

# Operating Systems

CS 311  
Spring 2016

**Instructor** Tom Kelliher, Ph.D., Associate Professor of Mathematics and Computer Science  
Office: Julia Rogers 133  
Office hours: MWF 11:00am–12:00pm, by appointment, or drop-in when my office door is open.  
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## Course Textbook and Other Resources:

1. A. Silberschatz, P. B. Galvin, and G. Gagne, *Operating Systems Concepts*, 9th ed., Wiley, 2013. Required.
2. See the course web site for additional resources:  
<http://phoenix.goucher.edu/~kelliher/s2016/cs311/>

**Meetings** Julia Rogers 121, MTh 1:40–3:40 pm.

**Description** The study of how modern operating systems are designed through the study of their fundamental pieces. Key features include symmetric multi-processing (SMP), threads, virtualization, demand paging, and virtual memory.

**Prerequisite** CS 205.

## Learning Objectives:

At the end of this course students will be able to:

1. Explain the objectives and functions of modern operating systems.
2. Describe how computing resources are used by application software and managed by system software.
3. Contrast kernel and user mode in an operating system.
4. Demonstrate the potential run-time problems arising from the concurrent operation of many separate tasks.
5. Compare and contrast the common algorithms used for both preemptive and non-preemptive scheduling of tasks in operating systems.
6. Describe the difference between processes and threads.
7. Defend the different ways of allocating memory to tasks, citing the relative merits of each.
8. Identify the relationship between the physical hardware and virtual devices maintained by the operating system.

9. Compare and contrast different approaches to file organization, recognizing the strengths and weaknesses of each.

## **Expectations**

You are expected to give CS 311 the attention it deserves as a college-level computer science course. In particular, you are expected to:

- Spend an average eight hours per week outside of class working on the course. This includes the entire range of activities from preparing for class, to completing assignments and projects that you weren't able to complete in class, to attending office hours.
- Attend class each time it meets, with all assigned preparation activities completed. During each class meeting, you are expected to pay attention respectfully, work productively, and not interrupt the learning of your classmates.
- Take initiative to seek out help in a combination of forms and channels when needed, and to be honest about when help is needed.

Registering for a four-credit class is a 12-hour-per-week commitment, four hours of which take place during our class meetings. The other eight hours are to be spent in productive, engaged work in individual and group study and in attending office hours.

## **Grading:**

### **Grade Distribution**

At the conclusion of the semester, your grades will be weighted into a single grade as detailed below, rounded up, and converted to a letter grade as follows: A = [92–100], A- = [90–92), B+ = [88–90), B = [82–88), B- = [80–82), etc.

### **Graded Work**

As necessary, grades will be scaled to a [0–100] scale.

1. Written problem sets — One or two problems will be assigned with each reading assignment. Problems assigned during week  $n$  will be due in hard-copy form during Monday's class of week  $n + 1$ . Late problem sets will be accepted up to the start of the following class, for a 15% penalty.

The problem sets will account for 15% of your final grade.

2. Presentation — You will prepare and present a 10–15 minute presentation on some aspect of operating systems, either going into more detail on a topic covered by the readings, or presenting a topic not covered by the readings. Presentations will be spread-out across the semester, with one given at the beginning of each class. A one-paragraph presentation topic description is due at the beginning of class on Thursday, Feb. 4. The description must include two or three references. The presentations will commence on Thursday, Feb. 18.

The presentation will account for 10% of your final grade.

3. Exams — There will be three exams, following the completion of Chapters 5, 9, and 14. The third exam will be scheduled during the finals period, but will not be cumulative.

The exams will account for 30% of your final grade.

4. Projects — There will be seven graded projects, with two weeks allocated for each project. You will work on the projects in groups of two. The project topics will be:
  - (a) Environment familiarization, including virtual machine access, Linux kernel compilation and boot, use of git/GitHub, and use of gdb.
  - (b) Implement a simple Linux shell.
  - (c) Implement system calls in the Linux kernel.
  - (d) Implement Pthreads-based solutions to variations of the Dining Philosophers and Sleeping Barber problems using various synchronization primitives.
  - (e) Evaluate the CFS CPU scheduler in the Linux kernel.
  - (f) Implement a virtual character device in the Linux kernel.
  - (g) Implement a simple API for accessing a FAT12 filesystem in user space.

Projects will be due at 5:00 pm on Fridays. Even if your project isn't working, submit what you have. You will receive partial credit and you will later have the opportunity to earn some of the points that you lost. Projects will not be accepted late.

The projects will account for 45% of your final grade.

