

ECE 362: Embedded Operating Systems

Winter 2021: This term's classes will be delivered using *active remote learning* methods. Lectures, office hours, group work, etc. will all be done using online communication tools. While not optimal, I've taught Westside campus classes for several years that were taken by students away on internships who excelled in them. Many of these students have sent me unsolicited feedback (after their graduation) that they found those courses very beneficial to their careers.

Nevertheless, I want to acknowledge that we're operating in unusual circumstances. The current COVID-19 pandemic is affecting all of us in various ways, both big and small. PSU is working to keep the community informed (see <https://www.pdx.edu/coronavirus-response>) and you are not alone. Faculty are adjusting course plans to accommodate remote teaching and I anticipate we may have to make additional changes as the term progresses and we learn what is and is not working. Please reach out if you have questions or concerns.

Course Description: Introduction to the principles of modern operating system design. Topics include: introduction to basic operating system concepts, processes, inter-process communication and concurrent programming, scheduling, memory management, file systems, device management, introductions to protection & security, RTOS structure and operation. Linux will be used for class examples and lab assignments.

Prerequisites: ECE 361 or equivalents (includes exposure to C programming in a Unix environment)

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Office Hours: Monday 11am, Friday 2:30pm, or by appointment.

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D2L website active: Lecture notes, homework assignments and dropbox, announcements, etc.

ECE compute servers: Please use either `auto` or `mo` to complete assignments. While the college offers other machines that run some of the software packages used in this class, it may not be configured properly and assignments that require use of software tools will be graded based on whether or not turned in solutions work on one of these servers.

Zoom: We will use Zoom for virtual meetings. Your use and my use of Zoom is governed by the [Acceptable Use Policy](#) and PSU's [Student Code of Conduct](#). A record of all meetings and recordings is kept and stored by PSU, in accordance with the Acceptable Use Policy and FERPA. Individual use and distribution of recording is limited to academic purposes. Class recording content cannot be shared outside of the class without a FERPA release from all course participants.

Lectures will be available for replay, but office hours will not be recorded. Like other ECE faculty, I teach multiple recorded courses each year and we find there are cases when a lecture recording failed. This is a not-so-subtle way of saying that skipping the live lectures figuring you can watch them later is not a good strategy for successfully completing this course.

Background: PSU purchased a Zoom license in September 2019 and all PSU users can access Zoom at pdx.zoom.us with their Odin credentials. Zoom was selected by a faculty-led steering group, replacing Blackboard Collaborate as our virtual classroom solution. Zoom was selected because of its strong reliability and broad menu of features.

Texts:

- Operating Systems: Three Easy Pieces. Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau. Available at: <http://pages.cs.wisc.edu/~remzi/OSTEP/>
- Advanced Programming in the Unix Environment, Third Edition. Stevens and Rago

Course Objectives: The objectives of this course are to provide students with the fundamental concepts of operating systems, and real-time operating systems, specifically the Linux Operating System.

Course Concepts/Student Learning Outcomes: At the end of this course, students will be able to:

1. Describe the basic components and organization of a modern operating system, such as Linux.
2. Use man pages, debugging tools, and basic Linux command-line programs.
3. Describe the basic components and layers of the Linux kernel.
4. Describe the Linux process scheduler, including processes, priorities, and protections.
5. Write shell scripts that fork processes, use file I/O, and access system resources.
6. Write concurrent C/C++ programs that use multiple processes, threads, synchronization, semaphores, and locks.
7. Understand and be able to avoid deadlocks and livelocks in simple programs.
8. Program file I/O operations
9. Understand the Linux memory management process, including paging.
10. Write simple programs that meet real-time constraints.

Outline of Course Content

- Basic Operating System Design
 - implementation/structure/organization
 - performance/quality/reliability/security
- Process Management
 - multi-programming
 - scheduling
 - process synchronization
 - inter-process communication and concurrent programming
 - deadlock and starvation
- Storage Management
 - memory management
 - file systems
- Device management and I/O systems
- Distributed Systems
- Embedded and RTOS Systems

Course Requirements: midterm (30%), final (40%), homework (30%)

There will be approximately 5 homework assignments. To pass the course, each assignment must be turned in on or before its due date. Assignments may be done in groups of 2. If you choose to work in a group, please turn in only one solution, indicating the names of all group members. Of course, individually, you will be expected to understand the material and demonstrate so on exams.

The text is in widespread use across the country and solutions can sometimes be found through web surfing or from previous classes. **Doing so is very counterproductive!** To pass exams, you'll need to develop analysis skills by working through problems. I strongly encourage you to come to my office hours after struggling and we'll work out the correct answer together.

Grading: Grades are not curved. The course covers material that you need to know to be a successful engineer. Percentage grades can be converted to letter grades as follows:

	A >93%	A- >90%
B+ >87%	B >83%	B- >80%
C+ >77%	C >73%	C- >70%
D+ >67%	D >63%	D- >60%
F	Below 60%	

Attendance: As a student in this class, you are expected to attend each class meeting. Attendance is essential for success. Unfortunately, absences are sometimes unavoidable. If you are absent, it is your responsibility to find out what work was covered.

Professionalism: In our worldwide discipline, we work with many people with different genders, cultures, races, sexual preferences, religions, political affiliations, etc. We expect a culture of professionalism and mutual respect in our department. To pass this course, each student must demonstrate they are a good team player. Students are expected to work/learn in a harassment free environment with the highest professional standards.

Safe Campus: As an instructor, one of my responsibilities is to help create a safe learning environment for my students and for the campus as a whole. Please be aware that as a faculty member, I have the responsibility to report any instances of sexual harassment, sexual violence and/or other forms of prohibited discrimination. If you would rather share information about sexual harassment, sexual violence or discrimination to a confidential employee who does not have this reporting responsibility, you can find a list of those individuals. For more information about Title IX please complete the required student module *Creating a Safe Campus* in D2L.

Academic Honesty: I enjoy teaching very much and consider students to be professionals. Thus cheating is an extremely depressing thing for me to encounter and will be taken very seriously. Cheating is definitely not just a harmless prank. It can have very serious effects, harmful to your standing at the university, and also possibly very harmful to your job prospects when you seek employment after graduation. The penalty for cheating is an F in the course and a letter describing the incident sent to the Vice Provost for Student Affairs. Please avoid any actions during an exam (e.g. talking, looking around, etc.) which might make the exam proctors doubt your honesty.

Doing Well: Lectures cannot cover all aspects of the material. Much of the detail will be learned through exercises or supplied by consulting the book. The reading assignments are absolutely crucial to success in the course, so make sure that you set aside enough time to do the reading carefully, thoroughly and thoughtfully. Ask me about anything that you don't understand, no matter how minor it seems. Finally, note that grading is non-competitive, so it is possible for everyone to do well.