CSCI 3110: Data structures and Algorithms Analysis

2022 Spring Session	
Total Class Sessions: 25 **Class Sessions Per Week: 5** **Total Weeks: 5** **Class Session Length (Minutes): 145** **Credit Hours: 4**	**Instructor: Staff** **Classroom: TBA** **Office Hours: TBA** **Language: English**

Course Description:

This course provides the basic background of algorithms analysis, design and advanced data structures from the problem-solving perspective, for students in computer science. During this course, students will learn problem solving skills, how to analyze, implement and compare different solutions, and how to apply them in computational problems. The topics that will be covered include: Algorithms analysis (asymptotic notation,summations & recurrence relations), Advanced Data structure (E.g. Balanced binary search tress, red-black trees), Divide-and-conquer algorithms, Greedy algorithms, Dynamic programming, Graph data structures and algorithms.

We will begin with asymptotic notions, summations and recurrence relations. We will have a review on elementary data Structure and then discuss advanced data structure, including, hashing, binary search tress, red-black trees. We will introduce fundamental algorithmic problems such as searching, sorting and selection, matrix multiplication, as well as fundamental optimization and graph problems. We will discuss fundamental algorithmic techniques: divide-and-conquer, dynamic programming and greedy. We will explore solutions to given problems, understanding the principles to solving the problems and illustrating algorithm techniques that applied to other problems.

Course Materials:

Required textbook**: Introduction to Algorithms**, 3rd edition, Thomas H Cormen Charles E, Leiserson Ronald L Rivest Clifford Stein, MIT press.

Course Format and Requirements:

The course will take place in a computer lab and the course format including lecture, programming project, and in-class discussion. The specific topics that will be covered in the classes are listed in the course syllabus. The class period will consist of an active learning environment. During a majority of the class time, students will be actively working on problems in groups under the instructor's guides.

Course Assignments:

Quizzes:

There will be 5 quizzes this semester, given during the discussion sections. Each quiz will be on the material covered that week. There will be NO make-ups for quizzes for any reason. All of the quizzes will be closed book.

Midterm Exams

Two in-class, close-book and non-cumulative midterm exams will be given through this course. The midterm exams will be based on the knowledge covered in class. No excuse will be accepted if students do not have legitimate excuses for absence. Physician Statement is required for missing the exam due.

Weekly Programming Projects

There will be five hands-on projects based on course need. It will count for 35% of your grade for the course. The projects will enrich students' knowledge on writing large programs. The score will be given based on the correctness of the program.

Final Exam

The final will be in-class, cumulative and close-book. The final exams will be based on concepts covered in class. Note that the final will not be taken during the normal class times. Exact time and location for final will be announced later.

Course Assessment:

Quizzes	15%
Weekly Programming Projects	35%
Midterm Exams 1	15%
Midterm Exams 2	15%
Final Exam	20%
Total	**100%**

Grading Scale (percentage):

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
98-100	93-97	90-92	88-89	83-87	80-82	78-79	73-77	70-72	68-69	63-67	60-62	<60

Academic Integrity:

Students are encouraged to study together, and to discuss lecture topics with one another, but all other work should be completed independently.

Students are expected to adhere to the standards of academic honesty and integrity that are described in the Chengdu University of Technology's Academic Conduct Code. Any work suspected of violating the standards of the Academic Conduct Code will be reported to the Dean's Office. Penalties for violating the Academic Conduct Code may include dismissal from the program. All students have an individual responsibility to know and understand the provisions of the Academic Conduct Code.

Special Needs or Assistance:

Please contact the Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material. Our goal is to help you learn, not to penalize you for issues which mask your learning.

Course Schedule:

Week	Topics	Activities
1.	Go through syllabus, Course introduction Linear and binary searching Insertion sort, Analysis of selection sort Asymptotic analysis, Asymptotic notation Summations Recurrences. Mergesort. ***Reading: Chapter 1, 2, 3, 4***	Quiz 1 Project 1 (recurrence and merge sort)
2.	Heaps and heapsort. Quick Sort. Bounding problems. Sorting in linear time. Lower bounds for sorting Medians and order statistics: Minimum and maximum, selection in expected linear time, selection in worst-case linear time ***Reading: Chapter 6, 7, 8, 9***	Quiz 2 Project 2 (heap, quick sort) Review Midterm 1
3.	Review Elementary data structures Hashing tables Binary Search Trees, Red-Black Trees Disjoint Sets: Amortized analysis ***Reading: Chapter 10, 11, 12, 17***	Quiz 3 Project 3(Hashing, BSTs)

4.	Dynamic Programming: Matrix-chain multiplication Fibonacci, longest common subsequence. Greedy Algorithms. Graph Algorithms: Representations of graphs, Breath-first search(BFS) ***Reading: Chapter 15, 16, 22.1, 22.2***	Quiz 4 Project 4 (Dynamic Programming) Review Midterm 2
5.	Graph Algorithms: Depth-first search(DFS) Topological sort Minimum spanning trees (Kruskal and Prim's algorithms) Shortest paths in DAGs, shortest paths: Bellman-Ford and Dijkstra's algorithms ***Reading: Chapter 22.3, 22.4, 23, 24*** Review for final	Quiz 5 Project 5 (Graph Algorithms) Review Final Exam