Course Information:

Number: CSE-420-01-4262
Title: Design of Operating Systems
Format: In-Person
Meeting Times: Tue & Thu 2:30 PM - 3:45 PM
Meeting Location: JB Speed 100
Credit Hours: 3
Website: http://faculty.cse.louisville.edu/nihat/teaching/cse420s26

Staff Information:

Instructor: Dr. Nihat Altiparmak
Office: DC 209
Phone: 502-852-7533
E-mail: nihat.altiparmak@louisville.edu
Office Hours: Tue & Thu 1:00 PM - 2:00 PM in-person (DC 209), or by appointment (in-person or online through MS Teams).

TA 1: Stephanie Sithu
Office: DC 242
Phone: 502-852-0462
E-mail: stephanie.sithu@louisville.edu
Office Hours: Tue & Thu 10:00 AM - 11:00 AM in-person (DC 242), or by appointment (in-person or online through MS Teams).

TA 2: Rinku Deuja
Office: DC 242
Phone: 502-852-0462
E-mail: rinku.deuja@louisville.edu
Office Hours: Mon & Wed 12:00 PM - 1:00 PM in-person (DC 242), or by appointment (in-person or online through MS Teams).

Technology and Logistics Requirements:

- For projects:
  - A working computer with Ubuntu Linux (24.04 LTS) installed on bare metal (preferred) or virtually.
- For exams:
  - A working computer equipped with a webcam, speakers, microphone, and a stable Internet connection.
  - UofL's version of the Respondus LockDown Browser software installed on the computer. This software works only on Windows 10 or 11, macOS 10.13 or later, or Chromebook (not Ubuntu). Phones, Linux OS, and iPads are not supported. Check the Respondus website or UofL's support page for the latest compatibility information.
  - A desk located in a private room, where you can be alone by yourself and close the door.

Use of Generative AI:

- The use of Generative AI is not permitted in this course for any exam or assignment.

Textbook:

Highly Recommended OS Book:

- Operating System Concepts, 10th Edition by Silberschatz, Galvin, and Gagne. ISBN: 9781118063330.

Recommended C Programming Books:

- Learn C the Hard Way, 1st Edition by Zhed Shaw. ISBN: 9780321884923. (**Highly recommended**)
- The C Programming Language, 2nd Edition by Kernighan and Ritchie. ISBN: 9780131103627.

Other Optional Supplementary Books:

- Operating Systems: Three Easy Pieces by Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau. (This is a very good OS Book free in PDF.)
- Advanced Programming in the UNIX Environment, 3rd Edition by Stevens and Rago. ISBN: 9780321637734. (This book might be useful for some projects.)

Prerequisites:

CSE 130, CSE 302, and {CSE 235 or CSE/ECE 412} are prerequisites. Consult the instructor immediately if you have not completed these courses or their equivalents. Taking one of CSE 235 or CSE/ECE 412 would suffice; you don't need to take both! Since these courses are prerequisites, taking them together with this course is not allowed!

Course Description and Topics Covered:

The course is designed to cover basic concepts of Operating System (OS) design and implementation including processes management, memory management, and storage management. It is composed of the following specific components, covering chapters [1-11,13-15] of the Recommended OS Book:

- **Introduction:** C, Linux, and Data Structures Review, Introduction to OS (Ch. 1), OS Structures (Ch. 2)
- **Process Management:** Processes (Ch. 3), Threads (Ch. 4), CPU Scheduling (Ch. 5), Process Synchronization (Ch. 6 & 7), Deadlocks (Ch. 8)
- **Storage Management:** Mass Storage Structure (Ch. 11), File System Interface & Internals (Ch. 13 & 15), File System Implementation (Ch. 14)
- **Memory Management:** Main Memory (Ch. 9), Virtual Memory (Ch. 10)

Course Schedule:

Please see the class website for a detailed, day-by-day schedule of the course:

http://faculty.cse.louisville.edu/nihat/teaching/cse420s26

Student Learning Objectives:

- Demonstrate understanding of process creation, thread creation, and inter-process communication mechanisms.
- Demonstrate understanding of available cpu scheduling, process synchronization, and deadlock handling mechanisms.
- Demonstrate understanding of storage management and file system implementation techniques.
- Demonstrate understanding of modern memory management techniques.
- Using the C programming language, develop hands-on experience in various systems programming and operating system concepts including process/thread creation, management, and parallel processing techniques, inter-process communication using shared memory and message passing, process synchronization using mutex locks and semaphores, implementation of cpu/disk scheduling algorithms, file system analysis techniques, file IO performance evaluation, as well as developing new system calls and kernel modules.

