College of Applied Science & Technology

1140 N. Colombo Ave.
Sierra Vista, AZ 85635
Tel: 520-458-8278
Fax: 520-458-5823
www.uas.arizona.edu

CSCV 452 Principles of Operating Systems Syllabus

1 General Catalog Information

Description: Concepts of modern operating systems; concurrent processes; process synchronization and communication; resource allocation; kernels; deadlock; memory management; file systems.

Expected Workload/Credit hours Components(s): This is a 3 unit course. As such, this course requires a minimum of 135 work hours consisting of 45 contact hours and 90 homework hours.

Credits: 3

Instructor: Li Xu, email *lxu@email.arizona.edu*

This is my preferred communication. I usually respond emails within 24 hours, excluding messages sent to me on Sundays.

Weekly Meeting Time: Mondays and Wednesdays, 4:00-5:15PM (Arizona Time Zone). This is an online course. However, I offer two meetings weekly. You are welcome to join me during the meeting time. I use the meetings to record lectures and code demos. The meetings are conducted with the support of Zoom. All meetings will be recorded and meeting records are available at the D2L course site.

Office Room: I will conduct office hours using my personal Zoom space.

Cell Phone: *520-220-1889.*

Office hours: I am typically available online at D2L Zoom space on Tuesdays and Thursdays between 11:00am and 2:00pm for questions. Please send me emails to schedule our online meetings.

2 Information Resources:

Homepage: d2l.arizona.edu. UA NetID account and password required to login. **Textbook:**

Required: Andrew S. Tanenbaum and Herbert Bos,

Modern Operating Systems, 4th Edition, 2015 Pearson Prentice Hall, ISBN 0-13-359162-X

The other reading materials will be distributed at D2L course site.

Course Home Page: d2l.arizona.edu. Check D2L course home page frequently, as this is where I will post assignment clarifications, due date changes, etc.

Online Discussion: d2l.arizona.edu. Check discussion forums frequently, as the class allows, encourages, and **requires** you to post (and answer) questions.

3 Course Objectives

A successful student will be able to understand the functions provided by a computer operating system (OS), the basic components in OS , and the interactions among the various components. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, I/O management, and file systems. The students will implement solutions using C, and through the USLOSS simulator.

4 Learning Outcomes

By the end of the course, the student will:

- Explain the evolution and objectives of operating systems;
- Explain the major functions of an operating system and describe issues relating to the design and implementation of operating systems;
- Identify and explain the inter-relations among the various components that make up an operating system;
- Identify and explain the inter-relationship between the operating system and the architecture of the computer;
- Synthesize and evaluate operating system and system architecture implications; and
- Produce components of an operating system including kernel- and user- process creation and communication, I/O device drivers, interrupt handlers, and system calls.

5 Course Schedule

Be advised that the course schedule lists the major topics to be covered. Smaller items could be added or removed later.

- Week 1 Introduction to Operating Systems
  - Learning objectives—Upon completion students will be able to
    - explain the functions of OS
    - identify computer hardware components encapsulated by OS
    - identify various kinds of operating systems
    - explain key concepts of OS including process, file, I/O, and system call
    - compare and contrast various OS structures in modern operating systems
  - Learning activities
    - Go over Course Syllabus

        * Read textbook Chapter 1.1 through 1.7
        * Go through Introduction slides
        * Watch video AT&T Archives: The UNIX Operating Systems
        * Online discuss the topic
        * Complete Quiz 1 Introduction to OS
        * Fill in the Project Group Survey

- Week 2: Process and Phase 1
    - Learning objectives—Upon completion students will be able to
        * identify process model and structure
        * identify life cycle of a process
        * implement process model
    - Learning activities
        * Form project development groups
        * Read textbook Chapter 2.1
        * Go through Processes slides
        * Read USLOSS Manual Sections 1—3 and 6.
        * Start to use GitHub
        * Online discuss the topic
        * Complete Quiz 2 Process
        * Start Project Phase 1: The Kernel

