# CSCI 475: Operating Systems

## Course Syllabus – Spring 2022

**Instructor:** Prof. David Chiu
**Office:** TH 303
**Email:** dchiu@pugetsound.edu
**Course Page:** https://canvas.pugetsound.edu
**Lecture Meeting Times:** Mon/Wed/Fri 3:00pm - 3:50pm in TH 381
**Final Exam:** Mon, May 9, 4:00pm - 6:00pm
**Office Hours (On Zoom):**

- Mon/Wed/Fri 11:00am - 12:00pm
- Thu 11:00pm - 1:00pm
- By appointment

# 1 Course Information

One the most complex software systems ever assembled, the modern operating system serves as the interface between the human and the machine. This course traces how the simple idea of "resource sharing" unravels into some of the most confounding problems and original breakthroughs in computer science. Course topics include process and thread management, input/output, CPU scheduling, synchronization primitives, memory management, and file systems. Students taking this course will learn how to deal with the intricacies of low-level programming, parallel computing and synchronization problems, and will also receive kernel-development experience through the design and implementation of various subsystems in a real operating system. The C programming language will be used for homework assignments and projects.

## Prerequisites

A grade of C- or higher in the following course(s) is required:

- *CSCI 281 - Assembly Language and Computer Architecture*

## Textbook

- Silberschatz, Galvin, and Gagne. *Operating Systems Concepts*. 8th Ed. or greater. (Required)
- zyBooks *Programming in C.* (Required)

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### Course Topics

- The history and current state of computer systems
- Process management
- Threads
- Interrupts and system calls
- CPU scheduling
- Synchronization of concurrent programs
- Memory management and virtual memory
- File system

## 2 Course Outcomes

Students taking this course will:

- Be proficient in the C programming language.
- Be proficient in the use of the Linux environment for coding, compilation, debugging, and testing.
- Design and implement concurrent programs using proper synchronization techniques.
- Evaluate the merits and downfalls of various CPU scheduling, memory management, and deadlock handling policies.
- Gain experience designing and implementing key components in a real OS kernel, including a ready queue, a robust CPU scheduler, synchronization mechanisms, and deadlock detection & recovery.

## 3 Grading

The following grade cutoffs are upper bounds - they might come down, but will not be set higher: A = 95, A- = 90, B+ = 87, B = 83, B- = 80, C+ = 77, C = 73, C- = 70, D+ = 67, D = 64, D- = 60, F = $<$ 60. Your overall grade will be composed as follows:

| | % Weight |
|---|---|
| Discretionary | 2 |
| Homework | 33 |
| Projects | 15 |
| Midterm I | 15 |
| Midterm II | 15 |
| Final Exam | 20 |

Table 1: Breakdown of Grades

### 3.1 Assignments

- **Homework Assignments (Work Alone!)** – You will work alone on all homework assignments. Collaboration among students is encouraged for problem interpretation, brainstorming, etc., but in general, I expect every student to submit their own work. **Do not help write or share each other's programs!** Duplications are easy to catch, and the penalty for cheating is severe: course failure.
- **Projects** – Paired-programming is *required* for the Xinu projects. Random pairs of students will be assigned per assignment. Your source code should conform to good programming style and documentation.
- **Late Work** – For each day either a homework or project assignment is late (includes weekends), a $10\%$ deduction will be assessed, and no late work will be accepted after one week past the due date.

#### Exams

There will be two midterms and a final exam. The final is cumulative. They will cover topics discussed in the lectures, readings from the assigned textbook, and assignments. The exams are cumulative. Study guides are provided and always reviewed on the lecture immediately preceding the day of the exam.

### 3.2 Discretionary

Discretionary points will be given based on your...

- Attendance
- Class participation
- Refrain from activities that can disrupt others, *e.g.*, texting, playing games on your laptop, etc.

## 4 Community Statement

The goals of this course can only be accomplished in a setting of mutual respect, where ideas, questions, and misconceptions can be discussed with civility. As your instructor, I am committed to creating a classroom environment that welcomes all students, regardless of their identities (e.g., race, class, gender, sexual orientation, religious beliefs). I firmly believe that everyone in the class is fully capable of engaging and grasping the material, and that the world of computing is stronger when it includes the broadest possible set of perspectives. We all have unconscious biases, and I will try to continually examine my judgments, words, and actions to keep my biases in check and treat everyone fairly. I hope that you will do the same. If you feel comfortable, please let me know if there is anything I can do to make sure everyone is encouraged to succeed in this class.