### **Academic Integrity**

Academic dishonesty is detrimental to the integrity of our learning community and will not be tolerated. All of us, including me, are bound by the Academic Honor Code. The College's Academic Honor Code is available at [www.goucher.edu/documents/General/AcademicHonorCode.pdf](http://www.goucher.edu/documents/General/AcademicHonorCode.pdf). I expect you to be familiar with its obligations and requirements. I have also written a statement that applies the Honor Code to this course. This statement is available on the course web site (see *Integrity in My Computer Science Courses*).

### **Disabilities**

If you have a documented disability you should contact the Academic Center for Excellence (ACE) to arrange for academic accommodations for the course. Carefully follow all of ACE's policies and procedures. Once you have coordinated with ACE, email me to make me aware of your accommodation. I will receive official correspondence from ACE; however, I would also like to receive an email from all students requiring accommodations for the semester. If your accommodation involves taking exams at ACE, it is your responsibility to schedule your exams with ACE. When scheduling exams with ACE, be sure to carbon copy me on any emails with ACE so that I have confirmation that everything is in order. This process is to be repeated for all exams throughout the semester.

### **Achieving Academic Success**

If you are struggling in this or other courses, I strongly encourage you to reach out for help sooner rather than later. Proactive strategies could include contacting me directly, attending office hours, and/or taking advantage of the multitude of academic services that the Academic Center for Excellence offers. The responsibility is upon you to recognize when you need help and to take the steps necessary to succeed. Goucher College has a variety of resources available to help you succeed in your classes; use them!

Office hours are perhaps the most effective and immediate way to get help. If I must cancel office hours, you will receive warning in advance and I will schedule “make-up” office hours. You do not need an appointment for office hours; simply drop in and ask your questions. My goal in office hours is to answer your questions in such a way that you will not only get your question answered, but also strengthen your ability to answer your own questions. You may also call my office during office hours. If you cannot make office hours due to a scheduling conflict, you may schedule time with me outside the normal office hours period. I will do my best to accommodate you.

If you don’t need an immediate answer to a question, you may submit it by email. I check email several times during the day, and usually during the evening. Please note, however, that I am not available on a 24x7 basis.

The first 10 minutes of each class may be reserved for addressing the most common issues I see occurring from all of our interactions.

### **Student-Athletes**

According to the Goucher College policy on Student-Athlete Responsibilities, if you are a student-athletes, you are expected to contact me at the beginning of the semester to request approval for absences associated with athletic events (or scheduled departure times for such events) that conflict with the regularly scheduled class meeting time. The approved absences will then be listed on a contract signed by both me and you. Additionally, it is the responsibility of the student-athlete to complete all assignments covered in class during the approved absences and to obtain all handouts, assignments, and notes from the missed class(es). Student-athletes who fail to coordinate with me prior to any class absences will not be permitted to make-up missed assignments.

### **Student Responsibilities in Academic Conflicts (Field trips, Performances, etc.)**

According to the Goucher College policy on Academic Conflicts, if you are in a situation in which you are confronted with obligations or responsibilities (ranging from participation in field trips in the visual arts or the sciences or rehearsals or performances in the performing arts to extra-curricula activities at which students are representing the College such as model senate events or varsity athletic contests) that conflict with regularly scheduled academic classes, you are expected to contact me at the beginning of the semester, or as soon as the conflict is known, to request approval for absences that conflict with the regularly scheduled class time. The approved absences will then be listed on a contract signed by both me and you. Additionally, it is your responsibility to complete all assignments covered in class during the approved absences and to obtain all handouts, assignments, and notes from the missed class(es). Students who fail to coordinate with me prior to any class absences will not be permitted to make-up missed assignments.

### **Readings Schedule**

(See next page.)

| <b>Week</b> | <b>Readings</b>                 |
|-------------|---------------------------------|
| 1           | Overview, 1.1,2,4-8,11          |
| 2           | 2.1,3-7,10 <sup>1</sup> , 3.1-3 |
| 3           | 3.4-6, 4.1-6                    |
| 4           | 5.1-9                           |
| 5           | Exam 1, 6.1-3                   |
| 6           | 6.4-8, 7.1-3                    |
| 7           | 7.4-7, 8.1-8                    |
| 8           | 9.1-6,8-11                      |
| 9           | Exam 2, 10.1-3                  |
| 10          | 10.5-8, 11.1-6                  |
| 11          | 12.1-9                          |
| 12          | 13.1-7, 14.1-4                  |
| 13          | 14.5-9, Open                    |
| 14          | Open, Exam 3 during Finals Week |

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<sup>1</sup>You should also read the *Linux startup process* article on Wikipedia.