Cmp Sci 4760 – Operating Systems
Department of Mathematics and Computer Science
Fall 2018

Instructor	Mark Hauschild
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Classroom	SSB 218
Office Hrs	TuTh 9:00AM to 9:30AM
	Any other time by appointment
Prerequisites	Cmp Sc 2700, Cmp Sc 2750, and Cmp Sc 3130
Textbooks	Stallings. *Operating Systems*. Pearson, 2018.
	Robbins/Robbins. *Unix Systems Programming – Communication, Concurrency, and Threads*. Prentice-Hall, 2003.

Course Description Covers the structure of a generic operating system, considering in detail the algorithms for interprocess communications, process scheduling, resource management, memory management, file systems, and device management. Presents examples from contemporary operating systems. This course also requires practical projects implemented within a modern operating system or simulator envrionment.

Topics We'll discuss the structure of a generic operating system, with an emphasis on the algorithms and data structures needed to perform various tasks to manage processes, resources, memory, files, and IO devices. There will be *extensive* programming in C under Linux environment. The sequence of topics will be as follows (in that order):

- Function, Types, and Structure of Operating Systems.

- Concurrent Programming, Process Interaction and Synchronization.

- Process Management and Scheduling.

- Deadlock Problem.

- Memory Management.

- File System and I/O management.

Outcomes At the end of this course, you are expected to be able to proficiently program system programming tasks. You should also be knowledgeable in different operating systems topics as outlined above. You should understand the algorithms to achieve various tasks in Operating Systems and use the knowledge to improve the performance of your programs.

Requirements I'll expect you to be present in most of the classes. I will not be taking attendance but if you start missing too many classes, please take responsibility for your absence, specially when it concerns tests and homeworks. When you come to class, you must change your cell phones to silent mode. If you are more than ten minutes late, please try to not disrupt the class.

Grading The grade will be based on programming assignments and three tests. All tests will be open book and open notes but no electronic devices will be permitted. Each assignment must be meticulously documented and clearly identify its purpose, author, and date. I will like to *read* your submitted code; I should *not have to figure it out*. It will

do you good if you peruse the Gnu Coding Standards at `http://www.gnu.org/prep/standards/`. When you come to me for help with the code, or when you submit the code, make sure that you follow good indentation practices. If you miss any test or assignment without making prior arrangements, you will have a zero. I will not give any make up tests. The distribution of grades will be as follows:

Programming Assignments	40%
Three Tests	20% each

Students taking this course for graduate standing will be required to show a greater mastery of the material. This can be shown in additional work and additional mastery shown on exams.

Failure to hand in any assignment will result in an automatic zero for that assignment. If some student is unable to hand in an assignment by the deadline, he/she must discuss it with me *before* the deadline. I'll encourage you to talk to other students regarding homework but you should not collaborate to the extent that two submissions are copies of each other. If you are found copying an assignment (from another student or internet), or if your submission has *unreasonable similarity* to another submission, you get a zero for that assignment automatically. A second offense will be reported to the University officials and students involved will face serious consequences. I may ask you to come to my office and explain your code to me; in case you are not able to explain the code to my satisfaction, I'll assign you a zero in that project.

The projects in this class will take up a lot of your time. So, you should start working on those as soon as they are assigned. In the past, the students who have asked a lot of questions have scored better grades. Do not hesitate to ask a question in class, in my office, or over email, especially if you do not have an idea on how to start working on the project.

Miscellaneous If you have any disability that requires an accommodation (as per UMSL policy), you must notify me in advance. If you cannot attend the class due to a religious holiday or a university-sanctioned event, please let me know in advance as well. In case you are down with the flu, please stay absent from the class till you recover, and contact me via phone or email. I'll try my best to make accommodation for you in that case.

You will have an account on the Linux machine `hoare.cs.umsl.edu` in the CS department and you should use it for all assignments. All programs must be done in C. Any assignment that fails to run on `hoare` automatically gets a zero. The lecture notes and old tests are available on the class web page in PDF format. You may want to print the lecture notes before you come to class. Please use the class email list on MyGateway for communications.

Exam Dates

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TBD

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The final test will be given during final exam week. In case of class cancellation due to weather-related or other campus emergency on the day of a test, the test will be held in the following class period.

UMSL Course Policies

1. Participation (expectations)

   - It is vitally important that our classroom environment promote the respectful exchange of ideas. This entails being sensitive to the views and beliefs expressed during discussions whether in class or online. Please speak with me before recording any class activity. It is a violation of University of Missouri policy to distribute such recordings without my authorization and the permission of others who are recorded.

- Turn off sound on beepers, cell phones, and other devices during class. Adherence to the Student Conduct Code is expected.

- I am committed to insuring a positive learning environment by respecting that University policy (p. 66): `http://www.umsl.edu/~studentplanner/index.html`.

- Your success in this course will heavily depend on your ability to communicate, engage and participate in all course activities. Successful completion of this course requires that a student keep up with all assignments, quizzes, projects and tests.

- If you are unable to participate in the scheduled class activities, you must notify the instructor within the week of that class module. **An unexcused failure to engage or participate with the class will be counted as an absence; unexcused absences may result in failure.** The instructor reserves the right to make judgment to accept and/or makeup assignments missed because of failed participation in the course activities.

