

COMP 3410: Computer Organization & Architecture – Fall 2018

Dr. James Yu

Contact Information:

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Class: DH 351 TR 3:10pm to 5:10pm

The best way to get in touch with me is through email – I will try to respond within 24 hours.

Office Hours:

W, F 9:30 am – 12:00 pm Dunn Hall 320

(I am generally available in the mornings (MWF). Just drop by or email me ahead to confirm)

Teaching Assistant: *(to be finalized)*

Ashok Gadde: Mr. Ashok Kumar Gadde (Ashok.Kumar.Gadde@memphis.edu)

Saikat Das: Mr. Saikat Das (sdas1@memphis.edu)

Lecture Meeting Times/Locations:

12687 - COMP 3410 – 001 TR 3:10pm to 5:10pm Dunn Hall 351

Catalog Description:

COMP 3410 – Basic concepts in assembly language programming, including logic, comparing and branching, interrupts, macros, procedures, arrays, program design, testing, debugging, loading, and linking; combinational, arithmetic and logical circuits ALU; memory circuits, latches, flip-flops, registers; computer structure; fetch-execute cycles, clocks and timing; microprogramming and microarchitecture; data path, timing, sequencing; cache memory organization; RISC architectures.

PREREQUISITE: COMP 2150

Course Website:

<https://elearn.memphis.edu>

You will find all the course material (lecture slides, handout notes, assignments, codes, grades, etc.) in this site.

Topics Include:

1. Introduction
 - Computer systems and computer organization;
 - Eight Great Ideas
2. Number systems and arithmetic for Computer;
 - Number conversion, arithmetic overflow handling,
 - Floating points
3. MIPS instruction set architecture and operations;
4. Digital logic and processor design;
 - Logic gates and modular ALU design
 - Combinational and sequential logic and control
5. Performance and pipelining
 - Building a datapath
 - Pipelined datapath and Control
 - Handling of data hazards
 - Parallelism via Instruction
6. Memory hierarchy and cache organization
 - Memory technologies
 - Basics of Caches and performance improvement
 - Cache mapping and memory hierarchy

Course outcome for COMP3410 (Computer Organization and Design)

- (1) Understand the keys components within a computer system and organization.
- (2) Understand number systems and implement binary arithmetic with overflow handling, and floating-point numbers.
- (3) Implement assembly language for MIPS processor ISA and operations.
- (4) Able to Analyze and convert a C program to MIPS instructions.
- (5) Implement digital logic and processor data path and control using logic gates, combinational and sequential components
- (6) Analyze instructions, data path, and control complexity for performance assessment
- (7) Analyze the cause of pipelines hazards and implement ways to overcome them.
- (8) Understand memory hierarchy and apply the principle of locality in caches design.

Required Text:

- zyBook: Computer Organization and Design, 5th Edition by David Patterson and John Hennessy
- Sign in or create an account at zybooks.com
- Enter zyBook code
MEMPHISCOMP3410YuFall2018
- Click Subscribe

Evaluation:

1. Assignments: 30 %: (zyBook exercises, (MIPS) programming, and written assignments)
2. Fours quizzes: 20% (5% each)
3. One Midterm: 20%
4. Final exam: 30%*

*You must pass the final exam (>50%) as well as the overall grade ($\geq 60\%$) to pass this course. If you score less than 50% in your final exam, you will receive a "F" grade independent of the grading results of the other attributes (Assignments, quizzes, and Midterm)

Grading Scale: Letter grades will be determined as follows:

A+: 96% and above; **A:** 90-95%
B+: 87-89%; **B:** 81-86%; **B-:** 79-80%
C+: 77-78%; **C:** 71-76%; **C-:** 69-70%
D+: 67-68%; **D:** 60-66%
F: Below 60%

Assignments: (30%)

The assignments include in-class zyBook exercises, MIPS assembly language programming, and other questions to enforce the concepts and understanding of the material discussed in class. There is no Lab session for this course. Some portions of lecture time (usually during the latter part of the lecture) are allocated to start those assignments (zyBook exercise) with the presence of your instructor and TA to help if necessary. The due date for each assignment is posted in the write-up and is usually one week after the published time.

Participation/Attendance: (part of zyBooks exercises):

It is crucial that you attend class regularly. The class will keep building on itself and moves at a fairly brisk pace, so you need to get a good handle on each concept soon after we discuss it. You can accomplish that by completing the assigned zyBook exercises, after almost every lecture. You are required to bring your laptop loaded

with the required zyBooks textbook installed for this course. You will need to submit a time-limited (closed to the end of the lecture) zyBook question to show your presence in class. If you are missing from the class, you will receive no marks for the zyBooks exercise of that lecture. Please be sure you have loaded your laptop with the subscribed zyBook and MIPS simulator (MARS4_5.jar).

Late/Makeup Policy:

All assignments are expected to be completed and turned in on schedule. Due dates are usually one week after the posted date for each assignment. Your TA/GA will not accept Late assignments except in extreme circumstances. Likewise, makeup quizzes and exams will be given only under extreme circumstances. If you feel that your circumstances warrant a late work submission or a makeup quiz/exam, get in touch with me as soon as possible. Be prepared to show documented proof of your situation.

