

Cmp Sci 2750 – System Programming and Tools
Department of Mathematics and Computer Science
Spring 2018

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urls	http://www.cs.umsl.edu/~sanjiv http://www.cs.umsl.edu/~sanjiv/classes/cs2750
Office Hrs	Mon: 11:00am – 1:00pm Wed: 12:00pm – 2:00pm Any other time by appointment
Prerequisites	Cmp Sci 2250

Course Description Covers systems programming, scripting, libraries, utilities, and development tools. Additional programming topics include piping, binary files, exception handling, command-line arguments, and symbolic debugging. This course also explores tools available in the Unix/Linux environments.

Required texts:

- Paul S. Wang. *Mastering Linux*. CRC Press. 2011.
- Yung-Hsiang Lu. *Intermediate C Programming*. CRC Press. 2015.
- Arnold Robbins. *Unix in a Nutshell (4th ed.)*. O'Reilly. 2005.
- Additional material from various web sites to be posted.

Goals of the course:

- Command-line processing in Unix
- Stream editing, using `sed`, `awk`, and regular expressions
- Program development and optimization tools, including `Makefile`, `gdb`, `git`, and `gprof`
- Introduction to C
- System calls in Unix

Outcomes At the end of this course, you are expected to program proficiently in C under Unix/Linux environment. You should be able to use various programming tools in Unix/Linux for compilation, execution, debugging, and code maintenance. Additionally, you should be able to understand some basic systems programming.

Topics This course is about advanced program development techniques in Unix. You are expected to be familiar with basic Unix usage, such as editing a C program, and compiling and executing the same using the `gcc` compiler. This course will cover more intricate aspects of Unix, including development tools and environment, and elementary system programming, as described below:

- Shellscripts using `bash` shell
 - `sed` and `awk`
 - Regular expressions
- Tools for programming in shell and C/C++
 - Revision Control System
 - Makefile
 - Debugging environment
 - Code profiling for optimization
- C Programming
 - Characters and Strings
 - Bit operations
 - File handling
 - C Preprocessor
 - Dynamic memory
- Unix systems programming
 - Pipes and system calls (`fork`, `exec` family, `exit`, `wait/waitpid`)
 - Signal handling (`sigaction`, `sigprocmask`, `kill`, `alarm`, `sigset_t`)
 - Exception control

Email requirements: All correspondence should be made through your UMSL-provided email.

Attendance 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. I'll penalize you by one letter grade for habitually coming late to class (more than five times I notice you coming late).

Projects: You will be given programming assignments, typically a set of programs every two weeks. Assignments will be due at 11:59pm on the day noted on the assignment. Assignments should be submitted on `delmar` and must execute properly on `delmar` for credit. You should start working on the project as soon as it gets assigned as some of them may get tricky. If you do not know how to work on a project, see me as soon as possible for help.

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*. 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

Anyone desiring an EXC grade after March 31, 2018 must be passing the course at that point to get EXC.

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 have an account on one of the Unix machines on campus (`delmar`) and you should use it for all assignments. Any assignment that fails to run on `delmar` 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.

Any unsigned email and email not in plain text will go unanswered by me. Please do not send me any attachments without talking to me first.

Exam Dates

Test 1 Feb 14, 2018

Test 2 Mar 21, 2018

Test 3 May 09, 2018; 07:45am

Test 3 (Final) will be comprehensive. Other tests are not comprehensive.

List of Unix commands expected to be known

These will be covered in the first week of classes.

Logging in: `login`, `ssh`, `logout`, `^d`

Files: `vi` editor, path names, `ls` (with options), `pwd`, `mkdir`, `rmdir`, `cd`, `mv`, `rm`, `cp`, file metacharacters, `cat`, `more`, `head`, `tail`, `chmod`, `chown`, `chgrp`, `spell`, `wc`

Process handling: `^c`, `^z`, `fg`, `ps`, `kill`

Environment: Acquaintance with `.cshrc` and `.login` files, modifying `cd` path, aliases, history and use of `!`, `env`, `stty`, `clear`, `date`, `cal`

Others: Redirecting and piping (basic), `man`, `grep`, `script`, `prof`

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.ums1.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.ums1.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.ums1.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.ums1.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

This is a rough outline; there will be two lectures allocated to tests and I have two extra lectures to make sure that we can cover the material.

- Week 1
 - Introduction; Different Unix shells; Shell metacharacters
 - Basic Unix philosophy and review of some commands to illustrate command line structure
 - Hand over a list of commands assumed to be known; if the students do not know these commands, they should be able to look them over using man pages
 - Organization of man pages; searching for help using man
- Week 2
 - Introduction to shells; command line
 - Variables; Environment variables. Shell built-in variables; I/O redirection, File streams
 - Programming assignment to write code by consulting the man pages
- Week 3
 - `bash` shell
 - Difference between child shell and subshell
 - Creating shellscripts
 - Control statements
- Week 4
 - Handling interrupts; Command line options; Filename generation
 - Receiving the output value; successful or unsuccessful termination
- Week 5
 - Regular expressions (with `sed` and `awk`)
 - Test 1
- Week 6
 - Functions and arrays in `bash` shell
 - Revision control system (`git`)
 - Make utility
- Week 7
 - Make utility
 - Library creation (static and dynamic linking)
 - Gnu debugger (`gdb`)
- Week 8
 - Debugger
 - Code profiling and optimization (`gprof`)
- Week 9
 - C Programming: Bit operators
 - C Programming: I/O and string handling
- Week 10
 - C Programming: Files, including binary files and random access
 - C Programming: multiple file compilation, header files, prototyping
 - Test 2
- Week 11
 - C Programming: Macros, preprocessor
 - Temporary files

- Week 12
 - Dynamic memory allocation/deallocation/use
 - System Programming: System calls, fork/exec/wait/waitpid
- Week 13
 - System Programming: Signal handling
- Week 14
 - System Programming: Shared memory