CS3841: Design of Operating Systems

Dr. Walter Schilling

Fall, 2012

1 Administrative Details

Instructor:	Dr. Walter W. Schilling, Jr.
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Course Web Page:	`http://myweb.msoe.edu/~schilling/msoe/Fall2011/cs3841/cs3841.shtml`
Credits:	4.0
Meeting Times:	M,T,R 9:00-9:50 (CC49)(Class)
	F 8:00-9:50 (CC46)(Lab)

2 Catalog Description

This course introduces the design and implementation of modern operating systems. Topics covered include the history of operating systems, process synchronization and scheduling, deadlock detection and avoidance, memory management, file systems, protection and security, and input/output systems. Laboratory projects provide experience in using operating system facilities available on a Unix-like system.

3 Outcomes

Upon successful completion of this course, the student will be able to:

1. identify the components of operating system process management

2. recognize issues related to concurrent processes and synchronization techniques

3. discuss and illustrate several approaches to operating system memory management

4. discuss and illustrate several scheduling algorithms

5. describe input/output handling in operating systems

6. illustrate file system interfaces and implementation

7. Construct software applications which use POSIX/UNIX system calls to spawn additional processes.

8. Construct software which uses multiple POSIX/UNIX threads.

9. be able to perform independent research on a focused technical topic

10. be able to document research results in a technical paper

11. Construct software which implements a fundamental data structure in C and manages memory using malloc and free.

12. Construct a software library which manages a memory heap.

4 Pre-Requisites

- CE-2810

- CS-2852

5 Textbook

Operating Systems Concepts Essentials, Silberschatz/Galvin/Gagne, J. Wiley, 2011

6 Other References

C: A Reference Manual, 5th ed. Harbison / Steele, Prentice-Hall, 2002.

7 Computer Software Resources

This course has been constructed assuming your laptop is using the standard MSOE image. If your laptop has been modified from this image, there is the potential of difficulties arising during the course of this class. In particular, this course will make use of Virtual Linux machines. The virtual machines have been tested with the standard image, and may or may not function properly in other environments.

In any case, no matter the configuration of your laptop or the state of your laptop, you are responsible for completing all assignments on time. **Absolutely no extensions will be granted due to Computer difficulties.**

8 Class Participation and Activities

Lecture will be a mix of instructions, discussion, and code examples. Participation is expected.

Class attendance is mandatory. If you are unable to attend a class for any reason, please inform the professor as soon as possible.

Excessive, unexcused absences may result in a grade reduction.

Attendance is required at all lab sessions. It is expected that you will be working on the assigned lab assignment through the lab period unless the assignment is completed and submitted. You must stay for the entire lab period unless the current assignment is complete and turned in. This includes both the software that is to be written / developed as well as the written report on the lab activity. Failure to abide by this policy may result in a grade reduction.

9 Grading

Grades will be based upon Midterm Exams, Lab Work, Homework, Quizzes, and a comprehensive final exam.

Midterm Exams (1)	25%
Labs	30%
Quizzes / Homework	10%
Final Exam	25%
Research Paper	10%
Total	100%

Grades will be based upon the following grading scale

A	92-100
AB	89-91
B	82-88
BC	80-81
C	71-79
D	65 - 70
F	Below 65

In order to receive a passing grade in this course, you must receive a passing grade (a grade of greater than 65%) on the final exam.

10 Late Submission Policy (Non-Homework)

Assignments are due to the designated time and place. Late submissions will not be tolerated and may result in a 10% per business day late penalty from the due date until the assignment is received.

11   Early Submission Bonus

In order to encourage timely completion of assignments, an early submission bonus will be available for all lab assignments. Lab assignments submitted 48 hours or more in advance of the due date may receive a 10% early submission bonus. Lab assignments submitted 24 hours or more in advance of the due date may receive a 5% bonus. However, in the event of incomplete or significantly flawed work being submitted, the early submission bonus will be forfeited.

12   Grading Challenges

Any grading challenges, unless specifically noted by the professor, must be submitted in writing within 5 days of the assignment being returned to the student. The writing shall clearly delineate the problem with the assignment as well as justification for the change in grade.

13   Student Integrity

All students are expected to abide by MSOE's policy on student integrity. If at any point in the semester you have a question about an assignment, please come discuss it with me.

Violations of this policy will be dealt with seriously, and may result in significant penalty, up to and including failure of the course. In specific, violations of student integrity on a lab assignment will most likely result in failure of the course.

In specific, it is expected that you will perform your own work and not work as a group or a team unless specifically allowed by the instructor. To be in possession of another students source code or design or to submit an assignment which matches in whole or in part another students assignment shall be considered a violation of academic integrity.

