

# CSC 373: Computer Systems I

## Winter 2018

### Sections 501/510

Tuesdays and Thursdays: 11:50 – 1:20 pm, CDM 226

Professor Robin Burke

Office hours: Tuesdays and Thursdays 10:00 – 11:30 am and by appointment.

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(Slack – best) <https://csc373win2018.slack.com/> or via the Slack app.

### Description

A course on computer systems topics, focusing on machine-level programming and architecture and their relevance for application programming. Information representations, assembly language, C programming, and debuggers, processor architecture.

### Learning Objectives

Upon successful completion of this course, students should be able to:

- Use C's bit operators to manipulate data
- Explain how specific kinds of data (numbers, text, instructions) are stored in a memory
- Simulate the execution of various x86 assembly instructions
- Explain how a buffer overflow attack works as well as carry one out
- Reverse engineer parts of a compiled program to understand what it is doing
- Understand programs that use arrays, structs, and pointers in the C language

### Prerequisites

The prerequisites for this course are data structures (CSC300 or CSC393) and discrete math (MAT140).

The assumption is that you are already familiar with structural programming concepts like branching, loops, and functions, as well as structured data like arrays and objects.

### The C programming language and the UNIX environment

We will be using C and UNIX extensively in this course. It is used throughout the book and in the lectures as well as on practice problems, the take home labs, and the exams. However, both the main textbook and the lectures will spend minimal time teaching you these tools. You will need to become very comfortable with both by spending time interacting with the server for the class as well as consulting references. The assumption is that at this point in your studies, you can mostly teach yourself how to use these tools and class time is better spent on more advanced topics. I will provide a very brief introduction just to get you started, and I will answer any questions students have about C and Linux in class, but students are expected to pick up C and UNIX on their own. This will require a great amount of time reading the C text for the course, interacting with the Linux server, writing and debugging programs, and looking things up in UNIX and C manuals. Do not underestimate the amount of extra time this will take.

### Readings

*Computer Systems: A Programmer's Perspective*, 3rd Edition. Bryant & O'Hallaron, Prentice Hall/Pearson, 2016. ISBN: 978-0134092669. (CSAPP below)

*Programming in C*, 4th edition. Kochan, Prentice Hall/Pearson, 2015. ISBN: 978-0-321-77641-9 (PC below)

Important: Make sure you have access to the correct version of the textbooks. Verify the ISBN! There are other versions of CSAPP out there (still 3rd edition, but a different ISBN) that are different.

Other documentation and resources available online.

## Advice

To succeed in this class, you must engage the material actively. You will need to master new tools and new languages. My advice:

- start early,
- be methodical,
- be proactive in finding solutions, and
- ask questions about issues you cannot quickly resolve on your own.

Time is of the essence! You need to start work early and ask questions early. If you delay, you will be lost in an incomprehensible morass!

## Tools

### Linux server

All of the assignments in this course will be performed on a CDM Linux (Ubuntu) server: `burke373.cdm.depaul.edu` for which all students will be issued accounts. You will need to become familiar with a number of Linux-based tools including `nano` (text editor), `bash` (command shell), `gdb` (debugger) and `gcc` (compiler). There will be two lab days in which students will gain experience using the Linux tools, but in general, you will be learning this part of the course material on your own.

### Slack

We will be using Slack for class discussion and communication. Slack has a mobile app and a web front-end.

The course site is `csc373win2018.slack.com`. I will set up student accounts during the first week of class using your email address listed in CampusConnect.

- Make sure that your email address listed under "demographic information" at `http://campusconnect.depaul.edu` is correct. All my emails to you will go to that address.
- Use Slack to post questions about the course, including questions about lectures and assignments, but please do not post code or discuss solutions to the labs. Posting your question on the forum allows other students to answer the question and so you could get your answer faster. Also, any questions I receive by email that are not of a personal nature may be posted to the forum together with my answer.

Use email if you have a specific question about code that you have written. To ensure a prompt response, put "CSC 373" in the message subject. It is also helpful if your name appears in the email, as email addresses are often insufficient identifiers.

### SCuiz

We will be using the SCuiz student-generated quiz system: `scuiz.org`. You are required to generate 2 of your own questions each week, and to answer correctly at least 20 questions from your fellow students per week. Note that questions from other students will only appear when you create your own questions. You can challenge questions as too hard or too easy and also questions that are incorrect.

