ECE 445: Computer Organization

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(Please note, there is an underscore between "ECE" and "445")

Course Objectives

This course is an *intensive* introduction to the fundamentals of computer architecture. Relying heavily on the elementary principals taught in ECE 331 and ECE 332, we will discuss the basic design, or architecture, of computing hardware. Taking a largely bottom-up approach, we will focus on the microarchitecture level (the computing hardware itself) and the instruction set architecture level (the interface between software and the computing hardware). This course has a demanding design component; you will implement the concepts presented in lecture using real hardware design tools.

Topics to be covered in this course:

1. Computer Arithmetic
2. The Arithmetic and Logic Unit
3. Memory
4. The Instruction Set Architecture
5. Register-to-Register Instructions
6. Input and Output Operations
7. Addressing Modes
8. Single cycle and Multi-cycle Datapaths
9. Hardwired and Microprogrammed Control
10. Behavioral Modeling of Computer Organization using VHDL
11. Performance
12. Assembly Language
13. Pipelining
14. Exceptions
15. Hazards
16. Cache

A more detailed schedule of the topics covered in lecture are provided in a separate document.

Textbook
Title: "Computer Organization and Design", 3rd Edition, Revised Printing
Authors: David Patterson and John Hennessy

Lecture and Recitation Sections

Lecture	Monday, Wednesday	1:30 – 2:45 pm	Dr. Craig Lorie

Office Hours

Dr. Craig Lorie	Tuesday	9:00 – 10:00 am
	Wednesday	12:00 – 1:00 pm
Ekawat Homsirikamol	Wednesday	3:00 – 7:00 pm

If you cannot attend the provided office hours, please feel free to contact the TA or myself via email with questions that you have, or to schedule an alternate meeting time.

Recommended background for ECE 445: ECE 331 – Digital System Design
ECE 332 – Dig. Electronics and Logic Design Lab

Attendance
Attendance in lecture is highly recommended. You are expected to be adults and, as such, make decisions that give you the best chances for success. The material covered in the lectures will supplement that which is covered in the textbook and offer you opportunities to ask questions to clarify the material. Thus, it will benefit you to attend lecture. However, I reserve the right to change this policy if attendance falls below an unacceptable level.

You are responsible for all material covered in lecture.

Homework
Homework will be assigned on a weekly basis. However, it will be neither collected nor graded. Instead, there will be weekly quizzes (discussed below). The solutions for each homework assignment will be posted (along with the assignment) to allow you to check your answers. You are encouraged to attempt the homework problems on your own, without the assistance of the solutions, and then to check your answers against those provided in the solution set. You will **not** learn the material if you simply review the answers without attempting the problems on your own. This cannot be stressed enough. Try the homework problems! It is the only way you will learn the material!

Quizzes
Weekly quizzes will be conducted to test you on your knowledge of the material covered in class and reinforced in the homework assignments. The quizzes will be given in the week following the week in which the associated homework is assigned, and will last approximately 20 minutes. It will include two (2) or three (3) questions modeled after those included in the homework assignment. There will be no makeup quizzes, unless a satisfactory excuse for missing the quiz is provided to me in advance of the quiz. You will, however, be allowed to drop the lowest quiz score.

Machine Problems

This course features three significant projects, called machine problems (MPs). Students in ECE 445 will be granted access to the New Engineering Building, Room 3208 computer lab to complete their machine problems. All machine problems must be tested using Aldec ActiveHDL. Students are encouraged to discuss with TA options for working remotely.

Machine Problem #1 (MP1): The first MP is a tutorial project. You will be given a step-by-step tutorial, along with low-level source code, and be expected to create an LC3b processor containing six (6) instructions, which is a subset of the full LC3b processor (the full LC3b processor contains 20+ instructions). You will then be expected to write an LC3b testbench program based on the created instruction set. Please note, **do not** underestimate the difficulty of this MP. Start early or you will not complete it on time.

Machine Problem #2 (MP2): The second MP is a group project (each group consists of two (2) students). You will extend the instruction set completed in MP1 to the full instruction set of the LC3b processor (i.e. 20+ instructions). You will then be expected to write an LC3b testbench program, as in MP1, to verify the functionality of the processor.

Machine Problem #3 (MP3): TBD

Late submissions will be subjected to a 10% grade reduction per day including weekends. No credit will be given to any submissions that are more than 7 days past the due date.

Exams

There will be a Midterm exam and a Final exam. Both exams are ***closed book***. You will, however, be allowed to use one side of an 8.5" x 11" sheet of paper on which to write your own notes.

There will be no make-up exams. (See Dr. Lorie for an exception).

Students must arrive on time for the exams. Those arriving more than 15 minutes late may be turned away (in which case, they will receive a zero (0) for the exam).

Midterm Exam:	Wednesday, October 14, 2009
Final Exam:	Wednesday, December 16, 2009; 1:30 – 4:15 pm

Grading

Your final grade will be the weighted average of the weekly quizzes, the midterm exam, the final exam, and the three (3) machine problems, as calculated from the formula below:

Quizzes	10%
Midterm Exam	25%
Final Exam	30%
MP #1	10%
MP #2	15%
MP #3	10%

Honor Code

All rules of the GMU Honor Code system will be enforced in both the lecture and the lab.
You must review the rules of the GMU Honor Code and be familiar with them.

Duplicating another student's hardware/software designs, diagrams, source code, machine project solutions, project reports, and exam notes is considered cheating. If you use material from other sources such as but not limited to the web, books, journals, data sheets, etc. you must reference the source.

Honor code violations will be pursued and prosecuted to the fullest extent.

Classroom Etiquette

Cellphones are to be turned off during class; minimally they must be silenced. Emergency calls may be taken, but must be taken outside of the classroom.

Texting, using your laptop for something other than lecture-related work, etc. is considered a distraction to me and to the other students trying to learn in the class, and will not be tolerated.

Students with Disabilities

If special assistance is required or special accommodations need to be made, please contact me as soon as possible so that the proper arrangements can be made.