

COSC 273A

Computer Organization & Architecture

Fall 2021

Syllabus

Instructor

David A. Sykes, Ph.D.

Class sessions

TR 9:30-10:50 A.M. in Olin 201

Office hours

TR 8:30-9:20 A.M., 2:30-3:30 P.M.

MWF 9:30-11:00 A.M., 2:30-3:30 P.M.

Or by appointment or happenstance.

Telephone / e-mail

(864) 597-4524 / sykesda@wofford.edu

Catalog description and goals

An introduction to computer organization and principles of computer design. Topics include digital logic and digital systems, machine level representation of data, instruction sets, CPU implementation, memory system organization, I/O and communication, and assembly language programming. Prerequisite: "C" or better in Computer Science 235.

We will study digital logic, Von Neumann architecture, data representations, the fetch/execute cycle, instruction formats and addressing, machine and assembly language, memory structure, interrupts, and input/output.

By the end of the course, you should be able to answer these questions:

- ☞ What are the logical parts of a computer and what is the purpose of each part?
- ☞ How can we get electrical circuits to perform tasks such as adding, multiplying, and comparing numbers?
- ☞ How do programming languages and computer hardware to work together?

By the end of this course, you should be able to:

- 🔧 Construct digital logic circuits to implement a variety of operations and chips and then from them construct a simple computer.
- 🔧 Explain the components of the *von Neumann architecture* and how they interact.
- 🔧 Understand how bits can represent values of various data types, including integer values, real number values, character values, and bit strings.
- 🔧 Know what an *assembler* does and write programs in *assembly language*.
- 🔧 Be able to use *bit twiddling* [https://en.wikipedia.org/wiki/Bit_manipulation#Terminology] to implement algorithms.
- 🔧 Identify the major components of a computer and explain what each does.
- 🔧 Understand the roles of high-level programming languages and an operating systems in computer systems.
- 🔧 Explain why interrupts are useful and how a CPU handles them.

Textbooks, web resources, and software

Required textbooks

We will use two textbooks:

- 🔧 Code: The Hidden Language of Computer Hardware and Software [<http://www.charlespetzold.com/code/index.html>] by Charles Petzold, Microsoft Press. October 11, 2000. 400 pages (softcover). ISBN: 0-7356-1131-9.
- 🔧 The Elements of Computing Systems: Building a Modern Computer from First Principles [<http://www.nand2tetris.org/book.php>] by Noam Nisan and Shimon Schocken, June 2005. ISBN: 9780262640688. It has a companion website [<http://www.nand2tetris.org>]. Note: The first six chapters are available via links from Projects [<https://www.nand2tetris.org/course>].

Web resources

We will use these web applications this semester (and other):

- 🔧 Mimir Classroom [<https://class.mimir.io/>]. You will need to create an account (free) **using your Wofford email address**. Homework exercises and some projects will be administered from within Mimir Classroom.
- 🔧 Piazza [<https://piazza.com/wofford/fall2021/cosc273/home>]. The class page will host announcements, descriptions on homework assignments, handouts, and discussions about class topics and projects. If you have a question that comes up outside of class time, post it at Piazza. Note: You may post *anonymously*, but be aware that your post will be anonymous only to classmates and not to me.

- 🔗 Moodle [<https://moodle.wofford.edu/course/view.php?id=12803>]. You will submit some project files in Moodle. Your scores for graded work (quizzes and projects) will be recorded in the Moodle gradebook, too.

Software

We will use two computer applications:

- 🔗 *The Nand2Tetris Software Suite* [<http://www.nand2tetris.org/software.php>].
- 🔗 MIPS Assembler and Runtime Simulator (MARS) [<https://courses.missouristate.edu/KenVollmar/MARS/>]

To run these apps, you might need to download and install Java from Java SE Downloads [<https://www.oracle.com/java/technologies/javase-downloads.html>] if you have not already installed Java on your computer. Both applications have been installed on the Macs in the Computer Science Lab (Olin 112A). Use one of the lab computers if you can't run it on your own computer. *Be sure you do not leave your files on a lab computer's storage.*

Grades

Your grade for the course will be based on a weighted average of scores for homework, tests, projects, and a final exam. The usual grading scale applies: 93–100: A, 90–92: A-, 87–89: B+, 83–86: B, 80–82: B-, 77–79: C+, 73–76: C, 70–72: C-, 60–69: D, 0–59: F.

A final average will be calculated using two methods using weightings shown in the table. The higher of the two values will be mapped to a letter grade. Under Method #2, the homework scores are not factored into the calculation, the test scores are weighted less, and the final exam is weighted more. Note: The Moodle Gradebook will reflect Method #1 weightings.

