



Savitribai Phule Pune University, Pune Second Year Artificial Intelligence & Machine Learning (2020 Course) 218542:Data Structure & Algorithms		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH):03hrs/week	03	Mid_Semester: 30 Marks End_Semester: 70 Marks
Prerequisite Courses, if any: Fundamental knowledge of programming language and basics of algorithms		
Companion Course, if any: Discrete Structures/Discrete Mathematics		
Course Objectives: <ol style="list-style-type: none"> 1. To study data structures and their implementations and applications. 2. To learn different searching and sorting techniques. 3. To study some advanced data structures such as trees, graphs and tables. 4. To learn different file organizations. 5. To learn algorithm development and analysis of algorithms. 		
Course Outcomes: On completion of the course, students will be able to– CO1: Perform basic analysis of algorithms with respect to time and space complexity. CO2: Select appropriate searching and/or sorting techniques in the application development. CO3: Implement abstract data type (ADT) and data structures for given application. CO4: Design algorithms based on techniques like brute -force, divide and conquer, greedy, etc. CO5: Apply implement learned algorithm design techniques and data structures to solve problems. CO6: Design different hashing functions and use files organizations.		
COURSE CONTENTS		
Unit- I	Introduction	07hrs
Introduction to Data Structures: Concept of data, Data object, Data structure, Concept of Primitive and non-primitive, linear and Nonlinear, static and dynamic, persistent and ephemeral data structures, Definition of ADT Analysis of algorithm: Frequency count and its importance in analysis of an algorithm, Time complexity & Space complexity of an algorithm Big 'O', 'Ω' and 'Θ' notations, Sequential Organization: Single and multidimensional array and address calculation. Linked Organization: Concept of linked organization, Singly Linked List, Doubly Linked List, Circular Linked List (Operations: Create, Display, Search, Insert, Delete).		
Case Study	Set Operation, String Operation	
Mapping of Course Outcomes for Unit I	CO1, CO3, CO5	
Unit- II	Searching and Sorting	06 hrs
Searching and sorting: Need of searching and sorting, Concept of internal and external sorting, sort stability, Searching methods: Linear and binary search algorithms, Fibonacci Series. Sorting methods: Bubble, insertion, Quick, Merge, shell and comparison of all sorting methods. Analyze Insertion sort, Quick Sort, binary search, hashing for Best, Worst and Average case.		

Case Study	Study and Analyze Selection sort, bucket sort, radix sort.	
Mapping of Course Outcomes for Unit II	CO1, CO2, CO4, CO5	
Unit- III	Stack & Queue	06 hrs
Stack: Concept of stack, Concept of implicit and explicit stack, stack as an ADT using sequential and linked organization, Applications of stack: recursion, converting expressions from infix to postfix or prefix form, evaluating postfix or prefix form. Queue: Concept of queues as ADT, Implementation of queue using array and linked organization, Concept of circular queue, double ended queue, Applications of queue: priority queue.		
Case Study	Reversing a string, balanced parentheses in algebraic expressions, Towers of Hanoi problem, double ended queue as Stack and Queue.	
Mapping of Course Outcomes for Unit III	CO1, CO3, CO4, CO5	
Unit- IV	Trees	06 hrs
Tree : Trees and binary trees-concept and terminology, Expression tree, Binary tree as an ADT, , Binary search tree, Recursive and Non recursive algorithms for binary tree traversals ,Binary search tree as ADT(Insert Search Delete, level wise Display) Threaded binary tree: Concept of threaded binary tree (inorder, preorder and postorder). Preorder and In-order traversals of in-order threaded binary tree, Applications of trees.		
Case Study	Construction of BST from pre and postorder traversal, Expression Tree construction	
Mapping of Course Outcomes for Unit IV	CO1, CO2, CO3, CO5	
Unit- V	Graph and Symbol Table	07hrs
Graph -Concept and terminologies, Graph as an ADT, Representation of graphs using adjacency matrix and adjacency list, Breadth First Search traversal, Depth First Search traversal, Prim's and Kruskal's algorithms for minimum spanning tree, Shortest path using Dijkstra's algorithm, topological sorting. Symbol Table -Notion of Symbol Table, OBST, AVL Trees Heap: Heap data structure, Min and Max Heap, Heap sort, applications of heap		
Case Study	Consider a network of computers connected to each other. The connection has various parameters associated with it as distance, propagation delay, bandwidth (capacity of carrying data), etc. Based on these parameters, decide which path should be chosen to send data from one computer to every other on the network. In a system, jobs are submitted for execution at different times. If the system is idle, the job is taken for executed immediately. If there is a job in execution, the newly submitted job is added to a queue. The jobs are assigned a number, which indicates tells the priority of the jobs. The system must execute the high priority jobs first for execution. Implement the above said system using heap data structure.	

Mapping of Course Outcomes for Unit V	CO1, CO2, CO3, CO4, CO5	
Unit- VI	Hashing and File Organization	06 hrs
Hashing: Hash tables and scattered tables: Basic concepts, hash function, characteristics of good hash function, Different key-to-address transformations techniques, synonyms or collisions, collision resolution techniques- linear probing, quadratic probing, rehashing, chaining with and without replacement.		
File: Concept of File, File types and file organization (sequential, index sequential and Direct Access), Comparison of different file organizations.		
Case Study	What are the advantages of binary tree and binary search in file handling? Study Hashing techniques for expandable Files(Extendible, Dynamic and Linear Hashing)	
Mapping of Course Outcomes for Unit VI	CO1, CO3,CO5,CO6	
Text Books:		
1. E. Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi, 1995, ISBN 16782928 2. Y. Langsam, M. Augenstin, A. Tannenbaum, "Data Structures using C and C++", 2nd Edition, Prentice Hall of India, 2002, ISBN-81-203-1177-9.		
Reference Books:		
1. G. A.V, PAI , “Data Structures and Algorithms “, McGraw Hill, ISBN -13: 978-0-07-066726-6 2. A. Tharp , "File Organization and Processing", 2008 ,Willey India edition, 9788126518685 3. M. Folk, B. Zoellick, G. Riccardi, "File Structure An Object Oriented Approach with C++", Pearson Education, 2002, ISBN 81 - 7808 - 131 - 8. 4. M. Welss, “Data Structures and Algorithm Analysis in C++", 2nd edition, Pearson Education, 2002, ISBN- 81-7808-670-0		