COMP3080-201 & COMP3080-202
Operating Systems
3 contact hours - 3 credits
Fall 2019 Syllabus

General Information

Instructor	Dr. Charles T. (Tom) Wilkes
Office	Dandeneau Hall 323
Email	Charles_Wilkes@uml.edu
Phone	(978) 934-3634
Class Time	Section 201: MWF noon-12:50 PM Section 202: MWF 1:00-1:50 PM
Class Location	Olsen Hall 410
Office Hours	MWF 3:00-5:00 PM (with exceptions for faculty meetings, etc., as announced)
Teaching Assistant	Section 201: Zubin Bhuyan Section 202: Olga Kovaleva (expected)

Required Textbook

- Avi Silberschatz, Peter Baer Galvin, and Greg Gagne (2018), *Operating Systems Concepts*, 10th Ed., John Wiley and Sons, ISBN 978-1119456339 (abridged print companion with eText card).
- Lubomir Bic, *Operating Systems*, interactive book (December 2018 Initial Release), zyBooks. This is a trial version provided **free of charge** this semester.
  To subscribe:
  - Sign in or create an account at learn.zybooks.com
  - Enter zyBook code: **UMLCOMP3080WilkesFall2019**
  - Click Subscribe

Supplementary Textbook / Materials

- Silberschatz et al. textbook's Companion Site

Course Description

- This course presents an introduction to major operating systems and their components. Topics include processes, concurrency and synchronization, deadlock, processor allocation, memory management, I/O devices and file management, and distributed processing. Techniques in operating system design, implementation, and evaluation will be examined.

Course Prerequisites

- COMP3050 Computer Architecture

Course Category

- Required

Additional Course Information

- **Course Objectives** – This course will introduce the student to the fundamentals of concurrent programming and operating systems architecture. At the completion of this course, the student will be able to:
  - Apply the concept of separation of mechanism and policy in operating systems for a written assignment.
  - Use the notions of processes and threads in order to control and exploit concurrency in a programming project assignment.
  - Evaluate operating system resource scheduling policies as applied to example situations for a written assignment.
  - Explain and apply memory management policies, especially virtual memory concepts, for a written assignment.
  - Evaluate basic file system, security, and protection concepts as applied to example situations for a written assignment.
  - (Schedule permitting) Explain and apply virtual machine and distributed operating system concepts for a written assignment.
- **Web Page** – on Blackboard
- **Software** – Linux virtual machine provided by textbook authors Silberschatz, Galvin, and Gagne; hosted on Oracle VM VirtualBox: http://people.westminstercollege.edu/faculty/ggagne/osc10e/vm/index.html

Methodology

Teaching methods: This course will be conducted as a "Flipped Classroom" with Before-Class, During-Class, and After-Class activities and assignments. Students are expected to do substantial preparation before class using the materials provided on the Blackboard course page. During class, brief presentations may be provided before continuing with in-class activities to explore the course objectives. Assignments will consist of problem sets or other tasks to exercise and assess the student's understanding of the course topics. Blackboard will be used extensively to post assignments, provide additional course materials, and to make general announcements.

Assessment: There will be regular quizzes and/or post-class exercises involving practice problems, programming exercises and/or projects, two in-class written exams, and a comprehensive final exam. In-class participation will also be assessed via presentation of solutions to post-class exercises.

Grading:

The percentage weights of the various assignments in this class are as follows:

Programming Exercises/Projects Average	30%
Post-class Exercises/Quizzes Average	10%
In-Class Participation	10%
In-Class Exams	2x15%
Final Exam	20%

At the end of the semester, a course average is computed for each student using the percentage weights, and the final grade is assigned using the following scale:

A 90.0-100

B+ 87.0-89.9
B 83.0-86.9
B- 80.0-82.9

C+ 77.0-79.9
C 73.0-76.9
C- 70.0-72.9

D+ 67.0-69.9
D 60.0-66.9

F below 60

Factors such as attendance, improvement (especially as demonstrated on the final exam), and class participation may be considered when making the final decision in borderline cases.