## 5 Policies

### Laptops and Phones

**Laptops:** Laptop computers have proved to be a distraction during my lectures. Except for those who can provide documentation of need from the office of Student Accessibility and Accommodation (SAA), please don't bring your laptops to lectures. **Phones:** Please put your phones on silent during class.

## Academic Integrity

You should be aware of the *Student Integrity Code* at the university. Any suspected cheating (*e.g.*, plagiarizing code, copying homework solutions, etc.) will be reported to the Registrar, which may result in possible suspension/expulsion. See this link for more info:
http://www.pugetsound.edu/student-life/personal-safety/student-handbook/academic-handbook/academic-integrity

## Student Accessibility and Accommodation

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Peggy Perno, Director of the Office of Accessibility and Accommodation, 105 Howarth, 253.879.3395. She will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

## Classroom Emergency Response Guidance

Please review university emergency preparedness and response procedures posted at . There is a link on the university home page. Familiarize yourself with hall exit doors and the designated gathering area for your class and laboratory buildings.

If building evacuation becomes necessary (*e.g.* earthquake), meet your instructor at the designated gathering area so she/he can account for your presence. Then wait for further instructions. Do not return to the building or classroom until advised by a university emergency response representative.

If confronted by an act of violence, be prepared to make quick decisions to protect your safety. Flee the area by running away from the source of danger if you can safely do so. If this is not possible, shelter in place by securing classroom or lab doors and windows, closing blinds, and turning off room lights. Lie on the floor out of sight and away from windows and doors. Place cell phones or pagers on vibrate so that you can receive messages quietly. Wait for further instructions.

## Student Bereavement Policy

The University of Puget Sound recognizes that a time of bereavement can be difficult for a student. Therefore, the university provides a Student Bereavement Policy for students facing the loss of a family member. Students are normally eligible for, and faculty members are expected to grant, three consecutive weekdays of excused absences, without penalty, for the death of a family member, including parent, grandparent, sibling, or persons living in the same household. Should the student feel that additional days are necessary, the student must request additional bereavement leave from the Dean of Students or the Dean's designee. In the event of the death of another family member or friend not explicitly included within this policy, a bereaved student may petition for grief absence through the Dean of Students office for approval.

## Student Religious Accommodation

The university provides reasonable religious accommodations for academic courses and programs, and the university policy is found at:
https://www.pugetsound.edu/about/offices-services/human-resources/policies/campus-policies/student-religious-accommodations-in-academic-courses-or-programs.

# 6 Course Schedule

The following course schedule is tentative and subject to change.

| Week | Topics | Reading |
|---|---|---|
| 1 | Course overview, computer system history and trends | Silberschatz, *et al.*: Chap 1 |
| 2 | Interrupts, traps, and dual-mode operation | Silberschatz, *et al.*: Chap 2 |
| 3 | Process management | Silberschatz, *et al.*: Chap 3 |
| 4 | Threads and parallel processing | Silberschatz, *et al.*: Chap 4 |
| 5 | CPU scheduling | Silberschatz, *et al.*: Chap 6 |
| 6 | *Review and Midterm I* | — |
| 7 | Synchronization: critical section problem, atomicity, locks | Silberschatz, *et al.*: Chap 5 |
| 8 | Synchronization: semaphores and classical problems | Silberschatz, *et al.*: Chap 5 |
| – | *Spring Break* | — |
| 9 | Synchronization: monitors and condition variables | Silberschatz, *et al.*: Chap 5 |
| 10 | Deadlocks | Silberschatz, *et al.*: Chap 7 |
| 11 | *Review and Midterm II* | — |
| 12 | Memory management and virtual addressing | Silberschatz, *et al.*: Chap 8 |
| 13 | Virtual memory | Silberschatz, *et al.*: Chap 9 |
| 14 | File system | Silberschatz, *et al.*: Chap 12 |
| 15 | *Review and reading period* | — |