- Week 3: Process Scheduling
    - Learning objectives—Upon completion students will be able to
        * describe process scheduling in OS systems

        * compare and contrast scheduling algorithms
        * create process scheduling driven by clock interrupts
        * implement round-robin, priority based CPU scheduling algorithm
    - Learning activities
        * Read textbook Chapter 2.4.1—2.4.5
        * Read USLOSS manual and Project 1 Section 3.2
        * Go through Process Scheduling slides
        * Go through Project 1 implementation slides
        * Go over Phase 1 test cases
        * Online discuss the topic
        * Complete Quiz 3 Process Scheduling
        * Implement project Phase 1

- Week 4: Inter-Process Communication (IPC)
    - Learning objectives—Upon completion students will be able to
        * describe issues on IPC including race conditions
        * compare and contrast solutions to avoid race conditions
        * describe three IPC approaches when solving problems in practice
        * Implement process communications
    - Learning activities
        * Read textbook Chapter 2.3
        * Go through IPC slides
        * Discuss phase 1 test cases
        * Online discuss the topic
        * Work on Quiz 4 IPC

        * Implement project Phase 1

- Week 5: IPC, Deadlock, and Phase 1 Implementation
    - Learning objectives—Upon completion students will be able to
        * describe IPC problems using semaphores
        * describe and identify deadlock
        * implement check-deadlock
    - Learning activities
        * Review textbook Chapter 2.3
        * Review IPC slides
        * Reflect on project Phase 1 implementation
        * Online discuss the topics
        * Complete Quiz 4 IPC
        * Complete Project 1

- Week 6: Message Passing and Phase 2
    - Learning objectives—Upon completion students will be able to
        * describe message passing primitives
        * apply message passing to synchronize processes
        * apply IPC methods to solve classical IPC problems
    - Learning activities
        * Read textbook Chapter 2.3.8 and 2.5
        * Go through Message Passing and Classical IPC Problems slides
        * Read Phase 2 Message Passing and Interrupt Handling
        * Online discuss the topic

        * Start project Phase 2 Message Passing and Interrupt Handling

- Week 7: Message Passing Implementation
    - Learning objectives—Upon completion students will be able to
        * develop data structures to implement message passing
        * develop functions to send and receive messages among processes
    - Learning activities
        * Go through project Phase 2 (part 1) implementation slides
        * Go over project Phase 2 test cases
        * Online discuss the topic
        * Implement project Phase 2

- Week 8: Interrupt Handling in Phase 2 Development
    - Learning objectives—Upon completion students will be able to
        * implement interrupt handling in Phase 2
        * implement interrupt handling via message passing with mailboxes
    - Learning activities
        * Go though Phase 2 (part 2) implementation slides
        * Online discuss the topic
        * Discuss Phase 2 development
        * Work on project Phase 2

- Week 9: More Phase 2 Development
    - Learning objectives—Upon completion students will be able to
        * have a good spring break

  - Learning activities
    * Complete project Phase 2

- Week 10: System Call and Phase 3 Implementation
  - Learning objectives—Upon completion students will be able to
    * introduce Phase 3 User Process and System Call
    * describe system call functions to manage user-level processes
    * compare user- and kernel- level processes
    * develop user-level process management
  - Learning activities
    * Review Phase 3 Specification
    * Go through Project 3 implementation slides
    * Online discuss the topic
    * Complete quiz 5 Memory Management Basics
    * Implement project Phase 3

- Week 11: Memory Management Basics and Phase 3
  - Learning objectives—Upon completion students will be able to
    * identify memory management with abstraction and without abstraction
    * describe virtual memory
    * compare and contrast approaches to manage memory in operating systems
  - Learning activities
    * Read textbook Chapter 3.1through 3.3
    * Go through Memory Management Basics slides
    * Online discuss the topic and reflect on project development

        * Complete Quiz 5 Memory Management Basics
        * Develop project Phase 3 User Process and System Call

