CSPB 3753 - Fall 2024 - Knox - Operating Systems

Course Syllabus (Fall 2024)

Design and Analysis of Operating Systems

CSPB 3753 Syllabus (Fall 2024)

Instructor Name:	David Knox (preferred to be addressed as Dr. Knox or Professor)
Course Communication	All communications with anyone in this course must be respectful (see Classroom Behavior below).
Preferred Method of Caontact:	*Piazza should be used for all class related matters.* Piazza is used to ask questions and get clarifications. All student benefit from the questions and answers that you post. If you are uncomfortable asking questions in public, you can post anonymously (to your classmates) in Piazza. You should use a *private* post to the Instructors when the issue is private. Please use Piazza to make a *private post* to the instructors if you have private issues. Piazza is preferred as the email mailboxs for most Instructors are always full and emails can go unseen for a while. Piazza link will be available on the Moodle front page on the first day of the classes.
When communication via Piazza is not possible:	Email: david.knox@colorado.edu We will attempt to respond to all communications promptly, but please allow up to 24 business hours for a reply. Please put "CSPB 3753" somewhere in the subject of the email and keep the email brief. More than two paragraphs should be saved for office hours or individual checkin meetings.

Course Description

Operating systems are an essential part of every computing system and play a major role in determining the performance and usability of the system. This course is an introductory course covering the fundamental concepts in the design, implementation and evaluation of an operating system. While the field of operating systems has been undergoing rapid change, the fundamental concepts remain firmly clear. This course covers these fundamental concepts comprised of device management, process management, memory management and network management.

This is a 4 credit course, so please be prepared to put in a significant amount of effort, and make sure that you are not taking too many other courses alongside this one.

This course assumes a basic understanding of Unix/Linux and the C programming language. To be sure that we are all proficient in these areas, there will be Week 0 labs on Unix/Linux and C. After you take these labs, you must pass an ungraded Linux Proficiency Exam and an ungraded C Programming Proficiency Exam to access the rest of the course material. If you have taken CSPB 2400, then you should revisit your notes for this course as well.

You are expected to complete these proficiency exams by the end of Week 1. You can take each of these exams as many times as you want, and if you get a perfect score, then you'll receive some bonus points towards your exam average.

Learning Goals

Specific Goals for the Course

- To describe operating systems components, services, and the principles and complexities of I/O hardware.
- To describe the various features of processes, including scheduling, creation, and termination.
- To explore interprocess communication using shared memory and message passing.
- To discuss the APIs for the Pthreads, Windows, and Java thread libraries.
- To examine several classical process-synchronization problems and the critical-section solutions that can be used to ensure the consistency of shared data.
- To discuss evaluation criteria for selecting a CPU-scheduling algorithm for a particular system.
- To develop a description of deadlocks, which prevent sets of concurrent processes from completing their tasks, and to present a number of different methods for preventing or avoiding deadlocks in a computer system.
- To describe the benefits of a virtual memory system, explore various techniques of allocating memory to processes, and explore how paging works in contemporary computer systems.
- To evaluate the performance characteristics of mass-storage devices, disk scheduling algorithms.
- To understand operating-system services provided for mass storage (including RAID) and describe the interfaces to file systems.
- To discuss the goals and principles of protection in a modern computer system, including security threats, attacks, and the uses of cryptography in computing.
- To discuss the various virtual machine technologies and explain how they are used by operating-system modules.
- To provide a high-level overview of distributed systems and the networks that interconnect them.
- To explain general communication structure, communication protocols and issues concerning the design of distributed systems.

Brief List of Topics to be Covered

- Basic System Structure
- Processes and Threads
- Virtual Memory
- File Systems
- Scheduling
- Networking and Distributed (File) Systems
- Virtual Machines

Prerequisites

CSPB 2270 - Computer Science 2: Data Structures CSPB 2400 - Computer Systems Course prerequisites, place in sequence, etc.: see Pathways to Completion

Required Texts

See Week 0 Moodle page for links to the reading materials.