Grading:

- 40% Projects (Three projects, first one 10%, the following two 15% each)
- 60% Tests (Four tests, 15% each)

The letter grade is calculated as follows: $100 \geq$ A+ $\geq 97 >$ A $\geq 94 >$ A- $\geq 90 >$ B+ $\geq 87 >$ B $\geq 84 >$ B- $\geq 80 >$ C+ $\geq 77 >$ C $\geq 74 >$ C- $\geq 70 >$ D+ $\geq 67 >$ D $\geq 64 >$ D- $\geq 60 >$ F ≥ 0.

Announcements:

All announcements will be posted in BlackBoard and will also be immediately emailed to you.

MS Teams:

This course will be utilizing MS Teams to facilitate class discussion. Rather than emailing questions to the course staff (instructor/TA), please post your questions on MS Teams. The course staff will monitor MS Teams closely and you will usually get a quick response. If you know the answer to a question, you are encouraged to help your classmates by replying to their posts, which will improve your virtual class participation and it is highly recommended! **You should ask your questions directly to the course staff only if your question might reveal part of your solution to an assignment.** MS Teams is the most effective way to communicate with the course staff. Please avoid email if MS Teams will do.

Attendance:

Attendance will not be taken in this class.

Projects:

Projects will be programming based and will be assigned and submitted through Blackboard as scheduled in the class website. All programming will be performed **in Linux using C only** (not C++, Java, Python, etc.).

Academic Integrity and Plagiarism:

1. This course assumes that assignments submitted by students will be generated by the students themselves, working individually or in groups as directed by class assignment instructions. This policy indicates the following constitute violations of academic honesty: a student has another person/entity do the work of any portion of a graded assignment for them, which includes purchasing work from a company, hiring a person or company to complete an assignment or exam, **and/or using generative AI tools (such as ChatGPT, Gemini , GitHub Copilot, DeepSeek R1, Claude Sonnet, Cursor, etc.).**
2. All submitted assignments should be done individually unless explicitly stated as a group assignment. **Except your group members (if a group project), you are not allowed to go over your friends' code, and your friends cannot see your code.** You are only allowed to make high-level verbal discussions on the projects with other students to make sure what is being asked for. Please note that high-level discussions do not translate into specific algorithms/code implemented in your assignments - such discussions would be considered low-level. Such low-level discussions specific to the implementation of the assignment can only be made with the course staff, and those discussions cannot be shared with other students!
3. Posting assignments and/or solutions online is not permitted. You cannot publish your code partially (in forums or other sites for asking questions) or completely (in public source code repositories). **For instance, you cannot post your code on your public GitHub account unless you make it private!**
4. **You are not allowed to share your code with the future students of this class.**
5. **You are not allowed to use Chegg.com, CourseHero.com, MyAssignmentHelp.com, or any other sites to post any course material, including syllabus, exams, projects, slides, etc., and/or**

to find solutions to assignments. Instead, post your questions on MS Teams if they do not reveal your answer, or email them to the course staff if your answer might be revealed on MS Teams. In addition, both the Instructor and the TA have dedicated office hours, and are also available via appointment for one-on-one help. Seek immediate help through these means when you need help!