Plagiarism/Cheating Policy:

An essential part of learning is getting plenty of practice with it yourself. As such, all assignments (unless specifically indicated otherwise) are expected to be done in individual effort. If I determine that you have copied something directly from a book, the Internet, or some other source, you will receive a failing grade on the assignment and (at my discretion) a failing grade in the course. If I determine that you have copied another student's assignment, this will happen to both you and the person from whom you copied. The first-time offender will receive a warning in the form of face-to-face meeting and an email. For the 2nd occurrence, you will be asked to see the department chairperson. The Office of Student Conduct will also receive a copy of this incident for further disciplinary action. Please don't put me in this situation.

Getting Help:

Although I expect you to do your work individually, I encourage you to seek help if you get stuck:

- Talk to me! I'm very willing to sit down and try to provide hints without giving away the solution.
- Contact your lab TA.
- The Computer Science Learning Center (Dunn Hall 208) will be open throughout the semester. Hours will be posted on the door. The hours for this semester should also be posted online soon. You can find them by going to memphis.edu/cs/ and click on "Current Students" and then click on "Computer Science Learning Center." The lab will be staffed by friendly, knowledgeable computer science students whom you can ask for help.

Student Disabilities:

If you have a disability that may require assistance or accommodations, or if you have any questions related to any room for testing, note taking, reading, etc., please speak with me as soon as possible. You must contact the Student Disability Services Office (678-2880) to request such accommodations/services officially.

Course Schedule: (subject to change):

Date	Lecture Topics	Text (zyBook)	Quizzes	Assignments
28-Aug	Introduction: course outlines; making of a computer chip	1.12		
30-Aug	Computer Abstraction and Architecture: key components and technologies	1.1-1.5		
4-Sep	Performance: execution, response, TPut, CPU performance and factors; power wall	1.6.1 - 1.6.8; 1.7,1.8;1.10; 1.11		HW1 - computer technology, Components, performance
6-Sep	Information as bits : ASCII, Unicode, Numbers	21.1, 21.4 - 21.5	Quiz1	
11-Sep	Computer Arithmetic : signed/unsigned numbers, 2's complement, number bases	2.4; 21.2 - 21.3		
13-Sep	Binary Multiplication and Division	3.1 - 3.4		
18-Sep	Floating point numbers and Arithmetic	3.5; 21.6 - 21.7		HW2 - Numbers, Arithmetic,
20-Sep	Operation and Operands of computer HW	2.1 - 2.3	Quiz2	
25-Sep	Representing Instructions	2.5		
27-Sep	Logical operations and decision instructions	2.6 - 2.7		
2-Oct	MIPS programming 1	2.8; 22.1 - 22.10		HW3 - MIPS programming
4-Oct	MIPS programming 2	2.10; 23.1 - 23.9		
9-Oct	C to Assembly	2.12 ;24.1 - 24.7		
11-Oct	Mid-Term exam		MidTerm	
16-Oct	Fall Break (Oct 13 - 16)			
18-Oct	Implementing a processor (MIPS)	4.1		
23-Oct	Logic design convention	4.2		HW4 - Logics
25-Oct	Combinational logic / circuits	12.1 - 12.7; 13.1-13.8; 25.1	Quiz3	
30-Oct	Boolean Algebra with circuit and truth table	12.8 - 12.15		
1-Nov	Sequential Logic	14.1 to 14.5		
6-Nov	Data Path components	4.3, 4.4 15.1		HW5 - datapath control; pipelining hazard
8-Nov	Single Cycle MIPS operation	4.3, 4.4		
13-Nov	Multiple Cycle data path and control	25.1- 25.11		
15-Nov	Pipelining; data and control Hazards	4.5 - 4.8	Quiz4	
20-Nov	Memory Hierarchy / Cache Organization /			
22-Nov	Thanksgiving (No Class) (Nov 21-25)			
27-Nov	Cache performance	5.1 - 5.3; 26.7, 26.3		HW6 - Mem, Cache Organization
29-Nov	Cache Mapping	5.4;26.4, 26.5,26.6		
4-Dec	Reviews and prep for Final Exam			
6-Dec	Study day (No Class)			
11-Dec	Final Exam			

Final Exam: December 7 – 13. Exact details (date, time, location) will be announced when it is available

Tentative Quiz and Exam Topics:

- Quiz 1: Computer Organization, Key components, performance Ch 1-2
- Quiz 2: Number conversion, Arithmetic (Ch 2 – 3)
- Exam 1: MIPS, Arithmetic for computer, Ch1-3
- Quiz 3: Logic gated, ALU, sequential logic, and control Ch 4, B1-3
- Quiz 4: Datapath (single and multiple cycles), data hazard Ch 4, B10-11
- Final Exam: (Comprehensive, some MIPS prog, with focus on Ch 4 – 5)