ECE469: Operating Systems Engineering
Spring 2023 Syllabus

Course Information

CRN:	17479
Meeting time:	3:00pm – 4:15pm Tuesday and Thursday
Meeting venue:	University Church 114
Course credit hours:	4
Course web page:	https://engineering.purdue.edu/~ee469/
Piazza web page:	https://piazza.com/purdue/spring2023/ece469 (access code: notpizza)
Teaching staff email:	ee469@ecn.purdue.edu
Prerequisites:	ECE368 (Data Structures), [Optionally] ECE437 (Computer Design and Prototyping). Programming proficiency in C is *absolutely* required.

Instructor and TAs Contact Information

Name of the instructor:	Y. Charlie Hu
Office Location:	MSEE 232
Email Address:	ychu@purdue.edu
Office hours, times & location:	1:00 – 3:00pm Wednesday via Zoom: https://zoom.us/j/4683658957 Additional in-person office is available by request (please email the Instructor).
Teaching Assistants:	Xinqi Jiang (jiang679@purdue.edu) Ravi Gokulan (ravig@purdue.edu) Zeyang Yu (yu742@purdue.edu)
TA group email:	ee469@ecn.purdue.edu

Course Description

This course will cover basic design principles of major components of modern Operating Systems:

- Processes Management: processes, threads, CPU scheduling, inter-process communication, process synchronization, mutual exclusion, deadlocks;
- Memory Management: dynamic address relocation, segmentation, paging, virtual memory, page replacement algorithms, protection, sharing;
- File Systems: file system interface, file system implementation, including directories, disk allocation, disk scheduling, memory-mapped files, Network File System
- Storage Systems: Disk structure, disk scheduling, swap-space management, RAID.

The course will additionally introduce (1) system design principles including extra-level of indirection, optimizing the common case, separation of policy and mechanism, and the principle of locality and caching, (2) advance OS topics such as Network File System, and (3) Case study of a modern OS such as Linux. Students are expected to spend at least three hours per week gaining hands-on experience building major components of a modern time-sharing operating system.

Teaching Philosophy

As the instructor, it is my responsibility to maximize opportunities for every student in the class to learn, grow, and succeed in reaching their personal goals and desires related to the class. To meet this responsibility, I draw on the first-hand experiences teaching this course in the past two decades to develop and implement two key ingredients to the

effective learning of this subject: active in-class discussions and extensive hands-on programing projects outside the classroom.

How to Succeed in this Course

If you want to be successful in this class:

- Be self-motivated and self-disciplined.
- Be open-minded and have curiosity
- Be good at time management as programming projects (3) come in large chunks
- Be effective working as a team (of 2).
- Be willing to "speak up" if problems arise.
- Be willing and able to commit to 5 to 10 hours per week.
- Accept critical thinking and decision making as part of the learning process.

Learning Resources, Technology, & Texts

- Textbook: Silberschatz, Galvin, and Gagne, *Operating System Concepts*, 10th (or Essentials, 8th, 7th) edition, John Wiley & Sons.
    - You will read approximately 500 pages of the textbook that cover the topics discussed in class
- Lecture note: If available, notes for the lectures will be made available on the Web at engineering.purdue.edu/~ee469/lectures. These notes are not necessarily self-contained, complete, or coherent. They are provided to aid you in your own note-taking. They are certainly not a substitute for attending class.
- Software: We will be using DLXOS, an OS emulator for doing the programming projects.

Learning Objectives

A student who successfully fulfills the course requirements will be able to

1. understand basic concepts of processes, process control, synchronization, scheduling (1,a)
2. understand concepts and technologies in memory management, secondary and tertiary storage management, file system, and distributed and networked operating systems. (1,3,a)
3. model and analyze the performance of OS components (1, 2, 4, a, b)
4. design and modify components of an operating system (1, 4, 3, a, b, c, e, k)

Course Schedule

Week	Topic & Readings	Book Chapters
1	Intro to OS	*1-2*
2	Processes and Threads	3-4
3-5	Process Synchronization	6
6	CPU Scheduling	5
7	Deadlocks	*7*
8-11/12	Memory Management	*8-9*
10	Spring break	
12-15	File System	*10-13*
16	Course review	*Lecture notes*

* Schedule and assignments subject to change. Any changes will be posted in the learning management system.