- Week 12: Design and Implement Paging Systems
    - Learning objectives—Upon completion students will be able to
        * compare and contrast page replacement algorithms
        * identify issues when designing and implementing paging systems in OS
        * Implement semaphore system call functions
    - Learning activities
        * Read textbook Chapter 3.4 through 3.6
        * Go through Design and Implement Paging Systems slides
        * Online discuss the topic
        * Complete Quiz 6 Design and Implement Paging Systems
        * Complete project Phase 3

- Week 13: Input/Output Hardware and Software and Phase 4
    - Learning objectives—Upon completion students will be able to
        * describe issues to address I/O management
        * identify approaches to programming I/O in OS
        * Identify software layers in I/O management
    - Learning activities
        * Read textbook Chapter 5.1 through 5.3
        * Go through I/O Software and Hardware slides
        * Review USLOSS manual
        * Read and discuss Phase 4 Device Drivers and System Calls

        * Online discuss the topic
        * Work on Quiz 7 Input and Output Basics
        * Start project Phase 4 Device Drivers and System Calls

- Week 14: Device Driver and Phase 4 Development
    - Learning objectives—Upon completion students will be able to
        * implement system call functions for I/O operations
        * implement device drivers for clock device, disk device, and terminal device
    - Learning activities
        * Go through Phase 4 implementation slides
        * Online discuss the topic
        * Complete Quiz 7 Input and Output Basics
        * Implement project Phase 4

- Week 15: File System Basics
    - Learning objectives—Upon completion students will be able to
        * explain concepts of file systems
        * describe how modern operating systems implement file systems
        * compare and contrast multiple file systems
    - Learning activities
        * Read textbook Chapter 4.1 though 4.3
        * Go through File System Basics slides
        * Discuss Phase 4 upon requests
        * Online discuss the topic
        * Work on Quiz 8 File System

    * Implement project Phase 4

- Week 16: File System Management.
  - Learning objectives—Upon completion students will be able to
    * identify techniques to backup file systems and make file system consistency
    * identify techniques to optimize file systems
    * compare and contrast various file systems
  - Learning activities
    * Read textbook Chapter 4.4 and 4.5
    * Go through File System Management slides
    * Discuss Phase 4 upon requests
    * Online discuss the topic
    * Implement project Phase 4
- Week 17: Project Review
  - Learning objectives—Upon completion students will be able to
    * successfully complete the final project report scheduled during the examination week
  - Learning activities
    * Discuss project development on the kernel development
    * Reflect the course learning process and learning outcomes
    * Complete Quiz 8 File System
    * Complete project Phase 4

6 Final Exam

The final report is the designated final exam. Every student is required to write a reflection report, which specification will be available at D2L web site in Week 17. Make sure you check the specification before you start to write the report. The report will be due on May 9.

7 Programming Exercises and Quizzes

Programming exercises and quizzes are due by specified due dates. The programming exercises are designed as pair-programming projects. Please note that it is your responsibility to read assignment specifications in a timely manner and clarify any questions you may have. "I didn't understand what was required" is not an acceptable excuse for incorrect answers to questions or implementation code that doesn't behave as specified.

8 Online Discussion

Online discussions are required in this class. During each week, you are required to write a reflective learning post. (You can post more than one entry each week.) Each post will be due on Saturday except the last one. Late submissions will NOT be graded except extraordinary conditions including being sick, business trips, etc.

For more specific requirements on discussion entries, please check the online document titled *Guidelines for Online Discussion* at D2L.

9 Grades and Grading

I use the common 90-80-70-60 grading scale. It's possible that final grade cutoffs will be lowered a little (from 90% to 89.5% for the bottom of the 'A' range, for example). I make such determinations only at the end of the term, after the final exam has been graded. Note that you are responsible to check your grades of the assessment items at D2L as we

Grading Scale		Grade Distribution (Total: 100%)	
A	90% to 100%	Syllabus Quiz	1%
B	80% to 89%	Online Discussion	19%
C	70% to 79%	Homework Assignments	50%
D	60% to 69%	Online Quizzes	20%
E	Below 60%	Final Project Report	10%

make progress during the term. University policy regarding grades and grading systems is available at: http://catalog.arizona.edu/policy/grades-and-grading-system

10 Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.

