
\preceq COMP 220 Computer Organization & Assembly Language \succeq
M-W-F *Lecture (SC 1315) – 9:30-10:20*

(Some assembly required)

This course is part of
CONX 20022: Computer Architecture
connecting with
PHYS 110: Electronic Circuits

Who: Michael Gousie
Where: Discovery Center 1325
When: Mon, Wed 3:30-4:30; Tue 11:00-12:30; Fri 10:30-11:30
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Content:

- Are computer processors getting faster?
- If x and y are floating point values, why shouldn't a programmer write `if (x == y)`?
- How does a program written in C++ ultimately run using just zeroes and ones?

These are some of the questions to be answered in this course. We will explore the basic workings of computer hardware and how different architectures affect performance. We will cover how numbers, especially floating point values, are represented in the computer processor (CPU). An important theme of the course is to understand how data flows through the CPU, and how that is connected to the software. In this vein, we will cover basic circuitry using a virtual circuit board and write programs in MIPS, a common assembly language. By combining architecture and programming, the relationship between the hardware and software will be made more obvious. This, in turn, will give you an understanding of how the way you write programs in high-level languages affects performance. Thinking like this is another aspect of computer science, or more broadly, Computational Thinking.

Required Text:

Patterson and Hennessy. *Computer Organization and Design: The Hardware/Software Interface; MIPS Edition*, 6th Edition (Morgan Kaufmann, 2021).

Recommended Text:

Matthews, Newhall, and Webb. *Dive into Systems* (Published online, updated 2022). This is available through a link on the course web page.

Requirements:

There will be 2 exams during the semester and a comprehensive final exam. The exams will comprise 50% of your grade. Exams will take place during the afternoon/evening so as to afford you more time.

We will also cover some assembly language programming, for which you will complete three small projects, the first two worth 6% each, and the third worth 10%. The course text or *The Google* is a valuable reference for these programs. Due dates for these projects are shown below.

Five or six written homework assignments, roughly one week in length, will comprise 20% of your grade. Due dates for all homeworks will be announced in class.

The remaining 8% of your grade will be a project comprised of a physical model of some [portion of] computer hardware **or** a working set of virtual circuits that model a part of a simplified CPU. The project also entails creating a poster and giving a presentation during the *2023 Comp Org Crazy Model Expo*. A portion of the grade will be determined by your peers. More details about the project will be given as the due date nears.

Grading:

Grades will be assigned according to the following scale:

A = 93-100, A- = 90-92, B+ = 87-89, B = 83-86, B- = 80-82, C+ = 77-79, etc.

Exam Schedule:

Exam	Weight	Date	Time
Exam 1	15%	February 21	Afternoon/evening
Exam 2	15%	April 6	Afternoon/evening
Final	20%	Monday, May 8	9:00 AM

Programming Assignments:

Program	Weight	Topic (Subject to change)	Due Date
MIPS 1	6%	Conditionals, loops, arrays	February 23
MIPS 2	6%	Integer vs. floating point	April 9
MIPS 3	10%	Subroutines (functions)	April 30

Course Policies:

- You are responsible for all material covered in class, including the reading (shown below).
- You should bring a scientific calculator to class; your phone calculator may or may not have the necessary functionality, or at the very least, may not be very intuitive. Phones will not be permitted during exams, so a calculator is necessary in any case.
- You should bring your heavy book to class, especially when we cover Chapter 4 and/or when instructed to do so.
- If you must miss a quiz or exam for any reason, you must inform me **before** the test. Except in the case of emergency, illness, or you found aliens in Wheaton's original observatory, makeup exams will not be given.

- Programs will be written in MIPS, a PC assembly language. The MARS simulator will be used to edit, translate (assemble), and run your MIPS code. MARS is available for free and is written in Java, so it works on all platforms.
- Written homeworks should be neat and done on loose-leaf or plain paper. Do not tear paper out of a notebook. Staple multiple pages together.
- Assignment due dates are **firm**.
 - All programming projects must be submitted electronically by 11:59:59 PM on the due date unless otherwise noted. Projects submitted on the following day will receive a 15% penalty. Anything turned in later will receive a 0. Hard copy must be submitted the following day or as indicated in the program specifications.
 - Written homework must be handed in at the start of class on the due date. There are **no** provisions for late homework.
 - Although deadlines are firm, please contact me **beforehand** if there are extraordinary circumstances.
 - Homework and projects may be turned in early! You can also resubmit projects any number of times before the deadline if you find an error in an earlier submission.
 - There will not be any individual “extra credit” work. If you did not have time to do a good job on the original assignment, how will you have time to do *additional* work?
- You are expected to adhere to the Honor Code.
 - Although *discussion* of projects or homework is encouraged, the final *implementation* of programs should be the result of your own work. Any copying of programs or homework is prohibited.
 - Collaboration on exams is prohibited.
 - You will be required to write and **sign** the pledge on all work turned in: *I have abided by the Wheaton Honor Code in this work.*
 - Any violation of the above guidelines will result in a 0 for the assignment/exam and/or a failing grade for the course.
- **The use of a laptop or other computer/pad is not allowed during lecture.** Special arrangements can be made if necessary.
- The use of cell phones, iPods, iPads, iPhones, iPlops, iFlops, and other personal electronic devices is prohibited during class, lab, and exams.
- Accommodations for disabilities:

Wheaton is committed to ensuring equitable access to programs and services and to prohibit discrimination in the recruitment, admission, and education of students with disabilities. Individuals with disabilities requiring accommodations or information on accessibility should contact Jeremiah Bergstrom, Director of Accessibility Services, at the Filene Center for Academic Advising and Career Services.

~ accessibility@wheatoncollege.edu or (508) 286-8215 ~

Course Schedule:

Wk #	Week Begin	Topic	Reading*
	January		
1	22	Introduction	Sections 1.1–1.5
2	29	Performance	Sections 1.6–1.11
	February		
3	5	Low level instructions, MIPS, and MARS	Chapter 2
4	12	MIPS	Appendix A
5	19	Numbers, digital logic, Exam 1 on February 21	Sections 2.4–2.7, Appendix B
6	26	Integer arithmetic	Sections 3.1–3.4
	March		
7	5	Floating point arithmetic	Sections 3.5–3.10
8	12	<i>SPRING BREAK</i>	
9	19	More MIPS	Appendix A
	⇒3/22⇐	No class! MAP Day!	
10	26	The CPU	Sections 4.1–4.2
	April		
11	2	Building a datapath, Exam 2 on April 6	Sections 4.3–4.5
12	9	Pipelining	Sections 4.6–4.16
13	16	Cache memory	Sections 5.1–5.5
14	23	Virtual memory	Sections 5.6–5.16
15	30	Parallelism, Crazy Model Expo	Selections in Ch. 6
	May		
16	7	Final Exam, May 8 @ 9 AM	Happy Summer!

* Readings are from Patterson & Hennessy.