Component	Weight	
	Method #1	Method #2
Homework	25%	0%
Projects	30%	30%
Tests	30%	15%
Final exam	20%	55%
TOTAL	100%	100%

Homework

Homework assignments help you to prepare for class. Homework will usually consist of some reading and some exercises. **Homework is due before the start of the class meeting for which it was assigned.**

You are allowed to use any resources you find useful for completing homework assignments, including working with other students in the class. Your primary goal should be to get a perfect score on every homework assignment so you will be prepared for the next class meeting.

Tests

You will take two tests. The first, on October 12, will cover up through *sequential logic*. The second, on November 11, will cover up through *machine language* and *computer architecture*.

You may bring an index card, maximum size 6"×9", containing *handwritten* notes to each test.

Projects

Projects play a central role in this course and comprise 30% of your final grade. It is important to complete each project successfully, working on your own.

Final exam

The final exam is comprehensive, covering the material on the first and second tests as well as material covered after the second test. The objective of the final exam is to assess how well you reached the objectives for the course.

You may bring an index card, maximum size 6"×9", containing *handwritten* notes to the final exam.

Policies

Logistics

Most class meetings will start with a brief review of the homework assignment and continue with discussions and/or exercises based on what has been covered so far. Some in-class exercises will require you to work on a laptop computer or work with another student in the class. You may have a laptop computer open on your desk only if I direct you to use it. Most projects will be started during a class meeting.

You are encouraged to take copious notes during class. Take *handwritten* notes on paper or on a tablet.

Handwritten notes engage more of the senses. The brain is more active, so the learning process is enhanced. This is actually part of an area of study called "haptics." Researchers in this arena are studying the way our minds and bodies interact in the learning process.

It's the "tactile" or "kinesthetic" learning idea in action. The more physically active you are, including taking handwritten notes, the more likely you are to remember information well.

Source: Handwritten notes vs. typed notes: is there a difference?
[<https://www.studyright.net/blog/handwritten-notes/>]

Attendance

You are expected to attend class meetings. The *Class Attendance Policies* described in the Wofford College Student Handbook [<https://www.wofford.edu/Wofford.edu/Documents/student-experiences/campus-life/student-handbook.pdf>] (pp. 81ff) makes *you* responsible for catching up on missed classes. I suggest you find a "buddy" from whom you can get notes in the event you are absent. I will post links to handouts in Piazza.

Do not attend class if you are not feeling well and might have a contagious illness. Seek appropriate medical attention at the Wellness Center. A doctor's note concerning absences is not required.

The final exam period is scheduled for 2:00-5:00 P.M. on Tuesday, December 14, 2021. You must be present for the exam.

Late work

You are expected to complete all assigned work on time.

I understand that sometimes you must miss a class, a test, or a project or homework deadline. As long as such occurrences are not excessive, I will work with you as best I can to help you succeed in the course.

You must meet homework and project deadlines. To submit your work late, you must contact me **at least 18 hours before the deadline to request an extension. Your request must indicate how much more time you need. I will still expect you to submit by the deadline the work you have completed so far even if you are given an extension.**

Communication

Post questions and comments about this course at Piazza. Feel free to respond to a question or to edit a response to a question. We are all learning together.

All questions about coursework, including about projects, must be posted at the Piazza Q&A page. If you send me a question via email or via private post that should be posted publicly at Piazza, my reply will direct you to post your question publicly. After you post it publicly, I will reply.

Do not post working code at Piazza. Do not include in a response either "fixed" code or a detailed description of how to change code to get it to work. It is acceptable to post non-working code.

I usually respond to email messages sent Sunday through Thursday within 24 hours—longer when sent on a Friday or a Saturday. I usually respond much sooner to Piazza

posts since I have the Piazza app [<https://piazza.com/product/mobile>] on my phone and receive notifications.

It is appropriate to send me email messages for private matters, such as letting me know you will be absent or that you'd like to schedule a meeting. A better strategy is to post a private message via Piazza.

Note: Anonymous Piazza posts are anonymous to classmates but not to me.

Academic integrity

The Honor Code [<http://catalog.wofford.edu/college/academic-program/honor-code/>] requires faculty, staff, and students to maintain a high standard of individual honor and integrity. Work represented as your own must be your own.

I encourage you to help others in the class or get help from others on projects. However, you may not write code for another student or provide code to copy. Conversely, you may not get code from another student. Doing any of these things is a violation Honor Code.

There is a distinction between collaboration and cheating.

