

Course Information

Course: COP 4610 Operating System
Credit Hours: 3

Lecture Room: HCB (Huge Classroom Building) 01030
Lecture Day/Times: Monday, Wednesday 1:20 p.m.- 2:35 p.m.

Recitation Room: MCH (Milton Carothers Hall) 0201
Recitation Day/Times: Friday, 1:20 p.m. - 2:10 p.m.

Course Website: <https://xinliulab.github.io/FSU-COP4610-Operating-Systems/>

Contact Information

Instructor: Dr. Xin Liu
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Office Hours: Monday, Wednesday, 4:00 a.m.- 5:00 p.m..
Office: James Jay Love Building, 160

Teaching Assistants 1 (Lead): Michael Nguyen mtn18@fsu.edu
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Teaching Assistants 4: Rongchao Xu rx21a@fsu.edu

Course Objectives

■ Fundamental Understanding of Operating System Concepts:

- **Virtualization:** Understand how operating systems virtualize the CPU (processes, scheduling) and memory (address spaces, paging, segmentation, caching, TLBs) to enable secure and concurrent execution.
- **Concurrency:** Learn thread-based programming, synchronization primitives (locks, semaphores, condition variables), and identify common concurrency bugs such as data races and deadlocks.
- **Persistence:** Study file systems, I/O management, and reliability techniques for managing disk-based storage.

■ Low-Level System Programming Proficiency:

- **C Programming:** Gain fluency in writing C programs to interact with OS-level APIs and perform low-level memory operations.
- **UNIX/Linux System Calls:** Use system calls to create/manage processes, memory, and file descriptors.
- **Binary Analysis & Reverse Engineering:** Understand ELF binaries, linking/loading, and security vulnerabilities like buffer overflows and return-to-libc attacks.

■ Practical Application and Problem-Solving:

- **Hands-on Implementation:** Complete programming assignments that involve building or modifying operating system components.

- **Debugging and Troubleshooting:** Identify and resolve issues in system-level code, especially concurrency-related bugs.
- **Understanding System Internals:** Analyze OS design and its impact on performance and security.

■ Secondary Course Objectives:

- **Hardware-Software Interface:** Explore how OS uses hardware features (e.g., MMU, DMA) for resource management.
- **Command-Line Tools and Scripting:** Become proficient in shell scripting and using UNIX tools for automation and debugging.
- **Security Implications:** Identify OS-level vulnerabilities (e.g., buffer overflows, Melt-down/Spectre).
- **Modern OS Context:** Relate OS principles to real-world systems like data centers, HPC platforms, and AI servers.

Course Prerequisites

- CDA 3100: Understanding of computer organization.
- COP 4530: Understanding of data structures.

Course Material

- **Textbook:** Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau, Operating Systems: Three Easy Pieces.
(Note: Free and legal electronic versions are available online.).
- **Slides and Codes:** Available directly on the course website.

Computer Accounts

- **GitHub Account:** You will need a GitHub account to access course assignments and use GitHub Codespaces.
- **GitHub Student Developer Pack:** It is strongly recommended to apply for the GitHub Student Developer Pack to access free credits for Codespaces and other developer tools.
- **FSU Email:** You will need a `my.fsu.edu` account for receiving class emails. For more information, visit: <https://servicecenter.fsu.edu/s/article/Email-Account-Management-Information2>.

Your Responsibilities

- Check the course website and your email account regularly
- Understand the lecture slides and reading assignments
- Uphold academic honesty in completing your assignments, projects, and exams
- Turn in your projects on time
- Attend office hours for extra help, as needed

Course Calendar

- For the most up-to-date course calendar, including lecture topics, assignment deadlines, and exam dates, please refer to the course website.
- In recitation sessions, the TAs will present materials pertaining to the course projects.