Not complying with these collaboration and code sharing rules will put you under the risk of plagiarism for this semester or the following semesters, including the cases where future students of this class copying your code from online resources (forums, GitHub, etc.). **WE USE ADVANCED COPY CHECKERS! Cheating/copying of assignments (including Internet resources) will be reported to the dean's office for plagiarism and a grade of F will be recorded for the course. NO EXCEPTIONS WILL BE MADE!!!** The following procedure will be followed to deal with potential plagiarism cases:

https://engineering.louisville.edu/academicdishonesty/

To clarify even further, here we provide some example scenarios of plagiarism:

- My friend promised to only check, not to submit my code, so I just emailed them my solution.
- My friend and I sat side-by-side and did the project together.
- I did not see my friend's code and they did not see my code, but I gave line-by-line instruction on how to solve part of the project. (*Clarification: You can only have high-level discussions of the assignment to make sure what is being asked for. High-level discussions do not translate into specific algorithms or code. Any low-level discussions specific to the implementation of the project can only be made with the course staff, and those discussions cannot be shared with other students!*)
- My friend asked me to debug their code so I went through it and helped them to debug before/after the deadline. (*Clarification: Only the course staff can go through your code for debugging help; however, you can post the errors you get on MS Teams without revealing your source code/solution!*)
- I shared my solution with a friend only **after** the deadline. (*Clarification: Sharing your code after the deadline is still plagiarism!*)
- The project asked me to implement my version of the insertion sort (or any other algorithm/task), I googled it, went through specific implementations, and copied some code partially/completely in my project. (*Clarification: You can check Internet/textbooks for textual descriptions of algorithms, if applicable, but you cannot check their implementations - pseudo or actual code - and/or copy any code partially or completely from other sources - even though you change some variable names or move some code around!*)
- I googled project description (fully/partially), found some code online, and used it in my solution.
- I asked ChatGPT/Gemini/Copilot/R1/Sonnet/Cursor/OthersSimilar to solve the project (fully or partially) and used code it generated in my solution.
- I shared my code publicly on GitHub (or other sites) after the course ended. (*Clarification: Sharing your code after the end of the course is still plagiarism.*)

Please note that plagiarism scenarios are not limited to the ones discussed above but there is no need to get stressed about it! Just check with the instructor in advance if you are not sure. A simple MS Teams chat with the instructor would clarify it very easily!

Exams:

Exams will be administered online on Blackboard using Blackboard's LockDown Browser and Respondus Monitor feature. Exam windows are provided on the class website, and a grade of zero will be recorded for missed exams unless prior arrangements are made **with valid proof of excuse (such as a doctor's note)**. If you have not used Blackboard's LockDown Browser and Respondus Monitor feature yet, please make sure to read the provided "Online Test Guide" and "Using LockDown Browser

and Monitor for Students" documents in Blackboard for specific instructions on installing the necessary software and taking an online exam using LockDown Browser and Respondus Monitor. Additionally, you can watch the following introductory videos explaining how LockDown Browser and Respondus Monitor work:

- http://youtu.be/e-QRHkoF8Xg
- http://youtu.be/hv2L8Q2NpO4

Please note that to take the exam with LockDown Browser and Respondus Monitor:

1. You will need a working computer equipped with a webcam, speakers, microphone, and a stable Internet connection.
2. UofL's version of the Respondus LockDown Browser software should be installed on the computer. This software works on Windows 10 or 11, macOS 10.13 or later, or Chromebook. Phones, Linux OS, and iPads are not allowed or currently supported. Check the Respondus website or UofL's support page for the latest compatibility information. A practice testing environment will be provided on Blackboard for you to get used to online testing using LockDown Browser and Respondus Monitor. Please test your system with the provided practice before the exam to make sure everything works properly.
3. You need to be alone in a room with the door closed, and take the exam on a desk.

Exam Rules:

- Exams will be closed book and closed notes. There will be four non-cumulative exams in this course, where each exam will include 20 automatically graded questions (mostly True/False and Multiple Choice), involving both theoretical and calculation-based questions. You will be responsible for what is covered in **our lecture videos and slides**, as outside materials might be misleading.
- Practice problems and Kahoot review activities are provided for each exam, as well as practice lecture videos going over some of the practice problems. Note that practice problems do not cover all possible test questions. Anything discussed in lectures may appear on the test, so be sure to watch the lecture videos and review the slides for the relevant chapters.
- You will not be allowed to use the Internet, calculators, cellphones, or other electronics during the exam. You may use blank paper and a pen/pencil to work through problems, but papers will not be submitted. At the beginning of the exam, you must show your blank papers during the environment check.
- You can have two attempts per exam. Your highest score will count. Each attempt will generate a different set of questions. If you are satisfied with your first score, you do not need to use the second attempt.
- You will have 60 minutes per attempt, and each attempt must be finished in one sitting (no pausing or resuming).
- Each exam will have a provided availability window, during which you may take it at any time.

