless in extraordinary circumstances, e.g., medical emergency, University/College approved absences, etc.
- Missed exams and assignments can only be made up in case of documented illness or personal emergency. Please submit a written documentation (including supporting documentation) to me ASAP. When possible, make-up arrangements must be made prior to the scheduled activity.

Disability/Counseling Resources

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, https://drc.arizona.edu) to establish reasonable accommodations.

Additionally, resources are available on campus to students having personal problems or lacking clear career and academic goals. Students who need assistance should contact Counseling and Psych Services for the necessary assistance.

Inclusive Excellence

Inclusive Excellence is a fundamental part of the University of Arizona's strategic plan and culture. As part of this initiative, the institution embraces and practices diversity and inclusiveness. These values are expected, respected, and welcomed in this course.

This syllabus is subject to change at the discretion of the instructor, with proper notice to the students.