Grade Breakdown

The final grade is distributed among reading quizzes, programming assignments, and exams, with the following distribution:

Assessment	% of grade	Description
Reading and Lecture Quizzes	10%	Moodle quizzes to review the material presented in the weekly reading assignment and weekly video lecture assignments. Each week's quiz over the material is due at the beginning of the next week.
Programming Labs	20%	Each week there will be a programming lab that walks you through concepts that are needed to complete the programming assignments.

Programming Assignments	25%	The programming assignments will be the most challenging part of the course and will require you to start far in advance: they are substantially more difficult than the programming assignments you have completed in previous courses in the CSPB program. Each assignment must be completed and submitted via Moodle and Git Classroom by its due date to earn full credit.
Programming Assignment Interviews	15%	A live interview with an instructor or TA to assess your understanding of submitted code, and the your ability to explain concepts in the code.
Exams	30%	The Unit Exams in the course will have and exam to assess your knowledge of the concepts and theory of the unit.

You must have at least a 70% average on both the programming assignment interviews and the exams to pass the course!

Programming Assignment Grading

The labs are very important to ensure you have the skills to solve the Programming assignments. Each week you will need to submit to the Moodle assignment and push your lab repository to the Classroom server. The programming assignments will cover a number of labs and are designed to have you apply the skills learned in multiple labs to solve a problem.

No late programming labs or programming assignments will be accepted!

Exams

Exam Day Communications On exam days, no communication with your colleagues is allowed. If you have questions about a unit exam after you take it, then you must send me your questions via a private message in Piazza, not a public post. This is because your classmates may be taking the exam at a later date, and a public post would be leaking information about the exam.

Missing an Exam Day Because the exam dates are known well in advance, make-up exams will not be given unless you provide an acceptable and valid reason for missing an exam. Examples would be something serious like surgery, illness, or a family emergency.

If other life events are in conflict with an exam date, contact the instructors at least a week before the exam to arrange an earlier exam time.

The unit exams in this course are not cumulative Each exam is just over the material for that particular unit, which is indicated clearly in Moodle. There is no cumulative final exam for this course. In these exams you will be asked questions similar to the reading and module quizzes, but you will also be required to run certain algorithms by hand, analyze code, and write code. You are given exam review questions and a term sheet to help prepare you for the written questions of the unit exams. Any programming questions on the unit exams will be related to the labs for that unit.

Re-Grading Any requests for regrading any graded course material must be asked no later than 1 week after grades are posted for the assignment. Be sure to regularly check your grades and review the feedback provided.

Piazza

- You are expected to participate on Piazza in this course.
- All course communications will be via Moodle Announcements and Piazza posts.
- Instructor(s) will not immediately answer Piazza questions about being stuck on labs and programming assignments. **Please help out your fellow students** as you are encouraged to use Piazza to collaborate with colleagues on such questions. We will endorse your posts when they contain good advice.
- Instructor(s) are not required to answer Piazza from 6pm MT Friday – 9am MT Monday.
- Instructor(s) will try to immediately respond to Piazza posts if they are emergencies (e.g., Moodle not working, exam not working, etc..).
    - Instructor(s) will consider your Piazza participation at the end of the semester and your final grade is close to a higher letter grade.

Technologies

Students should have access to a Chrome browser and a computer that they can use for development. We will install various data systems and tools throughout the course. Students should have a basic proficiency with a computer and be able to install programs on their machine.

The following is a tentative schedule for our course:

- Unit 1: General Concepts, Processes, Threads, Virtual and Distributed Systems
    - Week 0: Revision: Unix/Linux and C Boot Camp