Course Logistics

- The lectures will be in-person.
- There are no written homeworks in this class.
- There may be up to three pop quizzes during class.
- All programming projects are due on Monday midnights. No extensions will be given except for medical and other emergency reasons, as typically the next project starts right after the previous project is due.
- The midterm and final exams will be closed book.

Instructor's Email Availability and Policies

The Instructor will be available via email daily, and try to respond as soon as possible (generally within 24) hours. When emailing the instructor, please place the course number/section and the topic in the subject line of the email (*e.g.,* ECE469 – Lecture 3 Question). This will help the instructor tremendously in locating and responding to your emails quickly.

Office Hours

Office Hours are a synchronous session (through Zoom) to discuss questions related to weekly lectures, exams, or programming projects. Office hours will be held Wednesdays from 1:00-3:00 pm EST. To connect to the weekly session, go to the instructor's Zoom room: https://zoom.us/j/4683658957.

Additional in-person office hour is available by request (please email the instructor.)

Assignments, Exams, and Points

Your learning will be assessed through a combination of programming projects, a midterm and a final exam, and class interactions (such as pop quizzes). Details on these assignments and exams will be posted on the course website.

Assignments	Due	Points
Pop quizzes	Throughout the semester	Up to 6
Programming project 1	Jan 23 (1 week)	0 (not graded)
Programming project 2	Feb 13 (3 weeks)	15
Programming project 3	Mar 6 (3 weeks)	15
Programming project 4	Apr 3 (4 weeks, incl spring break)	15
Programming project 5	Apr 24 (3 weeks)	15
Midterm exam	March 9	20
Final exam	TBD	20
Total	(n/a)	100 (up to 106)

* Final exam will be non-cumulative – it will only cover topics discussed after the Midterm exam.

Programming Projects

The programming projects in this course are to build an operating system for a simulated architecture using Linux machines (Linux is a POSIX-compliant version of UNIX which runs on x86 architectures). The students will be building three major components of modern operating systems (e.g. virtual memory, file system). The projects are to be done in groups of two students, but you have the option to work independently.

Questions and Answers Regarding Programming Projects
This term we will be using Piazza to share both the questions and the answers to common problems encountered in doing the programming projects (Solutions should by no means be shared.) The system is highly catered to getting you help fast and efficiently from classmates and the TA. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com. Find our class piazza signup link at: https://piazza.com/purdue/spring2023/ece469 (signup code: notpizza)

Late policy and extensions

Each group is allowed to request an extension for up to 2 days for all labs, i.e., **you have two days of extension that you can use for labs. However, each day extension comes with a penalty of 10% on the grade of the corresponding lab.** For example, if a group requests 1 day extension for a lab, then the total grade for that lab would be 90% of the achieved grade. Similarly, a 2-day extension results in 80% of the total grade. **Please email the TAs (ee469@ecn.purdue.edu) to request an extension for a lab.**

Missed or Late Work under special circumstances

Deadline-missed programming projects may only be made up without penalty if (1) it was due to medical or other emergency reasons and (2) when you notify the instructor ahead of time with an explanation and plan for completion. These requests will be accepted at the instructor's discretion.

Grading Scale

In this class, the grades reflect the sum of your achievement throughout the semester. You will accumulate points as described in the assignments portion above, with each assignment graded according to a rubric. At the end of the semester, final grades will be calculated by adding the total points earned and translating those numbers (out of 100 plus bonus points) into the following letters (fraction points will be rounded up):

- A+: > 95
- A: [91, 95]
- A-: [86, 90]
- B+: [82, 85]
- B: [79, 81]
- B-: [76, 78]
- C+: [72, 75]
- C: [69, 71]
- C-: [66, 68]
- D: [56, 65]
- F: 55 or below

Note that failure to demonstrate the Learning Objectives for the class will result in a failing grade. Please see class webpage https://engineering.purdue.edu/~ee469/ for whether you achieve the Learning Objectives.

Incompletes

A grade of incomplete (I) will be given only in unusual circumstances. To receive an "I" grade, a written request must be submitted prior to December 1, and approved by the instructor. The request must describe the circumstances, along with a proposed timeline for completing the course work. Submitting a request does not ensure that an incomplete grade will be granted. If granted, you will be required to fill out and sign an "Incomplete Contract" form that will be turned in with the course grades. Any requests made after the course is completed will not be considered for an incomplete grade.

