CMSC 442: Operating Systems (3 credits)
Fall 2017

http://marmorstein.org/~robert/Fall2017/cs442.html

Lecture: 3:00pm - 3:50pm MWF (Ruffner 352)
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Office Hours: 2:00pm - 3:00pm MTWRF or by appointment

Course Description:
A programming-intensive course in which students learn the important data structures and algorithms of an operating system and apply them to the implementation of core O.S. components. Particular focus will be given to problems that arise in the presence of concurrency in both implementation of the operating system and application of programming. Topics include threads, synchronization constructs, I/O and interrupt handling, memory management, addressing, scheduling, and file system design.

Prerequisites: CMSC 201 and CMSC 242.

Course Objectives:
The student will learn to:

1. Make use of semaphores, monitors, and locks to synchronize concurrent processes and threads.

2. Describe common algorithms and data structures for scheduling, memory management and file system organization.

3. Explain how the design of an operating system impacts design and performance of user-space applications.

Textbook and Other Resources:

This course uses two textbooks:

1. The Little Book of Semaphores, by Allen B. Downey, Version 2.1.5, available as a free PDF at http://www.greenteapress.com/semaphores/

2. Operating Systems: Internals and Design Principles, by William Stallings, Prentice Hall, Ninth Edition, ISBN: 978-0-13-467095-9.

Most of the homework assignments will consist of problems from these two books.

Course Requirements:

This class will have both a strong programming and a strong homework component. The projects will comprise 40% of your grade. Homework and quizzes will comprise another 35%. The midterm and final exams will be worth 10% each. The remaining 5% of your grade will consist of a participation grade.

The projects in this class are hard -- probably much harder than anything else you've done in the major -- and require a significant investment of time and effort. You will be allowed to work in groups and your grade will reflect both the quality of your group's contribution and your individual contribution within your group.

Group Work:

For the projects you will be required to work in groups of two or three. I will allow you to choose your own groups, but if you do not select a group by the time I hand out the first project, I will assign you to a group. Choose your group carefully, as the projects are cumulative and **you will not be able to switch groups between projects.** I will NOT play referee in your groups, so be sure to pick people you can work with all semester.

Slip Days:

Your group will be allocated a fixed number of slip days at the start of the semester which you

may use to extend the due date of one or more *programming labs*. You may use all of your group's slip days on as many or as few projects as you like. Keep in mind, however, that once you use them up, they are gone for good. Slip days are calculated from the minute the assignment is due until you turn it in and are rounded *up* to the nearest integer value of days. That means that if you turn an assignment in 24 hours and 1 minute late, you will use up *two* slip days. The slip day clock runs over weekends and holidays, so if a lab is due on Friday and you turn it in on Monday, you will have used three slip days, not just one. Slip days cannot be exchanged, traded, bought, or sold.

Grading Scale:

100-91:	A	90:	A-		
89:	B+	88-81:	B	80:	B
79:	C+	78-71:	C	70:	C-
69:	D+	68-64:	D		
63 or lower: F		(There is no grade of D- in this course.)			

Grading Policy:

Late work will not be accepted unless you have a medical condition or family emergency which prevents you from completing the assignment on time. In such circumstances, you do not need a doctor's note, but you must contact me by e-mail at least 12 hours before the assignment is due to explain the circumstances and arrange to make up the work.

Cell Phones and Laptops:

Cell phones, music players, and laptops must be turned off and put away during lecture and class discussions. Violations of this policy will be considered an unexcused absence and may also affect your homework or participation grades.

Food and Drink:

Please do not eat in class (it distracts me and the other students). You may bring water or other non-alcoholic beverages to class. I occasionally make exceptions to this rule for students who would otherwise miss lunch or have medical needs that require them to eat in class. If you feel that you need such an exception, you MUST make arrangements with me before you bring food to class. Violations of this policy will be considered an unexcused absence and may also affect your homework or participation grades.

Attendance:

This class is heavily lecture-driven and will require your regular attendance.
I expect you to attend class unless you are sick or engaged in a school sponsored sports event or extra-curricular activity.

In accordance with Longwood policy, missing more than 10% of scheduled class time will result in loss of one letter grade. Absences for school events or illness may be excused if you make arrangements with me within 12 hours of the missed class. Students who miss more than 25% of classes, for any reason, may at my discretion receive an F for the course in accordance with Longwood policy.

