# CMSC 442: Operating Systems (3 credits)
# Fall 2015
*http://marmorstein.org/~robert/Fall2015/cs442.html*

**Lecture:** 2:00pm - 3:00pm MWF (Ruffner 352)
**Instructor:** Robert Marmorstein          **Office:** Ruffner 329
**Office Phone:** 434-395-2185              **E-mail:** marmorsteinrm@longwood.edu
**Office Hours:** 10:00am-12:00pm 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:
1. Make use of semaphores, monitors, and locks to synchronize concurrent processes and threads.

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

3. Understand 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, Eighth Edition, ISBN: 9780133805918.

Most of the homework assignments will be 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 40%. The midterm and final exams will be worth 10% each.  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.

## 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 Policy:**
Late work will not be accepted unless you have a serious medical or family condition which prevents you from completing the assignment on time. You do not need a doctor's note, but you must send an **e-mail** to my Longwood account within twelve hours of the assignment due date to make arrangements for the work to be completed.

**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.) | | | |

**Attendance:**
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.

**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 grant exceptions to this rule for students who must otherwise forgo 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 in advance.  Violations of this policy will be considered an unexcused absence.

**Cell Phones and Laptops:**
Cell phones, music players, and laptops are to be turned off and put away during class, except for use during the lab sessions.  Violations of this policy will be considered an unexcused absence.

**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.

**Collaboration:**
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 or mercurial repository.

**3. You may NOT download code from the Internet.**
There are several web sites that have solutions to some of the NachOS projects. You may NOT use these sites in **any** way. However, there are other sites that you may find useful (man pages, articles on operating system concepts, and the NachOS project documentation). You may use these web sites as long as you follow the other guidelines.

*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. 24-28)          Introduction, Hardware, Interrupts and System Calls
                            **Read Stallings Ch.1 and 2**

Week 2 (Aug. 31 - Sept. 4)  Processes and Threads, The Process Control Block (PCB), Process
                            Management
                            **Read Stallings Ch. 3 and 4**
                            **Read Downey Ch. 1-2**

*Aug. 31*                   *Last Day to Drop (by 5pm)*

Week 3 (Sept. 9-11)         Synchronization, Signaling, Rendezvouses
                            **Read Downey Ch. 3.1-3.2**

Week 4 (Sept. 14-18)        Mutual Exclusion, Multiplexing, Barriers
                            **Read Downey Ch. 3.3-3.6**
                            **Project 1 Due**

Week 5 (Sept. 21-25)        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. 28-Oct. 2)    Catch up and Review, **Midterm Exam**

Week 7 (Oct. 5-9)           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**

**Oct. 12-13**                              **Fall Break**

Week 8 (Oct. 14-16)         Memory Management: Fixed and Dynamic Partitioning,
                            Pages and Segments, Page Tables
                            **Read Stallings, Ch. 7**

**Oct. 14**                              **Deadline to Withdraw without an F**

Week 9 (Oct. 19-23)         Virtual Memory, Logical and Physical Addresses, The TLB,
                            Swapping, Page Faults and Thrashing
                            **Read Stallings Ch. 8**

Week 10 (Oct. 26-30)        Replacement Algorithms, Demand Paging, Prefetching,
                            Write-back and Write-through
                            **Project 3 Due**

Week 11 (Nov. 2-6)          Scheduling Algorithms, Multi-processor Scheduling
                            **Read Stallings Ch. 9 and 10**

Week 12 (Nov. 9-13)          Files and File Systems, Directories
                            **Read Stallings Ch. 11**

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|---|---|
| Week 13 (Nov. 16-20) | Modern File Systems<br>**Read Stallings Ch. 12**<br>**Project 4 Due** |
| Week 14 Nov. 23 | Catchup and Review |
| **Nov. 25-27** | **Thanksgiving Break** |
| Week 15 (Nov. 30-Dec. 4) | Networking<br>**Read Stallings Ch. 17** |
| **Dec. 11** | **Final Exam (Friday, 8:00am-10:30am)** |