PURDUE UNIVERSITY

CS 50011: Introduction to Systems
Summer 2022

Class:
Online

Course Web Page:
Brightspace

Course Newsgroup:
https://campuswire.com/p/G32572CB1
Access code: 1899

Instructor:
Prof. Jeff Turkstra, jeff@purdue.edu, HAAS 128, 49-63088.

Office Hours:
TBD

Lecturer and Content Expert:
Dr. George B. Adams, III

Text:
Recommended
The C Programming Language (2nd ed); Kernighan and Ritchie; Prentice Hall, March 1988
ISBN-13: 978-0131103627

Beej's Guide to C Programming; Brian "Beej" Hall; 2007
https://beej.us/guide/bgc/

Operating Systems: Three Easy Pieces; Arpaci-Dusseau; Online, 2015
http://pages.cs.wisc.edu/~remzi/OSTEP/

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

Prerequisites:
Experience commensurate with a minor in Computer Science
Programming proficiency is *absolutely* required

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

1. be able to write shell scripts in the UNIX environment
2. understand basic data structures and constructs in C
3. be able to write or revise advanced C code
4. understand dynamic memory allocation
5. have foundational knowledge for understanding software vulnerabilities in C/C++
6. understand how C/C++ programs are compiled into assembly, how the call stack works in function calls, and stack-based buffer overflows
7. understand basic concepts in computer architecture including instruction sets, assembly code, CPU modes, registers, MMUs, and paging
8. understand basic OS concepts including processes, system calls, virtual memory, and file system structures
9. understand basic concepts in networking, databases, and web applications

Class Attendance
Since this is an online course, interactions with course staff requires use of email, Zoom, and Campuswire. Students are expected to watch lectures as scheduled.

Requirements for Internet Access and Software Tools
Students must have Internet access and bandwidth sufficient to watch videos. Students will receive a Purdue University computer account and must be able to remotely login to that account on the data.cs.purdue.edu system.

Preparation for Lectures
You are expected to check your email and the course website regularly. Here is the lecture schedule:

Wk	Subject
1	1.1 UNIX Operating System Introduction
	1.2 UNIX File System Design
	1.3 UNIX Users and File Permissions
	1.4 File System Storage Technology
	1.5 UNIX Processes
	1.6 UNIX Commands for Login and Files
	1.7 UNIX Commands for Processing Files
	1.8 The Shell
	1.9 Introduction to C
	1.10 Example C Programs
2	2.1 Integers and Strings
	2.2 if, while, for, and switch
	2.3 Program Organization in Memory
	2.4 Memory Organization and Pointers
	2.5 Big Endian and Little Endian
	2.6 Common Pointer Uses and Errors
	2.7 Working with Pointers and Arrays
	2.8 Passing Arguments in C
	2.9 String Operations with Pointers

	2.10 Arrays
	2.11 structs
	2.12 The union Data Structure
3	3.1 Scope and Lifetime of Data
	3.2 malloc() and Dynamic Memory
	3.3 Memory Allocation Errors
	3.4 Singly-Linked Lists
	3.5 Pointers to Functions and Polymorphism
	3.6 Function Pointers and Iteration
	3.7 Standard File I/O
4	4.1 Execution Modes and Process Creation
	4.2 Introduction to C++
	4.3 C++ Extended Example
	4.4 C++ Objects
	4.5 C++ Copy and Assignment Defaults
	4.6 C++ Defining Class Copy and Assignment
	4.7 C++ Inheritance, Dynamic Casting, Virtual Methods
	Exam Review
5	5.1 Storage Technology
	5.2 Disk Drive Details
	5.3 Exploring the File System
	5.4 I/O Redirection
	5.5 grep, Search Using Regular Expressions
	5.6 head, tail, cut, paste, wc
	5.7 sort
	5.8 Computers and Moore’s Law
	5.9 Computer Architecture
	5.10 Instruction Set Architecture
	5.11 Machine Language and Processor Circuit
	5.12 Memory Details
	5.13 Processor Execution Modes
	5.14 Introduction to Assembly Language
	5.15 Introduction to Intel Assembly Language
6	6.1 Program Layout in Memory
	6.2 Stack Contents and Operation
	6.3 Virtualization
	6.4 CPU-Level Security Technology
	6.5 Introduction to Virtual Memory
	6.6 Page Tables
	6.7 Memory Map Function
	6.8 Executable File Format
	6.9 C Preprocessor
	6.10 Compiling, Linking, and Loading
	6.11 Makefiles
7	7.1 Architecture of the Internet
	7.2 ARP, DNS, and DHCP
	7.3 Brief Overview of TCP/IP
	7.4 Network Address Translation (NAT)

7.5 Ports, Sockets, and Servers
7.6 Relational Databases and SQL
7.7 A Brief Introduction to Web Server Issues
8 8.1 The Stack Buffer Overflow
8.2 Advanced Topics / Future Trends

Labs
There will be seven "labs" during the course of the semester. The lab exercises are designed to further acquaint one with the material covered during lecture – particularly in a practical manner.

Examinations
The 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 exams.

Regrades
Problems regarding grading of lab exercises and the exam must be resolved within **two days** 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 two day period.

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.

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 written work. Among other ways to get an F, you are guilty of academic dishonesty if:

- You examine another student's solution to a written assignment
- You allow another student to examine your solution to a written assignment
- You fail to take reasonable care to prevent another student from examining your solution to a written 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.

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 has cheated on any assignment, we may inform the student promptly, or we may decide to silently accumulate evidence against the student on later assignments.

Grading
Final grades will be assigned according to the following weighting:
Module I Exam – 25%
Module II Exam – 25%
Lab Assignments – 42% (7 @ 6% ea)
Homework (Code Reviews) & Discussions – 8%

Questions and Answers
Questions of general interest should be posted on the course campuswire site. 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. Dunsmore, 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. ****