

Welcome to Operating Systems! Everyone who uses a computer, smartphone, or even microwave regularly interfaces with an *Operating System*, the software that manages a computer's resources. An operating system is what allows multiple programs to run on the same hardware at the same time, provides abstract interfaces to the hardware, and provides a standard design for running applications. In this course, you will learn key concepts related to operating system designs, pitfalls, and open challenges in principle and in practice. Topics covered will include:

- Processes, Process Design, and Process Management;
- Process Scheduling and Thread Scheduling;
- Virtualization;
- Memory Management and Address Translation;
- Isolation and Security.

In this class, you will implement six C-based programming assignments throughout the course culminating in a minimally functional, usable operating system.

Prerequisites CS105: Computer Systems

Lecture MW 2:45-4PM (Lincoln 1125)

Final Exam Period Friday, December 18, 2:00-5:00PM.

Required Materials There are no required materials for this course. Access to the course VM will require a Pomona email and access to the Pomona network, which can be provided by ITS. Devices are available in the Edmunds computer labs to do so.

Course Feedback Feel free to notify me of things that are working, not working, or otherwise about this course before/after class, in office hours, or via the anonymous feedback form. This only works if I follow up and make the appropriate changes, so please hold me accountable if I fail to accommodate.

Course Staff

Instructor Prof. Sam Thomas (email: samuel.thomas@pomona.edu; office: Edmunds 112).

- Monday, 4-5pm
- Tuesday, 2:30-3:30pm
- Wednesday, 4-5pm
- Thursday, 2:30-3:30pm
- Friday, 2:30-3:30pm
- Also by appointment (send me an email).

Course Policies

Attendance Policy Lecture attendance is required, particularly for code review sessions. Students may have up to 4 excused absences (informing the instructor 48+ hours in advance) throughout the semester. Failure to meet the attendance policy may result in lower marks in the participation score.

With this in mind, we live in a post COVID-19 world. If you are feeling unwell, please do not come to class and contact the instructor when you are well. You will be directed to the appropriate resources to get back on track.

To ensure your well-being, missing two lectures in a row without communication will result in a direct communication from me to you via email. If you miss a third session in a row without response, I will issue a Low-Grade Notice, which will notify the Dean of Students.

Assignment Submission All assignments are to be submitted on Gradescope. If you need an extension, please contact the instructor at least 48 hours before the assignment is due. Expect extensions to be granted for reasons similar to excused absences. Every 48 hours the assignment is late will be a 10% deduction in the overall score.

Note, deadlines are designed for your benefit and the benefit of your peers. Grades are only to be released after all submissions have been made, and failure to meet the deadline prolongs the release of grades for you and your peers.

Collaboration Policy Assignments in this course are intended to be implemented as a *pair-programming* assignments! That means that you and your partner are working on the assignment **together**.

AI Policy As part of the Pomona CS Pilot AI Policy, this class maintains the Tier 1 level of acceptable AI use. As such, use of AI and LLMs is permitted in this course *under limited circumstances*. These tools should be treated in the same way that you would use a TA. Any submitted generated code or textual output must be cited. All session logs that have been used to facilitate the generation of submitted materials must be saved, and these logs may be requested by the instructor at any point.

The guiding philosophy of acceptable use is designed to enhance your learning in the classroom while still demonstrating the intended learning goals of the course. As such, the following behaviors are allowed under this policy:

- Asking to generate practice problems;
- Asking to explain high level concepts;
- Asking for high level explanations of error messages (as per searching on StackOverflow).

The following behaviors are not allowed under this policy:

- Generating code for an assignment (please include “Do not generate code. Only explain in concepts.” in any prompt related to assignment help);
- Debugging code by pasting in the your code directly.

Additionally, students may not:

- Using assignment and exam documents or direct language from assignments and exams as part of a query;

- Using assignment code scaffolding as part of a query.

Note, this list is not exhaustive. If you are unsure if it is acceptable to use AI or LLMs for a particular use case, please verify it with your instructor. Appropriate response to violation of the AI policy will be determined on a case-by-case basis in a meeting with the instructor.

Statement of Academic Integrity Please see the Computer Science's Academic Honest Policy.

In-Class Discussion Policy A non-exhaustive list of things to consider include¹:

1. Constructing an inclusive environment in which discussion participants are encouraged to take risks;
2. Ensuring discussion participants come to the discussion prepared to be effective participants;
3. Initiating discussion with engaging, relevant topics or challenges;
4. Encouraging active listening;
5. Helping participants digest what they are hearing;
6. Managing and facilitating the flow of the session;
7. Making clear the statements open for further discussion;
8. As needed, help the group reach a satisfactory closure point.

Office Hours Policy Office hours are a resource for you to use, and are designed to facilitate your learning. Please come to office hours! At the same time, because it is a shared resource, office hours must be equitably distributed. At my discretion, I will set limits on individual feedback in office hours to ensure that other students are able to receive help.

