

MODULE: Algorithms and Data Structures

SEMESTER	I (Fall)
STAGE	III
NUMBER OF CREDITS:	4 semester credits/6 quarter units
THEME	Software Development
ASSESSMENT	Continuous Assessment 50%
	Examination 50%

Aims

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

Learning Outcomes

Upon completion of this module, a student will be able to:

- Implement and use data structures introduced on the course.
- Analyse simple algorithms using asymptotic analysis.
- Compare the efficiency of algorithms solving similar problems.
- Implement algorithms on data structures and relate these to real world problems.
- Understand the application of approximation algorithms to intractable problems.

Indicative Content

Topic	Description
Data Structures	Elementary data structures – Stacks, Queues, Priority queue (Heap), Linked Lists; Trees – representing rooted trees, binary search tree, query, insertion, deletion, traversal; Graphs
Analysis	Analysis of algorithms; Asymptotic analysis; Summations and Recurrences; Effectiveness v efficiency; Time and Space analysis;
Sorting	Review Simple Sorts – Insertion, Bubble, Selection; Merge Sort, QuickSort, Sorting in linear time – Counting Sort
Problem Solving	Divide and Conquer – recursion; Greedy algorithms – Knapsack, Fibonacci;
Graph Algorithms	Breadth First Search; Depth First Search; Minimum Spanning Tree – Kruskal and Prim; Single Source Shortest Path – Dijkstra
Complexity Theory	P, NP and NP-Completeness; Travelling Salesman Problem

Teaching and Learning Methods

Students will be taught using a combination of lectures, tutorials and practicals. Practical sessions will be based on lab workbooks. This will involve implementing algorithms and comparing performances. A number of graded assignments will also be given as part of the course.

Assessment Methods

Assessment will include both a continuous component and an end of semester examination. The continuous assessment component is used to develop practical skills and will be based both on the lab workbooks and graded assignments / in class tests. Emphasis will be on practical implementation of data structures and the comparison of algorithm performance.

Primary Reading List

Title	Author	Publisher
Introduction to Algorithms (2 nd Edition)	Cormen T, Leiserson C, Rivest R, Stein S	MIT Press
Data Structures & Algorithms in Java (2 nd edition)	Goodrich M. T. Tamassia R.	Wiley

Recommended Reading List

Title	Author	Publisher
Combinatorial Optimization : Algorithms and Complexity	Papadimitriou C. Steiglitz K.	Dover
Algorithms + Data Structures = Programs	Wirth N.	Prentice Hall
Data Structures & Algorithms in Java	Waite M, Lafore R	Mitchell Waite Signature Series