13.1   Student Integrity Policy (as stated in the MSOE Handbook)

As an institution of higher learning, MSOE is committed above all to the educational development of its students as responsible and principled human beings. As such, MSOE is accountable to all whom it serves and by whom it is scrutinized. The university has a priority interest in promoting personal integrity and in ensuring the authenticity of its graduates credentials.

The university is similarly mindful that the professions, business and industry are concerned with ethical behavior, no less than the professional practice of their members and employees. It follows, therefore, the students of MSOEpreparing for professional careers and leadership roles that are founded on responsibility and trustmust observe and be guided by the highest standards of personal integrity both in and out of the classroom. The expectations of the university with respect to academic and classroom integrity are reflected in, but not limited to, the following guidelines:

1. Each student must recognize that even a poorly developed piece of work that represents his or her best efforts is far more worthwhile than the most outstanding piece of work taken from someone else.

2. Assignments prepared outside of class must include appropriate documentation of all borrowed ideas and expressions. The absence of such documentation constitutes plagiarism, which is the knowing or negligent use of the ideas, expressions or work of another with intent to pass such materials off as ones own. It is an act of plagiarism if a student purchases a paper or submits a paper, computer program, or drawing claiming it to be his/hers when he/she did not write it.

3. Each student should consistently prepare for examinations so as to reduce temptation toward dishonesty.

4. A student may not share examination answers with others for the purpose of cheating, nor should he or she, intentionally or through carelessness, give them an opportunity to obtain the same.

5. Academic dishonesty or cheating includes the act of obtaining or attempting to obtain credit for academic work through the use of any dishonest, deceptive, or fraudulent means. Cheating at MSOE includes but is not limited to:

   - Copying, in part or in whole, from anothers test or homework assignments, worksheets, lab reports, essays, summaries, quizzes, etc.
   - Copying examinations and quizzes, in whole or in part, unless approved by the instructor.
   - Submitting work previously graded in another course unless this has been approved by the course instructor or by departmental policy.
   - Submitting work simultaneously presented in two courses, unless this has been approved by both course instructors or by the department policies of both departments.
   - Communicating electronically (unless approved by the instructor) during examinations with the intent to seek or provide answers.
   - Attempting to present as the students own work, materials or papers purchased or downloaded from the Internet.

- Any other act committed which defrauds or misrepresents, including aiding or abetting in any of the actions defined above.

- Claiming credit for a group project or paper when the individual student made little or no contribution to the groups product.

- Accessing reference documents during a computerized exam or quiz unless approve by the course instructor.

6. A student of integrity will not support, encourage or protect others who are involved in academic dishonesty in any way, and will furthermore attempt to dissuade another student from engaging in dishonest acts.

Acceptance of this responsibility is essential to the educational process and must be considered as an express on of mutual trust, the foundation upon which creative scholarship rests. Students are directed to use great care when preparing all written work and to acknowledge fully the source of all ideas and language other than their own.

In cases of alleged academic dishonesty, procedures involving the student, the instructor, the department chair, and a Board of Review have been established to assess the facts and determine the appropriate penalties. For further information on the policy please see the MSOE Academic Catalog.

13.2 Lecture Note and Handout Availability

To the greatest extent possible, all lecture notes and handouts will be made available on the course website following class / lab. These materials are made available for your learning enrichment. These materials, however, are governed by the Copyright Laws of the United States and are not to be distributed beyond the MSOE environment. This includes, but is not limited to, lecture notes and slides, lab assignments, homework problems, sample solutions, source code examples, and quizzes.

Failure to adhere to this policy may result in a reduction of final course grade.

14 Cell Phone Policy

To enhance learning and reduce disruptions, cell phones will be turned off during class. If a cell phone rings during class, one point will be subtracted from your final grade. Two additional points will be subtracted from your final grade for each additional offense. If your cell phone rings during a quiz or exam, the final grade for the course will be reduced by one half letter grade (i.e. from A to AB). For each additional offense during an exam, the final grade will be reduced by one full letter grades (i.e. from A to B).

Under no circumstances may a cell phone be used as a calculator during exams or quizzes.

15 Laptop Usage

No laptop usage is allowed during lecture periods unless specifically requested by the instructor.

16 Course Drops

Under no circumstances will the professor drop you from this course. If you desire to withdraw from this course, it is your responsibility to complete the process in the appropriate fashion.

17 Examinations

Midterm exams will be held during class meetings unless other arrangements are made prior to the exam. NO MAKEUP EXAMS will be given without advanced reason excepting documented medical or family emergencies.

