Course Syllabus

Operating Systems (CS4420/CS5420) Fall Semester 2021/2022
M, W, F - 4:10-5:05 PM – Walter Hall Room 145

Call Numbers 15818 / 15819

Instructor
Dr. Shawn Ostermann

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Office Hours: Monday, Friday 10:30-11:30 PM (in person or via Microsoft Teams), any time via email or Teams (preferred), and by appointment

I intend that this course be enjoyable but demanding. There is a large amount of material, several large projects, and it can be overwhelming at times. If you find yourself concerned that you are doing poorly in the course, please come talk to me.

Course Objective

In-depth coverage of computer operating systems and related computer architecture issues. Coverage of physical devices, interrupts, and communication between the computer and external hardware. Interfaces between user programs and the operating system, system calls, software interrupts, and protection issues. Context switching, process address spaces, and process scheduling. Process synchronization, interprocess communication, critical sections, and deadlock detection and recovery. Memory mapping, swapping, paging, and virtual memory. These lectures will cover and complement the material in the text that the student is responsible for reading. The quizzes and tests will provide feedback on the student's comprehension of the issues and the assignments will provide an opportunity for in depth application of these same issues.

Student Outcomes and Course Outcomes

1. Analyze a complex computing program and to apply principles of computing and other relevant disciplines to identify solutions.
   a. A detailed understanding of the three basic classes of critical section problems: bounded buffer, reader/writer, and the dining philosophers.
   b. A detailed understanding of the Unix command interpreter.
   c. An understanding of the causes of deadlock.
   d. An understanding of the evolution of operating system software.
   e. An understanding of the general problem of race conditions and the critical section.
   f. An understanding of the mechanisms that can be used to detect deadlock in a program.
   g. An understanding of the purpose of command interpreters.
   h. An understanding of the reasons why operating systems behave the way they do based on the evolution of software over the last half century.
   i. A detailed understanding of dual-mode operation of modern hardware.
   j. A detailed understanding of how processes are created, managed, and destroyed under UNIX.

k. A detailed understanding of how to interact with generic memory, disk drives, and serial devices.
l. A detailed understanding of how to protect hardware on particular platforms such as SPARC and Intel hardware.
m. A detailed understanding of the components of a process: CPU registers, memory, etc.
n. A detailed understanding of the mechanisms for switching between modes on various kinds of hardware.
o. A detailed understanding of the relationship between virtual memory and memory management.
p. A detailed understanding of the various mechanisms used to provide synchronization: disabling interrupts, software algorithms, semaphores, monitors.
q. A general understanding of how to protect time, memory, and devices on a general platform.
r. An understanding of major computing components: CPU, bus, memory, cache, hardware controllers, serial devices.
s. An understanding of the distinction between the personal computer model and the model of a real operating system: multiple users and multiple copies of a program.
t. An understanding of the fundamental pieces of a modern operating system: memory model, process model, protection model, and device abstraction.
u. An understanding of the general solutions to deadlock: avoidance, prevention, detection.
v. An understanding of the most fundamental concept in operating systems: the division between user-level programs and the OS code itself.
w. An understanding of why hardware protection is fundamental.

2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
   a. An ability to design and implement a parallel/distributed application. Such designs often involve deadlock and critical section issues.
   b. An ability to design and implement a simplified UNIX command interpreter.
3. Recognize professional responsibilities and make informed judgements in computing practice based on legal and ethical principles.
   a. An understanding of the implications of the security features of an operating system.

Important Dates

Midterm Exam – Friday, October 15 (*tentative*)

Final Exam - **Friday**, December 10, at 12:20 p.m. (note that this is late in the week!!!!)

Attendance

I expect students to attend each class and I hold them responsible for all material discussed. Some of the class material will not be in your textbook. You will only be allowed to make up work missed due to participation in authorized University activities or due to other legitimate absences as defined in the Undergraduate Catalog.

Class Organization

I will use blackboard (primarily) for course materials and Microsoft Teams (mostly for questions) for this course. All course materials will be posted on blackboard (syllabus, lecture slides, project assignments, and homework assignments). You are required to regularly check for updates (contents/announcements) on the blackboard page for CS 4420/5420.

