CMSC 411 | Computer Architecture

Semester:	Fall 2022	**Section :**	05
Day & Time:	MoWe 2:30 – 3:45pm	**Classroom:**	Sondheim 110
Instructor:	Dr. Ergun Simsek	**E-mail:**	simsek@umbc.edu
Office:	ITE 325K	**Office Hour:**	Wednesday, 10 am – 12 noon
TA:	Saquib Ahmed	E-mail:	saquiba1@umbc.edu
Office:	TBA	**Office-Hour:**	TBA

Course Description

This course covers the design of complex computer systems making heavy use of the components and techniques discussed in CMSC 313, CMPE 212 and CMPE 310. All parts of the computer system - CPU, memory and input/output - are discussed in detail. Topics include information representation, floating-point arithmetic, instructions set design issues (RISC vs. CISC), microprogrammed control, hardwired control, pipelining, memory cashes, bus control and timing, input/output mechanism and issues in the construction of parallel processors

Prerequisites: C or better in CMSC 313

Credits: Three credits

Learning Outcomes

At the end of this course, students are expected

- To have a fundamental understanding of the organizational paradigms that determine the capabilities and performance of computer systems
- To design software that can reduce the cost while increasing the performance
- To understand the effects of their architectural design choices on software applications

Textbook: Computer Organization and Design MIPS Edition: The Hardware/Software Interface

Authors: David Patterson, John Hennessy (Zybooks Edition)

1. Sign in or create an account at https://learn.zybooks.com/signup

Important Note: For signing up, you need to use your UMBC email account in the following format: CampusID@umbc.edu. For example, I used OI64858@umbc.edu (not simsek@umbc.edu)

2. Enter zyBook code: UMBCCMSC411SimsekFall2022

3. Subscribe. Note that the book is not free. You will need to pay $72 to subscribe. Subscriptions will last until Jan 06, 2023.

Reference: Introduction to MIPS Assembly Language, Charles W. Kann

https://cupola.gettysburg.edu/oer/2/

Tentative Schedule

Lect #	Date	Topic
1	8/31	Introduction
2	9/7	Performance
3	9/12	Performance (cont.) & Benchmarking
4	9/14	Representing Info
5	0/19	Instruction Set Part 1
6	9/21	Instruction Set Part 2
7	9/26	Instruction Set Part 3 & Addressing Modes
8	9/28	Procedures and Stacks
9	10/3	MIPS Simulator
10	10/5	ALU
11	10/10	Multipliers Design
12	10/12	Performing Division & Floating Point Operators (Brief)
13	10/17	Single Cycle Datapath and Control
14	10/19	Multi-cycle Processor and Design
	10/24	MIDTERM
15	10/26	Introduction to Pipelining
16	10/31	Pipelined Datapath and Control
17	11/2	Handling Pipeline Hazards
18	11/7	Branch Prediction
19	11/9	Exceptions
20	11/14	Instruction Level Parallelism
21	11/16	Super Scalar and Dynamic
22	11/21	Memory Hierarchy and Cache
23	11/23	Cache Performance
24	11/28	Virtual Memory
25	11/30	Parallel Processors
26	12/5	Multithreading
27	12/7	Introduction to GPUs
28	12/12	Domain specific architectures and clusters
	12/16	Final Exam (1 – 3 PM)

Grading

Homework Assignments (20%), Quizzes (10%), Midterm (30%), Final Exam (40%)

Grade Distribution: 90 – 100: A, 80 – 89: B, 70 –79: C, 60 – 69: D, < 60: F.

Course Workload

This course is a 3-credit course, which means that in addition to the scheduled meeting times, students are expected to do at least 5+ hours of course-related work outside of class each week during the semester. This includes time spent completing assigned readings, studying for tests and examinations, preparing written assignments, group activities and other course-related tasks.

MIPS Simulators

- Download SPIM: http://spimsimulator.sourceforge.net/
- Download MARS: http://courses.missouristate.edu/kenvollmar/mars/download.htm
- Online manual for MIPS using QtSpim: http://www.egr.unlv.edu/~ed/MIPStextSMv11.pdf

MIPS Reference:

- ❑ Quick Reference
- ❑ MIPS Opcode LookUp
- ❑ "Cheat Sheet"MIPS Reference (Green Card from the text for use on exams)

Calculators:

- ❑ Decimal-Binary-Hex Converter
- ❑ IEEE754 Floating Point Calculator
- ❑ Desmos Graphing Calculator

Logic Circuit Simulator:

- ❑ https://circuitverse.org (Warning: 32-bit)

Homework Assignments (20%)

- 5-6 assignments will be given and normalized to 20% of the final grade
- An average assignment requires about 2-3 hours to perform
- Assignments are due on the due date listed in Blackboard

Exams (30% + 40%)

- A midterm exam is scheduled for 75 minutes (30%)
- The final exam is scheduled for 2 hours (40%)
- The Final Exam is comprehensive, encompassing everything that was covered in class but the focus will be subjects covered after the midterm exam.

Quizzes (10%)

- There will be one-question tests that will be run via Blackboard. Please bring your laptop or smart phone to participate. These quizzes will be also used to collect attendance!

