

Certificate in Data Structures with Python (CDSP)

Course Overview

The *Certificate in Data Structures with Python* is designed to provide students with a solid foundation in understanding, implementing, and analyzing data structures using Python. The course introduces fundamental concepts such as arrays, stacks, queues, linked lists, trees, and graphs, along with problem-solving approaches. Students will also learn about time and space complexity, enabling them to write efficient programs.

This course is suitable for beginners and intermediate learners who want to strengthen their programming skills and pursue careers in software development, data science, and competitive programming.

Course Objectives

By the end of this course, learners will be able to:

1. Understand the importance of data structures in software development.
 2. Implement common data structures using Python.
 3. Analyze algorithms in terms of time and space complexity.
 4. Solve computational problems efficiently using appropriate data structures.
 5. Gain hands-on practice through coding exercises and mini-projects.
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Course Outcomes

After successful completion of the course, learners will be able to:

1. Demonstrate understanding of different linear and non-linear data structures.
 2. Apply Python programming concepts to implement and manipulate data structures.
 3. Evaluate the efficiency of algorithms using Big-O notation.
 4. Solve real-world problems using optimal data structures.
 5. Develop confidence to tackle coding interviews and competitive programming challenges.
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Course Syllabus

Module 1: Introduction (2 Sessions)

- Overview of Data Structures & Algorithms
- Role of Python in DS implementation
- Understanding Algorithm Analysis (Time & Space Complexity, Big-O Notation)

Module 2: Linear Data Structures (10 Sessions)

- **Arrays:** Basics, Operations, Searching & Sorting
- **Strings:** Manipulation and Applications in DS
- **Stacks:** Implementation (List & Class), Applications (Expression Evaluation, Backtracking)
- **Queues:** Simple Queue, Circular Queue, Priority Queue, Deque
- **Linked Lists:** Singly Linked List, Doubly Linked List, Circular Linked List

Module 3: Non-Linear Data Structures (10 Sessions)

- **Trees:** Binary Trees, Binary Search Trees, Traversals (Inorder, Preorder, Postorder), AVL Trees (Intro)
- **Heaps:** Min Heap, Max Heap, Heap Sort
- **Graphs:** Representation (Adjacency List, Matrix), BFS, DFS, Shortest Path (Intro)

Module 4: Searching & Sorting Algorithms (4 Sessions)

- Linear Search, Binary Search
- Bubble Sort, Selection Sort, Insertion Sort
- Merge Sort, Quick Sort

Module 5: Applications & Project (4 Sessions)

- Hashing Concepts & Applications
- Problem-solving with DS (mini-projects like: Expression Evaluator, Contact Book using HashMap, Path Finding using Graphs)
- Final Project Presentation

 **Duration:** 2 Months (Approx. 40 Sessions – 5 sessions/week)