CMPE 110: Computer Architecture
Fall 2018

Basic Information

- Lectures: MWF 4:00–5:05 PM (Thimann Lecture 3)
- Instructor: Professor Ethan L. Miller (elm+cmpe110(at)ucsc.edu)
- Office: 337A Engineering 2, Mon 5:15–6:15 PM and Wed 11:30 AM–12:30 PM
- Prerequisites: CMPE 12 and either CMPE 13 or CMPS 12A/L
- Home page: [https://canvas.ucsc.edu/courses/16122](https://canvas.ucsc.edu/courses/16122)

Course Overview

The goal for students in this course is to learn the fundamental principles of computer architecture. To help students accomplish this goal we’ll cover the various important aspects of computer architecture in general, examine specific examples from current CPUs and systems, and consider the RISC-V instruction set architecture and its possible impact on system design. Topics include:

- Computer system performance
- Instruction set architectures
- Pipelining & forwarding
- Branching & branch prediction
- Multi-execution units
- Caches
- Memory hierarchy
- Virtual memory
- Multicore CPUs
- GPUs and SIMD instructions

Prerequisites

The formal prerequisites for this class are **CMPE 12 and either CMPE 13 or CMPS 12A/L**. We assume that you gained (and retained!) the knowledge and skills from these classes as taught at UCSC. If you took the equivalent classes at another university or community college, you may want to look over the syllabi and familiarize yourself with the material covered by the offerings on this campus.

Resources

The required text, *Computer Organization and Design RISC-V Edition: The Hardware Software Interface*, is available at the UCSC bookstore as well as online booksellers such as Amazon. Homework problems may be taken from the book (the RISC-V version), and lectures will complement the material as presented there. You should read the material in the textbook **before it is covered in lecture**. Studies have shown that students tend to comprehend material better when it’s read from printed books, but the choice of which medium to use is yours.

Other than the textbook, all of the material in this class, including assignments and grades, will be available on Canvas ([https://canvas.ucsc.edu/courses/16122](https://canvas.ucsc.edu/courses/16122)), and will require that you log in to access it. We’ll be conducting all class-related discussion, including announcements, on Piazza, at [http://piazza.com/ucsc/fall2018/cmpe110](http://piazza.com/ucsc/fall2018/cmpe110).
Evaluation & Grading

Homework
There will be 4–5 graded homeworks over the course of the quarter. You’ll typically have about a week to do each assignment. Please see the “Academic Integrity” section for details on allowed forms of collaboration.

Homework will be submitted on Canvas: each assignment must be submitted as a single PDF file. You may type up your homework, or scan in handwritten material (or both), as long as it’s submitted as a single PDF file. There are scanner programs available for Android and iOS cell phones that you may wish to use. Your homework must be scanned in black and white (not color, not grayscale) and at a resolution between 150–300 DPI, so that the files don’t get too big. You must also ensure that the PDF page dimensions are no larger than 9 x 14 inches; you can verify this using Acrobat Reader or a similar program.

Rather than approve extensions on a case-by-case basis, you may turn in one homework of your choice up to 48 hours late with no penalty. Think of this like “sick days” that you may use if you’re feeling ill. We won’t try to verify your illness, but neither will you get a second extension later in the quarter. Other than this single exception, late homework will not be accepted.

Programming Assignments
You will work in teams of three, over the quarter, to develop code that simulates a RISC-V CPU. Some of the framework will be provided for you; your team will be responsible for writing the rest of the code. Programming will be done in C, and your team must use git and gitLab@UCSC to manage your code. There will be tutorials on C and git during the first full week of class in discussion sections.

Programming assignments submitted late will lose 25% of the point value of the assignment per day late.

Quizzes
There will be about one quiz per week (some weeks won’t have one), each taking about 15 minutes. Quizzes will have 3–5 multiple choice or short answer questions on recently-covered material. Quizzes will be given by iClicker, so you’ll need to sign up for an iClicker account and bring your cell phone or other device to take the quiz (we won’t be using iClicker remotes). We’ll drop the lowest two quiz grades when computing your quiz average so, while you’ll get a zero if you miss a class in which a quiz is given, you can miss two quizzes without it affecting your grade.

Final Exam
There will be a final exam during the scheduled slot in exam week. As required by the university, you must take the final at the scheduled time unless you have an unexpected illness or family emergency. You must let the professor know by email or text message before the exam’s scheduled start, unless you’re incapacitated by illness. In addition, you must provide a doctor’s note or letter from the funeral home before you can make up the exam. There are no exceptions to this policy.

There will be no midterm exam in this class.

Notes & Class Participation
You may optionally turn in (on Canvas) notes that you take in class or on other materials such as the textbook. Notes can only raise your overall grade, but can’t lower it—we’re giving you an extra opportunity to demonstrate mastery of the material. These notes may be handwritten or typed by you—you may not turn in material copied verbatim from other sources, including class slides, textbooks, other students, or the Internet). Each week’s notes must be turned into Canvas by Monday at 3 PM following the week in which the material was covered in class in order to
receive credit for them. Submission format is the same as for written homework (see above). We’ll use the higher of your notes grade and your final exam grade for 7% of the overall class grade.