2. Academic Integrity/Plagiarism

   - Students are responsible for being attentive to and observant of campus policies about academic honesty as stated in the University's Student Conduct Code (p. 60): `http://www.umsl.edu/~studentplanner/index.html`

   - To avoid accusations of academic dishonesty, please submit all written work to the Turnitin system before finalizing what you submit for evaluation. Check information about The Writing Center @UMSL that is linked to MyGateway Home.

   - Plagiarism is the use of another persons words or ideas without crediting that person. Plagiarism and cheating will not be tolerated and may lead to failure on an assignment, in the class, and dismissal from the University. View this campus policy here: `http://www.umsl.edu/services/academic/policy/academic-dishonesty.html`

3. Mandatory Reporting: Under Title IX, all UMSL faculty, staff, and administrators (with limited exception) are obligated to report any incidents of sexual harassment, sexual misconduct, sexual assault, or gender discrimination to the Student Affairs office and/or other University officials. This ensures that all parties are protected from further abuses and that victim(s) are supported by trained counselors and professionals. Note: There are several offices at UMSL (e.g., Counseling Services, Health Services, Community Psychological Service, Center for Trauma Recovery, and Student Social Services) whose staff are exempt from Title IX mandated reporting, when the information is learned in the course of a confidential communication.

4. Access, Disability and Communication

   - Students who have a health condition or disability, which may require accommodations in order to participate effectively in this course, should contact the **Disability Access Services Office**. Information about your disability is confidential.
     - 144 Millennium Student Center
     - Phone: (314) 516-6554
     - Website: `http://www.umsl.edu/services/disabled/`

   - If you have difficulty communicating in English with the instructor of this course, contact the **Office of International Students and Scholar Services**:
     - Phone: (314) 516-5229
     - Email: `iss@umsl.edu`
     - Website: `http://www.umsl.edu/~intelstu/index.html`

Student Support and Services

- **Technical Support**

  - My Gateway (Blackboard): If you have problems logging into your online course, or an issue within the course site, please contact the **Technology Support Center**:
    * Phone: (314) 516-6034
    * Email: `helpdesk@umsl.edu`
    * Website: `http://www.umsl.edu/technology/tsc/`

  - Wimba: If you have any questions regarding Wimba Classroom and Wimba Voice Tools, contact the Faculty Resource Center:
    * Phone: (314) 516-6704
    * Email: `frc@umsl.edu`
    * Website: `http://www.umsl.edu/technology/frc/`
    * Outside normal office hours, you may also contact Wimba for 24/7 assistance:
      · Phone: (866) 350-4978
      · Email: `technicalsupport@wimba.com`

- **Academic Support**

  - **The Online Writing Lab**: At our My Gateway site, students can send their papers to our tutors, who will read them and send them back with suggestions. Students can also access SafeAssign, which identifies quoted material in their essays.
    * Visit the online Writing Lab page on MyGateway to submit drafts online.
    * We try to respond within 48 hours, but it may take longer, so allow ample time.

  - **NetTutor**: Online tutoring in many subjects is now available through NetTutor®. In your courses on MyGateway, click on Tools and select NetTutor® to log in.

- Student Services

  - The Student Retention Services office offers assistance tailored to specific student needs.
    * 225 Millennium Student Center
    * Phone: (314) 516-5300
    * Email: `umslsrs@umsl.edu`
    * Website: `http://www.umsl.edu/services/srs/`

- Departmental Tutoring

  - The department offers tutoring for up to Cmp Sci 3130, and occasionally for other courses
  - Check MyGateway organization CSTutoring.

Tentative Calendar

Week 1	Overview of operating systems and concepts
Week 2	Overview of operating systems and concepts; Interprocess Communications
Week 3	Interprocess Communications
Week 4	Interprocess Communications
Week 5	Interprocess Communications; Test 1
Week 6	Process Management
Week 7	Process Management
Week 8	Process Management
Week 9	Resource Management
Week 10	Spring Break
Week 11	Resource Management; Test 2
Week 12	Memory Management
Week 13	Memory Management
Week 14	File Systems
Week 16	I/O Management; Test 3

Detailed course outline

1. Introduction

   - Basic elements of a computer system: processor, memory, I/O modules
   - Evolution of a microprocessor
   - Instruction execution
   - Interrupts
   - Processor registers
   - Memory hierarchy
   - Multiprocessor and multicore organization
   - Classification of operating systems
   - Process execution modes in Unix/Linux
   - Overview of operating systems structuring methods like monolithic, layered, and object-oriented
   - I/O communication
   - Multiprogramming and multitasking

2. Process Coordination and Synchronization

   - Process concept
   - Overview of multitasking and role of interrupts
   - Concurrent execution and precedence graphs (process flow diagrams)
   - Race conditions, Sharing access
   - Critical Section Problem
     - Models for two processes, including Dekker's Algorithm
     - Models for multiple processes, including Bakery Algorithm
     - Semaphores, mutex locks, and monitors

3. Process Scheduling and Dispatch

   - Preemptive and non-preemptive scheduling strategies
   - Short term, medium-term, and long-term scheduling

4. Deadlocks – Causes, conditions, avoidance, prevention, and resolution

5. Physical and Virtual Memory Organization

   - Offset registers, partitions, pages, segments, swapping, overlays
   - Caching and associative buffers
   - Fetch, placement, and replacement policies
   - Thrashing and working sets

6. Device and File Management

   - File systems

- File types
- File access and directory management
- Distributed file systems
- Equivalence of files and devices
- Organization of I/O subsystems, free space management, and file layout
- Disk scheduling algorithms