Required Text

"Operating System Principles & Practice. Edition 2," Thomas Anderson, Michael Dahlin, Recursive Books, Ltd. 2011-2014

Grading

Programming Assignments:

There will be a sequence of in-depth programming assignments for this course. They will be written in C or C++. You may develop your code on any platform, but (unless stated otherwise) your code must run on the prime machines (Stocker Center labs) under Ubuntu Linux. You need to make sure that you can log into those machines remotely using ssh and are able to transfer files using sftp/scp. Here is a list of some of the available prime machines:

- pu1.cs.ohio.edu (Ubuntu Linux),
- pu2.cs.ohio.edu (Ubuntu Linux),
- pu3.cs.ohio.edu (Ubuntu Linux),
- any of the lab machines (locally or remotely)

Let me know if you do not have access to those machines.

My intention is to use *Github Education* for project submission and grading in the class. I'm not yet sure how that will work, but we will discuss it in detail before the first project is due.

Homework:

There may be several smaller homework assignments. They can either take the form of quizzes or may require writing small programs.

Tests:

There will be a midterm and a final test in addition to the quizzes. The tests are cumulative by nature, but strongly emphasize more recent material.

Graduate students enrolled in CS 5420 will complete additional, more challenging work in this course, generally in the form of additional components of assignments.

Final grades:

Grades for this class will be based on examinations, quizzes, homework, and programming projects. Because this is a dual-level class, graduate students will be held to higher standards. Grade weightings are as follows:

- *50% Examinations (25% Midterm, 25% Final)*
- *50% Programming projects (4-6 projects) (and homework/quizzes)*

To earn an "A" you need 90%, to earn a "B" you need 80%, to earn a passing grade ("C") you need at least 70%. I reserve the right to curve this scale downward iff necessary at the end of the semester. In addition, to receive a passing grade, you must turn in all programming projects.

Late Policy:

I always try to provide an adequate amount of time in which to complete assigned class projects, typically 1 to 2 weeks. Because assignments that are turned in late interfere with grading, allow students to fall behind in class, and interfere with my ability to discuss the projects in class, I discourage late assignments with a late penalty, as follows:

1. All projects are due at the **beginning** of class on the due date.
2. Projects that are turned in one day late (defined as the first class period following the class period in which they were due) will have 10% of their total value deducted as a late penalty.
3. Projects which are turned in two classes late will have 25% of their total value deducted as a late penalty.
4. Projects which are turned in three classes late (or later) will have 50% of their total value deducted as a late penalty.

The key to passing this course is to complete all projects and turn them in on time!!!

Academic Conduct:

All work is to be done individually unless specific team projects are assigned. Cheating on examinations, submitting the work of others as your own, or plagiarism in any form will result in penalties ranging from loss of credit for a project to expulsion from the University, depending on the severity of the offense. I am very serious about this continuing problem and promise that I will deal harshly with cheaters with no further warning.

Classroom COVID-19 policies

Ohio University is committed to maintaining a safe learning environment for all members of its community – students, faculty, and staff – regardless of whether they have been vaccinated against COVID-19.

Because the university is not requiring vaccination nor are faculty or staff permitted to ask students about their vaccination status, all members of the OHIO community are expected to take certain precautions in classrooms and elsewhere on campus to keep each other safe:

- Select a testing pathway as part of the COVID-19 Testing Pathway Program. If you have not already made your pathway selection, please do so immediately. If you select the Weekly Testing Pathway, I expect you to adhere to your required testing schedule.
- Maintain physical distance as directed on signage in classrooms, vaccinated or not.
- All individuals are required to wear masks in indoor public spaces on campus, including classrooms.
- Complete a daily COVID-19 symptom assessment and do not come to class if you feel sick, even if you are vaccinated against COVID-19. If you need a thermometer, you can request one at the Guest Services desk on the fourth floor of Baker Center.
- If you test positive, feel sick or suspect exposure to COVID-19, it is your responsibility to follow the OHIO COVID-19 Protocol.

If you do test positive or need to isolate or quarantine this semester, after you have taken care of yourself and followed all the steps in the OHIO COVID-19 Protocol, please email me so that we can develop a plan for you to receive necessary course content. COVID-related illness, quarantine, isolation, and remain-in-room directives are legitimate university absences, and I will work with you to manage your academic requirements and connect you to resources.

If you feel that your class performance is being impacted by COVID-19, please talk with me and/or contact COVID Operations by phone (740.566.8445) or email (COVIDoperations@ohio.edu) Monday through Friday, 8 a.m. to 8 p.m., and noon to 5 p.m. on weekends. The University has resources available to help with quarantine and isolation support, as well as access to COVID-19 testing, counseling services, food assistance, and more. COVIDoperations@ohio.edu