

CSCI 281: Assembly Language & Computer Architecture

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Meetings MWF 11:00-11:50 in Thompson 374. The final will be on Wednesday, December 13th at 12:00.

Course Description Computers are real machines that obey real physical laws. They are not “magic math boxes”. In this class, we will learn *how* computers truly work.

Most of this class consists of a “dive” into the workings of a computer program:

- Whenever you compile a program, you are really translating it into “assembly language”. Assembly language is specific to the kind of processor a computer uses (e.g. Intel’s x86, ARM for newer Macintoshes, or MIPS). It can be read by humans, but its structure and flow are much more oriented toward the computer’s point of view.
- Assembly then needs to be translated into “machine code”. Machine code looks like a stream of raw data, and is not easily readable. Each line of machine code is relatively simple, but whole programs can appear incomprehensible.
- Even machine code eventually needs to be translated, down to the physical shifts of electrons that make a computer compute. Computer architecture is the study of designing computer hardware, from computer chips to hard drives. We will learn how chips work, and experiment with some basic circuit designs.

Topics Covered (“Learning Outcomes”) The topics we will cover include:

- Basics of the C language.
- Digital logic.
- Hardware design.
- MIPS assembly language.
- Data representation.
- Memory addressing.
- Pipelining of instructions.
- Caching and virtual memory.
- Pros and cons of different architectures.

Web Page The class web page is located at <https://cs.pugetsound.edu/~aasmith/cs281/>. Valuable info and links are posted there.

Text We will be using COMPUTER ORGANIZATION AND DESIGN, by Patterson and Hennessy. You may use either the 4th, 5th, or 6th edition. (Please be careful if you buy this online, as there is an unrelated book by the same authors reversed: “Hennessy and Patterson”. *All editions of the book we are using have an abacus on the front cover.*)

Prerequisites You should have already passed CSCI 261 or its equivalent, with a C- or higher. I will also assume basic scientific literacy (e.g. high school chemistry and physics).

Course Policies There will be twelve assignments over the course of the class—usually one each week. You are free to talk to others in the class about them, and to work in teams on written assignments, but all programming and chip design must be *100% your own work*.

Assignments will be penalized by 20% for each working day (or fraction thereof) they are late, down to 40%. However, you will have three “extension days” during the

semester to extend a deadline by one working day. These are intended for unforeseen circumstances, and will be used automatically unless you specify otherwise. Every assignment also has a hard deadline just before the exam that follows it, so that I may release the answer keys. After this, I will not accept your work for a grade.

There will also be a course project toward the end of the semester. This is a self-directed project, expanding on one of the areas we have covered. You may work in pairs, if you wish. One-paragraph proposals will be due at ten weeks into the semester, and the project itself will be due on the last day of class.

Use of telephones is forbidden in class. Laptops or tablets may be used only in ways directly relevant to the material. Anyone violating these rules will be asked to leave.

You all should be aware of the Honor Code at the college. Please do not cheat—it will not go well for you. *Any suspected cheating will be immediately reported.* If you use resources outside the text and lecture notes, you must cite them in order to avoid academic dishonesty. AI sources such as ChatGPT are strictly forbidden.

Exams are closed book, and will be cumulative. You are allowed a calculator (or your phone, so long as it is in “airplane mode”) and one two-sided, letter-sized page of notes.

Grading

Class work will count toward your final grades with the following weights:

| Homeworks | Project | Midterm 1 | Midterm 2 | Final |
|-----------|---------|-----------|-----------|-------|
| 25% | 10% | 20% | 20% | 25% |

In particular, notice how heavily weighted assignments are. *Missing assignments is the easiest way to get a lower grade.* Please be sure you do them, and on time.

Tests will be cumulative. They will each be divided by the top score, so the top performer gets 100%.

Here are the percentages you must earn for each final letter grade:

| | | | | | |
|------|-----|------|------|-----|-------|
| 95% | 90% | 86⅔% | 83⅓% | 80% | 76⅔% |
| A | A- | B+ | B | B- | C+ |
| 73⅓% | 70% | 66⅔% | 63⅓% | 60% | Lower |
| C | C- | D+ | D | D- | F |

In addition, class participation and effort may help bump you up, if your final grade is borderline.

Attendance

I will not be keeping attendance (except on the first day). However, odds are that your attendance will correlate highly with your final grade.

Miscellany

If there are any special holy days that you will be taking off, please let me know as soon as you can so that we can work around them.

Please consider getting a flu shot. Influenza kills, and disease can spread rapidly in the dorms. (And you really don’t want to miss a week of class. Trust me.)

Finally...if there’s anything else I can do to help you, please let me know. I’m willing to go out of my way to make this a valuable class for you, but I can’t do that unless you talk to me.

Mandatory UPS Boilerplate Syllabus Text

In their infinite wisdom, the lawyers and administrators that lead us have decreed that this text will be included in every class syllabus.

University, Academic, and Administrative Policies

There are many university policies and resources that offer guidance on how to be safe and make the most of your college education. Here are a few that you should take a moment to review:

- Please review university emergency preparedness, response procedures and a training video posted at www.pugetsound.edu/emergency/.
- Protect yourself and others from COVID-19 by following our ongoing campus safety protocols, posted here: <https://www.pugetsound.edu/emergency/communicable-disease-outbreak-prevention/university-response-covid-19/protect-yourself/>.
- For information on academic and administrative policies (such as policies on grade policies, leaves of absence, declaring a major, academic integrity, and academic petitions) please refer to the University Bulletin located here: pugetsound.edu/sites/default/files/2023-08/AD23BULLETIN_online_Academic%20and%20Administrative%20Policies.pdf.
- If you are seeking a religious accommodation in an academic course or program, please follow the process provided in the university's policy on Student Religious Accommodations in Academic Courses or Programs, available at <https://www.pugetsound.edu/office-university-counsel/policies/campuswide-policies/student-religious-accommodations-academic-courses-or-programs/>.
- If you have any concerns about prohibited harassment or discrimination that may be affecting you or others at Puget Sound, please contact the university's Title IX Coordinator/Equal Opportunity Officer, Wheelock 218, 253.879.3793, website: <https://www.pugetsound.edu/title-ix-equal-opportunity/>, email: titleix-ooo@pugetsound.edu. The Title IX Coordinator/Equal Opportunity Officer can explain available options and help address concerns informally or formally.
- If you have a physical, psychological, medical or learning disability that may impact you as a student at Puget Sound, please contact Student Accessibility and Accommodation, Howarth 105, 253.879.3399, website: pugetsound.edu/saa/, email: saa@pugetsound.edu. They will determine with you what accommodations are necessary and appropriate.