PURDUE UNIVERSITY

CS 252: Systems Programming

Fall 2024

Class:
MWF 9:30am – 10:20am, Room UC 114

Course Web Page:
https://mandalore.cs.purdue.edu/~cs252/

Course Newsgroup:
https://edstem.org/us/join/DyrpuM

Instructor:
Prof. Jeff Turkstra, jeff@purdue.edu, DSAI 1139E, 49-63088.

Office Hours:
TBD

Teaching Assistants:
This course has five graduate teaching assistants as well as a number of undergraduate teaching assistants. The names and email addresses for the GTAs are given below.

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Text:
Book Online: Introduction to Systems Programming; Rodriguez-Rivera and Ennen; 2014
https://www.cs.purdue.edu/homes/grr/SystemsProgrammingBook/

Recommended
Advanced Programming in the UNIX Environment; Stevens and Rago; Addison-Wesley Professional, 2013
ISBN-13: 978-0321637734

Prerequisites:
Computer Architecture – CS 25000
Programming in C – CS 24000
Foundations of Computer Science – CS 18200
Problem Solving and Object-Oriented Programming – CS 18000
Data Structures and Algorithms – CS 25100 (Corequisite)
Programming proficiency is *absolutely* required

Course Outcomes:
A student who successfully fulfills the course requirements will:

1. have consolidated their programming skills from previous core courses
2. understand how programs run in userland and interact with the OS
3. be able to write "large" programs with over 1,000 lines of code
4. be able to use tools---including IDEs, debuggers, profilers, and revision control---to create quality, maintainable code
5. learn how to work in teams
6. be able to use and write scripts
7. learn how to write multi-process and multi-threaded programs

Lecture:
Lecture attendance is expected and required. Quizzes will be given for randomly selected lecture sessions. Please arrive in the classroom on time. If you must miss a lecture, you are responsible for procuring any material, information, handouts, announcements, etc., that you missed.

Preparation for Lectures:
You should try to read over the relevant pages in the course text before lecture. Additionally, you are expected to check your email, the course website, and the course newsgroup regularly. Due to Purdue IT's approach to email, you must also monitor your junk folder and spam reports. Email from the instructor is often flagged as spam.
Here is the *tentative* lecture schedule:

Wk	Lec	Subject
1	1	Introduction, *NIX Commands
	2	Shell Scripting in BASH
	3	More Shell Scripting
2	4	Operating Systems and UNIX
	5	Program Structure
	6	Memory Management and malloc()
3	X	Labor Day - No Lecture
	7	malloc() and Memory Allocation Errors
	8	Program Generation and Loading
4	9	File Systems
	10	File Systems cont.
	11	System Calls and Shell Introduction
5	12	Lexical Analysis and Parsing
	13	Files, fork(), and pipe()s
	14	Shell Executor, Processes
6	15	Signals, Built-ins, and Subshells
	16	Wildcards and Computer Architecture
	17	Execution Modes, Interrupts, and System Calls
7	18	Syscall Wrap-up, Processes and Scheduling
	19	Processes and Scheduling
	20	Threads and Synchronization
8	X	October Break – No Lecture
	X	Midterm Exam Review
	21	Semaphore Implementation, Thread Safety and Race Conditions
9		Exam Makeup – No Lecture **(Midterm Exam – 8pm)**
	22	Resource Allocation Graphs, Dining Philosophers, and Semaphore Review
	23	Condition Synchronization, Bounded Buffer
10	24	Readers/Writers Problem, Monitors and Condition Variables
	25	POSIX Condition Variables, Sockets
	26	Networking Introduction
11	27	Servers and Concurrency, Web Server Introduction
	28	More Web Server, SSL and HTTPS, More Networking
	29	Networking
12	30	UDP and TCP, Network Address Translation
	31	Networking Wrap-up
	32	Teams and Software Development
13	33	Revision Control and git
	34	git Wrap-up, Software Testing
	35	Software Testing and Software Patterns
14	36	Time and Systems, Relational Databases
	37	Relational Databases
	38	SQL Wrap-up, Program Optimization
15	X	Exam Makeup – No Lecture
	X	Thanksgiving – No Lecture
	X	Thanksgiving – No Lecture
16	39	Optimization Wrap-up
	40	Profiling, Buffer Overflows
	X	Final Exam Review

Quizzes:
There will be a number of unannounced, 5 to 10 minute quizzes in class. A score of zero will be given in case of absence.

Projects:
There will be a number of intensive projects that will be assigned throughout the semester. The goal of these assignments is to reinforce material covered in lecture as well as to provide practical experience through the exploration of low-level implementation details. These are C programs that are submitted electronically. To ensure success, **compile your code on a Linux system, like data.cs.purdue.edu (even remotely), with GCC** and only GCC. For full credit, your code must follow the code standard established for this course (graded as style points). The course website has the code standard and examples.

