

Operating Systems

CS 411
Spring 2020

Instructor Tom Kelliher, Ph.D., Associate Professor of Computer Science
Office: Julia Rogers 133
Office hours: MTuWThF 10:00–11:00 am, 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*, 10th ed. (2018) or 9th ed. (2013), Wiley. Required.
2. See the course web site for additional resources:
<http://phoenix.goucher.edu/~kelliher/s2020/cs411/>

Meetings Julia Rogers 121, TuTh 2:30–3:20 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 411 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- = [90–91], B+ = [88–89], B = [82–87], B- = [80–81], etc.

Graded Work

1. Written problem sets — One or two problems will be assigned with each reading assignment. Problems assigned during week n will be due in **hardcopy** form during Tuesday's class of week $n + 1$. Late problem sets will be accepted up to the start of the following class, for a 10% penalty.

The problem sets will account for 20% of your final grade.

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

The exams will account for 35% of your final grade.

3. Projects — There will be five graded projects, with two to four weeks allocated for each project. You will work on the projects singly. 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) Implement a simple API for accessing a FAT12 filesystem in user space.

Projects are due at 11:59 pm on the due date. Projects will be accepted late with a 4% penalty per day for up to three days after the due date. Saturday and Sunday are counted as one day, spring break is counted as one day, and GIG and the following weekend is counted as one day.

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. 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

Week	Readings
1	Overview, 1.1,2,4–8,11
2	2.1,3–7,10 ¹ , 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
Final Experience Week	Exam 3

¹You should also read the *Linux startup process* article on Wikipedia.