Course Outline

Course Title	Data Structures & Algorithms
Course Code	CC-215
Course Webpage	✓ Class Webpage: https://piazza.com/pucit.edu.pk/fall2022/cc215 ✓ Teacher Notes @ PUCIT Intranet: \\printsrv\\Teacher Data\\Fareed ul Hassan ✓ CMS: online.pucit.edu.pk *Mobile Apps for Piazza Course Page https://apps.apple.com/us/app/piazza/id453142230 https://play.google.com/store/apps/details?id=com.piazza.android&hl=en_US&gl=US
Course Email	fareed@pucit.edu.pk
Instructor	Fareed Ul Hassan Baig
Teacher Assistant(s) (T.A)	TBA
Credit Hours	3 *Theory/week:* Weight 3 Cr. hrs. Lectures: 2 Duration 1.5 hrs.
Prerequisite Course	Object Oriented Programming
Prerequisite Skill/Knowledge/Understanding	○ Excellent concept of object manipulation. ○ Expertise in design, implementation, testing, and strong skills of debugging object-oriented programs. ○ Good concepts of Types. ○ Well versed with Streams and Templates. ○ Strong concept with the notion of Abstraction, Information hiding, and Aggregation
Follow Up	Design & Analysis of Algorithms
Program Name	BS Software Engineering
Aims and Objectives	○ To gain knowledge of basic data structures through which students should enable themselves to write code in optimized way.
Syllabus	**Topics:** Introduction: Introduction to Course, Review of Object Oriented Programming Concepts. Algorithm Specification: Properties of Algorithm, examples, performance, analysis, measurement, and Big Oh notation. Introduction to ADTs: Array and Polynomial as an ADT, Sparse Matrices, and Representation of Arrays. Bag ADT, The Stack ADT, Expressions, Postfix Notation, and Infix to postfix conversion. Recursion: Recursive Definition and Processes, Writing Recursive Programs. Queue: The Queue ADT, Circular and Double Ended Queue. Self-Referencing Classes and Dynamic Memory Allocation. Linked List: Singly Linked Lists, Circular Lists, Linked Stacks and Queues (Double Ended List), Doubly Linked Lists. Trees: Introduction to Trees, Logical construction and Traversing of Binary Trees, Implementation of Binary Trees (Insertion and Traversing), Searching and deletion in Binary Trees, Binary Search Tree, Introduction to Balanced and AVL Trees. Heaps: Heaps and Heaps as Priority Queues, Double Ended Priority Queue. Searching: Linear Search, Binary Search, and Types of Indexing. Hashing: Hash Functions: Division; Overflow Handling: Chaining; Introduction to other advanced topics like: B-Trees, Generalized List, etc. Sorting types and Techniques: Logical and Algorithmic Implementation of Selection, Bubble, Insertion, Shell, Radix, Merge, Quick, Heap, and Tree sorts. Graphs: Graph terminology, Adjacency List and Adjacency Matrix and Adjacency list representation of Graph; Elementary Graph Operations: Breadth First Search and Depth First Search, Spanning Trees (BFSST, DFSST).
Text Book(s)	A. Ellis Horowitz, Sartaj Sahni, and D. Mehta "Fundamentals of Data Structures in C++", 2nd Ed., Computer Science Press, 1995. ISBN 81-

	7808-792-8 B. Adam B. Drozdek "Data Structure and Algorithm in C++" ISBN 0-534-37668-1
Reference Material	R1. Reference from different books enlisted in reference material will be given as required or lecture notes for reading will be provided. R2. D. Samanta. "Classic Data Structures", Prentice Hall, 2001 R3. Mark Allen Weiss, "Data Structure and Algorithms in C++", 2nd Ed., Pearson Education, ISBN 81-7758-943-1 R4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 2nd Ed, MIT Press, 2001, ISBN 0-07-013151-1
Assessment Criteria	<table><tr><td>Sessional …… 25%</td><td colspan="2">Mid …… 35%</td><td>Final …… 40%</td></tr><tr><td>Quizzes/Test</td><td>10</td><td rowspan="2">Written Exam ……35</td><td rowspan="2">Written Exam ……40</td></tr><tr><td>Assignments + Project</td><td>15</td></tr><tr><td rowspan="2">Total</td><td>25</td><td>35</td><td>40</td></tr><tr><td colspan="3">100</td></tr></table> ○ Sessional marks distribution may vary depending upon the time available in the semester and activities conducted in different heads. ○ Sessional Marks will be updated online on the Google Docs during the semester but at the end, it will be populated on PUCIT CMS.