Requests for re-grading assignments may be made up to one week after the assignment is returned. The request must be submitted in writing and include a short paragraph outlining the rationale for the re-grade. Acceptable requests include correcting errors in calculating a score, marking a correct answer incorrect, etc. (See also "Resubmission Policy" below.)

University Policies and Advising Resources

Students are expected to be familiar with the following policies from the Undergraduate Catalog:

- Academic Policies (including Academic Integrity, Grading, and Student Complaints): https://www.uml.edu/Catalog/Undergraduate/Policies/Academic-Policies/Academic-Policies.aspx
- Kennedy College of Sciences Policies: https://www.uml.edu/Catalog/Undergraduate/Sciences/policy/default.aspx
- Computer Science Department Policies: https://www.uml.edu/Catalog/Undergraduate/Sciences/policy/Continuance-appeal-dismissal.aspx

Also, students are urged to be aware of advising resources (including Accommodations / Disability Services) and tutoring services provided by the University:

- https://www.uml.edu/Academics/Provost-office/Faculty-success/Professional-Engagement/advising-resources.aspx
- https://www.uml.edu/class/tutoring/

We are a campus that cares about the mental health and well-being of all individuals in our campus community. If you are experiencing a mental health issue including heightened levels of stress or anxiety at any time during the semester, or need to talk with someone about a personal problem or situation, I encourage you to seek support as soon as possible. I am available to talk with you about stresses related to your work in my class. Furthermore, I can assist you in reaching out to any one of a wide range of campus resources, including:

- UMatter2, University Crossing Suite 300, at 978-934-6671, https://www.uml.edu/UMatter2/
- Counseling and Health Services, University Crossing Suite 300, at 978-934-6800:
  - https://www.uml.edu/student-services/counseling/
  - https://www.uml.edu/student-services/health/
- Disability Services, University Crossing Suite 300, at 978-934-4574, https://www.uml.edu/student-services/Disability/
- Your college's Academic Advising or Student Services Office
- Centers for Learning, Southwick Hall 308, or https://www.uml.edu/CLASS/

Course Policies

Attendance: Formal attendance is mandatory. Three unexcused absences are permitted. Additional absences may result in a failing grade and/or removal from the course.

Academic integrity: The practice of good ethical behavior is essential for maintaining good order in the classroom, providing an enriching learning experience for students, and as training as a practicing computing professional upon graduation. This practice is manifested in the University's Academic Integrity policy. Students are expected to strictly avoid academic dishonesty and adhere to the Academic Integrity policy as outlined in the course catalog. Violations will be dealt with as outlined therein.

As a general rule*, all work submitted for grading must be the student's own work. Students are allowed to help each other solve compiling and linking problems, and may generally discuss issues related to a student's particular program, but students may not share code, write code, or examine another student's code.

Also, as a general rule*, regarding homework and projects, students may discuss the problems (what is being asked for), appropriate material from class lectures or the textbook or acceptable other sources. Students, however, may not share answers or the specifics of how to answer the question.

**Other policies may apply to specific assignments (e.g., group projects or homework assignments) as specified by the instructor.*

Use of material from previous classes, solution manuals, material from the Internet or other sources (e.g., parents, siblings, friends, etc.) that directly bears on the answer is strictly prohibited.

At the discretion of the instructor, students may be asked to sign a statement that they have abided by the University's Academic Integrity policy and its application to this class. This statement may appear on homework, tests, or projects.

When in doubt, consult the course professor before doing something that may result in violation of the University's Academic Integrity policy.

Application to this course:
Assignments specified as "**solo assignments**" are to be done by the student alone. No outside help is permitted. If you need help on a programming assignment you can only receive aid from the instructor of the course, teaching assistant or approved tutors.