Academic Integrity (If you cheat, you will get an F without any explanation)

By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the Academic Integrity Resources for Students page (https://aetp.umbc.edu/ai/resources-for-students/) or the Faculty Handbook (http://provost.umbc.edu/faculty-handbook/), specifically Sections 14.2-14.3.

If you need help with a project, see your instructor, your TA, or tutors provided by the Learning Resource Center. We also encourage you to consult textbooks and code examples provided on Blackboard. Consult Blackboard for additional Academic Integrity policies for projects.

Any act of dishonesty will be reported to the University's Academic Conduct Committee for further action, which may include, but is not limited to, academic suspension or dismissal from the University.

We will be using special software to check for cheating. The software is quite sophisticated and has surprised many students in the past. There is no difficulty in comparing every pair of assignments – even assignments submitted to other sections of this course, or from previous semesters.

This is a *non-exhaustive* list of restrictions for completing your assignments in this course.

- **If you have questions about what is acceptable, please contact a professor or TA.**

You may not look at, access, download, or obtain anyone else's work.

- You should think carefully about the assignment, and the assignment you turn in should be entirely a product of your own understanding of the material.
- You may not use any online resources to request additional help. Please contact a professor or TA for additional help.
- You may not post any part of a course document online. Posting any slides, projects, or labs will be considered a violation of this course policy and will result in an "F" for the course.
- You may not look at someone else's code "for reference," even if you put it aside before programming, and even if that person is not a CMSC student.
- You may not Google or search for the solution to an assignment, even if it's "only for reference."
- You may not copy code other than that provided in the course materials (slides, book, labs, etc.).
- You may not let someone else explain a solution to you in such detail that they are effectively dictating the code to you line by line. It does not matter if this person has never taken this course, or if they are not looking at their own code while doing so!

Late & Make-up Policies

Late Individual Assignments

- All individual assignments are due at 11:59 pm on the due date. No individual assignments will be accepted late.

Make-up exams

- You will have a 24-48 hour time frame to take the exam. There will be no make-up exams unless there are exceptional circumstances.

Communication

Email Policy Guidelines:

- Use my UMBC e-mail (simsek@umbc.edu) for all private communication Generally, I will respond to e-mails within 24 hours during the week and 48 hours over the weekend or holidays.
- If a time arises when I will be unable to respond to email within two business days, I will let the class know.

Backing up your work

In this course you will complete some of your assignments on a computer. You are responsible for ensuring the safety of your work by making regular backups. "The computer ate my homework, I lost my flash drive or my hard drive crashed", are not acceptable excuses. Make frequent backups of your work and save the work in multiple places. I would recommend using Google Drive, Box, Dropbox (www.dropbox.com) or Git (www.GitHub.com) or something similar to keep a copy of your files externally. Students are responsible for keeping a copy of all graded assignments. If there is no copy of graded work in question, no grade change or credit for a missing assignment is possible.

Privacy: Electronic communications do not always guarantee privacy. Sharing personal information is voluntary, not required.

UMBC Policies and Resources during COVID-19

Please refer to the document at the following link for UMBC policies and resources during COVID-19: https://docs.google.com/document/d/1xWWGAR8qEzKYr7qaVHoEhvO6lyXIyn6M3M7EFZPJQgA/edit

Accessibility and Disability Accommodations, Guidance and Resources

Support services for students with disabilities are provided for all students qualified under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that would create equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures.

SDS email: disAbility@umbc.edu
SDS phone: (410) 455-2459

If you will be using SDS approved accommodations in this class, please contact me (instructor) to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

Please note: Shady Grove campus (USG) student accommodation needs are arranged through the UMBC main campus SDS office.

For students at the Shady Grove campus, the Center for Academic Success (CAS) provides additional support. CAS provides test-proctoring services and can act as a liaison between students at USG and their home campus, as well as between students and their professors. For more information on the services CAS provides, please contact Kaitlin Mills (kmills3@umd.edu) or visit

https://shadygrove.umd.edu/student-services/center-for-academic-success/dss.

Sex and Gender Based Violence, Harassment and Discrimination

Any student who is impacted by sexual harassment, gender-based harassment, sexual assault, sexual coercion, relationship violence, domestic violence, sexual exploitation, sexual intimidation, sex, gender-based stalking or retaliation or gender or pregnancy discrimination is encouraged to seek support and resources.
You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.
As an instructor, I am considered a *Responsible Employee*, per UMBC's Policy on Prohibited Sexual Misconduct, Interpersonal Violence, and Other Related Misconduct I am required to report disclosures of possible violations of the Policy to the Title IX Coordinator, even if the experience occurred before you attended UMBC.
While I want you to be able to share information related to your life experiences through discussion and written work, I also want you to understand that I must report Sexual Misconduct to the Title IX Coordinator so that the University can inform you of your rights, resources and support.
If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, about an incident, UMBC has the following Confidential Resources available to support you: The Counseling Center: 410-455-2742; University Health Services: 410-455-2542; For after-hours emergency consultation, call 301-314-7651.
Other on-campus supports and resources: The Women's Center (for students of all genders): 410-455-2714; Title IX Coordinator, 410- 455-1250.
Child Abuse and Neglect: Please note that Maryland law requires that I report all disclosures or suspicions of child abuse or neglect to the Department of Social Service and/or the police.