Lecture Breakdown

Week	Lecture	Topic	Source
1	1	Introduction to Data Structures; Role of Data Structures in Computer Science Defining Algorithm: Properties of Algorithm	B-(1.9) A-(1.5) R4-(1.1)
	2	Introduction to Algorithm's Performance Analysis and Measurement Learning to Calculate Running Time of Different Code Snippets, Examples i.e., Binary search, Selection sort etc.	A-(1.6) R3-(1.2) R1-(Reading Material)
2	3	More on Step Counting (Big Oh Notation)	R1-(Reading Material)
	4	Case Study: Polynomial as ADT: Take it as sample application to decide its structure and operations and also calculating the step counting of its operations.	R3-(3.2, 3.2.1)
3	5	(Arrays)Matrix, Row major and column major Representation of N-Dimensional Arrays in different Languages.	R2-(2 ~ 2.4.1, 2.4.3) A-(2.1 ~ 2.3, 2.5)
	6	Sparse Matrices	R2-(2)
4	7	The Stack ADT, Applications of Stack: Function Call Stack, Usage of Stack in different CS Applications.	A-(3.2, 3.5)
	8	Application of Stack: Expressions Evaluation	A-(3.6)
5	9	Queues: Linear/Circular, Applications of Queue.	A-(3.3)
	10	Recursive Definition and Processes, Direct Recursion, Learning the Recursive Trace	B-(5)
6	11	Recursion Continued: Binary Search, Exiting from Maze, Towers of Hanoi and Islamic Fractals as an example	B-(5)
	12	Recursion Continued:	B-(5)

7	13	Review of Dynamic Memory Allocation; Object Manipulation of Self Referential objects	R1-(Reading Material)
	14	Linear Single Link List Linked Stacks/Queues Linear Double Link List	B-(3.1)
8	15	Circular Single Link List, Circular Double Link List Container vs Iterator: Defining Iterator for Link List	B-(3.2, 3.3) R1-(Reading Material)
	16	Array-based implementation of Link-based Structures, Generalized Lists	R1-(Reading Material)
Mid Term Examination			
9	17	Introduction to Trees, Tree Terminology, Logical construction and Representation of Trees, Introduction to Binary Tree ADT, Mathematical properties Tree Traversals Array-Based Implementation of Binary Trees (Insertion and Traversing)	A-(5.1, 5.2)
	18	Linked Implementation of Binary Trees (Insertion, Traversing, Searching and deletion in Binary Trees)	A-(5.3, 5.4)
10	19	Linked Implementation of Binary Trees Continued:	
	20	Binary Search Tree: Mathematical Properties and its implementation	A-(5.7)
11	21	Height Balance Trees: AVL Tree: Insertion in AVL	A-(10.2)
	22	Deletion Operation in AVL	A-(10.2)
12	23	Heaps (MinHeap and MaxHeap) Heaps as Priority Queues	A-(5.6)
	24	Heap continued: (Min-Max Heap, Deaps)	
13	25	Introduction to graph and related terminology Representation of Graphs Elementary Graph Operations, DFS, BFS	A-(6.1)
	26	Spanning Trees Connectivity in Graphs	A-(6.2, 6.3)
14	27	Hashing and Overflow Handling	A-(8.1, 8.2)
	28	Hashing continued…	A-(8.1, 8.2)
15	29	Introduction to Sorting types and Techniques, Logical and Algorithmic Implementation of Bubble, Insertion, Selection, Merge, and Quick Sort	A-(7.1 ~ 7.6), R1-(Reading Material)
	30	Sorting Continued…	A-(7.1 ~ 7.6)
16	31	Balanced Search Trees: Theoretical Comprehension of Insertion/Deletion Operations in Balanced-Search Trees; 2-3:Tree insertion	R1-(Reading Material)
	32	Balanced Search Trees cont…: 2-3 Tree Deletion	R1-(Reading Material)
Final Term Examination			

Code of Conduct

- In Quizzes/Tests, you are allowed to use any helping material available at that time unless specified otherwise. Neighbors and machines are exception.

- Big NOs
  - Any sort of communication/help on assigned tasks may lead you to Grade 'F' in the course/Lab.
  - Violation of coding convention.
  - Late Submissions.

- Once the marks are published on Google docs for any graded task (sessional), You can question about any discrepancy about the marks within *three* working days otherwise grading will be considered final.

- Mobile Phones must be switched off during the class.

- How to Approach Me:
  - Observe the counseling hours! *(Preferred/Recommended Option)*
    When: (Mon, Tue, Wed, Thu): (1300 ~ 1400)
    Where: Graduate Block - 1st Floor - Office# 1
    OR
  - Send an E-mail
    - Send/post all course related messages to https://piazza.com class page only.
    - For any other information/query, you may send the email at fareed@pucit.edu.pk, but send it through your PUCIT Email-ID.