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| Savitribai Phule Pune University<br>Second Year of Engineering (2019 Course)<br>210252: Data Structures and Algorithms | | |
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| **Teaching Scheme** | **Credit Scheme** | **Examination Scheme and Marks** |
| **Lecture: 03 Hours/Week** | **03** | **Mid_Semester(TH): 30 Marks**<br>**End_Semester(TH): 70 Marks** |

Prerequisite Courses: 110005: Programming and Problem Solving
210242: Fundamentals of Data Structures

**Companion Course:** 210257: Data Structures and Algorithms Laboratory

**Course Objectives:**

The course is intended to provide the foundations of the practical implementation and usage of Data Structures and Algorithms to ensure that the learner evolves into a competent programmer capable of designing and analyzing implementations of data structures and algorithms for different kinds of problems.

- To develop a logic for graphical modeling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

**Course Outcomes:**

On completion of the course, learner will be able to–

CO1: **Identify and articulate** the complexity goals and benefits of a good hashing scheme for real-world applications.

CO2: **Apply** non-linear data structures for solving problems of various domain.

CO3: **Design and specify** the operations of a nonlinear-based abstract data type and implement them in a high-level programming language.

CO4: **Analyze** the algorithmic solutions for resource requirements and optimization

CO5: **Use** efficient indexing methods and multiway search techniques to store and maintain data.

CO6: U**se** appropriate modern tools to understand and analyze the functionalities confined to the secondary storage.

## Course Contents

| **Unit I** | **Hashing** | **(07 Hours)** |
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**Hash Table-** Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining.

**Skip List-** representation, searching and operations- insertion, removal

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| **#Exemplar/Case Studies** | Book Call Number and Dictionary |
| ***Mapping of Course Outcomes for Unit I** | CO1, CO4 |

| **Unit II** | **Trees** | **(08 Hours)** |
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| **Tree-** basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals(recursive and non-recursive)- inorder, preorder, post order, depth first and breadth first, Operations on binary tree. Huffman Tree (Concept and Use), Binary Search Tree (BST), BST operations, Threaded binary search tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary search tree, in order traversal of in-order threaded binary search tree. | | |
| #Exemplar/Case Studies | Use of binary tree in expression tree-evaluation and Huffman's coding | |
| *Mapping of Course Outcomes for Unit II | CO2, CO3,CO4 | |
| **Unit III** | **Graphs** | **(07 Hours)** |
| Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. **Traversals**-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, All pairs shortest paths- Flyod-Warshall Algorithm Topological ordering. | | |
| #Exemplar/Case Studies | Data structure used in Webgraph and Google map | |
| *Mapping of Course Outcomes for Unit III | CO2,CO3, CO4 | |
| **Unit IV** | **Search Trees** | **(08 Hours)** |
| Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Weight balanced tree - Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree. Red-Black Tree, AA tree, K-dimensional tree, Splay Tree | | |
| #Exemplar/Case Studies | Keyword search in a document using OBST | |
| *Mapping of Course Outcomes for Unit IV | CO2, CO3, CO5 | |
| **Unit V** | **Indexing and Multiway Trees** | **(07 Hours)** |
| **Indexing and Multiway Trees-** Indexing, indexing techniques-primary, secondary, dense, sparse, Multiway search trees, B-Tree- insertion, deletion, B+Tree - insertion, deletion, use of B+ tree in Indexing, Trie Tree. | | |
| #Exemplar/Case Studies | Heap as a Priority Queue | |
| *Mapping of Course Outcomes for Unit V | CO2, CO3, CO5 | |
| **Unit VI** | **File Organization** | **(07 Hours)** |
| **Files:** concept, need, primitive operations. **Sequential file organization-** concept and primitive operations, **Direct Access File-** Concepts and Primitive operations, **Indexed sequential file organization-**concept, types of indices, structure of index sequential file, **Linked Organization-** multi list files, coral rings, inverted files and cellular partitions. | | |
| #Exemplar/Case Studies | **External Sort-** Consequential processing and merging two lists, multiway merging- a k way merge algorithm | |
| *Mapping of Course Outcomes for Unit VI | CO4, CO6 | |

## Learning Resources

### Text Books:


1. Horowitz, Sahani, Dinesh Mehata, “Fundamentals of Data Structures in C++”‖, Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. M Folk, B Zoellick, G. Riccardi, “File Structures‖, Pearson Education”, ISBN:81-7758-37-5
3. Peter Brass, “Advanced Data Structures”‖, Cambridge University Press, ISBN: 978-1-107-43982-5