Week	Date	Topic	Notes
Introduction			
1	8/25 (M)	L1: Preparation for Learning OS (Linux, VS Code, GitHub, JSON, and AI)	Mandatory attendance.
	8/27 (W)	L2: Hello, OS World! (Viewing Operating Systems from Multiple Angles)	HW 1 posted
	8/29 (F)	Recitation	Proj 1 released
Virtualization: Creating a Universe for "Hello World"			
2	9/1 (M)	No class due to Labor Day.	
	9/3 (W)	L3: Interacting with the OS (OS Structure, System Call, Object, File Descriptor, and Pipe)	HW 1 DDL HW 2 posted
3	9/8 (M)	L4: Programs and Processes (Definition, Creation, and Management)	
	9/10 (W)	L5: Terminal and UNIX Shell (Terminal, Sessions and Process Groups, Shell Programming)	HW 2 DDL HW 3 posted
4	9/15 (M)	L6: Process' Address Space (Initial State, Management, and Hacking)	
	9/17 (W)	L7: Address Translation (Protection, Segmentation, and Paging)	HW 3 DDL HW 4 posted
5	9/22 (M)	L8: Caching (Cache Hit/Miss, TLB, Meltdown and Spectre Attack)	
	9/24 (W)	L9: Stack (Stack Layout and Return Address)	HW 4 DDL HW 5 posted
6	9/29 (M)	L10: More on Stack (Shell Code and Buffer Overflow)	Proj 1 DDL
	10/1 (W)	L11: ELF (From ELF to EXE and Hacking)	HW 5 DDL HW 6 posted
	10/3 (F)	Recitation	Proj 2 released
7	10/6 (M)	L12: libc (Dynamic Linking, GOT, PLT, ret2libc, ROP, GOT Leak)	
	10/8 (W)	Midterm Exam Review	HW 6 DDL
Concurrency: Why Doesn't 1+1 Equal 2?			
8	10/13 (M)	L13: CPU Scheduling (Threads, Dispatching, and Scheduling Policies)	
	10/15 (W)	Midterm Exam (1:20 p.m. – 2:35 p.m.)	HW 7 posted
9	10/20 (M)	L14: Shared-Memory Concurrency (Multithreading Model, Libraries, and Challenges)	
	10/22 (W)	L15: Mutual Exclusion (Exclusion, Peterson's Algorithm)	HW 7 DDL HW 8 posted
10	10/27 (M)	L16: More on Mutual Exclusion (Spin Locks, Mutexes, and Futexes)	
	10/29 (W)	L17: Synchronization (Producer-Consumer, Condition Variables)	HW 8 DDL HW 9 posted

Week	Date	Topic	Notes
11	11/3 (M)	L18: More on Synchronization (Semaphores, Dining Philosophers)	Proj 2 DDL
	11/5 (W)	L19: Concurrency Bugs and Debugging (Deadlocks, Data Races, Atomicity/Ordering Violations)	HW 9 DDL HW 10 posted
	11/7 (F)	Recitation	Proj 3 released
12	11/10 (M)	L20: Real World Concurrent Programming (HPC, Data Center, Web, AI)	
Persistence: Teaching Software to Speak to Hardware			
12	11/12 (W)	L21: Storage Device and File Systems (Storage Methods, Abstraction, Sharing, Directory, FAT, ext2)	HW 10 DDL HW 11 posted
13	11/17 (M)	L22: Data Reliability and Modern Storage Systems (RAID, Crash, FSCK, Journaling, Distributed Storage)	
	11/19 (W)	L23: I/O Device (Interface, Bus, Interrupt, DMA, Heterogeneous Computing)	HW 11 DDL HW 12 posted
14	11/24 (M)	L24: Device Driver (Abstraction, Design, CUDA)	
	11/26 (W)	No class due to Thanksgiving.	
15	12/1 (M)	Final Exam Review	HW 12 DDL
	12/3 (W)	L25: What Makes Android a Good OS? (Code from Classroom to Global Stage)	
	12/5 (F)	Recitation	Proj 3 DDL
16	12/9 (M)	No Class due to Final Examination Week.	
	12/10 (W)	Final Exam (1:20 p.m. – 2:35 p.m.) NO MAKE-UPS	

Course Evaluation and Grading Policies

The following coursework components contribute to your final grade, and to the degree shown:

In-Class Quizzes:	7%
Homework Assignments:	28%
Exams (2 total):	30%
Projects (3 total):	35%

- Assignments consist of short-answer questions, essays, or problems. The purpose of these assignments is to prepare you for exams.
- On exams, 80% of the questions asked will be based on lecture materials, assignments, and projects; 20% of the questions will test your ability to apply various principles learned in the class.
- The midterm exam will cover the course content related to process management, while the final exam will cover memory, file and network management.
- There will be three increasingly challenging projects due during this course. You are expected to work in teams of two to three people. For both homework and projects, if you receive help from others, or if you find helpful information from various sources, please include appropriate acknowledgements.

