$\preceq$ COMP 220 Computer Organization & Assembly Language $\succeq$

M-W-F *Lecture (SC1315)* – 9:30-10:20
T *Lab (SC1315)* – 3:30-5:20
(Some assembly required)

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

Who: Michael Gousie
Where: Science Center 1325
When: Mon 2:00-3:30; Tue 10:30-12:00; Wed 12:30-1:30
and by appointment
E-mail: mgousie@wheatoncollege.edu
Web: http://cs.wheatoncollege.edu/mgousie

Content:

We will explore the basic workings of computer hardware and how different architectures affect performance. An important theme of the course is to understand how data flows through the computer processor. We will cover low-level assembly language programming (in SPIM) as well, using computers running Linux. Weekly labs put lecture concepts to immediate use in designing parts of the hardware (such as an adder) by creating and experimenting with circuits built with `Logisim` and writing programs in SPIM. 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*, 5^{th} Edition, Morgan Kaufmann, 2014.

Recommended Text:

Britton. *MIPS Assembly Language Programming*. Pearson Prentice Hall, 2003. Alternatively, there are many MIPS (SPIM) tutorials and examples available online.

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 lab time.

We will also cover some assembly language programming, for which you will hand in three small projects, the first two worth 6% each, and the third worth 10%. The *MIPS* text or The Google is a valuable reference for these programs. Due dates for these projects will be announced in class.

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. Note that some labs may have a graded component that will be added to the homework or project that is next due.

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 a lab session. You will be able to work in a group. 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, etc.

Exam Schedule:

Exam	Weight	Date	
Exam 1	15%	February 21	(during lab time)
Exam 2	15%	April 4	(during lab time)
Final	20%	May 10 @ 9:00 AM	

Programming Assignments:

Program	Topic (Subject to change)	Due Date Month
SPIM 1	Conditionals, loops, arrays	February
SPIM 2	Integer vs. floating point vs. character	March
SPIM 3	Subroutines (functions)	April

Course Policies:

- You are responsible for all material covered in class, including the reading (shown below).
- You should bring your heavy book and calculator to class, especially when we cover Chapter 4.
- 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 got trapped in Wheaton's original pool[1], makeup exams will not be given.
- Programs will be written in SPIM, an emulation of MIPS, a PC assembly language. Software for writing assembly programs in SPIM is available for free on Linux and other 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.

[1] Do you know where that is?

  - 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.
- Plan your restroom breaks so that you will not disrupt class.

Course Schedule:

Wk #	Week Begin	Topic	Reading	Lab
	January			
1	22	Introduction	Sections 1.1–1.5, slides (available on Web page)	
2	29	Performance	Sections 1.6–1.11	Performance
	February			
3	5	Low level instructions, SPIM	Chapter 2	SPIM
4	12	SPIM	App. A	SPIM
5	19	Numbers, digital logic	Sections 2.4–2.7, App. B	Exam 1
6	26	Arithmetic	Sections 3.1–3.4	Digital logic
	March			
7	5	Floating point arithmetic	Sections 3.5–3.10	Circuit simulator
8	12	*Spring Break*		Ski bumming
9	19	More SPIM	Appendix A	SPIM
10	26	The CPU	Sections 4.1–4.2	K & S Computer
	April			
11	2*	More CPU	Sections 4.3–4.4	Exam 2
12	9	Pipelining	Sections 4.5–4.15	Circuit simulator
13	16	Cache memory	Sections 5.1–5.5	Circuit simulator
14	23	Virtual memory	Sections 5.6–5.16	Hardware
15	30	Parallelism	Selections in Ch. 6	Presentations
	May			
16	7	Final Exam, May 10 @ 9:00 AM	Happy Summer!	

* No class on April 7