The following actions will result in an automatic zero and may be reported to the plagiarism office:

- Not showing your entire environment at the beginning of the exam, including your desk, walls, and surroundings. Show a full 360-degree view. Only a pen or pencil and blank papers should be visible on your desk. Take your time to show everything, with verbal explanations if needed, and do not rush this step.

- Not being fully visible on camera, turning off the video/audio mid-exam, or failing to provide a recording of yourself or your screen, as we also review your screen recording. Make sure to perform webcam and audio checks at the start to confirm functionality. We should be able to see and hear everything to ensure there is no one helping you during the exam.
- Using electronics other than your computer. Headphones, smartphones, smartwatches, smart glasses, tablets, calculators, or other similar electronics are not allowed. Using headphones is a very common problem that causes students to receive a zero. If you are using a headphone for its microphone, it should be on the desk and you should not be wearing it. To eliminate external noise, you can use non-electronic foam earplugs or over-ear earmuffs if needed.
- Using books, notes, sticky notes, or any other materials. The test is closed book and closed notes (blank scratch papers are allowed if shown to be empty at the start).
- Not being in a room by yourself or having others in the same room. You are not allowed to take the exam outdoors or in public places. If needed, you can schedule to take it at DRC. The exam must be taken at a proper desk (not on a bed).
- Suspicious behavior such as talking to someone, leaving the frame, or any unusual test-taking behavior. Please note that no restroom breaks are allowed. You must remain at your desk for the entire duration. It is acceptable to think out loud, which may even help us verify your thought process and eliminate certain suspicions as we hear how you approach solving the questions.
- Poor Internet connection. This is not a plagiarism issue but will result in a zero for that attempt. Make sure your Internet is stable before you start.
- Not showing your school ID when prompted. In emergencies, a driver's license may be used, but private information should be obscured.
- Similar academic integrity issues described above for the projects also apply to the exams. **Suspicious behavior and/or not following the aforementioned rules in exams will be reported to the dean's office for plagiarism and a grade of F will be recorded for the course.**

Disability Resource Center (DRC) Statement:

The University of Louisville is committed to providing access to programs and services for qualified students with disabilities. If you are a student with a disability and require accommodation to participate and complete requirements for this class, notify me immediately and contact the Disability Resource Center (Stevenson Hall 119, 502-852-6938, askdrc@louisville.edu) for verification of eligibility and determination of specific accommodations.

Computer Issues and IT Support:

- Speed IT staff are available by appointment from 9:00 am to 4:00 pm to assist you with your technology needs. You may schedule an appointment by sending a detailed email including any relevant error codes and screen snips at SPDHelp@Louisville.edu (preferred) or 502-852-7620.
- You can also seek help from the course staff or the CSE IT Staff (Nathan Russell, DC 216, njruss01@louisville.edu) if you need assistance with your Ubuntu installation. Make sure you set up an appointment in advance, preferably early in class before the first project is assigned. In emergency cases, Nathan can also provide you a virtual machine from the CSE cluster to complete your programming assignments.

Title IX/Clery Act Notification:

Sexual misconduct (including sexual harassment, sexual assault, and any other nonconsensual behavior of a sexual nature) and sex discrimination violate University policies. Students experiencing such behavior may obtain **confidential** support from the PEACC Program (852-2663), Counseling Center

(852-6585), and Campus Health Services (852-6479). To report sexual misconduct or sex discrimination, contact the Dean of Students (852-5787) or University of Louisville Police (852-6111).

Disclosure to University faculty or instructors of sexual misconduct, domestic violence, dating violence, or sex discrimination occurring on campus, in a University-sponsored program, or involving a campus visitor or University student or employee (whether current or former) is **not confidential** under Title IX. Faculty and instructors must forward such reports, including names and circumstances, to the University's Title IX officer.

For more information, see http://louisville.edu/hr/employeerelations/sexual-misconduct-brochure.

The instructor reserves the right to make changes in the syllabus when necessary. Such changes will be announced via BlackBoard.