Letter grades are assigned based on the final percent using the cut-off values:

Grade	% bound
A	93 - 100
A-	90 - 92.9
B+	87 - 89.9
B	83 - 86.9
B-	80 - 82.9
C+	77 - 79.9
C	73 - 76.9
C-	70 - 72.9
D	60 - 69.9
F	<60

Course Policies, Support Services, and Other Information

Missed Exam Policy

Unexcused missed exams and homework will be given a grade of 0. See the University Attendance Policy for a discussion of valid reasons to excuse absences: https://registrar.fsu.edu/bulletin/graduate/information/academic_regulations/.

Grade of “I” Policy

Incomplete (“I”) grades should be recorded only in exceptional cases when a student, who has completed a substantial portion of the course and who is otherwise passing, is unable to complete a well-defined portion of a course for reasons beyond the student’s control. Students in these circumstances must petition the instructor and should be prepared to present documentation that substantiates their case.

University Attendance Policy

Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

Academic Honor Policy

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to "...be honest and truthful and...[to] strive for personal and institutional integrity at Florida State University." (<http://fda.fsu.edu/Academics/Academic-Honor-Policy>).

For this course, in particular, every student must complete his/her assignments, quizzes, and exams independently. Showing your work to your peers or making it accessible to them is considered academic dishonesty. You are responsible for ensuring that your work is adequately protected and not accessible to others.

Americans with Disabilities Act

Students with disabilities needing academic accommodation should:

1. Register with and provide documentation to the Student Disability Resource Center (SDRC).
2. Bring a letter to the instructor indicating the need for accommodation and the specific type required.

Please note that instructors cannot provide classroom accommodations until appropriate verification from the SDRC has been received. This syllabus and other class materials are available in alternative formats upon request.

For more information about services available to FSU students with disabilities, please contact the SDRC:

- Address: 874 Traditions Way, 108 Student Services Building, Florida State University, Tallahassee, FL 32306-4167
- Phone: (850) 644-9566 (voice), (850) 644-8504 (TDD)
- Email: sdrc@admin.fsu.edu
- Website: <http://www.disabilitycenter.fsu.edu>

Confidential Campus Resources

Various centers and programs are available to assist students with navigating stressors that might impact academic success. These include the following:

- **Victim Advocate Program:** University Center A, Room 4100, (850) 644-7161, Available 24/7/365, Office Hours: M-F 8-5, <https://dsst.fsu.edu/vap>
- **University Counseling Center:** Askew Student Life Center, 2nd Floor, 942 Learning Way, (850) 644-8255, <https://counseling.fsu.edu/>
- **University Health Services:** Health and Wellness Center, (850) 644-6230, <https://uhs.fsu.edu/>

Free Tutoring from FSU

On-campus tutoring and writing assistance are available for many courses at Florida State University. For more information, visit the Academic Center for Excellence (ACE) Tutoring Services' comprehensive list of on-campus tutoring options at <http://ace.fsu.edu/tutoring> or contact tutor@fsu.edu. High-quality tutoring is available by appointment and on a walk-in basis. These services are offered by tutors trained to encourage the highest level of individual academic success while upholding personal academic integrity.

Late Policy and Make-up Exams

- Late assignments will not ordinarily be accepted. If, for some compelling reason, you cannot hand in an assignment on time, please contact the instructor as far in advance as possible.
- No credit will be given to late course projects.
- No make-up exams (except under extremely unusual circumstances).

Syllabus Change Policy

Except for changes that substantially affect the implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.