**CS/ECE 3810: Computer Organization**
Fall Semester 2020
Thursday 8:35-9:25 (02), 9:40-10:30 (03), Friday 11:50-12:40 (04), 2:00-2:50 (05); IVC

**Instructor:** Mahdi Nazm Bojnordi
**Email:** mahdi.bojnordi@utah.edu
**Zoom:** https://utah.zoom.us/j/8244189779
**Office Hours:** email instructor for appointment
**Office Location:** 3418 MEB

**Note:** For the protection of your personal information, the University of Utah requires all correspondences to be to and from your .utah.edu email or Canvas messages.

**Credits:** 4

**Pre-requisites:** Knowledge of structured programming languages such as C/Java.

**Required Materials**

Textbook: Computer Organization and Design - The Hardware/Software Interface - 5th Edition, David Patterson and John Hennessy

Website: The class website is the Canvas course available through CIS. It will be updated throughout the semester with the class schedule, lecture notes, videos, assignment specifications, and much more. Moreover, a public webpage for the class is available at http://www.cs.utah.edu/~bojnordi/classes/3810/f20/

MIPS and MARS Simulator: The course is based on the MIPS architecture (refer to the textbook) for microprocessors. We use the MARS (Links to an external site.) simulator for executing MIPS assembly.

**Course Description**

This course is designed for both CS and ECE students. The course provides an in-depth study of computer architecture and design, including topics such as RISC and CISC instruction set architectures, number representation, CPU organizations, pipelining, memory systems, input/output, and parallel machines. The course familiarizes the students with machine/assembly programming with an emphasis on register allocation, mapping c code snippets to assembly, and procedure calls.

**Course Outcomes**

At the end of the course, students will be able to
- write assembly code for MIPS processor

- represent numbers in signed/unsigned integer and floating-point formats
- understand the control and dataflow of logical functions for simple processor pipelines
- measure processor performance, energy, and power
- identify data, structural, and control hazards in the microprocessor pipelines

**University Policies**

1. ***The Americans with Disabilities Act***. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

2. ***University Safety Statement.*** The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

3. ***Addressing Sexual Misconduct***. Title IX makes it clear that violence and harassment based on sex and gender (which Includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information.  If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066.  For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776.  To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

4. ***COVID-19 Campus Guidelines.*** Students are required to self-report if they test positive for COVID-19**.** To report, please contact:
   **COVID-19 Central @ The U**
   801-213-2874
   coronavirus.utah.edu

   To reduce the spread of COVID-19 on campus, **face coverings are required in all in-person classes for both students and faculty.**

Based on CDC guidelines, the University requires everyone to wear face coverings in shared public spaces on campus. **If you repeatedly fail to wear a face covering in class, you may be referred to the Dean of Students for a possible violation of the Student Code.**

**Some courses may require attendance due to hands-on coursework.** Please read the syllabus and attendance requirements for the course thoroughly.

**Some students may qualify for accommodations & exemptions from these guidelines through the Americans with Disabilities Act (ADA).** Accommodations should be obtained prior to the first day of class.

If you believe you meet these criteria, contact:

> **Center for Disability & Access**
> 801-581-5020
> disability.utah.edu
> 162 Union Building
> 200 S. Central Campus Dr.
> Salt Lake City, UT 84112

**Course Policies**

Please refer to the [College of Engineering Guidelines (Links to an external site.)](#) for disabilities, add, drop, appeals, etc. Notice that we have zero tolerance for cheating; as a result, please read the [Policy Statement on Academic Misconduct (Links to an external site.)](#), carefully. Also, you should be aware of the [SoC Policies and Guidelines (Links to an external site.)](#).
Class rosters are provided to the instructor with the student's legal name as well as "Preferred first name" (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and please update CIS) so I can help create a learning environment in which you, your name, and your pronoun will be respected.

Special Needs:
The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

Cheating Policy:
Working with others on assignments is a good way to learn the material and is encouraged.

However, there are limits to the degree of cooperation that is permitted. Students may discuss among themselves the meaning of homework problems and possible approaches to solving them. Any written portion of an assignment, however, is to be done strictly on an individual basis. BOTTOM LINE: You may not copy from another student or from any other source, and you may not allow another student to copy your work!! Any violation of the above is considered to be cheating and will result in a reduced or a failing grade in the class. TAs will be on the lookout for solution sets that appear very similar. Also, if your class rank in the assignments is significantly different from your class rank in the exams, only your rank in the exams will count towards your grade.

## Assignments

Homework assignments will be released on Canvas; all submissions must be made through Canvas. Only those submissions made before midnight will be accepted. Any late submission will be considered as no submission. Please upload and verify your uploaded files before deadlines.

Dropped Score: Students may end up missing an assignment deadline for a reason that is not granted an exception (generally, documented medical reasons or official University activities). Therefore, to allow for such an occurrence, the lowest score earned on an assignment is dropped from the record of each student at the end of the semester. Students should plan to use the "drop score" judiciously — there is only one for an assignment. These dropped scores are automatically applied. No test, quiz, or final exam scores are dropped.