### PollEv

We will use the PollEv app for in-class interactive question answering. You can access this app by text or web browser when questions are posed.

## Grading Policy

Your overall grade for the course will be computed as follows:

- Lab projects (3) 30%
- Lab exercises (3) 10%
- Quizzes (200 points) 10%
- Midterm exam 25%
- Final exam 25%

Letter grades will be assigned according to the table below; however, the instructor reserves the right to adjust the scale in the student's favor. In other words, the table indicates the minimum letter grade you will receive for the given overall percentage. You may receive a slightly higher grade if the instructor feels an adjustment is necessary.

- 93-100 A
- 90-92.9 A-
- 87-89.9 B+
- 83-86.9 B
- 80-82.9 B-
- 77-79.9 C+
- 73-76.9 C
- 70-72.9 C-
- 67-69.9 D+
- 60-66.9 D
- 0-59.9 F

## Late Assignments

All assignments must be turned in on time, usually 11:59 pm on a Thursday. Students have a total of three late assignment days for the quarter. They can be used without penalty on any assignment. Late assignments will not be accepted beyond those three days.

## Schedule

(Lab classes - **in bold** - meet in CDM 801)

1/2: Introduction / Overview

Course structure and expectations. Course tools. Overview of course material.

Reading: CSAPP 1.1-1.6

1/4: Logic

Bit level representation of data. Hexadecimal notation. Data types and sizes. Byte ordering.

Reading: CSAPP 2.1

1/9: Integer representations and operations

Representations for unsigned and two's complement integers. Type conversions. Extension and truncation.

C data types and operations. Operations on unsigned and two's-complement integers.

Reading: CSAPP 2.2-2.3

### 1/11: Linux / C lab

The Linux environment. Using the command shell, compiling and executing programs.

Reading: PC 2, 3, 8, 9

1/16: Assembly language: introduction

Machine formats for program code. Reading and understanding x86-64 assembly code.

Reading: CSAPP 3.1-3.2, PC 10, 11

1/18: Assembly language: data

Data storage in registers and memory. Instructions for data movement.

Reading: CSAPP 3.3-3.4

Due: Linux / C exercise

1/23: Assembly language: arithmetic

Arithmetic instructions. Shift operations and division.

Reading: CSAPP 3.5

1/25: Assembly language: logic

Logic operations. Compare instructions and condition codes. Jump instructions.

Reading: CSAPP 3.6.1-3.6.4

1/30: Assembly language: control flow

Implementing conditional constructs and loops. Conditional move instructions. Jump tables and switch statements.

Reading: CSAPP 3.6.5-3.6.8

Due: Data lab project

## **2/1: GDB lab**

Using the GDB debugger. Setting breakpoints. Inspecting registers and stack frames.

Reading: CS 17

2/6: Midterm

2/8: Assembly language: procedures

The call stack. Frame and stack pointers. Calling conventions. Recursive functions.

Reading: CSAPP 3.7

Due: GDB exercise

2/13: Assembly language: arrays

Array allocation. Accessing array data: pointer manipulation. Multi-dimensional array. Fixed- and variable-sized arrays.

Reading: CSAPP 3.8

2/15: Assembly language: structs 1

Structure definition, allocation. Data alignment.

Reading: CSAPP 3.9, Review PC 8

2/20: Assembly language: structs 2

Arrays of structures. Unions.

Due: Bomb lab project

2/22: Assembly language: pointers

Arrays, structs, pointers: review of memory access.

Reading: CSAPP 3.10

2/27: Buffer overflow

Buffer overflow and stack corruption.

Reading: CSAPP 3.10.1-3.10.5

3/1: Floating point

Floating point representations. Normalized and denormalized numbers. Rounding. Floating point operations.

Reading: CSAPP 2.4

3/6: Memory hierarchy

RAM memory. Disk and other I/O devices. Access latencies. Locality of reference and the memory hierarchy. L1 (and L2/L3) caches. Cache types and operation.

Reading: CSAPP 6.1-6.4

### **3/8: Assembly lab**

Due: Attack lab project

3/13: Final exam (11:35 am – 1:45 pm)

3/15: Due: Assembly lab exercise

## **Course Policies**

### **Attendance**

Students are expected to attend each class and to remain for the duration. Coming 15 minutes late or leaving 15 minutes early constitutes an absence for the student. Students are individually responsible for material they may have missed due to absence or tardiness.

