OS

CS-371 Advanced Systems Computing, Operating Systems

Calvin Deutschbein

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Office Hours: MWF 1200-1300 Lecture: MWF 1:10-2:40

Office: Ford 307, Discord Classroom: Salem TBD

Course Description

Advanced Systems Computing

A semester-long study of computer architecture and organization, information management, networking and communication, operating systems, or parallel and distributed computing that applies or extends the content of CS 271 or more advanced classes.

Operating Systems

This course studies design and implementation of operating systems. Beginning with a bare metal binary, students will iteratively implement a minimal operating system kernel on an emulated embedded system using a systems programming language such as Rust or C. Students will scientifically examine the hardware/software interface through topics such as memory management, processes, context switches, kernels, interrupts, system calls, and signals.

In Spring 2025, the course will be conducted in Rust, though students are welcome to complete the coursework in C or Zig under their own self-direction pending individual approval from the course instructor.

About Me

Calvin Deutschbein is an assistant professor of computer science.

Required Materials

Required materials for a given class will be available on the course webpage. All course materials will be made available at no cost to the student.

Supplementary Text

Writing an OS in Rust will be provided to students in electronic copy.

Writing a Hypervisor in 1,000 Lines is a helpful supplementary text.

Accessability

I will make every effort to ensure all coursework and materials are accessible to all students, including working with on-campus specialists. However, there is always room for improvement. I always appreciate hearing from students about how I can make the course more accessible, so please reach out if there is something I can be doing better!

Course Objectives

- Implement a computer systems in a compiled, non-garbage collected language.
- Design, implement, and apply computing solutions to actual existing problems using linear, hierarchical, and associative data structures without reliance on external libraries.
- Learn modern development practices in a state-of-the-art coding framework specific to systems computing.
- Utilize the command line and command line tools to create executables that target a variety of architectures with varying degrees of library support.
- Become familiar with security-relevant design and implementation decisions when developing a computer system.
- Survey number, set, graph, and automata theory in an applied setting.

Course Structure

The course will be composed of lecture, labs, and hoemwork on systems computing.

Class Structure

Classes are scheduled for Monday and Wednesday at 13:10 PM. The lecture schedule is on the course webpage.

Midterm

There will be an in-class code-based midterm, which will be “open-everything" (except other students).

Final

The final is the release of an open-source operating system maintained under version control.

Feedback and Grading

Grading Scale

In systems computing, either a system works, as defined by some specification, or does not. Specification grading, wherein student work is graded based on whether or not it adheres to a speci-

fication is well-suited for this course. We note that there are two ways to earn an A or A-, based on either consistent work over the term or strong performance on cumulative assessments.

Grade	Requirements
A	Final meets specification
A	90+% ave on HW/Lab/Midterm $\wedge$ Final compiles
A-	90+% ave HW/Lab, Midterm $\vee$ Final compile
A-	Midterm meets spec, Final compiles
B+	90+% ave HW/Lab, Midterm compiles
B	80+% ave HW/Lab, Midterm compiles
B-	80+% ave HW/Lab
C	80+% ave Lab
D	60+% ave Lab
F	Anything else

Lab Grading

- "A" (=100%)
  - Meets spec by end of class
- "B" (=90%)
  - Compiles at end of class
- "F" (=0%)
  - Anything else

Homework Grading

- "A" (=100%)
  - On time
  - Passes autograder.
    - I lack confidence I can make excellent autograders for all stages, so give me some grace here.
- "B" (=90%)
  - On time
  - Compiles
- "F" (=0%)
  - Anything else

Final

- Create, document, and publish an operating system… in Rust!
  - Free-standing binary
  - Faults/exceptions/interrupts
  - Memory management

- Under version control.

Late Work Policy

- Late work is not accepted.
  - No exceptions.
  - The specification grading framework incorpates tolerances.
  - An OS that meets spec by end-of-term is an A, always.

Course Policies

Collaboration Policy

All collaboration is by mutual enthusiastic consent. Any collaboration is permitted on homeworks and labs, none on the midterm, and partners on the final. This will conducted via honor system unless I receive a (anonymous) student complaint.

AI Policy

Use of anything considered AI is allowed but not recommended. I've tried using it and thought it was horrible. There are variety of good tools that actually work I would recommend instead, beginning with the tools installed in the first week of class.

