Cornell College

CSC 301: Algorithms & Data Structures

Spring 2023 (Block 7)

Instructor:

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Classes:

- Monday – Friday, 9:00 – 11:00 AM (West Hall 201)
- Monday – Friday, 1:15 – 3:00 PM (West Hall 201)

Office Hours:

- Monday, Wednesday – Friday, 11:00 AM – 12:00 PM (West Hall 201)
- Monday – Wednesday, Friday, 3:00 – 4:00 PM (West Hall 201)
- By appointment

Textbook:

"Introduction to Computer Algorithms," by Thomas Cormen, Charles Leiserson, Ronald Riverst, Clifford Stein, Third Edition.

Resources:

1. **Moodle:** Moodle will be the primary platform for sharing class material, creation and submission of assignments, and posting grades. If you have any questions regarding the use of Moodle, please contact me and I will be happy to walk you through the process.
2. **Piazza:** Piazza will be primarily used as a discussion forum. You are allowed to discuss the questions/problems you encounter during your assignment on the Piazza. I highly encourage you all to use Piazza to connect with your classmates, to post your questions and participate in the discussion.

Course Objectives:

This course focuses on two of the essential skills any good software engineer should possess: Data Structures and Algorithms. In order to propose a programming solution for any real-world problem, we first need to figure out how to store the provided data. Then, we need to use one of the hundreds of different algorithms that help us to come up with the solution quickly. This is the first interview you will appear for in any software engineering job interview, especially if you are appearing for a position in one of the Tier 1 tech companies such as Meta, Amazon, Apple, Netflix, Google, etc.

In this course, we will practice solving algorithms problems and converting algorithms into Python programs. **FINDING SOLUTIONS ON GOOGLE AND UNDERSTANDING HOW THESE**

SOLUTIONS WORK IS NOT SAME AS COMING UP WITH THE SOLUTIONS ON YOUR OWN. In order to convert the proposed algorithm into a Python program quickly and efficiently requires solid foundational knowledge of Python programming concepts and syntax and a ton of practice. I will closely work with each one of you to achieve this goal.

We will use morning sessions to learn about data structures, while afternoon sessions will be only be used for solving problems and writing programs. We will learn following data structures:

1. Array
2. Stack and Queue
3. Linked List
4. Trees
5. Maps

In algorithms, we will cover following important concepts:

1. Approach vs Algorithm vs Program
2. Correctness of algorithms
3. Asymptotic Analysis of Algorithms
4. Searching and sorting algorithms
5. Divide and conquer
6. Dynamic Programming
7. Greedy Algorithms

Again, being able to quickly identify which algorithm technique to be used and come up with an efficient algorithm requires a **HUGE** amount of practice. We will try to solve at least one (ideally at 2-3) problem(s) every day to prepare us for the final exam and the job interviews in real life.

I completely understand that this is a lot to cover in a block and in a way that would stay with you after the block is over. Please note that the goal is not just get through the block but to build a sound foundation in data structures and algorithms, and acquire problem solving skills. This knowledge will help you become an excellent programmer and will set you up to be successful in the upper-level CS courses such as networks, graphics, operating systems, database engineering, machine learning. Therefore, consistent efforts and hard work will be required from both side (students and instructor) to successfully achieve our learning goals this block.

We will give special attention to the following education priorities as guided by Cornell College's Mission and Core Values:

1. **Knowledge:** We will develop overall understanding of key data structures and operations on these data structures. Additionally, we will also acquire knowledge of widely used algorithm techniques.

2. **Inquiry:** A problem can have multiple solutions. We will work in groups to figure out the correctness of a solution, and then determine which of the correct solutions is the most efficient solution. We will also learn how to determine if we have all the information we need to solve the problem.
3. **Communication:** In the software industry, most of the time you will need to work in teams, many times the team members will be in different continent. Communication is the key to be successful in such environment. We will practice our communication skills and team work skills during this course.
4. **Ethical Behavior:** We will recognize personal, academic, and professional standards and act with integrity.

Assessment:

Assignments	30 %
Quizzes	15 %
Exams	35 %
Class Participation	20 %

Assignments:

All the assignments will be individual assignments. Most if the assignments will be programming assignments. I will discuss common errors during the class time. **You must take notes and modify your assignment appropriately.**

Quizzes:

As usual, the goal is to have daily quizzes to reduce weight of each quiz. Quizzes will have one to two questions and will be for 10 minutes. I am planning to have at least 10 quizzes.

Exams:

We will have three exams in this course (2nd, 3rd, and 4th Wednesday of the block). Usually I take these exams as a mock 30-minute, individual, on-site interviews where you need to do whiteboard coding (we will discuss what is a whiteboard coding during the first class). Since we have 21 students, we cannot do all the exams as whiteboard coding. We will discuss and come up with a plan so that everyone will get at least one experience of whiteboard coding before the final exam. **FINAL EXAM WILL BE A WHITEBOARD CODING INTERVIEWS!**

Class Participation:

Attendance is mandatory for this class. I will take attendance at the start of every session. Attendance is only 5% of the final grades. The remaining 15% is for the following things:

- Your attention during the class.
- Use of electronics during the class (No electronic devices are allowed during the lecture)
- Participation during group exercise
- Participation during class and group discussion
- Communication/responsiveness to the criticism by peers.

