



Design and Analysis of Algorithms

Code:	CCOM 5050
Number of Hours/credits:	3 conference hours / 3 credits
Prerequisites:	CCOM 3034, MATE 3152
Corequisites:	None

Description

Basic combinatorics and counting techniques. Mathematical induction. Recurrence relations and closed form solutions. Asymptotic notations, definitions, and properties. General techniques for the development of algorithms and appropriate data structures for the solution of typical problems, their proofs of correctness and their asymptotic behavior in terms of worst-case and average-case time and space requirements. Dictionary data structures and their access algorithms, indexes, searching and sorting. Graphs algorithms, string algorithms, sequence algorithms, polynomial and matrix algorithms, and their applications. Introduction to parallel algorithms and computational complexity.

Course Objectives

At the end of the course, the student:

1. Understand mathematical induction and apply it to elementary problems.
2. Understand the asymptotic notation, its properties and its use in measuring the behavior of algorithms.
3. Design algorithms to solve problems.
4. Determine asymptotic expressions for worst-case execution time and space requirements of algorithms and data structures.
5. Understand the process of testing the correctness of the algorithm and provide tests for the classical algorithms studied in the course and similar ones.
6. Understand the importance of a data structure in providing efficient algorithms to solve a particular problem.
7. Know the different strategies that are known to be useful to find efficient algorithms to solve problems and be able to apply them.
8. Make comparisons between different solutions and decide the circumstances in which one may be better than others.
9. Understand the concepts of computational complexity and its use in the categorization of problems in terms of their computational requirements, and know different techniques to face difficult problems.

10. Understand the concept of parallel algorithms and the influence of different parallel computer architectures.

Outline of content and time distribution

Subject	Hours
Mathematics Background 1. Summations 2. Mathematical Induction 3. Sets, Roles and Relationships	1.5
Foundations 1. Roles of algorithms 2. Introduction to algorithm design: Divide and Conquer 3. Growth functions 4. Recurrences	6.0
Sorting 1. Heapsort 2. Quicksort 3. Sorting in linear time	6.0
Multithreaded Algorithms 1. Basic dynamic multithreaded 2. Planning multithreaded	4.5
Data Structures 1. Elementary Structures 2. Hash tables 3. Binary 4. trees Red-Black trees	3.0
Advanced design and analysis techniques 1. Dynamic programming 2. Greedy algorithms	12.0
Graph Algorithms 1. Elementary Algorithms 2. Minimum Spanning Trees 3. Shortest path algorithms	6.0
NP-Completeness	6.0
Total	45.0 hours

Instructional strategies

Discussions, laboratories, collaborative work, independent study, reading of articles from specialized magazines, among others.

Resources

Computer room and Internet service

Assessment

Strategies	Percentage
Two midterm exams	60% (30% each)
Final Exams	30%
Quizzes and Assignments	10%
Total	100%

Grading

Students will receive an A-D, and F grade based on their performance on the assessment strategies and according to the rules of the university.

Bibliography

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein: Introduction to Algorithms, second edition, The MIT Press, Mc-Graw-Hill (2009)
2. Jeffrey J. McConnell: Analysis of Algorithms, An Active Learning Approach, Jones and Bartlett Publishers, 2008
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++ (Third edition), Addison-Wesley (2006)
4. A. V. Aho, J. E. Hopcroft, and J. D. Ullman: The Design and Analysis of Computer Algorithms, Addison Wesley Series in Computer Science and Information Processing (1975)
5. Donald E. Knuth: The Art of Computer Programming, Addison-Wesley

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