### **Assignment Submission**

All assignments will be submitted to the online autograder or to D2L. Do not submit assignments by email.

### **Attitude**

A professional and academic attitude is expected throughout this course. Measurable examples of non-academic or unprofessional attitude include but are not limited to: talking to others when the instructor is speaking, mocking another's opinion, cell phones ringing, emailing, texting or using the Internet whether on a phone or computer. If any issues arise a student may be asked to leave the classroom. The professor will work with the Dean of Students Office to navigate such student issues.

### **Civil Discourse**

DePaul University is a community that thrives on open discourse that challenges students, both intellectually and personally, to be socially responsible leaders. It is the expectation that all dialogue in this course is civil and respectful of the dignity of each student. Any instances of disrespect or hostility can jeopardize a student's ability to be successful in the course. The professor will partner with the Dean of Students Office to assist in managing such issues.

### **Cell Phones/On Call**

If you bring a cell phone to class, it must be off or set to a silent mode. Should you need to answer a call during class, students must leave the room in an undistruptive manner. Out of respect to fellow students and the professor, texting is never allowable in class. If you are required to be on call as part of your job, please advise me at the start of the course.

## **University Policies**

### **Changes to Syllabus**

This syllabus is subject to change as necessary during the quarter. If a change occurs, it will be thoroughly addressed during class, posted under Announcements in D2L and sent via email.

### **Online Course Evaluations**

Instructor and course evaluations provide valuable feedback that can improve teaching and learning. The greater the level of participation, the more useful the results. As students, you are in the unique position to view the instructor over time. Your comments about what works and what doesn't can help faculty build on the elements of the course that are strong and improve those that are weak. Isolated comments from students and instructors' peers may also be helpful, but evaluation results based on high response rates may be statistically reliable (believable). As you experience this course and material, think about how your learning is impacted. Your honest opinions about your experience in and commitment to the course and your learning may help improve some components of the course for the next group of students. Positive

comments also show the department chairs and college deans the commitment of instructors to the university and teaching evaluation results are one component used in annual performance reviews (including salary raises and promotion/tenure). The evaluation of the instructor and course provides you an opportunity to make your voice heard on an important issue – the quality of teaching at DePaul. Don't miss this opportunity to provide feedback!

### **Academic Integrity and Plagiarism**

This course will be subject to the academic integrity policy of DePaul University. More information can be found at <http://academicintegrity.depaul.edu/>. The university and school policy on plagiarism can be summarized as follows: Students in this course should be aware of the strong sanctions that can be imposed against someone guilty of plagiarism. If proven, a charge of plagiarism could result in an automatic F in the course and possible expulsion. The strongest of sanctions will be imposed on anyone who submits as his/her own work any assignment which has been prepared by someone else. If you have any questions or doubts about what plagiarism entails be sure to consult the instructor. While students are permitted to discuss assignments at the conceptual level, under no circumstances should students share specific answers (electronically or otherwise).

### **Withdrawal**

Students who withdraw from the course do so by using the Campus Connection system (<http://campusconnect.depaul.edu>). Withdrawals processed via this system are effective the day on which they are made. Simply ceasing to attend, or notifying the instructor, or nonpayment of tuition, does not constitute an official withdrawal from class and will result in academic as well as financial penalty.

### **Retroactive Withdrawal**

This policy exists to assist students for whom extenuating circumstances prevented them from meeting the withdrawal deadline. During their college career students may be allowed one medical/personal administrative withdrawal and one college office administrative withdrawal, each for one or more courses in a single term. Repeated requests will not be considered. Submitting an appeal for retroactive withdrawal does not guarantee approval. College office appeals for CDM students must be submitted online via MyCDM. The deadlines for submitting appeals for this quarter is the last day of the last final exam of Winter Quarter 2014.

### **Excused Absence**

In order to petition for an excused absence, students who miss class due to illness or significant personal circumstances should complete the Absence Notification process through the Dean of Students office. The form can be accessed at <http://studentaffairs.depaul.edu/dos/forms.html>. Students must submit supporting documentation alongside the form. The professor reserves the sole right whether to offer an excused absence and/or academic accommodations for an excused absence.

Exceptions to the late assignment policy and requests for makeup exams will only be permitted if the Absence Notification protocol is followed.