Some assignments may be specified as "**group assignments**" with different rules as specified by the instructor.

The sanction for the first violation of the Academic Integrity policy or plagiarism policy will result in a minimum failing grade on the

relevant assignment and the violation will be reported to the student's department chair. Once the final decision has been rendered and any or all appeals exhausted by any parties involved, the instructor or appropriate parties will carry out the recommended sanction.

Personal conduct: In order to minimize distractions and interruptions, students will be expected to:

1. Arrive to class on-time and fully prepared.

2. Give the instructor full and undivided attention once the lecture has begun.

3. Turn off and stow all cell phones, pagers, and any other personal electronic devices once the lecture has begun.

Failure to adhere to these policies may result in immediate dismissal from class and loss of any in-class credit for relevant assignments or activities.

Computer use: Students are encouraged to use their laptop computer for taking notes and other activities directly related to the course. The manner in which students use the computer in class is considered a matter of honor and professionalism. Students will adhere to the following guidelines:

1. Computer use must be for taking notes or other activities related directly to the course.

2. Computer use must be subtle and must not distract fellow classmates or the instructor.

Inappropriate use of a computer in the classroom will be viewed as disrespectful to the instructor and classmates and will be considered unprofessional. Examples of inappropriate use include, but are not limited to:

- Sending, receiving, or reading e-mail
- Instant messaging
- Web browsing
- Working on assignments
- Playing games
- Listening to music
- Watching movies

Judgments regarding the appropriateness of computer use are at the discretion of the instructor. The consequences for violating this policy are also at the discretion of the instructor, and may include loss of in-class computer privileges, grade reduction, and so forth.

Course readings: Readings and "before-class" assignments are to be completed before the class session for which they have been assigned; material covered in each reading is fair game for class discussions and unannounced quizzes.

Assignments: Assignments will be distributed via a mixture of paper and electronic means. Students are responsible for managing due dates and understanding submission procedures to turn in programming assignments.
Exceptions to assignment due dates will be made only in very dire circumstances (see "Late work" below); therefore, please submit whatever you have by the due date—even if it's only reasonable preliminary thoughts or pseudocode!—so that the instructor can give you at least some partial credit instead of a zero on the assignment.

Resubmission Policy: Assignments may be submitted an unlimited number of times before the due date; only the last submission will be graded. An assignment may be resubmitted up to one week after the student receives comments from the instructor or grader concerning the assignment.

Exams: A discussion of the topics covered by each exam will occur during class at most one week from the scheduled exam date.

Final exam: The schedule for the comprehensive final exam for this class currently is TBD by the Registrar.

Late work: Late assignments or projects will not be accepted without prior approval. Students must consult the instructor at least three days prior to the scheduled due date of any assignment to make alternative arrangements; however, the instructor is under no obligation to grant any such request. Penalties such as a reduced score may be applied at the instructor's discretion.

In-class exams will not be rescheduled except in the event of an excused absence. The instructor will work with the student to schedule such a makeup exam; however, it is in the student's best interest not to miss the regularly scheduled in-class exam.