Other important notes on homework:

1. If you feel you have a valid reason for not having your work done on time, then send the appropriate head TA an email **BEFORE** the assignment is due.
2. Don't wait until the last minute. If the computer goes down, so does your grade.
3. Down time and crashes of the computer network are, in general, NOT valid excuses for late or missed assignments.

Labs:
Attendance is mandatory and counts toward the 10% attendance portion of your final grade. Projects will be introduced and explained during your scheduled lab session. This is also a time to ask questions and receive help.

Examinations:
Exams will be closed book and closed notes. You must solve the exam problems yourself, without any help (knowing or unknowing) from any other student. You must not seek any knowledge in advance of the test questions (beyond that given in class) and must report any advance knowledge of the test questions by any student that you are aware of. You must not allow any other student access to your solutions during the exam. If the seating situation makes this difficult, please inform the instructor or TAs.

Midterm Exam: Wednesday, October 16, 8pm – 10pm CL50 224

Final: TBD

Regrades:
Problems regarding grading of assignments and the exam must be resolved within **one week** after the graded work has been returned to you. It is your responsibility to pick up the graded work on time. Grades will not be modified after the one week period.

Late Submissions:
Project solutions that are submitted after the specified deadline will incur a 10% reduction in score per day late. No late work will be accepted beyond 5 days after the original deadline.

Make-up Examination Policy:
Make-up exams will be given only in the **most extreme** circumstances and require certification for such circumstances. Eg, a medical doctor's statement certifying that the student is **unable** to attend the scheduled exam. Any travel (including interview trips), load from work or from other classes, failed alarm clocks, or simply not being able to make it to the exam will **not** be grounds for a make-up. If you have any recurring medical problems that may unexpectedly prevent you from making it to class or exams, please obtain a doctor's statement certifying your circumstance.

Extensions:
Because of the extended length of time provided for projects, extensions are typically only granted in extreme cases and only for university-approved reasons. These include serious illness, family emergency, and official university commitments. In all cases, some form of evidence or documentation must be provided. If the absence is planned (band trips, course field trips, etc.), you must inform your instructor ahead of time. Failure to do so will result in the absence being unexcused.

Academic Integrity:
As a student at Purdue you are subject to the *Purdue University Student Code of Conduct*, which enjoins you to respect the highest standards of honesty and integrity. All work that you submit in this course must be your own; unauthorized group efforts are considered academic dishonesty. See the online brochure *Academic Integrity: A Guide for Students* for definitions and sanctions. Academic dishonesty is a serious offense which may result in suspension or expulsion from the University. In addition to any other action taken, such as suspension or expulsion, a **grade of F** will normally be recorded on the transcripts of students found responsible for acts of academic dishonesty. Students are encouraged to report academic dishonesty to the instructor directly, or to the Office of the Dean of Students.

You may discuss assignments in a general way with other students, but you may not consult anyone else's work. Among other ways to get an F, you are guilty of academic dishonesty if:

- You examine another student's solution to an assignment
- You allow another student to examine your solution to an assignment
- You fail to take reasonable care to prevent another student from examining your solution to an assignment and that student does examine your solution. For example, if you allow another student to check his/her email from your terminal while you step out of the room, you have failed to take reasonable care to prevent him/her from accessing your files.
- You submit an assignment that is not completely your own work
- You share results or notes during quizzes or exams
- You utilize ChatGPT or other software to programmatically generate solutions to any part of an assignment, quiz, or exam

All work is subject to computer-based comparison and analysis. Do not con yourself into thinking that you can hide any collaboration. The risk of getting caught is too high, and the standard penalty is way too high.

If we find reason to believe that a student or team has cheated on any assignment, we may inform the student or team promptly, or we may decide to silently accumulate evidence against the student or team on later assignments.

Grading:
Final grades will be assigned according to the following *approximate* weighting:
Projects – 40%
Exams – 50%
Attendance – 10%

Final letter grade cutoffs are determined at the end of the semester. In addition to achieving a final course percentage at or above a cutoff, both project/attendance and exam averages must individually be no more than 5% below that cutoff. Should this not be the case, the cutoff that satisfies this requirement will instead be applied.

Questions and Answers:
Questions of general interest should be posted on the course newsgroup. Answers will be posted as soon as possible. Project questions should be directed to the appropriate project coordinator via email. Answers will be sent to you directly. If you need to contact a specific TA or instructor, send email to that individual or go see him/her during office hours.

Modifications:
This syllabus may be modified at any time with notification.

**** As an interesting side note, a significant portion of this syllabus is copied from Dr. Rodriguez-Rivera's, Dr. Dunsmore's, Dr. Hosking's, Dr. Brylow's, and Dr. Hu's policy pages from previous semesters. One of the major differences between plagiarism and proper reuse is giving credit where credit is due. ****