College Policies

The following material is adapted from "Information for Syllabus" recommended language on syllabus prepartion provided to instructors in the College of Arts & Sciences.

Academic Integrity

Students of Willamette University are members of a community that values excellence and integrity in every aspect of life. As such, we expect all community members to live up to the highest standards of personal, ethical, and moral conduct. Students are expected not to engage in any type of academic or intellectually dishonest practice and encouraged to display honesty, trust, fairness, respect, and responsibility in all they do. Plagiarism and cheating are especially offensive to the integrity of courses in which they occur and against the College community as a whole. These acts involve intellectual dishonesty, deception, and fraud, which inhibit the honest exchange of ideas. Plagiarism and cheating may be grounds for failure in the course and/or dismissal from the College. http://willamette.edu/cla/catalog/policies/plagiarism-cheating.php

Commitment to Positive Sexual Ethics

Willamette is a community committed to fostering safe, productive learning environments, and we value ethical sexual behaviors and standards. Title IX and our school policy prohibit discrimination on the basis of sex, which regards sexual misconduct — including discrimination, harassment, domestic and dating violence, sexual assault, and stalking. We understand that sexual violence can undermine students' academic success, and we encourage affected students to talk to someone about their experiences and get the support they need.

Please be aware that as a mandatory reporter I am required to report any instances you disclose to Willamette's Title IX Coordinator.

If you would rather share information with a confidential employee who does not have this responsibility, please contact our confidential advocate at confidential-advocate@willamette.edu. Confidential support also can be found with SARAs and at the GRAC (503-851-4245); and at WUTalk - a 24-hour telephone crisis counseling support line (503-375-5353). If you are in immediate danger, you may reach campus safety at 503-370-6911.

DACA/Undocumented Student Advocate

Willamette is committed to supporting our DACA/Undocumented students in a variety of ways. This year, Tori Ruiz is the contact person for all DACA/undocumented students can provide those students with a number of external and internal resources that are available. Her contact information is email: truiz@willamette.edu, Office: 3rd Floor UC, Phone: 503-370-6447.

Diversity and Disability Statement

Willamette University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. My goal is to create a learning environment that is usable, equitable, inclusive and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify me as soon as possible. Students with disabilities are also encouraged to contact the Accessible Education Services office in Smullin 155 at 503-370-6737 or Accessible-info@willamette.edu to discuss a range of options to removing barriers in the course, including accommodations.

Religious Practice

Willamette University recognizes the value of religious practice and strives to accommodate students' commitment to their religious traditions whenever possible. Please let me know within the first two weeks of the semester if a conflict between holy days or other religious practice and full participation in the course is anticipated. I will do my best to work with you to determine a reasonable accommodation.

As an instructor, I will exercise my discretion to offer accomodations for conflicts after the first two weeks of the semester. You may always reach out to me, including retroactively, though the quality of the accomodation I am able to offer may improve given advanced warning!

SOAR Center Offerings: Food, Clothing, and School Materials

The Students Organizing for Access to Resources (SOAR) Center strives to create equitable access to food, professional clothing, commencement regalia, and scholarly resources for WU and Willamette Academy students. The SOAR Center is located on the Putnam University Center's third floor (in the former Women's Resource Center and across from the Harrison Conference Room). The space houses the Bearcat Pantry, Clothing Share, and First-Generation Book Drive and is maintained by committed students and staff and faculty advisers.

Trans Inclusion and Gender Justice

I am always appreciative of the opportunity to address you by your affirming name or pronoun. Please advise me of the most affirming way to address you at any time so that I may do so.

If I ever misgender you in any way, I would greatly appreciate that you let me know, in whatever manner makes you comfortable, so that I can correct that error and endeavour to repair any harm.

Mental Health

As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. Willamette services are available and treatment does work. If you think you need help, please contact Bishop Health as soon as possible at http://willamette.edu/offices/counseling/. Crisis counseling is available 24/7 at WUTalk: 503-375-5353 and Campus Safety is available at 503-370-6911. Emergency resources are also available from the Psychiatric Crisis Center at 503-585-4949 and the National Suicide Prevention Lifeline at 1-800-273-8255.