Heads-up: homework assignments 4 and 5 require executing code on the MARS simulator. Please, manage your time accordingly.

|  | Release Date | Submission Deadline |
|---|---|---|
| Homework 1 | 09/02 | 09/09 |
| Homework 2 | 09/09 | 09/16 |
| Homework 3 | 09/16 | 09/23 |
| Homework 4 | 09/23 | 09/30 |
| Homework 5 | 09/30 | 10/07 |
| Homework 6 | 10/07 | 10/13 |
| Homework 7 | 10/19 | 10/26 |
| Homework 8 | 10/26 | 11/02 |
| Homework 9 | 11/09 | 11/16 |
| Homework 10 | 11/16 | 11/23 |
| Homework 11 | 11/23 | 12/02 |

Quizzes:

Quizzes comprising multiple-choice, true/false, yes/no, and fill-in-the-blank questions will be released on Canvas. Please, read the relevant chapters of the textbook and review the lectures before taking each quiz. Only one attempt is allowed for each quiz during the specific dates below.

|  | Lectures | Release Date | Submission Deadline |
|---|---|---|---|
| Quiz 1 | 1-3 | 08/31 | 09/02 |
| Quiz 2 | 4,5 | 09/09 | 09/11 |
| Quiz 3 | 6,7 | 09/16 | 09/18 |
| Quiz 4 | 8,9 | 09/23 | 09/25 |
| Quiz 5 | 10,11 | 09/30 | 10/02 |
| Quiz 6 | 12,13 | 10/07 | 10/19 |
| Quiz 7 | 14,15 | 10/19 | 10/21 |
| Quiz 8 | 16,17 | 10/26 | 10/28 |
| Quiz 9 | 18-21 | 11/09 | 11/11 |
| Quiz 10 | 22,23 | 11/16 | 11/18 |
| Quiz 11 | 24,25 | 11/23 | 12/04 |

Regrades. Students who wish to appeal a score on an assignment, a quiz, or a test must do so within one week of receiving the score and send the instructor a request message in Canvas.

**Grading Policy (Evaluation Methods & Criteria)**

The following items will be considered for evaluating the performance of students. The cutoffs for the letter grades will be 95(A), 90(A-), 85(B+), etc.

|  | Fraction | Notes |
|---|---|---|
| Homework Assignments | 30% | as scheduled below |
| Quizzes | 10% | as scheduled below |
| Midterm Exam | 30% | Oct. 13, 2020 |
| Final Exam | 30% | Dec. 7, 2020, at 3:30-5:30PM |

**Course Schedule (pre-recorded lectures and slides)**

| Date | Topic/Discussion | Reading |
|---|---|---|
| 08/24 | 1. Introduction and Logistics | Chapter 1 |
| 08/26 | 2. Measuring Performance | Chapter 1 |

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|---|---|---|
| 08/31 | 3. Performance, Power, Energy | Chapter 1 |
| 09/02 | 4. MIPS ISA I | Chapter 2 |
| 09/09 | 5. MIPS ISA II | Chapter 2 |
| 09/14 | 6. Assembly Programs | Chapter 2 |
| 09/16 | 7. Control Instructions | Chapters 2 |
| 09/21 | 8. Procedure Calls | Chapter 2; Appendix A |
| 09/23 | 9. Number Representations | Chapter 3 |
| 09/28 | 10. Number Operations | Chapter 3 |
| 09/30 | 11. Multiplication, Division | Chapter 3, Appendix B |
| 10/05 | 12. Floating Point | Chapter 3, Appendix B |
| 10/07 | 13. Floating Point Operations, Logic Design | Chapter 3, Appendix B |
| 10/14 | 14. Hardware for Arithmetic | Appendix B |
| 10/19 | 15. Arithmetic and Logic Unit | Appendix B |
| 10/21 | 16. Sequential Circuits | Appendix B |
| 10/26 | 17. CPU Organization | Chapter 4 |
| 10/28 | 18. Single-Cycle and Pipelined Processor | Chapters 4 |
| 11/02 | 19. Pipeline Hazards I | Chapter 4 |
| 11/04 | 20. Pipeline Hazards II | Chapter 4 |
| 11/09 | 21. Memory System | Chapter 5 |
| 11/11 | 22. Cache I | Chapter 5 |
| 11/16 | 23. Cache II | Chapter 5 |
| 11/18 | 24. Cache III | Chapter 5 |
| 11/23 | 25. Virtual Memory | Chapter 5 |
| 11/25 | 26. Multiprocessors | Chapter 6 |

*Note: This syllabus is meant to serve as an outline and guide for our course. Please note that I may modify it with reasonable notice to you. I may also modify the Course Schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas under Announcements.*