Given the Collaboration Policy of the course, I expect you **and your partner** to be in attendance for debugging help. If my posted hours do not work, please email me to schedule an alternate time. Otherwise, I am happy to go over high level concepts, but will recuse myself from looking at code with you. The goal of this policy is not to be punitive but rather to encourage working together and realize the well studied benefits of pair-programming!

My hours are spread out across time slots throughout the week to accommodate students with different availability. If the scheduled times do not work for you, feel free to schedule an appointment. If a large cohort of students is unavailable for office hours, I will do my best to change my schedule to accommodate.

My office hours are split by course-specific times and general times to increase their frequency and utility. General times are designed to be times to chat about the course, research, life, or otherwise – so feel free to attend these to discuss course materials or otherwise!

Policies Policy These policies are designed to help facilitate your learning, but no policy is set in stone. Accommodations can be made on a case-by-case basis where appropriate. Please contact me with any concerns. I am happy to try to help however possible!

¹Adopted from The Sheridan Center at Brown University.

Diversity and Inclusion Statement

Materials in this class are largely derived from materials and innovations from a time period in which a small subset of privileged voices wrote the materials for and heavily influenced the discussion of topics in this course. I acknowledge that the materials that influenced the design of this course have been largely put together by white men. I also want to acknowledge the possibility of overt and covert biases in the materials due to the lens with which it was written. I will also do my best to highlight the contributions of historically underrepresented groups in computing throughout the term in an effort to demonstrate the richness and importance of integrating a diverse set of experiences towards a comprehensive understanding of an area.

The promise of science at its best is that the strength of your contribution does not depend on your identity. While this promise has never been truly fulfilled, part of my job as an instructor aspires to bridge this gap. If you find yourself wondering whether the ways in which you are different from your peers or from the historical figures of academic canon makes you less qualified to be a student or scientist, please remember: the only thing I care about in this class is what you can do, and I promise to work with you to make sure you have what you need to be able to do it. Our field needs more people like and unlike you to show what they can do.

I would like to create a learning environment for my students that supports a diversity of thoughts, perspectives and experiences, and honors your identities (including race, gender, class, sexuality, religion, ability, etc.). To help accomplish this:

- If you have a name and/or set of pronouns that differ from those that appear on your official registration, please let me know!
- If you feel as though your performance in class is impacted by your experiences outside of class, please don't hesitate to come talk to me. I want to be a resource for you. Remember, you can submit anonymous feedback to vocalize your concerns. If you prefer to speak with someone outside of the course, Dean April Mayes is an excellent resource!
- I am always in the process of learning about diverse perspectives and identities. If something was said in class (by anyone, myself included) that made you feel uncomfortable, please talk to me about it (again, anonymous feedback is an option).

If you feel empowered already, I hope you will join me in taking responsibility to empower your peers.

This statement was largely influenced by the "Sample syllabus statements" from the Sheridan Teaching Center at Brown University.

Grading

- Assignments: 0b01000110%
- Final Exam: 0b00010100%
- Participation: 0b00001010%

Assignments There are six² assignments throughout this course. Assignments are scheduled to take 0b0010-0b0011 weeks (with suggested intermediate deadlines), and points are evenly split between the programming component and the code review component. For more on what you can expect from assignments in this course, be sure to look at the assignments page on the course website.

Final Exam This course has a final exam. The exam will feature short answer questions that will allow students to demonstrate their conceptual grasp of cross-cutting topics in the design and application of operating systems. The role of this exam is to evaluate students' comprehension of the learning goals of the course.

²Subject to change.

Tenative Course Schedule

Table 1: Subject to change!

Week	Monday	Wednesday	Assignment
1	BIOS and Boot	System Calls	Shell (C Programming Review)
2	Labor Day (no class)	Introducing OS Subsystems	Shell Code Review
3	Process Subsystem Organization (Part 1)	Process Subsystem Organization (Part 2)	Procs
4	Context Switching and Interrupts	Synchronization and Scheduling	
5	File Systems Review	FS + Process Interaction	Procs Code Review
6	FS + Procs (cont.)	Disk Layouts	File System
7	FS Case Studies	VFS	
8	Fall Break	Memory Management Subsystems	FS Code Review
9	Physical Mmemory Management	Virtual Memory Management	
10	TLBs and Page Faults	VM + Procs (CoW + fork, etc)	
11	Case Study: Dynamic Linking	Device Management and Drivers	MM Code Review
12	I/O and Network	NFS	Drivers
13	Hacking our OS	Thanksgiving	Final Exam Review
14	Implementing Security	Performance Engineering + eBPF	Drivers Code Review
15	OS-less systems	Course in Review	Put It All Together!

