CSCE 4110: Introduction to Algorithms

1. Timing and Access

Class Hours: Tuesday and Thursday 1:00-2:20
In Person Class: Discovery Park B155
Remote Zoom Link: https://unt.zoom.us/j/92488262402
Zoom Meeting ID: 924 8826 2402
Both Remote and In-Person class will be at the same time

2. Course Content

This is a first undergraduate course on analysis of algorithms. Course will focus on the design strategies, the mathematical analysis of the algorithms, and their proofs of correctness.

3. Course Objectives

(i) Be able to analyze the time and space complexity of a nontrivial algorithm, using mathematical, tools, and prove/justify the correctness.
(ii) Understand the Divide and Conquer, Greedy, and Dynamic Programming strategies for algorithmic design.
(iii) Be familiar with the algorithms for Matrix Multiplication (Strassen's), Activity Selection, Knapsack, Shortest Paths (single source, and all pairs), Minimum Spanning Tree , Matrix Chain, and Longest Common Subsequence problems.
(iv) Be exposed to approximation algorithms for solving NP-hard problems.
(v) Be able to determine and measure the efficiency of a given algorithm, in practice, through different possible implementations, and by testing on suitable data sets.
(vi) Be able to communicate clearly and precisely in writing about the theoretical analysis of an algorithm and its efficiency in practice.

4. Prerequisites.

Students planning to enroll in this course should have taken course numbers 3110, 2100, 2110. They should have been exposed to the following:

(i) Time and space analysis; asymptotic notation
(ii) Basic sorting algorithms: insertion, merge and heap sort
(iii) Data structures including trees, heaps, BSTs, union/find data structures, and graphs
(iv) Recurrence Relations and Proof techniques
(v) Graphs: BFS, DFS, MST (Prim's and Kruskal's algorithms)
(vi) Mathematical structures: Sets, relations
(vii) Important mathematical manipulations: Sums, combinatorics

5. Evaluation

There will be one midterm (around week 7) and one final (during finals week). Each will be worth 25%, **together making 50% of the total grade**
There will be one project (posted around week 7) and due the last week of classes. **Project will be worth 15% of the total grade**
There will be 7 assignments/exercises. The time for each assignment will be 1 to 1.5 weeks. Each assignment will be worth 5%, so together the **assignments will be 35% of the total grade**.
Extra Credit: There will be approximately 8-10 in class exercises. These will be one point each. So total 8-10 extra credit points.

The project and the assignments can be done in **groups of no more than four people**. The exams and the in-class exercises have to be done individually.
All exams and in class exercises are open book, open notes and open internet.

Grading scheme. The highest score will be set to 100, and the scores of the rest of the class will be scaled based on the highest grade.
Two points will be deducted for each day (weekends included) of late submission of assignments.
The passing marks in this class is 55 or lower. Anyone getting lower than 55 will get an F

Plagiarism Policy. Academic Integrity Standards in this course are consistent with UNT policy: STUDENT STANDARDS OF ACADEMIC INTEGRITY (18.1.16), or other related/existing UNT polices. The work that you turn in to be graded,must be your own work. Usage of unauthorized material and sources, or depending on any unauthorized assistance, to answer homework problems, tests questions, writing reports, or carrying any type of assignment, etc., without the permission of the instructor, or without complete and accurate and complete attribution/citation of the source, when applicable, is viewed as an academic misconduct.

Rules specific to this course. You can use any publicly available resource, including code snippets, so long as you cite the source. You cannot use resources from sites that you or others have to pay to access (such as Chegg etc.)

(i) Not citing the source is **CHEATING**
(ii) Using information from a homework helper site, such as Chegg, is **CHEATING**
(iii) Duplicating/nearly duplication answers from another student/ another groups submission is **CHEATING**

First offence for plagiarism is 0 for the entire submission. The second offence is an F in the course.

Policy for working in groups.
When working in groups, you can distribute the work among group members. However, if your name is in the submission you are responsible for the submission. This means

(i) you should be able to explain the algorithm/code/logic of the solution for all parts of the project even if you were not directly involved in implementing it
(ii) if any group member cheats, the entire group will be penalized

You can switch, merge or create new groups in course of the semester. The only constraint is that there can be no more than 4 people per group.