    - Week 1: Machine Components, Kernel Mode, System Calls. Reading: Ch. 1,2.
    - Week 2: Process Management & Process Scheduling. Reading: Ch. 3.
    - Week 3: InterProcess Communication (IPC), Threads & Thread Safety Reading: Ch. 3, 4.
    - Week 4: Virtual Machines and Distributed Systems Reading: Ch. 18,19.
- Unit 2: Mass Storage and File Systems
    - Week 5: I/O systems, Device Drivers, LKMs. Reading Ch. 12
    - Week 6: Mass Storage, Files, File Allocation Reading: Ch. 11.
    - Week 7: File Systems Interface Reading: Ch.13,14,15.
- Unit 3: Process Synchronization and Deadlock
    - Week 8: Process Synchronization. Reading: Ch. 6,7.
    - Week 9: CPU Scheduling. Reading: Ch. 5.
    - Week 10: Deadlock (Conditions, Detection, Avoidance). Reading: Ch. 8.
- Unit 4: Memory Management & Virtual Memory
    - Week 11: Memory Management Reading: Ch. 9.
    - Week 12: Virtual Memory Reading: Ch. 10.
    - Week 13: Security and Protection Reading: Ch. 16,17.
    - Week 14: Influential Operating Systems. Ch. 20.
- Additional Material
    - Week 15: Current Topics in Operating Systems

Course FAQ - Questions often asked by students

1. Can I do my assignment in C++ rather than C?
   No. Everything must be done in C.

2. Can I do my assignment with a partner?
   No. All assignments are individual work.

    - That said, getting together with another student to *talk* about concepts and algorithms is encouraged. You cannot share code, but you can share ideas and help others solve bugs. See the collaboration policy for more details.
3. Will my questions on Piazza or by email be answered over the weekend?
   The postbacc program does not operate on non-work days (i.e. not on weekends or holidays).

    - Piazza is the main communications channel for all course work. Often other students will respond to questions. Trying to answer other student's questions is a good way to increase your knowledge and skills. We will let you know when we have any availability on a non-work day, but responses should not be expected until the next work day.
4. Can I take my exam over the weekend instead?
   The postbacc program does not operate on non-work days.

    - Exams will not be rescheduled unless there is a legitimate issue as stated above. If an emergency occurs, please let us know as soon as possible.
5. Proctorio locked me out of my exam. What do I do?
   Please send me a private message in Piazza if this happens, just so I am aware of this.

    - Once you have done this, you must contact Proctorio and request that you be let back into the exam (unfortunately, we cannot do this on your behalf).
    - Note that you have two hours to take the exam, which is twice as long as the usual time allotted for exams. We have given you this extension to account for such Proctorio accidents, so no additional time to take the exam will be granted if this happens.
6. Can you write a letter of recommendation on my behalf to a graduate program?
   That depends on the program and if you have spent enough time interacting with me in office hours.

    - If it is a course-based graduate program, then I can most likely write on your behalf provided you have had enough interactions with me through office hours. Office Hours and interview session are the only way to get to know you in any online program.
    - If you are applying to a research-based graduate program, then I would not write a letter unless you have done research with me (See your advisor about CSPB-3112). Research graduate programs are harder to get into, and a letter from me stating how well you performed in my class has little bearing on your potential as a researcher.
    - If you are seriously considering a research-based degree, then you must get involved in research before you apply.

Program Policies and University Policies

Last updated August 19th, 2024

Individual Check-In

If you have a unique situation that may be affecting your work or class experience -or- you need clarification of an email, Piazza, or ZOOM exchange, please email your instructor with the subject line "Individual Check-In". Your instructor will email you back to set up a Zoom call to discuss the specific situation and work with you to develop a solution and/or strategy to move forward.

Service Interruptions and Support

Due to the online nature of this program, there is always the possibility of service interruptions. If you are unable to access the course materials (Moodle, Piazza, etc.), we encourage you to visit https://www.isitdownrightnow.com/applied.cs.colorado.edu.html.

For non-urgent issues related to platform support, please contact cscihelp@colorado.edu.

Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, marital status, political affiliation, or political philosophy.

For more information, see the classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

CSPB Program AI Policy

Students must represent any work (e.g., ideas, text, code, images) **submitted for evaluation** as the student's own creative or intellectual product. Unless instructors provide explicit permission or instruction to the contrary, students may not submit content for evaluation that was generated, in whole or in part, by genAI tools. Using genAI tools when unauthorized would be considered a potential violation of the University of Colorado Honor Code.