During *collaboration*,

- ☞ One person may discuss a problem or algorithm with another person.
- ☞ One person may work with another person to figure out how to attack a problem.
- ☞ One person may describe a problem and get suggestions for solving it.
- ☞ One person may describe to another person what some code must do, but not provide that code.

Ultimately, you must implement a solution to the problem yourself.

On the other hand, *cheating* occurs when

- ☞ One person copies code from another person or copies code available on the internet.
- ☞ One person allows another person to copy code.
- ☞ One person edits another person's code.
- ☞ Two people are working along with another and decide together what code to write, even if they are working on separate computers.

For some projects, you might be given an option to work with one other student in the class. In this case, you are allowed to share all your work with your teammate. However, you are expected to do all of the work together. One student should not work without the other present. However, one of you may meet with me without the other being present.

Don't cheat because you are up against a deadline. Manage your time effectively. Start each assignment as soon as it is given. If you run into a glitch:

- 🔗 Seek help from me, either by posting at Piazza or meeting with me.
- 🔗 Submit on time the work you have done, even if it is not fully completed. You will likely get partial credit for your work. Just make sure any code you submit contains no errors that prevent it from being executed.

Access and Accommodations

It is the policy and practice of Wofford College to create an inclusive and accessible learning environment. This course is intended for all students, including those with mental or physical disabilities, illness, injuries, impairments, or any other condition that tends to negatively affect one's equal access to education.

If you have not yet established services through Accessibility Services, but have a temporary health condition or permanent disability that keeps you from fully accessing the space, content, and experience of this course, you are welcome (but not required) to visit the ACCESSIBILITY SERVICES ACCOMODATIONS channel in my.wofford.

If you have already established accommodations with Accessibility Services, please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course.























Tentative Schedule

This is the plan for the semester. It is subject to change, although I will do everything I can to stay on schedule.




















If the schedule shows a chapter for a class meeting, then you should have read that chapter and completed any homework associated with that chapter before the start of the class meeting on that date. If the schedule shows a project, then we will spend at least part of the class meeting on that date getting started on that project.

Fall Semester 2021				
Mon	Tue	Wed	Thu	Fri
		SEP 1	SEP 2 🔗 Syllabus review 🔗 Get started	SEP 3
SEP 6	SEP 7 🔗 Basic concepts	SEP 8	SEP 9 📖 Chapter One 📖 Chapter Two 📖 Chapter Three 📖 Chapter Four	SEP 10

Fall Semester 2021

Mon	Tue	Wed	Thu	Fri
SEP 13	SEP 14  Chapter Five  Chapter Six  Chapter Seven  Chapter Eight	SEP 15	SEP 16  Chapter Nine	SEP 17
SEP 20	SEP 21  Chapter Ten	SEP 22	SEP 23  Chapter Eleven	SEP 24
SEP 27	SEP 28  Chapter 1  Project 1	SEP 29	SEP 30  Chapter Twelve  Chapter Thirteen  Chapter 2	OCT 1
OCT 4	OCT 5  Chapter Thirteen  Project 2	OCT 6	OCT 7  Chapter Fourteen	OCT 8
OCT 11	OCT 12  Test #1	OCT 13	OCT 14  Chapter 3	OCT 15
OCT 18	OCT 19  Chapter Fifteen  Chapter Sixteen	OCT 20	OCT 21 <i>Fall Academic Holiday</i>	OCT 22 <i>Fall Academic Holiday</i>
OCT 25	OCT 26  Project 4	OCT 27	OCT 28  Chapter Seventeen  Chapter Eighteen	OCT 29

Fall Semester 2021

Mon	Tue	Wed	Thu	Fri
Nov 1	Nov 2  Chapter 5  Project 5	Nov 3	Nov 4  Chapter 6  Chapter Nineteen	Nov 5
Nov 8	Nov 9  Project 6  Chapter Twenty  Chapter Twenty-One  Chapter Twenty-Two	Nov 10	Nov 11  Test #2	Nov 12
Nov 15	Nov 16  Chapter Twenty-Three  Chapter Twenty-Four	Nov 17	Nov 18  MIPS architecture	Nov 19
Nov 22 <i>Thanksgiving break</i>	Nov 23 <i>Thanksgiving break</i>	Nov 24 <i>Thanksgiving break</i>	Nov 25 <i>Thanksgiving break</i>	Nov 26 <i>Thanksgiving break</i>
Nov 29	Nov 30  MIPS architecture  Project 7	Dec 1	Dec 2  MIPS architecture	Dec 3
Dec 6	Dec 7  MIPS architecture  Project 8	Dec 8	Dec 9  Wrap-up	Dec 10
Dec 13	Dec 14  Final Exam 2:00–5:00	Dec 15	Dec 16	Dec 17