You may receive extra credit on your overall course grade for actively participating in class, including things such as actually participating (asking questions) in lecture, visiting office hours, and participating in Piazza discussions.

Grading

Grades in the class will be distributed as follows:

- Written homework assignments: 15%
- Programming assignments: 20%
- Quizzes: 15%
- Final: 50%

In order to pass the class, you’ll need to demonstrate basic mastery of the subject material as demonstrated by your homework, programming assignments, quizzes, and exam. You will not pass if your (weighted) average in any of these three areas is below 55%. Note that merely meeting this requirement isn’t sufficient to pass the class, since a 56% average is still an F.

We expect to use the following approximate ranges for overall scores. Individual assignments may be curved, but there is no guarantee of this.

- A: 89–100%
- B: 79–89%
- C: 69–79%
- D: 60–69%
- F: below 60%

Getting Help

There are several ways to get help with concepts covered in class, textbook, homework assignments, and the programming project, listed in approximately the order you should try them for help.

- Attend lectures and discussion sections.
- Read Canvas for information on assignments.
- Look on the Internet for help with C and git.
- Read and post to the class discussion forum, hosted at piazza.com.
- Meet with the course staff during office hours.
- Email the course staff (cmpe110-staff ⟨⟨ at ⟩⟩ ucsc.edu).

You’re encouraged to post general questions to the Piazza forum, and to answer questions others have posted there. Asking things like “how does this concept work?” or “can we work through this problem not on the homework?” are fine. Questions such as “what did you get for Problem 2 on this week’s assignment” or “what did I do wrong on this pipeline diagram?” are not acceptable, and should be asked during office hours (preferable), or via email. Course staff will read Piazza and reply to posted questions.

Office hours are your chance to ask the course staff in-depth questions about the material being covered, homework assignments, the programming project, or anything else about computer architecture (or other general computer engineering and computer science issues) you want to discuss. Many students find that discussions in office hours are highly informative and interesting, and it usually helps faculty members write you better recommendations for jobs and graduate school. Please don’t just drop by outside of office hours, since we’re likely to be busy. If you can’t attend office hours, arrange a meeting in advance by emailing the course staff member with whom you want to meet.
Appointments with me are managed by my admin, Cynthia McCarley; please email cymccar(at)ucsc.edu to set up an appointment if you have an academic conflict (lecture or section) that prevents you from attending my office hours.

Email to the course staff (cmp110-staff(at)ucsc.edu) will be answered if possible, especially if it only requires a short answer. More complex questions like “please explain this concept to me” can’t be answered via email, so you’ll get a brief “come to office hours” response. It may take up to one business day for an email response, depending on when the course staff read and respond to email. Email to me must be sent to elm+cmp110(at)ucsc.edu. Email regarding CMPE 110 sent to to any other address of mine may be deleted by my email filter.

Accommodations for Students with Disabilities

UC Santa Cruz is committed to creating an academic environment that supports its diverse student body. If you are a student with a disability who requires accommodations to achieve equal access in this course, please submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to Prof. Miller privately during office hours. If you cannot attend any office hours due to an academic conflict (another course or section only), you may make an appointment. Accommodations must be made three weeks before the assignment / exam for which you want accommodations, or we may not be able to accommodate you. All students who may benefit from learning more about DRC services are encouraged to contact the DRC by phone at 831-459-2089 or by email at drc@ucsc.edu.

Academic Integrity

Academic integrity is a requirement for this course (and, indeed, for your entire academic career). All material submitted for a grade must be your own independent work; this includes quizzes, notes, homework, and exams. For the project, you’re (of course) expected to work with your group partners. If you get help on an assignment from anyone else other than course staff, you must acknowledge their contribution on your submitted work. This includes help from tutors from MSI and similar programs as well as private tutors. Obviously, any form of collaboration during a quiz or exam is strictly forbidden, but studying in groups for the exam is encouraged.

You may discuss class material with others, and you may discuss general approaches to homework assignments. These discussions shouldn’t include the actual answers to any of the problems, but instead should focus on how to solve the problems. You may not look at or discuss someone else’s homework solutions or project code, and you may not show your solutions or code to anyone else. All collaboration must be whiteboard or discussion only. You may take handwritten notes from these discussions, but you may not mechanically record your discussion—no typing on a keyboard, photos, video, or audio recording during the discussion.

By taking this class, you agree to abide by the Personal Responsibility Document that’s available on the course Canvas page. You must turn in a signed copy of this document by Friday, October 5th, as your submission for homework assignment 0. Students enrolled as of Wednesday, October 3rd who do not turn in this form by October 5th will receive a failing grade (F/NP/U) for the class. If you add the class after October 3rd, you will have 72 hours to submit a signed copy of the Personal Responsibility Document, and must do so before turning in any other assignment.

We take academic integrity very seriously, and report all violations of academic integrity to the School of Engineering and to your college Provost. If you violate academic integrity, you will fail the class. Period. Depending on the severity of the violation, the university may impose additional penalties, including suspension and even expulsion in rare cases.

"The bottom line: don’t cheat!"

1Students with DRC accommodations should discuss note-taking with me.