Computer Organization and Design
CS 310 – Fall 2020
Credits: 3 hours
*** This is an online synchronous course ***

Instructor: David Furcy

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Office Hours: MWF 9:00 – 10:00 AM
Tu 9:00 – 11:00 AM
Th 9:30 – 10:30 AM
or by appointment

All office hours will be held on Canvas in Collaborate Ultra sessions.

Class Meetings: TuTh 11:30 AM – 1:00 PM

All class meetings will be held on Canvas in Collaborate Ultra sessions.

Prerequisites: CS 212 and CS 251 with a grade of C or better

Class Web Page: Canvas

You are expected to check the CS 310 Canvas course web site daily since it will be constantly updated with materials for this class including daily slides, daily Collaborate Ultra lecture sessions, daily reading assignments, and multiple programming assignment handouts. **You are also expected to check your email daily** for course announcements.

Textbook: No required textbook

Recommended Reference: ***** 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

Tests: Exam #1: Week of November 2nd
Exam #2: Week of December 14th

In this synchronous course, lectures will take place live during the regular class times on Collaborate Ultra. **Make sure to be available during EACH and EVERY class session.** This is also when all quizzes and exams will be administered on Canvas. Lectures will be recorded for the benefit of students who would like to listen to parts of them again while studying. Office hours will also take place on Collaborate Ultra. I will always be available for questions during the times listed above. You are also encouraged to set up an appointment by email if these times do not work you.

Official Course Description (outdated):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.

Topic Coverage and Learning Outcomes:

This course focuses on the design of microprocessors, especially the Arithmetic and Logic Unit and the Control Unit, as well as the memory hierarchy, especially registers, DRAM-based main memory, and caches. At the conclusion of the course, the student will be able to:

Outcome #1

a) describe the various ways in which computer performance can be measured and explain the pros and cons of each measure

b) explain the tradeoffs associated with instruction set architecture design

c) use the CPU performance equation to compare the performance of processor architectures

d) apply Amdahl's law to understand the impact of an architectural modification on performance

Outcome #2

a) understand and describe the tradeoffs 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

Outcome #3

a) understand the key principles used in creating datapaths and designing the control unit for single-cycle and multi-cycle microarchitectures

b) appreciate how the choice of implementation strategy affects the clock rate & 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) identify data, control and structural hazards for a given architecture/code segment pair

g) analyze the performance of a code segment in a given instruction execution pipeline

Outcome #4

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

Course Grading Policy

Your final grade for this course will be based on three components, namely quizzes, homework assignments, and exams. Homework assignments will be completed in pairs and will take between one and two weeks to complete. Your overall numerical grade for the course will be computed as the weighted sum of the component grades using the following weights:

Component	Weight
Quizzes	20%
Homework assignments	20%
Exam #1	30%
Exam #2	30%

Finally, your letter grade for the course will be computed as follows:

Numerical Score	Grade	Numerical Score	Grade
≥ 92	A	≥ 72	C
≥ 90	A-	≥ 70	C-
≥ 88	B+	≥ 68	D+
≥ 82	B	≥ 62	D
≥ 80	B-	≥ 60	D-
≥ 78	C+	< 60	F

While this overall grading scheme is fixed, I will be happy to discuss any issue you may have with individual grades. If you notice a mistake or have a question regarding a specific grade, please come and talk to me *as soon as possible*. Do not wait until the end of the semester to bring up grading issues. Also, I will *not* be available to discuss grades after the end of the final week.

Attendance and Participation

You are expected to not only attend **every** class meeting but also to come **prepared** for and **participate** actively in it. Necessary preparation requires you to have studied and assimilated the material covered in previous sessions, to have met with me outside of class to discuss any questions you may have, and to have completed all of the assignments on time, including the daily reading assignments. **It is hard to imagine how a student could do well in this course while missing classes or attending them unprepared.** On the positive side, I have high expectations for my students and will always support and encourage you. I **strongly encourage you to ask any question** or raise any issue you have with the course either during class or in my

office hours. I will also gladly meet with you by appointment. Send me email to make an appointment. While I will talk with you as soon as my schedule permits, do not expect me to be widely available just before an exam or the due date for an assignment since you may not be the only one needing help at the last minute.

Late Submissions

I will describe the submission procedure for your assignments when the time comes. However, let me point out right away that each one of them will come with a deadline (day and time) after which any submission will be considered late. The late-submission policy works as follows:

Turned in	Penalty
On the due date but after the deadline	30%
On the day after the due date	60%
Two or more days after the due date	100%

Note that assignments that are more than one day late receive no points. Weekend days and holidays DO count as "regular days" when computing late penalties. Each (late) day starts precisely at midnight. Extensions on assignments may be granted at the discretion of the instructor if you provide a valid justification (in the form of a written excuse from a medical doctor or the Dean of Students Office) before the due date. Late submissions can easily be avoided by starting to work on the assignment right away and asking for help early if you get stuck.

If you miss a scheduled exam, you **may** be able to take a make-up exam provided you give the instructor a valid justification (see above), ahead of time if possible. Only one make-up exam will be given. It will be a comprehensive exam scheduled at the end of the semester. If you miss a quiz, you **may** be able to take a make-up quiz, provided you have a valid justification (in writing) for your absence.

Accommodations

The University of Wisconsin Oshkosh supports the right of all enrolled students to a full and equal educational opportunity. It is the University's policy to provide reasonable accommodations to students who have documented disabilities that may affect their ability to participate in course activities or to meet course requirements.

Students are expected to inform instructors of the need for accommodations as soon as possible by presenting an Accommodation Plan from either the Accessibility Center, Project Success, or both. Reasonable accommodations for students with disabilities is a shared instructor and student responsibility.

The Accessibility Center is part of the Dean of Students Office and is located in 125 Dempsey Hall. For more information, email accessibilitycenter@uwosh.edu, call 920-424-3100, or visit the Accessibility Center Website.

Disclosure: 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/resources/consumer-information/

Collaborating versus Cheating

While it is acceptable to discuss the problem statement, premises, goals, constraints, etc., of the assignments with others, you must submit your and your partner's work exclusively. You may not "borrow" any piece of code or design of any length from anybody else, unless you can live with a zero and the other potential academic sanctions of cheating (see the UWO Student Discipline Code, Chapter UWS 14).

In conclusion, remember that computer science classes require a lot of work in addition to active participation in class. It takes considerable practice to develop the technical and analytical skills targeted by this course. You will need to spend **at least (and typically much more than) three hours of effort outside of class for each in-class hour**. Having said this, I expect every hardworking student to do well in this course.

Have fun this semester and good luck!