18 Final Exam

Per university policy, "A final examination is required in every credit course except in courses designated by the various departments, and that exam will be administered in the two-hour block designated. The type of examination should be in agreement with that specified in the departmental course outline and announced to the class near the beginning of the quarter. Final examinations may not count more than 40% of the final grade."

The final exam for this course will be given during a common final exam period during finals week. The final exam will be a common exam with all other sections.

19   Homework / Quizzes

Quizzes may be given weekly, either at a lecture or lab meeting. Homework may also be assigned from time to time. The lowest quiz score will be dropped. **Absolutely no make-up quizzes will be given.**

A homework assignment will be worth one quiz grade unless otherwise noted.

20   Reading Assignments

The syllabus indicates reading assignments. Students are expected to read the indicated pages prior to meeting that day.

21   Research Disclaimer

There is the potential the the instructor will perform research analyzing the effectiveness of instructional methods from this class. Should such research occur, your information will be kept confidential in all reports and publications, and all records will be managed in a manner to maintain minimal risk. You are free to withdraw at any time from said research. If you have any questions, please feel free to contact your instructor.

22 Course Coverage

Week	Day	Topic	Reading and References
1	Monday (9/3)	No Lecture - Labor Day	
	Tuesday	Course Introduction and a Review of C and the GCC Compiler Chain	None
	Thursday	An Introduction to Operating Systems	Chapter 1, pages 3 - 30
2	Monday (9/10)	Operating Systems Structures	Chapter 2, pgs. 47-68
	Tuesday	Operating Systems Structures and Virtual Machines	Chapter 2, pgs. 68 - 82, 87-88
	Thursday	Processes	Chapter 3, pgs 99 - 108
3	Monday (9/17)	Process Operations	Chapter 3, pgs 108-114, Chapter 15, pgs 606-609
	Tuesday	Communicating Between processes	Chapter 3, pgs 114 - 133, Chapter 15, pgs 631-633
	Thursday	Communicating Between Processes, Continued	Chapter 3, pgs 116 - 141, Chapter 15, pgs 631-633
4	Monday (9/24)	Threads	Chapter 4, pgs 145-157
	Tuesday	Threading Challenges	Chapter 4, pgs 157-166
	Thursday	CPU Scheduling	Chapter 5, pgs 175-184
5	Monday (10/1)	CPU Scheduling	Chapter 5 184-198, 192-206, Chapter 15 609-614
	Tuesday	Process Synchronization	Chapter 6 pgs 217-226
	Thursday	Semaphores, Monitors, and Condition Variables	Chapter 6 pgs 226-249
6	Monday (10/8)	Deadlocks and Resource Allocation Graphs	Chapter 6 pgs 249-258
	Tuesday	Exam Review / Catch Up	
	Thursday	Midterm Exam	
7	Monday (10/15)	Memory Management	Chapter 7, pgs 277 - 311
	Tuesday	Virtual Memory	Chapter 8, pgs 319-331
	Thursday	Page Replacement Algorithms	Chapter 9, pgs 331-344
8	Monday (10/22)	Paging Algorithms (Continued)	Chapter 9 pgs 344-358, 361-370
	Tuesday	File System Interface	Chapter 9, pgs 383-418
	Thursday	File System Implementation	Chapter 10 pgs 423 - 433
9	Monday (10/29)	File System Implementation (continued)	Chapter 10 pgs 441 - 452, Chapter 15 pgs 623-629
	Tuesday	I/O Systems	Chapter 12 493-503
	Thursday	I/O Systems	Chapter 12 503-518, 520-523, Chapter 15 629-631
10	Monday (11/5)	Protection	Chapter 13 pgs 529-543
	Tuesday	Security	Chapter 14 pgs 553-586, Chapter 15, pgs 635-637
	Thursday	Review for final exam	
11	DOW TBD	Final Exam 11:00 AM until 13:00.	

23   Lab Topics

Week	Day	Topic
1	Wednesday (9/7)	Getting used to Linux
2	Wednesday (9/14)	A Linked List in C
3	Wednesday (9/21)	A UNIX Word Counter using Linked Lists
4	Wednesday (9/28)	A Multi-Process Word Counter using Linked Lists
5	Wednesday (10/5)	No Lab
6	Wednesday (10/12)	A Multithreaded Chat Program - Week 1
7	Wednesday (10/19)	A Multithreaded Chat Program - Week 2
8	Wednesday (10/26)	A Virtual Memory Simulator
9	Wednesday (11/2)	A Dynamic Memory Manager - Week 1
10	Wednesday (11/9)	A Dynamic Memory Manager - Week 2