Prohibited conduct includes:

- Copying all or part of AI generated content (e.g., text, code, images, solutions) into a student answer on an assessment, essay, test, or other assignment submitted for evaluation (whether in-class or out-of-class).
- Providing a genAI tool with all or part of the prompt for an out-of-class assignment (e.g., essay or coding assignment) and paraphrases or otherwise adapts all or part of the generated content into their response without proper attribution of the genAI tool.
- **In short - do not copy/paste from AI.**

Adapted from Colorado School of Mines AI Policies.

Collaboration Policy

We welcome collaboration! Sharing insights, asking questions, learning by doing, and learning by helping others are essential skills in learning computer science.

Collaboration is discussing ideas of the course with others, sharing insights and extra resources, working through similar questions to an assignment, sharing resources, and helping others. The Piazza forum in your class is an ideal place to share ideas, lead a discussion or be the hero that asks the "dumb question" everyone else is afraid to ask. And Piazza is often a source for content for instructors to include in letters of recommendations. Your leadership, courage, and determination will not go unnoticed.

Collaboration is not:

- "Having a partner." In particular, Group Projects, or projects that specify "working with a partner" will have individual guidelines.
- One student solving problems 1-4, and another solving 6-10.
- An identical group solution submitted by multiple students.

Unless specified in the assignment, all coursework is individual.

In general:

- You must document resources and collaboration on any assignment. This should be in the form of comments at the start of code and/or within solution notes.
- Cite Your Sources: If you collaborated with someone on an assignment, or if your submission includes quotes from a book, a paper, or a web site, you must clearly acknowledge the source.
- Plagiarism is forbidden. Copying answers directly or indirectly from solution manuals, web pages, or your peers is a violation of honor code. The assignments and code that you turn in should be written entirely on your own

- Copying/soliciting a solution to a problem from the internet or another classmate constitutes a violation of the course's collaboration policy and the honor code and may have serious consequences.
- You may not actively search for a solution to the problem from the internet. This includes posting to sources like StackOverflow, Reddit, Chegg, CourseHero, etc.
- StackExchange Clarification: Searching for basic techniques in Python/C++ is totally fine.
- If you have taken this course prior to this semester and have done some/all of homeworks previous code or previous homework solutions may not be reused. You must start each homework from scratch.
- When in doubt, ask. If something doesn't seem right - you are not sure if you can use a resource or if you are feeling pressure to share a specific solution - please reach out to your instructor.

Note: Other information on the Honor Code can be found at www.colorado.edu/policies/honor.html and https://www.colorado.edu/sccr/honor-code.

Requirements for Infectious Diseases

Members of the CU Boulder community and visitors to campus must follow university, department, and building health and safety requirements and all applicable campus policies and public health guidelines to reduce the risk of spreading infectious diseases. If public health conditions require, the university may also invoke related requirements for student conduct and disability accommodation that will apply to this class.

If you feel ill and think you might have COVID-19 or if you have tested positive for COVID-19, please stay home and follow the guidance of the Centers for Disease Control and Prevention (CDC) for isolation and testing. If you have been in close contact with someone who has COVID-19 but do not have any symptoms and have not tested positive for COVID-19, you do not need to stay home but should follow the guidance of the CDC for masking and testing.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.

If you have a temporary illness, injury or required medical isolation for which you require adjustment, please contact your instructor.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course's syllabus is a vital part in adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: StudentConduct@colorado.edu. Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit Honor Code for more information on the academic integrity policy.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits protected-class discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email cureport@colorado.edu. Information about university policies, reporting options, and support resources including confidential services can be found on the OIEC website.

Please know that faculty and graduate instructors must inform OIEC when they are made aware of incidents related to these policies regardless of when or where something occurred. This is to ensure that individuals impacted receive outreach from OIEC about resolution options and support resources. To learn more about reporting and support for a variety of concerns, visit the Don't Ignore It page.

Religious Accommodations

Campus policy requires faculty to provide reasonable accommodations for students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please communicate the need for a religious accommodation in a timely manner. In this class, please contact me directly.

See the campus policy regarding religious observances for full details.

Mental Health and Wellness

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact Counseling and Psychiatric Services (CAPS) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through Academic Live Care. The Academic Live Care site also provides information about additional wellness services on campus that are available to students.

Last modified: Monday, 19 August 2024, 5:03 PM