External Resources

Quantitative Skills Center (QSC) The Quantitative Skills Center (QSC) provides academic support to Pomona College students in courses that feature a large degree of quantitative and/or scientific reasoning through our QSC Partners Program. QSC partners meet one-on-one with students to provide support for a variety of Pomona courses for course specific help. The QSC also offers non-course specific help in general quantitative skills and offers consultations for projects and theses involving quantitative methods. Additionally, Dylan Worcester, Director of the QSC, and Angel Bradley, Assistant Director of the QSC are available to meet with you regarding your success in STEM at Pomona College. To make an appointment at the QSC, please visit pomona.mywconline.com or contact us at qsc@pomona.edu. The QSC is located in SCC (Smith Campus Center) 228.

Accessibility Resources and Services (ARS) Pomona College is committed to the fair and equitable treatment of all members of our community. This includes providing and improving accessibility for everyone at Pomona College. Consistent with the open community of Pomona, this includes people with specific needs or disabilities. We encourage you to have a conversation with your instructors, coaches, mentors, and others on campus who can help you access what you need to succeed. See this link for a nonexhaustive list of accommodations. For specific academic accommodations, students need to submit documentation with the ARS office and engage in an interactive process to determine which accommodation(s) may be appropriate. For more information, please reach out to disability@pomona.edu. See this step-by-step guide to the accommodations process and ways that you can be supported. Additionally, students can receive assistance and resources from the 7C Student Disability Resource Center (SDRC). The SDRC hosts events, loans assistive technology, and offers student accommodation support.

Mental Health and Wellness Resources Monsour Counseling and Psychological Services (MCAPS) is the mental health resource to the five undergraduate institutions of The Claremont Colleges. Their professional staff serves all enrolled undergraduates and provides in-person counseling. There are no fees for counseling services and all services are confidential. In addition, 7C Health (TimelyMD) provides 24/7 access to on-demand medical care and “Talk Now” mental health support, along with links to short videos that support mental and physical wellbeing. The Student Assistance Program (SAP) is a free service available through Aetna for students. The SAP allows students to engage with a clinician for three, free sessions. Phone: 909-607-2000. MCAPS Crisis Line: 909-621-8202; Dial “1”. The Wellness Resources page contains additional information about mental, physical, and other student support services.

Religious & Spiritual Life At The Claremont Colleges, the Chaplains serve as confidential spiritual counselors, emotional leaders, and provide ethical leadership to the campus community at large. There are four Chaplains onsite, a Protestant Pastor, Rabbi, Imam and Catholic Priest. Though each Chaplain holds a specific faith, they encourage and support all religious and spiritual student groups and communities on campus. It is the goal of the Chaplains to strengthen individual faith and promote interfaith relations. The Chaplains offer religious support, engagement opportunities, and create a faith community for students as they pursue their education. The McAlister Center, a shared site for 7C religious activities, is located at 919 N. Columbia Ave. The Center includes a Prayer and Medication Room, Lounge, Library, Community Room, Kosher Kitchen, and outdoor patio. You can sign up for their mailing list and reserve spaces through the website. For further advice and to speak with a religious leader, please reach out

to the chaplains' office at chaplains@claremont.edu. For a list of major religious holy days for 2024-25, see the bottom of the Chaplain's information page.

Peer Mentoring Programs At the 7Cs we have a range of resource centers and student groups that offer peer mentoring programs and opportunities for social connection to Pomona College students. See below for a partial list of these programs and support systems. Interested students can visit Engage for a full list of current student organizations and how to get involved.

- Asian American Resource Center (AARC), serves Asian Pacific Islander Desi American (APIDA) students
- Chicano/Latino Student Affairs (CLSA), provides services to Chicanx/Latinx students in the 7Cs
- Draper Center for Community Partnerships, fosters collaborations between the campus and the community
- DACA/Undocumented Student Resources, provides support to DACAmented and undocumented students
- The Empower Center, 7C violence prevention and advocacy program
- First Generation and/or low-income (FLI) Scholars, provides support for FLI students at Pomona
- International Student Services, office providing support to international students
- Mellon Mays Undergraduate Fellowship Program (MMUF), 5C program for junior and senior humanists
- Native American Initiatives Office, serves the needs of Native & Indigenous students
- Office of Black Students Affairs (OBSA), 7C support, resources, and space for students of African decent
- International & Domestic Programs, offers support to students interested in off-campus study
- Queer Resource Center (QRC), 7C resource for LGBTQQ+ students and their allies
- Women's Union, provides space and programming tailored to the diverse needs of women at the 7Cs

Health and Safety Telephone Numbers

Campus Safety	909-607-2000	
Administrator On Call	909-607-2000	(On-campus administrator available to respond to emergent student concerns at all hours)
Student Health Services	909-621-8222	
After Hours Emergency	909-607-2000	
National Suicide & Crisis Lifeline	988	
Project Sister Family Services	800-656-4357	(24/7 Sexual Assault Crisis Hotline)