Course Information

Course Number:	CSCE 410
Course Title:	Operating Systems
Section:	500
Time:	MWF 10:20 AM – 11:10 PM
Location:	ZACH 350
Credit Hours:	3

Instructor Details

Instructor:	Chia-Che Tsai
Office:	PETR 228
E-Mail:	chiache@tamu.edu
Office Hours:	Monday 11:30 AM - 12:30 PM (PETR 214) Thursday 1:00 PM – 2:00 PM (Zoom ID: 97398779249 Passcode: 627171)

Course Description

The objective of this course is to make you familiar with the general architecture and the most critical components of operating systems. You will leverage your knowledge acquired in your previous courses on Computer Architecture and Computer Systems to understand and implement aspects of operating systems, such as system calls, processes, memory management, scheduling, threading, synchronization, file systems, and I/O devices. We will cover general aspects, realization approaches, and case studies. In addition, we will implement extensions to the open-source Linux kernels and operating system libraries in the user space.

Course Prerequisites

CSCE 313 (and its corequisites CSCE312/ECEN350), CSCE 315. In particular, the course assumes some familiarity with low-level programming, some understanding of interrupts from a hardware perspective, and some practice with multithreaded programming and synchronization.

Special Course Designation

This course has no special designation.

Course Learning Outcomes

Upon completion of the course, students should be able to:

- *Describe the role, the architecture, and the major components of an operating system.*
- *Describe the role and operations of kernels, system calls, exceptions and interrupt handling.*

- *Implement a virtual memory manager for a paged system.*
- *Describe and compare various forms of concurrency mechanisms.*
- *Describe and compare various synchronization mechanisms, both for single-processor and multiprocessor systems.*
- *Implement a threading system.*
- *Implement a simple file system in the user space.*

Textbook and/or Resource Materials

Textbook: Operating Systems: Three Easy Pieces by Remzi and Andrea Arpaci-Dusseau. This book is available for free at: https://pages.cs.wisc.edu/~remzi/OSTEP/

Grading Policy

This course will adopt the following grading scale:

A = 90-100 B = 80-89 C = 70-79 D = 60-69 F = <60

The grading will be based on textbook discussion, midterm and final exams, and projects. The weights of the activities and the correspondent policies are as follows:

Activity	*%*	*Policies*
Midterm Exams	*35*	***Three midterm exams** will be taken through the duration of the course. The exams will be based on the operating system concepts discussed in class. All the exams will be **in-person, closed-book exams**. The materials covered in each exam will NOT be accumulative; the same topics will not be covered in two exams.* *Students are allowed to bring a **double-sided A4-size note** to the exams.* *The highest score of the three exams will be worth 15% of the semester grade. The scores of the other two exams will each be worth 10% of the semester grade.*
Projects	*60*	***Six projects** will be finished through the duration of the course. No team submission is allowed; students must submit their projects individually.* *The three highest scores of the projects will each be accounted for 12% of the semester grade. The scores of the other three projects will each be accounted for 8% of the semester grade.*

Collaborative Note Taking	*5*	*Students can share lecture notes to gain extra points for the semester. Each student must submit an independently taken note for one course lecture to gain 0.5% of the semester grade. The maximum points each student can gain from sharing notes is 5%.* *Each note submitted must be complete and well-organized. Notes of poor quality will be returned by the instructor. To be counted toward semester grade, the note must be shared through the google drive* ***within one week (7 days)*** *from the lecture given, before 11:59 PM.*

Late Work Policy

Each student is allowed with at most 3 free late days throughout the whole semester, without any late submission penalty. Students can use the free late days on any project and must specify the free late days used when submitting a project. Without any free late days, a student will receive 20% penalty for each extra late day used on a project. For example, if a student has submitted a project three days after its deadline, and the student has specified to use exactly one free late day, the student will receive 40% penalty on the score of the project.

No late day is allowed for collaborative note taking. All notes must be submitted within 7 days after the lectures (before 11:59 PM).