Tentative Schedule

Week	Topic	Readings*	Assignments
1 (9/4-9/6)	**Introduction** to course; course policies and academic integrity policy. **Overview** of operating systems structure and operations; review of modern computer architecture and organization.	"Operating Systems Basics" video ZYB Chapter 1.1 OSC Chapter 1 BB Module 1 Part 1	In-class exercise covering "Operating Systems Basics" video
2 (9/9-9/13)	**Operating system structures:** mechanisms and policies; operating system architectures; system calls.	ZYB Chapter 1.2-1.3 OSC Chapter 2 BB Module 1 Part 2	Module 1 Post-Class Exercise assigned
3 (9/16-9/20)	**Processes and Inter-Process Communication:** scheduling; operations; IPC; communication in client/server systems.	ZYB Chapter 2.1-2.5 OSC Chapter 3 BB Module 2 Part 1	Module 1 Post-Class Exercise due Programming Project 1 assigned
4 (9/23-9/27)	**Threads:** multicore programming; thread models; thread libraries; implicit threading; issues; OS examples.	ZYB Chapter 2.6 OSC Chapter 4 BB Module 2 Part 2	Module 2 Post-Class Exercise assigned
5 (9/30-10/4)	**Process synchronization:** critical section problem; software and hardware solutions; mutex locks; semaphores; classic problems; monitors; examples; alternative approaches.	ZYB Chapter 4 OSC Chapters 6 & 7 BB Module 3 Part 1	Module 2 Post-Class Exercise due
6 (10/7-10/11)	**CPU scheduling**: criteria; algorithms; thread scheduling; multi-processor and real-time scheduling; OS examples. **Friday, October 11: Review for Exam 1**	ZYB Chapter 3 OSC Chapter 5 BB Module 4 Part 1	Module 3 Post-Class Exercise assigned
7 (10/15-10/18)	**Tuesday, October 15: Exam 1** **Deadlocks:** characterization; methods for handling; detection, avoidance, and prevention; recovery from deadlock.	ZYB Chapter 5 OSC Chapter 8 BB Module 4 Part 2	**Monday, October 14: Columbus Day Holiday (Tuesday, 10/15 is a Monday schedule)** Module 3 Post-Class Exercise due Module 4 Post-Class Exercise assigned

8 (10/21-10/25)	**Main memory:** swapping; address translation; segmentation; paging and page tables; Intel and ARM examples.	ZYB Chapter 6 OSC Chapter 9 BB Module 5 Part 1	Programming Project 1 due Module 4 Post-Class Exercise due
9 (10/28-11/1)	**Virtual memory:** mechanisms and policies; demand paging; copy on write; page replacement; frame allocation; thrashing; memory-mapped files; kernel memory allocation; OS examples.	ZYB Chapter 7 OSC Chapter 10 BB Module 5 Part 2	Programming Project 2 assigned Module 5 Post-Class Exercise assigned
10 (11/4-11/8)	**Storage management:** mass storage structure; I/O systems.	ZYB Chapter 9 OSC Chapters 11 & 12 BB Module 6 Part 1 BB Module 6 Supplement	Module 5 Post-Class Exercise due
11 (11/13-11/15)	**Wednesday, November 13: Review for Exam 2** **Friday, November 15: Exam 2**		**Monday, November 11: Veteran's Day Holiday**
12 (11/18-11/22)	**Storage management:** file-system interface; file-system implementation; file-system internals.	ZYB Chapter 8 OSC Chapters 13, 14, & 15 BB Module 6 Part 2	Module 6 Post-Class Exercise assigned
13 (11/25)	**Monday, 11/25: "Catch-up" session**		**Wednesday, 11/27 through Friday, 11/29: Thanksgiving Recess**
14 (12/2-12/6)	**Protection:** principles; domains; access matrix; access control; capability-based systems. **Security:** program threats; system and network threats; cryptography; authentication; classifications.	ZYB Chapter 10 OSC Chapter 16 BB Module 7 Part 1 OSC Chapter 17 BB Module 7 Part 2	Module 6 Post-Class Exercise due
15 (12/9-12/11)	**(Note: Coverage of the listed topics is subject to time available)** **Virtual Machines:** benefits and features; building blocks; virtualization of OS components. **Distributed Systems:** advantages; types; network structure; communication structure; protocols; robustness; design issues; distributed file systems. **Final Exam: TBD**	OSC Chapter 18 BB Module 7 Part 3 OSC Chapter 19 BB Module 7 Part 4	Programming Project 2 due **Reading Day: Friday, 12/13 (no classes or exams)**

*** "OSC" refers to the required textbook by Silberschatz et al.; "CS" refers to the textbook's Companion Site; "ZYB" refers to the OS zyBook; "BB" refers to the Blackboard pages for this course.**