Honor Code:

Exams and quizzes are to be completed entirely on your own. You may discuss the homework and lab projects subject to these restrictions:

1. You must turn in a copy of your own work which YOU have typed or hand-written. You may discuss the homework problems in the abstract, but please do not compare answers until after the assignment has been collected. On the projects, you may only turn in code that you (or others in your group) have typed.

2. You may NOT share code with anyone who is not in your group (except me). No one outside your group should ever see your code except me. This includes copying files

using flash drives, cell phones, e-mail, web sites, floppies, CDs, or any other electronic storage or communication device. It also includes printouts or hand-written copies of your code.

You MAY discuss the general design of the project with students outside your group, but you must limit these discussions to general design details. No one should be looking at your code who is not in your group. **Note that this means that no one who is not in your group should help you with debugging** except at a very high (conceptual) level! You SHOULD share code with the other members of your group. In fact, I strongly encourage you to set up (and use) a git repository.

3. You may NOT use code from the Internet.
There are several web sites that have full or partial solutions to some of the NachOS projects. In my experience, many of these "solutions" are not complete, correct solutions. Nevertheless, you may NOT use these sites in any way. If you should encounter them accidentally while looking for other resources, you should immediately click away from the web site or close the window.

There are other sites that you may find useful (man pages, articles on operating system concepts, and the NachOS project documentation), which you may use as long as you do not copy large blocks of code (more than three lines) and give proper attribution.

*Infractions of these policies will be dealt with harshly under the Longwood Honor Code. Any student convicted of an honor offense involving this class will automatically receive a final course grade of **F** in addition to any penalties imposed by the Honor Board. You should consider all work in this class to be pledged work, whether or not the pledge itself appears on the assignment.*

Tentative Course Schedule:

Week1 (Aug. 21 - 25)	Introduction, Hardware, Interrupts and System Calls **Read Stallings Ch.1 and 2**
Aug. 28	***Last Day to Drop (by 5pm)***
Week 2 (Aug. 28 - Sept. 1)	Processes and Threads, The Process Control Block (PCB), Process Management **Read Stallings Ch. 3 and 4, Downey Ch. 1-2**
Sept. 4	**Labor Day: No class**
Week 3 (Sept. 6 - 8)	Synchronization, Signaling, Rendezvouses **Read Downey Ch. 3.1-3.2**
Week 4 (Sept. 11 - 15)	Mutual Exclusion, Multiplexing, Barriers **Read Downey Ch. 3.3-3.6** **Project 1 Due**
Week 5 (Sept. 18 - 22)	Deadlocks and Races, Barriers, Queues, and FIFO, Dining Philosophers **Read Downey Ch. 3.5-3.8, Stallings Ch. 5.1-5.5**
Week 6 (Sept. 25 - 29)	Catch up and Review, **Midterm Exam**
Week 7 (Oct. 2 - 6)	Producer/Consumer and Readers/Writers, Non-classical Semaphore Problems **Read Downey Ch. 4.1-5.3, Stallings Ch. 5.6-5.7, Ch. 6** **Project 2 Due**
Week 8 (Oct. 9 - 13)	Memory Management: Fixed and Dynamic Partitioning, Pages and Segments, Page Tables **Read Stallings, Ch. 7**
Oct. 16 - 17	**Fall Break**

Week 9 (Oct. 23 - 27)	Virtual Memory, Logical and Physical Addresses, The TLB, Swapping, Page Faults and Thrashing **Read Stallings Ch. 8**
Week 10 (Oct. 30 – Nov. 3)	Replacement Algorithms, Demand Paging, Prefetching, Write-back and Write-through **Project 3 Due**
Week 11 (Nov. 6 - 10)	Scheduling Algorithms, Multi-processor Scheduling **Read Stallings Ch. 9 and 10**
Week 12 (Nov. 13 - 17)	Files and File Systems, Directories **Read Stallings Ch. 11**
Week 13 (Nov. 20)	Modern File Systems **Read Stallings Ch. 12** **Project 4 Due**
Nov. 23 - 25	**Thanksgiving Break**
Week 15 (Nov. 27 - Dec. 1)	Networking **Read Stallings Ch. 17**
Dec. 8	**Final Exam (Friday, 11:30am – 2:00pm)**