

MODULE: DATA STRUCTURES AND ALGORITHMS

CODE: BSCH-2-2-10

Stage: II

Credit Points: 4 semester credits / 6 quarter units

Overview and Aims

This module aims to provide you with an understanding of the relationship between Data Structures and the algorithms which run on them. You will study the analysis of algorithms and the complexity issues that arise.

Upon successful completion of this module, you should be able to:

1. implement and use data structures introduced on the course
2. analyse simple algorithms using asymptotic analysis
3. compare the efficiency of algorithms solving similar problems
4. implement algorithms on data structures and relate these to realistic problems
5. explain the basic theory of computability and complexity
6. explain how approximation algorithms may be used to solve intractable problems

Module Content

Data structures

Elementary data structures: stacks, queues, priority queue.

Linked Lists.

Trees: representing rooted trees, binary search trees, query, insertion, deletion,

traversal. Heaps. Hashtables.

Analysis of algorithms

Basic ideas and definitions of asymptotic analysis.

Using and solving simple summations and recurrences.

Basic time and space analysis.

Sorting

Simple sorting algorithms: insertion, selection, bubble.

QuickSort. Merge Sort. Heapsort. Sorting in linear time.

Problem solving

Divide and Conquer-recursion.

Greedy algorithms-knapsack, fibonacci.

Graphs and graph algorithms

Graphs: basic concepts and representation.

Breadth first search, depth first search. Dijkstra shortest-path algorithm, Dijkstra-Prim minimum spanning tree algorithm.

Kruskal minimum spanning tree algorithm. Belman-Ford single source shortest path algorithm. Floyd-Warsall all-pairs shortest path algorithm.

Complexity theory

Basic ideas of computability and complexity. Turing machines, Church-Turing hypothesis.

Classes P, NP, and NP-Complete.

Examples of approximation algorithms. E.g. travelling salesman, hamiltonian cycle.