PMDS605L - Data Structures and Algorithms

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Course Objectives

1. To provide knowledge on various data structures and its real time applications
2. To familiar in design and performance evaluation of data structure and algorithms
3. To familiar in advanced techniques with industrial development

Course Outcomes

At the end of the course, the students will be able to:

1. Understand the foundation of data structure, compute the complexity and notations, design and implement Array ADT.
2. Identify suitable algorithm for the abstract data structure Stack, Queue and List.
3. Classify various Tree data structures and its applications .
4. Select the suitable algorithm for Sorting and Searching.
5. Develop suitable data structure for Graph and its Applications.

Course Outline

Module 1: Foundations of Data Structures

- Introduction about time and space complexity and data structures, their uses.

Module 2: Stacks and Queue

- Understand what Stacks and Queues are. The various operations that we can perform on them.

Module 3: Lists

- Learn about what are linked lists, their uses and what are the various operations we can perform on them.

Module 4: Trees

- Discussion about the Tree data structures and tree traversals.

Course Outline

Module 5: Advanced Trees

- Study about Balanced Trees and AVL Trees and their uses.

Module 6: Graphs

- Graph algorithms - Minimum Spanning Trees, Shortest Path Algorithms

Module 7: Search and Sort

- Discussion about various search and sort algorithms: Linear/Binary Search; Bubble/Insertion/Selection/Merge/Heap Sort.

Module 8: Contemporary Issues: Industry Expert Lecture

Module 1: Foundation of Data Structures

- Data Structures and their importance
- Asymptotic Notations (Big O, Small O, Theta, Omega)
- Performance Analysis of Algorithms - Time and Space Complexity
- Abstract Data Types - Arrays, Structure and Union
- Pointers
- Storage Allocation - Static and Dynamic

Module 2: Stacks and Queue

- Stack - Definition, Operations, Implementation, Applications
- Recursion
- Infix, Postfix and their evaluation
- Queue - Definition, Operations, Implementation, Applications
- Circular Queues and Multiple Queues

Module 3: Lists

- Linked List - Definition, Operations (INSERT, DELETE, TRAVERSE, DISPLAY)
- Implementation of Linked Lists
- Single Linked Lists
- Double Linked Lists
- Circular Linked Lists
- Application - Polynomial Addition

Module 4: Trees

- Trees - Definition, Terminology
- Binary Trees
- Binary Search Tree
- Binary Tree Traversal - In Order, Post Order, Level Order
- Heap Data Structure
- Min Heap and Max Heap Construction

Module 5: Advanced Trees

- Balanced Trees
- AVL Trees - Basic Operations
- 2-3 Trees
- 2-3-4 Trees
- B Trees
- B+ Trees

Module 6: Graphs

- Graph ADT
- Elementary Operations on Graphs
- Minimum Spanning Tree Algorithms - Prim's and Kruskal's
- Shortest Path Algorithms - Dijkstra's and Floyd-Warshall

Module 7: Search and Sort

- Search - Linear Search and Binary Search
- Sorting - Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Heap Sort

Module-8: Contemporary Issues

- Research and Development problems related to various fields of Data Analysis

Textbooks and Reference Books

- **Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest and Clifford Stein, Introduction to Algorithms, 2022, 4th Edition, Mcgraw Hill/ MIT Press.**
- **Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2015, 2nd Edition, Pearson.**
- Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2008, 2nd Edition, University Press.
- R.C.T Lee, S.S Tseng, R.C Chang and Y.T Tsai, Introduction to the Design and Analysis of Algorithms, 2012, Tata McGraw-Hill.
- Ellis Horowitz and Sartaj Sahni, Fundamental of Computer Algorithms, 1985, Galgotia.

"It is my passion, as well as duty to educate you the best I can, but it is your responsibility to try hard to learn from me."

- Attend all classes, and listen attentively to what the Instructor says in the lectures.
- Do not hesitate to ask questions in the classes.
  Never pretend that you understand what is being said in the lecture.
- Do all homework problems if possible, and understand how they are done.
- Make sure to let the Instructor know your problems in learning whenever they occur.
- Make use of Instructor's office hours for questions and advice.
- Above all; take a proactive attitude of ENJOYING what you are learning from this course.

You will be successful if you do all the above