Course Schedule

Date	Topic
Week 1: Introduction	
8/24	Topic: Introduction to Operating Systems Required Reading: OSTEP - 2. Introduction
8/26	Topic: Let's Hack - Building Your Own Linux Kernel Releasing "Project 1: Building Your Own Linux Kernel"
Week 2: System Calls	
8/29	Topic: Kernel Required Reading: OSTEP - 6. Direction Execution
8/31	Topic: System Calls Required Reading: OSTEP - 6. Direction Execution

9/2	Topic: Let's Hack - Linux System Calls Releasing "Project 2: System Calls"
9/5	Labor Day (No Class)
Week 3: Processes & Address Spaces	
9/7	Topic: Processes Required Reading: OSTEP - 4. Processes
9/9	Topic: Address Spaces Required Reading: OSTEP - 13. Address Spaces "Project 1: Building Your Own Linux Kernel" due before 11:59PM
Week 4: Address Translation	
9/12	Topic: Address Translation Required Reading: OSTEP - 14. Address Translation
9/14	Topic: Page Tables Required Reading: OSTEP - 18. Introduction to Paging
9/16	Topic: x86 Page Table Required Reading: OSTEP - 20. Advanced Page Table
Week 5 & 6: Memory Management	
9/19	Topic: Free Memory Management Required Reading: OSTEP - 17. Free Space Management
9/21	Topic: Demand Paging & Swapping Required Reading: OSTEP - 21. Swapping Mechanism
9/23	Topic: Let's Hack - Linux Page Management Required Reading: OSTEP - 23. Complete VM Systems Releasing "Project 3: Paging in Linux Kernel"
9/26	Topic: Page Replacement Policy Required Reading: OSTEP - 22. Swapping Policies "Project 2: Linux System Calls" due before 11:59PM
9/28	Topic: Translation Lookahead Buffers Required Reading: OSTEP - 19. Translation Lookahead Buffers
9/30	Midterm I

Week 7: CPU Scheduling	
10/3	Topic: CPU Scheduling Required Reading: OSTEP - 7. CPU Scheduling
10/5	Topic: Multi-Level Scheduling Required Reading: OSTEP - 8. Multi-Level Feedback
10/7	Topic: Fair Scheduling Required Reading: OSTEP - 9. Lottery Scheduling
Week 8: Threading	
10/10	Fall Break (No Class)
10/12	Topic: Threading Required Reading: OSTEP - 26. Concurrency & Thread
10/14	Topic: Let's Hack - Thread Scheduling Optional Reading: OSTEP - 27. Thread API Releasing "Project 4: User-Level Thread Scheduling"
Week 9 & 10: Locks	
10/17	Topic: Locks & Atomicity Required Reading: OSTEP - 28. Locks
10/19	Topic: Locks & Atomicity Required Reading: OSTEP - 28. Locks
10/21	Topic: Locked Data Structure Required Reading: OSTEP - 29. Locked Data Structure
10/24	Topic: Race Conditions Required Reading: OSTEP - 32. Concurrency Bugs
10/26	Topic: Deadlock Required Reading: OSTEP - 32. Concurrency Bugs
10/28	Topic: Let's Hack - User-Level Deadlock Detection Releasing "Project 5: User-Level Deadlock Detection" "Project 4: User-Level Thread Scheduling" due before 11:59PM
Week 11: Synchronization	

10/31	Topic: Conditional Variables Required Reading: OSTEP - 30. Conditional Variables
11/2	Topic: Semaphores Required Reading: OSTEP - 31. Semaphores
11/4	Midterm II
Week 12: Virtual File System (VFS)	
11/7	Topic: File I/O Required Reading: OSTEP - 39. Files and Directories
11/9	Topic: Directories Required Reading: OSTEP - 39. Files and Directories
11/11	Topic: Let's Hack - Linux Virtual File System
Week 13 & 14: Filesystems	
11/14	Topic: File Blocks Required Reading: OSTEP - 40. Filesystem Implementation
11/16	Topic: Inodes Required Reading: OSTEP - 40. Filesystem Implementation
11/18	Topic: Let's Hack - User-Level File System Releasing "Project 6: User-Level File System" "Project 5: User-Level Deadlock Detection" due before 11:59PM
11/21	Topic: Journaling Required Reading: OSTEP - 42. FSCK and Journaling
11/23	Reading Day (No Class)
11/25	Thanksgiving Holiday (No Class)
Week 15 & 16: Device I/O	
11/28	Topic: Device I/O Required Reading: OSTEP - 36. I/O Devices
11/30	Topic: Device Driver Required Reading: OSTEP - 36. I/O Devices

12/2	Topic: Hard Disk Drives Required Reading: OSTEP - 37. Hard Disk Drives "Project 6: User-Level Filesystem" due before 11:59PM
12/5	Instructor Traveling (No Class)
12/7	Midterm III

University Policies

This section outlines the university level policies that must be included in each course syllabus. The TAMU Faculty Senate established the wording of these policies.

***NOTE**: Faculty members should not change the written statements. A faculty member may add separate paragraphs if additional information is needed.*

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below) Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most

instances, a person who is subjected to the alleged conduct will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care by utilizing available resources and services on your campus

Students who need someone to talk to can contact Counseling & Psychological Services (CAPS) or call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.