CS 310: Computer Organization and Design

Term: Spring 2022
Credits: 3
Lectures: 9:10 AM – 10:10 AM, MWF in HS 202
Prerequisites: CS 251 and CS 212, all with a grade of C or better.

Classroom Mask Requirement

All students are required to wear an appropriate mask that covers their mouth and nose when they're in the classroom. They must also adhere to additional expectations communicated by me or posted in the classroom. Note: UWO procedure dictates that, during the COVID-19 pandemic, I cannot begin class until all students are wearing a mask properly. If a student is non-compliant with the masking policy and refuses to leave the classroom promptly when requested, I am required to cancel class. Students responsible for class cancellation for these reasons will be referred to the Dean of Students office, and the student will be unable to attend class until they meet with the Dean of Students. The student may be dropped from the class by the Dean of Students.

Instructor

Instructor: Scott Summers
Email: summerss@uwosh.edu
Phone: 920-424-1324
Office: Halsey 220
Office hours: (subject to change):

	Mon	Tues	Wed	Thu	Fri
9:00 AM					
10:10					
11:10					
12:00 PM					
1:40					
2:40					

I encourage students to email me with your questions. Student should keep in mind that, when they email me, they should identify themselves and the class that you are taking with me before asking their question(s). It takes me a while to remember who is in what class. Emails should be written in a respectful and professional tone, using complete sentences. Note that I check my email quite frequently during the business week, but I don't tend to check it between about 7pm and 8am (I check it even less frequently on weekends).

Course Description (outdated)

An introduction to digital logic and computer hardware organization. The students are introduced to elementary Boolean algebra and switching theory as related to computer architecture. Emphasis is given to the design of Central Processing Units, Arithmetic and Logic Units, and main memories. A comparison of alternate computer organizations is presented.

Course Website

The course website is: `https://uwosh.edu/canvas/`. You should check Canvas on a regular basis, perhaps two or three times per day.

Recommended Textbook

This book is NOT required but is a classic

Computer Organization and Design: The Hardware/Software Interface MIPS Edition, David A. Patterson, John L. Hennessy
Fifth Edition, Morgan Kaufmann, 2013

Course Grade

Your final course grade will be based on the following components.

10% QUIZZES
There will be a quiz given roughly each week, each to be submitted online via Canvas. Each quiz must be completed individually and in isolation. Students shouldn't discuss quizzes with anyone other than the course instructor.

30% ASSIGNMENTS
There will several assignments. While a few will be stand-alone, the majority of the assignments will comprise a semester-long effort to implement a simple 16-bit micro-architecture. Students MAY work with one other student in the class on each assignment.

60% EXAMS
There will be three equally-weighted in-class exams. Exam material will come from the lecture notes, quizzes and homework assignments. There will be more information about each exam as it approaches. The actual exam dates will be announced in class at least one week before the exam. All exams will be taken during the regular class period.

If a student is unable to take a scheduled exam, it may be possible to take a make-up exam provided that the student do both of the following, which are then subject to my approval:

1. Make arrangements prior to the scheduled exam (for last minute emergencies, telephone me at 920-424-1324 or leave a message at the Computer Science office, 920-424-2068. **No after-the-fact notifications will be accepted**.

2. Have a written medical excuse signed by the attending physician OR have a note of justification from the Dean of Students Office.

If allowed, only one make-up exam will be given. It will be a comprehensive exam given at an arranged time during the last week of the semester.

Late Work

Late work will NOT be accepted. Late work is worth 0 points. Extensions may be granted at the discretion of the instructor if the student provide's a valid justification (in the form of a written excuse from a medical doctor or the Dean of Students Office) before the due date.

Grading Scale

Grading will be on a plus/minus system. Grading may be done on a curve depending on the overall performance of the class. If no curve is used, then your grade will be computed based on the following:

Percentage	Grade
> 91	A
> 89 and ≤ 91	A-
> 87 and ≤ 89	B+
> 81 and ≤ 87	B
> 79 and ≤ 81	B-
> 77 and ≤ 79	C+
> 71 and ≤ 77	C
> 69 and ≤ 71	C-
> 67 and ≤ 69	D+
> 61 and ≤ 67	D
> 55 and ≤ 61	D-
≤ 55	F

Re-grading

If a student believes an assignment, quiz or exam was graded incorrectly or unfairly and would like to have it re-graded, then they must let me know about it in writing within one day of receiving the assignment, quiz or exam. I will re-grade the entire assignment, quiz or exam and they may gain or lose points.

Course Objectives

At the conclusion of the course, the student will be able to:

1. Performance
   (a) Describe the various ways in which computer performance can be measured and explain the pros and cons of each measure.
   (b) Compare and contrast the goals of parallelism (e.g., throughput) versus concurrency
   (c) Explain the trade-offs associated with instruction set architecture design.
   (d) Use the CPU performance equation to compare the performance of processor architectures.
   (e) Apply Amdahl's law to understand the impact of an architectural modification on performance.
2. Instruction sets
   (a) Understand and describe the trade-offs between complex instruction set computers (CISC) and reduced instruction set computers (RISC).
   (b) Understand how fundamental mathematical operations, such as addition, subtraction, multiplication, and division, can be optimized with appropriate number representation, rounding, and digital circuit implementation schemes.
3. Micro-architecture design and implementation
   (a) Understand the key principles used in creating data-paths and designing the control unit for single-cycle and multi-cycle micro-architectures.
   (b) Examine how the choice of implementation strategy affects the clock rate and CPI of a computer system.

(c) Distinguish between microprogrammed and hardwired processor control, and describe the benefits of each approach.

(d) Explain the concept of instruction-level parallelism and describe the challenges associated with taking advantage of it.

(e) Describe the general design of a processor that implements instruction-level parallelism.

(f) Explain why instruction-level parallelism requires synchronization by the compiler and/or processor in order to support multiple simultaneous computations, a form of parallel computing

(g) Identify data, control and structural hazards for a given architecture/code segment pair.

(h) Analyze the performance of a code segment in a given instruction execution pipeline.

4. Cache

   (a) Describe how a cache works.

   (b) Enumerate various methods for enhancing cache and memory performance.

   (c) Distinguish among directly-mapped cache, associative cache, and set-associative cache, and describe the principal issues related to cache memory organization.

   (d) Quantify the impact of the hit ratio on the effectiveness of the cache memory system.

5. Teamwork – demonstrate the ability to work effectively in teams on small-scale digital design projects.

University Policy on Academic Integrity

The University of Wisconsin Oshkosh is committed to a standard of academic integrity for all students. The system guidelines state:"Students are responsible for the honest completion and representation of their work, for the appropriate citation of source, and for respect of others' academic endeavors" (UWS 14.01, Wisconsin Administrative Code).

Statement Regarding Diversity, Equity & Inclusion

Diversity drives innovation, creativity, and progress. At the University of Wisconsin Oshkosh, the culture, identities, life experiences, unique abilities, and talents of every individual contribute to the foundation of our success. Creating and maintaining an inclusive and equitable environment is of paramount importance to us. This pursuit prepares all of us to be global citizens who will contribute to the betterment of the world. We are committed to a university culture that provides everyone with the opportunity to thrive.

Required Disclosure Statement

Students are advised to see the following URL for disclosures about essential consumer protection items required by the Students Right to Know Act of 1990:
`https://uwosh.edu/financialaid/consumer-information/`