### **Incomplete**

An incomplete grade is a special, temporary grade that may be assigned by an instructor when unforeseeable circumstances prevent a student from completing course requirements by the end of the term and when otherwise the student had a record of satisfactory progress in the course. CDM policy requires the student to initiate the request for incomplete grade before the end of the term in which the course is taken. Prior to submitting the incomplete request, the student must discuss the circumstances with the instructor. Students may initiate the incomplete request process in MyCDM.

- All incomplete requests must be approved by the instructor of the course and a CDM Associate Dean. Only exceptional cases will receive such approval.
- If approved, students are required to complete all remaining course requirement independently in consultation with the instructor by the deadline indicated on the incomplete request form.
- By default, an incomplete grade will automatically change to a grade of F after two quarters have elapsed (excluding summer) unless another grade is recorded by the instructor.

- An incomplete grade does NOT grant the student permission to attend the same course in a future quarter.

### Students with Disabilities

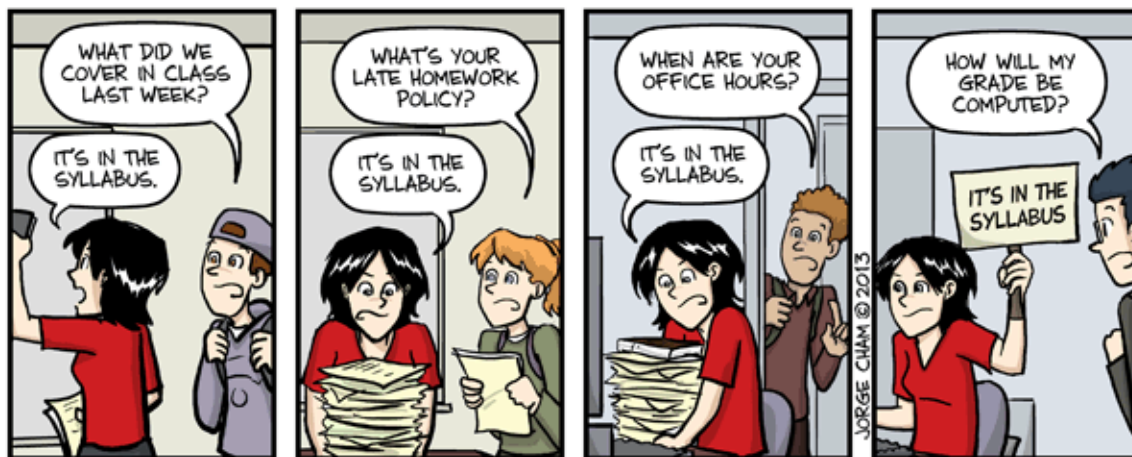
Students who feel they may need an accommodation based on the impact of a disability should contact the instructor privately to discuss their specific needs. All discussions will remain confidential.

To ensure that you receive the most appropriate accommodation based on your needs, contact the instructor as early as possible in the quarter (preferably within the first week of class), and make sure that you have contacted the Center for Students with Disabilities (CSD) at: Student Center, LPC, Suite #370 Phone number: (773)325.1677 Fax: (773)325.3720 TTY: (773)325.7296

### Quarter at a Glance

Lecture	Lab
CDM 226	CDM 801

Date	Topic	Assignments due	Reading (CSAPP, unless specified)
1/2	Overview		1.1-1.6
1/4	Binary representations		2.1
1/9	Integers		2.2-2.3
1/11	Linux / C		PC 2, 3, 8, 9
1/16	Assembly Intro		3.1-3.2, PC 10, 11
1/18	Assembly Data	Linux / C exercise	3.3-3.4
1/23	Assembly Arithmetic		3.5
1/25	Assembly Logic		3.6.1-3.6.4
1/30	Assembly Control	Data lab project	3.6.5-3.6.8
2/1	GDB		CS 17
2/6	Midterm		
2/8	Assembly Procedures	GDB exercise	3.7
2/13	Assembly Arrays		3.8
2/15	Assembly Structs 1		3.9, PC 8
2/20	Assembly Structs 2	Bomb lab project	
2/22	Assembly Pointers		
2/27	Buffer Overflow		3.10
3/1	Floating Point		2.4
3/6	Memory Hierarchy		6.1-6.4
3/8	Assembly	Attack lab project	
3/13	Final exam 11:30 – 1:45		
3/15		Assembly exercise	



# IT'S IN THE SYLLABUS

This message brought to you by every instructor that ever lived.

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