CS221	Data Structures and Algorithms (3 CH)	Fall 2025	SE/CYS

Pre-Requisite: CS112

Instructor: **Mr. Said Nabi**
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Office Hours: 11:25am ~ 12:25 pm (Tues, Wednesday, Thursday)

Course Introduction

This course aims to introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms. Efficient data structure provides basis for a good algorithm (code). This course focuses on the most common data structures utilized in various computational problems. It will be taught that how these data structures work and their implementation in C++/C. Students will practice implementing them in a number of programming assignments. This will help them understand the nuts and bolts of various data structures and enable to write efficient programs. In addition, another objective of the course is to develop effective software engineering practice, emphasizing such principles as decomposition, procedural abstraction, and software reuse.

Course Contents

Broadly, this course will cover following contents: asymptotic analysis, algorithm design, Abstract Data Types (ADTs), lists, stacks, queues, trees, Binary trees, B-trees, AVL tree, hashing, sorting, graph algorithms and other recent topics in data structures.

Mapping of CLOs to GAs

Sr. No	Course Learning Outcomes+	Graduate Attributes (GAs)	Bloom's Taxonomy level (Cognitive domain)
CLO 1	Utilize the basic techniques of data structure/algorithm analysis	GA-2 (Knowledge for Solving Computing Problems)	C 4 (Analyzing)
CLO 2	Apply the primitive data structures to design solutions for the computational problems	GA-2 (Knowledge for Solving Computing Problems)	C 3 (Applying)
CLO 3	Analyzing problems and writing program solutions to problems using the algorithmic techniques using a variety of data structures and techniques	GA-4 (Design/ Development of Solutions)	C3 (Applying)
	+Please add the prefix "Upon successful completion of this course, the student will be able to"		

CLO Assessment Mechanism

Assessment tools	CLO_1	CLO_2	CLO_3
Quizzes	30%	20%	20%
Assignments	5%	20%	20%
Midterm Exam	35%	30%	30%
Final Exam	30%	30%	30%

Overall Grading Policy

Assessment Items	Percentage
Quizzes	12%
Project	12%
Assignments	6%
Midterm Exam	30%
Final Exam	40%

Text and Reference Books

Text books:

- Introduction to Algorithms: A Comprehensive Guide for Beginners: Unlocking Computational Thinking by Cuantum Technologies, ISBN-13: 979-8854326957, Publication date July 30, 2023
- Introduction to Algorithms, Thomas H. Cormen et al,4th Edition, 2022.

Administrative Instruction

- According to institute policy, 100% attendance is *mandatory* to appear in the final examination.
- Assignments must be submitted as per instructions mentioned in the assignments.
- In any case, there will be no retake of (scheduled/surprise) quizzes.

- For queries, kindly follow the office hours in order to avoid any inconvenience.

Computer Usage/Software Tool

- Students are encouraged to solve some assigned homework problems using the available programming software, such as DevC, Visual Studio (using C/C++)

Lecture Breakdown

Week 1	• Fundamentals of data structures
	• An overview of computer programming
	• Data types, abstract data types
	• C/C++ background
	• Review of pointers
	  o Defining pointer variables
	  o Pointer arithmetic
	  o Memory diagrams

Week 2	• Review of pointers
	  o Pointers and arrays
	  o Pointer indirections
	  o Structures and pointers
	  o Passing pointer arguments to a function and returning pointers from a function

Week 3	• Computational complexity of algorithms and their time-space analysis
	  o Running time calculations
	  o Asymptotic notations for algorithmic complexity analysis

Week 4	• Lists
	  o Simple arrays
	  o Linked lists
	  o Linear search vs binary search

Week 5	• Lists
	  o Double linked lists
	  o Circular linked lists

Week 6	• Stacks & Queues
	  o Sequential/array implementation of stacks and queues
	  o Linked list implementation of stacks and queues

Week 7	• Arithmetic expressions, polish notation
	• Recursion
	  o Recursive implementation of stacks
	  o Recursive implementation of queues

Week 8	• Sorting
	  o Bubble sort
	  o Insertion sort
	  o Selection sort

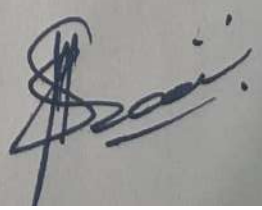
Week 9	• Sorting
	  o Merge sort
	  o Quick sort
	  o Counting Sort & Radix sort
	  o Heap sort (tentative)

Week 10	• Trees
	  o Data structure definition and generic implementation
	  o Tree traversals and its application
	  o Binary tree, binary search tree
	  o Expression trees

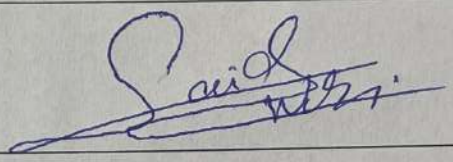
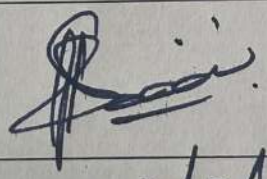
Week 11	• Trees
	  o AVL trees
	  o Huffman coding (tentative)
	  o B-Tree (tentative)

Week 12	• Graphs
	  o Adjacency matrix implementation
	  o Linked list implementation

Week 13/14	• Graphs



	○ Depth-first traversal of graphs ○ Breadth-first traversal of graphs ○ Shortest distance algorithms
Week 13/14	• Hashing and searching ○ Hashing techniques ○ Implementation of Hashing techniques
Week 15	• Priority Queues ○ Binary Heap ○ Applications

Version	Fall 2025
Name of Instructor	Said Nabi
Instructor's Signature	
Date	27/08/2025
Name of HoD	Prof. Dr. Ghulam Abbas
HoD's Signature	
Date	28/8/25