Course Outline

Course Title	Data Structures and Algorithms
Course Code	CMP-210
Course Webpage	http://groups.yahoo.com/group/dsa_pucit/ Teacher's Folder at Printsrv Server: fareedulhassan
Course Email	fareed@pucit.edu.pk
Instructor	Fareed Ul Hassan Baig
Teacher Assistant(s) (T.A)	To be announced later
Credit Hours	3 *Theory/week:* Weight 3 Cr. hrs. Lectures: 2 Duration 1.5 hrs.
Prerequisite Course	CMP-240 Object Oriented Programming
Prerequisite Skill/Knowledge/Understanding	○ Excellent concept of object manipulation. ○ Expertise in design, implementation, testing, and strong debugging of 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	Prerequisite: CMP-240 Object Oriented Programming Follow-up: SE-310 Analysis of Algorithms
Program Name	BS Software Engineering/Computer Science/Information Technology
Aims and Objectives	○ *"An apprentice carpenter may want only hammer and saw, but a master craftsman employs many precision tools. Computer programming likewise requires sophisticated tools to cope with complexity of real applications and only practice with these tools will build skill in their use. (Robert L. Kruse Data Structure and Program Design)".* ○ This subject deals to make students convenient in building a memory and time efficient data structures for the implementation of small to medium-scale (data intensive) computer systems and a view of large scale systems. In short Students learn 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 colspan="2">Sessional ..... 25%</td><td>Mid ..... 35%</td><td>Final ..... 40%</td></tr><tr><td>Quizzes/Test</td><td>9</td><td rowspan="3">Written Exam .....35</td><td rowspan="3">Written Exam .....40</td></tr><tr><td>Assignments</td><td>16</td></tr><tr><td></td><td></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 will be available online on the Google Docs. Google Docs Link https://docs.google.com/spreadsheet/ccc?key=0AvRHlVFRQPyUdG9aSXRuU2U4VHFxbzVsUndWcGhOM0E&usp=sharing

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	R1-(Reading Material)

		(Big Oh Notation)	
	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)	A-(5.6)

		Heaps as Priority Queues	
	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			

Reference Books:

Following Books contains valuable resources for this subject and can be used for reference purpose

1. Robert Sedgewick, "Algorithms in C++", 3rd Ed., Addison Wesley Publishers, 1998. ISBN 0-201-35088-2
2. James Roberge,Stefan Brandle, and David Whittington, "A Laboratory Course in C++ Data Structures",2nd Ed, Jones and Bartlett Publishers, 2003, ISBN 0-7637-1976-5
3. Larry Nyhoff, "C++ An Introduction to Data Structures",
4. 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
5. Alfred A. Aho, John E. Hopcroft, and Jeffrey D. Ullman, "Data Structures and Algorithms", 2nd Ed, Addison Wesley Publishers, 1985, ISBN 0-201-00023-7

Additional Topics:

- Disjoint Set
- Graphs (Shortest Path and Connected Components)
- Bipartite Graph
- Data Compression
- Pattern Matching
- Quad Trees
- Red Black Trees
- Topological Sort
- Splay Trees
- Tries
- Decision Trees
- Fibonacci Heap
- Binomial Heap
- STL

Code of Conduct

- Quizzes will be unannounced: so you are allowed to use any helping material available at that time. Neighbors and machines are exception.

- Things which surely lead to grade 'F'
    - Your neighbors are your enemies, so any sort of communication on assigned tasks may lead you to Grade 'F'.
    - Violation of coding convention.
    - Late Submissions.
    - Discussion or sniffing on neighbor's work in the laboratory/assigned tasks.

- Once the marks are published on Google docs for any graded task (sessional), you can question about any discrepancy about the marks within next two working days.

- Mobile Phones must be switched off during the class and laboratory.

- T.A's are also your teachers!

- How to Approach Me:
    - Observe the meeting hours! **OR**
    - Send an e-mail to Course E-mail
        - How to Send Email
            - Email Header/Subject
                - BSSEF12
            - Email Body
                - Email Text must contain your roll-no and complete name