Academic Integrity and Honesty

Cornell College expects all members of the Cornell community to act with academic integrity. An important aspect of academic integrity is respecting the work of others. A student is expected to explicitly acknowledge ideas, claims, observations, or data of others, unless generally known. When a piece of work is submitted for credit, a student is asserting that the submission is her or his work unless there is a citation of a specific source. If there is no appropriate acknowledgment of sources, whether intended or not, this may constitute a violation of the College's requirement for honesty in academic work and may be treated as a case of academic dishonesty. The procedures regarding how the College deals with cases of academic dishonesty appear in The Catalogue, under the heading “Academic Honesty."

Mental Health

As a college student, you may sometimes experience stress, anxiety, or other mental health challenges that affect your mood, energy level, concentration, and mental ability. Cornell recognizes that you may experience these challenges and provides resources to help you take charge of your mental health and overall well-being. If you, a classmate, or a friend experience mental health challenges at Cornell, please check out the Counseling Center’s website (www.cornellcollege.edu/counseling) for many resources on and off campus, and you can call the Counseling Center at 319-895-4292 for more information or to make an appointment. Visit the Student Gateway and the Cornell Well-being Network websites for additional student re- sources.

Disability and Accommodations

Cornell College makes reasonable accommodations for persons with disabilities. Students should notify the Office of Academic Support and Advising and their course instructor of any disability related accommodations within the first three days of the term for which the accommodations are required, due to the fast pace of the block format. For more information on the documentation required to establish the need for accommodations and the process of requesting the accommodations, visit Student Success Center’s Website.

Lesson Plan

Day	Session	Topic	Reading	Quiz
Week 1				
Monday, March 20	Morning	Course Overview, Course Policies		
	Afternoon	Python Programming Basics	CSC 140 Notes.	
Tuesday, March 21	Morning	**Growth Functions:** We will learn one of the most important concepts, how to measure the efficiency of a program.	Section 3.1 (T. Cormen)	
	Afternoon	**Lists:** We will start learning how lists are actually implemented in Python. Similar data structure exists in almost all programming languages, and they are all based on the same theory.	Section 5.2 (Goodrich)	Quiz 1 (CSC 140/44)
Wednesday, March 22	Morning	**Lists:** We will conclude the discussion of lists. We will also calculate the efficiency of all the list functions.	Section 5.3 (Goodrich)	Quiz 2 (Growth Function)
	Afternoon	**Lab Session 1:** Working on the assignment problems. **Assignment 1 (due at midnight).**		
Thursday, March 23	Morning	**Stack & Queue:** We will finish two more data structures. These data structures are also known as array-based data structures.	Section 6.1, 6.2 (Goodrich)	Quiz 3 (Lists)
	Afternoon	**Lab Session 2:** We will spend this session working on Assignment 2 problems. **Assignment 2 (due at midnight).**		
Friday, March 24	Morning	**Sorting:** We will review Insertion and merge sort, and we will learn quicksort.	P. 16- 19, 30-34, 170-178 (T. Cormen)	Quiz 4 (Stack & Queue)
	Afternoon	**Lab Session 3:** We will spend this session working on Assignment 3 problems. **Assignment 3 (due at midnight).**		
Week 2				
Monday, March 27	Morning	Linked List: We will start with another set of data structures - linked data structures.	Sections 7.1 - 7.4 (Goodrich)	Quiz 5 (Sorting)
	Afternoon	Singly and doubly linked list.		
Tuesday, March 28	Morning	Trees Basics		Quiz 6 (Linked List)
	Afternoon	**Problem Set:** Linked List, Binary Trees		
Wednesday, March 29	Morning	EXAM 1: Exams will be in the different format. They will be scheduled as a 30 minutes interviews. We will discuss this during the first day of the class.		
	Afternoon			

Thursday, March 30	Morning	Heaps:minheap and max heap	Section 6.1-6.4 (T. Cormen)	Quiz 7 (Trees)
	Afternoon	HeapSort and map basics.	Section 10.1, 10.2.1 (Goodrich)	
Friday March 31	Morning	Unsorted Map, Hash Functions	Section 10.2.2, 10.2.3, 10.2.4	Quiz 8 (Comprehensive)
	Afternoon	HashMap Implementation **Assignment 4 (due Saturday midnight)**		
Week 3				
Monday, April 3	Morning	Algorithms overview. What have we learned about algorithms so far?		
	Afternoon	Dynamic Programming: We will see the concept of dynamic programming.	Section 15.1, some pages of 15.3 (T. Cormen)	Quiz 9 (Efficiency)
Tuesday, April 4	Morning	Rod Cutting Problem: This is the first problem that uses dynamic programming to find an efficient solution. We will see recursive and iterative solutions.		Quiz 10 (Comprehensive)
	Afternoon	Review for Exam 2		
Wednesday, April 5	Morning	Exam 2: Same format as Exam 1.		
	Afternoon			
Thursday, April 6	Morning	Matrix Multiplication Problem	Section 15.2 (T.Cormen)	Quiz 11 (DP)
	Afternoon	**Lab Session 4:** Advanced problems.		
Friday, April 7	Morning	Greedy Algorithms: Activity Selection	Sections 16.1 to 16.3 (T. Cormen)	Quzi 12 (MatMult)
	Afternoon	Greedy Algorithms: elements and differences from Dynamic Programming.		
Week 4				
Monday, April 10	Morning	Course Review & Algorithmic Problem Solving.		
	Afternoon			
Tuesday, April 11		Final Exam!		
Wednesday, April 12				