Most, if not all, assignments in this class will be individual assignments, to be worked on outside of class. All individual work assigned to you in this class is to be completed only by you. It is not acceptable for you to 'borrow' (a.k.a. steal, copy, coerce, etc.) solutions or parts of solutions from other people or have other people write part or all of your solutions for you. However, it IS acceptable (and encouraged!) for students to help one another understand the assignment requirements and to help one another track down logic errors in exercises. In short, do your own work, but feel free to discuss problems with each other. Of course, you may always ask me, but don't expect that I'll just hand you solutions; I'll make you work for them.

The University Libraries have some excellent tips for avoiding plagiarism available at: http://new.library.arizona.edu/research/citing/plagiarism

All written work is submitted to Turnitin, an anti-plagiarism application that com-

pares submitted assignments to a comprehensive database that includes all published and internet sources as well of hundreds of thousands of student papers. You will be able to see for yourself what percentage of your written work is considered"non-original" once you have submitted it to the appropriate Dropbox in D2L. My position on plagiarism is non-negotiable—any written work that is plagiarized will result in a failure for that assignment and possibly the course. Please familiarize yourself with the rules regarding plagiarism.

11 Incomplete Grades

Requests for in-completes (I) and withdrawal (W) must be made in accordance with university policies which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively.

12 Absence and Class Participation Policy

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, http://policy.arizona.edu/human-resources/religious-accommodation-policy.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: https://deanofstudents.arizona.edu/absences

Both online discussion and **regularly** check D2L course content including announcement posts are essential to your success in this course. Registering for a class is a commitment to participate in learning activities.

13 Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.

The University Libraries have some excellent tips for avoiding plagiarism, available at http://new.library.arizona.edu/research/citing/plagiarism.

14 Code of Conduct

Please review the University's Code of Conduct information, which can be found at: https://deanofstudents.arizona.edu/student-rights-responsibilities/student-code-conduct

15 Classroom Behavior

I expect everyone to conduct her or himself in a professional manner during class. Everybody is expected to support others and contribute to our learning community. If you disagree with the instructor or another students, you are welcome to express your disagreement in a polite and concise manner. You should read the University of Arizona's student code of conduct.

16 Threatening Behavior by Students

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

17 UA Nondiscrimination and Anti-harassment Policy

The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

18 Communication

You are responsible for reading emails sent to your UA account from your professor and the announcements that are placed on the course web site. The official policy can be found at: http://www.registrar.arizona.edu/emailpolicy.htm

19 University's Intellectual Property

Policy:http://policy.arizona.edu/research/intellectual-property-policy

20 Accessibility and Accommodations

It is the University's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations. For additional information on Disability Resources and reasonable accommodations, please visit http://drc.arizona.edu.

If our class meets at a campus location: Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom

seating is not useable.

21 Grade Appeal Policy

https://catalog.arizona.edu/policy/grade-appeal

22 Additional Resources for Students

UA Academic policies and procedures are available at http://catalog.arizona.edu/policies

23 Confidentiality of Student Records

Family Educational Rights and Privacy Act of 1974 (FERPA) is the federal law that governs the rights of students and institutional responsibilities with respect to student records. FERPA is a federal law designed to protect the privacy of a student's educational record. More details on what FERPA is about and specifics of what constitutes an Education Record can be accessed at: http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa

If you have any questions regarding any of the information provided on this site, please contact the University of Arizona Office of the Registrar via email at: REG-reghelp@email.arizona.edu.

24 Honors Credit

Students wishing to contract this course for Honors Credit should email me to set up an appointment to discuss the terms of the contact. Information on Honors Contracts can be found at http://www.honors.arizona.edu/faculty-and-advisors/contracts.

25 Subject to Change Statement

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.