Attendance Policy

This course follows Purdue's academic regulations regarding attendance, which states that students are expected to be present for every meeting of the classes in which they are enrolled. Attendance will be taken at the beginning of each class and lateness will be noted. When conflicts or absences can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to the instructor is not possible, the student should contact the instructor as soon as possible by email or phone. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases falling under excused absence regulations, the student or the student's representative should contact or go to the Office of the Dean of Students website to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted for cases of grief/bereavement, military service, jury duty, and parenting leave. For details, see the Academic Regulations & Student Conduct section of the University Catalog website.

Academic Guidance in the Event a Student is Quarantined/Isolated

If you must miss class at any point in time during the semester, please reach out to me via Purdue email so that we can communicate about how you can maintain your academic progress. For COVID-19 concerns, please see the **Fall 2022: What you need to know guidance published July 27**. If you find yourself too sick to progress in the course, notify your adviser and notify me via email or Brightspace. We will make arrangements based on your particular situation.

Classroom Guidance Regarding Protect Purdue

Any student who has substantial reason to believe that another person is threatening the safety of others by not complying with Protect Purdue protocols is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights and the Violent Behavior Policy under University Resources in Brightspace.

Academic Integrity

As a student at Purdue you are subject to the *Purdue University Student Code of Conduct*, which enjoins you to respect the highest standards of honesty and integrity. All work that you submit in this course must be your own; unauthorized group efforts are considered academic dishonesty. See the online brochure *Student guide for academic Integrity* for definitions and sanctions. Academic dishonesty is a serious offense which may result in suspension or expulsion from the University. In addition to any other action taken, such as suspension or expulsion, a **grade of F** will normally be recorded on the transcripts of students found responsible for acts of academic dishonesty.

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

The Purdue Honor Pledge: "As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue"

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Link to Purdue's nondiscrimination policy statement.

Accessibility

Purdue University is committed to making learning experiences accessible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247."

Mental Health Statement

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If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack**.** Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. Considering the significant disruptions

caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the Critical Needs Fund.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

You are encouraged to familiarize yourself with Purdue University Key Emergency Preparedness Resources.

Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.

See the University's full violent behavior policy for more detail.

Diversity and Inclusion

1. In our discussions, structured and unstructured, we will explore a variety of challenging issues, which can help us enhance our understanding of different experiences and perspectives. This can be challenging, but in overcoming these challenges we find the greatest rewards. While we will design guidelines as a group, everyone should remember the following points:
    - We are all in the process of learning about others and their experiences. Please speak with me, anonymously if needed, if something has made you uncomfortable.
    - Intention and impact are not always aligned, and we should respect the impact something may have on someone even if it was not the speaker's intention.
    - We all come to the class with a variety of experiences and a range of expertise, we should respect these in others while critically examining them in ourselves."

2. This course, as with every course offered at Purdue, plays a part in creating and sustaining a welcoming campus where all students can excel. There are many initiatives in the School of ECE and supported by the university focused on this goal, and this course is designed to take advantage of those resources. Learning experiences and assignments address diversity and inclusion, not because they are "topics," but because they are necessary to prepare students to be successful in a diverse, global environment.

3. We strive for equity, providing equal access and opportunity, and working to maximize student potential. This requires both instructor and students to identify and remove barriers that may prevent someone from full access or full participation. You can help by:
    - Contacting me, anonymously if needed, if you see a potential barrier for someone or yourself in participating fully in the class. This might be a physical barrier such as access to technology or a personal situation.
    - Suggesting ways in which members of our class can support each other. Virtual study groups and discussion boards are examples, but I encourage you to be creative in your ideas.

- Getting to know each other as contributing members of our learning community. Everyone has something to contribute, and while I designed the course to take advantage of the wealth of knowledge, expertise, and experience we bring together, I cannot do it well without your participation. There are many opportunities built into this course for this type of work. It is important we do it together.

Course Evaluation

During the last two weeks of the course, you will be provided with an opportunity to evaluate this course and your instructor. Purdue uses an online course evaluation system. You will receive an official email from evaluation administrators with a link to the online evaluation site. You will have up to two weeks to complete this evaluation. Your participation is an integral part of this course, and your feedback is vital to improving education at Purdue University. I strongly urge you to participate in the evaluation system.

Disclaimer

This syllabus is subject to change. The Instructor will announce and share changes made to the syllabus via the class mailing list (which you are all automatically subscribed to).