6. Textbook

Introduction to Algorithms, by Thomas H. Cormen, Charles E. Leiserson, and Ronald L. Rivest. Any edition will do.
Links to the recording of the lectures will be available via the announcements after each class.

7. Instructor and TAs

Sanjukta Bhowmick
Email: Sanjukta.bhowmick@unt.edu
TA: **Saatvik Gannarapu** Email: saatvikgannarapu@my.unt.edu
TA: **Sounjanya Akella** Email: soujanyaakella@my.unt.edu

8. Office Hours

Instructor Office Hours: 3:30-4:30 Tuesdays and Thursdays
Remote Zoom Link: https://unt.zoom.us/j/98116629911

Meeting Id: 981 1662 9911

TA Office Hours: 1:00-2:00 pm Mondays and Wednesday
Remote Zoom Link: https://unt.zoom.us/j/98962403242
Meeting Id: 989 6240 3242

In person office hours can be scheduled on a case by case basis. Send me an email if you would like to meet in person, and we can schedule a convenient meeting time in my office (F291).
We are also available to help you outside the office hours. If you have any questions or clarifications send and email to all three of us. We will respond with 24 hours. If you want to discuss the material outside the regular office hours, send us an email and we can schedule an ad hoc meeting either by zoom or in-person.

All information about the class, any changes in schedule, details about assignments, etc. will be posted on the announcements. Please check the announcements regularly.

9. Syllabus and Tentative Schedule

Topic 1: Algorithm Analysis (Week 2)

How to compare the performance of algorithms?
Analysis of for loops and simple recursions
Understanding the meaning of big O, and other complexities.
Computing the value of n0 and C

Topic 2: Sorting as an example of different algorithm complexities (Week 3)

Bubble sort, Insertion sort, Heap sort, Merge-sort
Limit of Sorting complexity
Counting sort

Topic 3: Searching (Week 4)

Brief recap on BSt and AVL trees
Red-Black trees: Complexity, Insertion Deletion

Topic 4: Divide and Conquer (Week 5)

Master's Theorem and analysis of the formula
Quicksort and its complexitty
Strassen's multiplication

Topic 5: Dynamic Programming (Weeks 6+7)

Difference from Divide and Conquer
0-1 Knapsack
Matrix Chain multiplication
LCS algorithm
Shares and dividends

Topic 6: Greedy Algorithms (Weeks 8+9)

Event Ordering
How dynamic programming collapses to greedy algorithm
Huffman code
Fractional Knapsack

Topic 7: Graph Algorithms (Weeks 10+11)
Quick Recap of Graphs, Adjacency list, Adjacency matrix, BFS, DFS
Single Source shortest paths: Dijkstra
Minimum Weighted spanning tree
Floyd Warshall, Max-flow
Bi-connected components

Topic 8: Approximation Algorithms (Weeks 12+13)
Brief intro to what is NP-complete
Examples of reducing one NP complete problem to another
Approximation algorithms for
Vertex Cover, Travelling Salesman

10. Special Instruction Regarding COVID-19
COVID-19 Impact on Attendance
While attendance is expected, it is important for all of us to be mindful of the health and safety of everyone in our community, especially given concerns about COVID-19. Please contact me if you are unable to attend class because you are ill, or unable to attend class due to a related issue regarding COVID-19. It is important that you communicate with me prior to being absent so I may make a decision about accommodating your request to be excused from class.

If you are experiencing any symptoms of COVID-19 (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Hotline at 844-366-5892 or COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure. While attendance is an important part of succeeding in this class, your own health, and those of others in the community, is more important.

Class Materials for Remote Instruction
The UNT fall schedule requires this course to have fully remote instruction beginning November 28th. Additional remote instruction may be necessary if community health conditions change or you need to self-isolate or quarantine due to COVID-19. Students will need access to an internet connection (webcam and microphone access preferred but not essential) to participate in fully remote portions of the class. Information on how to be successful in a remote learning environment can be found at https://online.unt.edu/learn.

Statement on Face Covering
Face coverings are required in all UNT facilities. Students are expected to wear face coverings during this class. If you are unable to wear a face covering due to a disability, please contact the Office of Disability Access to request an accommodation. UNT face covering requirements are subject to change due to community health guidelines. Any changes will be communicated via the instructor.