

CSCE 351

OPERATING SYSTEM KERNELS

Fall 2001

TuTh 12:30 – 1:45pm
Avery 108

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Course Overview

An operating system is an essential part of almost all computer systems. The operating system is the software system that provides the interface between users, their applications, and the underlying hardware. The core of any operating system is the **kernel**. The purpose of this course is to study the design and implementation of operating system kernels. The following topics will be covered:

- Introduction to the organization and structure of operating systems.
- System calls (with hands-on experience using fork, exec, etc.).
- Introduction to processes and threads.
- Race conditions and critical sections.
- Principles of I/O Hardware: I/O devices, device controllers, DMA.
- Principles of I/O Software: interrupt handlers, device drivers, device-independent I/O software, and user-space I/O software.
- Study of drivers for block devices that use DMA (e.g., drivers for ram disks and hard disks).
- Clock hardware and software including clock (timer) management.
- Terminals: hardware and software including keyboard and display drivers.
- Overview of memory management and file systems.

Course Objectives

1. **Mastery & practice** in: system initialization, process context switching, interrupt handlers, device drivers, and clock (timer) management.
2. **Familiarity** with OS system calls, OS concepts, and OS structure.
3. **Exposure** to processor scheduling, IPC, memory management, file system concepts and structure.
4. **Practice** in critical thinking, identifying and evaluating system design tradeoffs, programming via a significant number of programming assignments.

Course Materials

The textbook for this course is *Operating Systems: Design and Implementation*, 2nd Ed, by Tanenbaum and Woodhull, Prentice Hall, 1997. We will cover chapter 1, about three-fourths of Chapter 2 (skipping Sections 2.2.4-2.2.7, 2.3 and 2.4), and most of Chapter 3 (skipping Sections 3.3).

You will be doing substantial programming in the C language and working with the MINIX operating system, which is written in C. You may want to purchase the book *The C Programming Language*, ANSI C Edition, by Kernighan and Ritchie, Prentice Hall or any other suitable C language book.

In addition to the texts, I will make available a set of lecture notes for each class. These notes are purposely incomplete and are meant to simply be a note-taking aid. The lecture notes, as well as copies of most class handouts, can be found on the CSCE 351 home page on the Web at URL:

<http://www.cse.unl.edu/~goddard/Courses/CSCE351/>

Prerequisites

Prerequisites for this course are CSCE 230 (Computer Organization), its Co-Requisite lab course CSCE 230L or CSCE 231 (Assembly Language and Systems Programming), and CSCE 310 (Data Structures and Algorithms). Prerequisites by specific topics are:

1. **Mastery** of computer programming, Boolean algebra, binary numbers, and powers-of-2.
2. **Mastery** of stack, list, and queue data structures and algorithms.
3. **Familiarity** with computer organization including I/O devices, and instruction set architecture.
4. **Familiarity** with assembler language principles and context switching.

As part of our ongoing accreditation process, there will be an evaluation of your understanding of the material covered in the prerequisite courses. This evaluation will be graded as a homework assignment.

Grading

Your grade in this class will be based on:¹

- class participation (5%),
- homework and programming assignments (50%),
- midterm examination (20%), and
- final examination (25%).

Homework will be assigned approximately on a bi-weekly basis. Assignments will range from programming exercises to pen and paper problems. All pen and paper assignments will be collected at the start of class on the day on which they are due. All programming assignments will be due at 6pm on the day on which they are due. (Programming assignments will usually be due on Wednesdays.) Written homework will be collected by the instructor; programming assignments will be submitted via the handin program.

All homework submitted after its deadline is considered late. Assignments that are submitted within 24 hours after the original deadline are considered to be “one day late,” within 48 hours, “two days late,” *etc.* A late homework assignment will be accepted without penalty if the following conditions are met:

- the total “lateness” of all homework assignments received to date (including the current assignment) does not exceed 4 days.
- the student does not miss class on the day the assignment is due (or on the day after the assignment is due in the case of programming assignments). Exceptions to this requirement must be approved by the instructor in advance.

Late programs should be handed in with the handin program. Late written assignments must be hand delivered to either the instructor or the TA.

The penalty for late assignments is 25% per day they are late. An assignment that is 4 days late will receive no credit. **Weekends count in evaluating the lateness of an assignment.**

There will be one midterm exam. The final exam for this course is scheduled for Thursday, December 20 at 1:00 pm. The final exam covers the entire course.

Course Conduct and Academic Integrity

Students are *encouraged* to work together on homeworks and programming assignments. *Acceptable collaboration* on homework includes:

- discussing the assigned problems to understand their meaning,

¹ The percentages listed are only approximate and are subject to change (by no more than 10%).

- discussing possible approaches to assigned problems,
- discussing the UNIX system features, or general programming principles in the solution of programming problems.

In all cases you must *explicitly* acknowledge any and all substantive help received from other individuals during the course of the preparation of your homework solution. That is, if you collaborate with other individuals then you must include an explicit acknowledgment in your homework solution of the persons from whom you received aid.

Unacceptable collaboration, unless explicitly stated, on homework includes:

- copying (verbatim use) of physical papers or computer files.²
- submission of solutions that are jointly authored, or authored either wholly or in part by other individuals (unless the assignment is a group project).

The general rule to be followed is that the strategy and approach of solutions may be developed jointly but *all* actual solutions (*i.e.*, the final solution) must be constructed and written up individually. Work done jointly should not be done in sufficient detail as to make it a solution. For example, the design of a program solution made be performed jointly, however, each student must write *all* the code they eventually submit as their solution. *No code may be shared between students, unless the assignment is a group project.* Similarly, for written assignments, solutions may *sketched* out jointly, however each student must construct the final form of their solution individually and write-up their own solution. You will be held accountable if someone else copies your work, even if you are unaware of the event. Thus, you should make sure all of your files are properly secured.

Unacceptable collaboration will be considered a violation of the Student Code of Conduct, and will result in a failing grade for the course. In other words: if you cheat, you will fail! In addition, the incident will be reported to the CSE Department, in accordance with new policy on academic integrity. You are responsible to read the department policy and adhere to it.

Should questions arise the course of working on a problem please feel free to immediately contact the instructor either by telephone, electronic mail, or by an office visit. In principle, if you work with others in good faith and are honest and generous with your attributions of credit you will have no problems.

Special Needs

Any student in this course who has a disability that necessitates accommodation should contact the instructor as soon as possible to discuss the appropriate accommodations necessary to complete the course requirements.

² This includes computer files that are copied and then edited and/or reformatted.