

The Islamia University of Bahawalpur

Department of Computer Science & IT

COURSE OUTLINE

Algorithms and Complexity

MSCS Regular/Weekend 2020-2022

Instructor: Mujtaba Husnain

Office: Office F8, DCS&IT, IUB

E-mail: mujtaba.husnain@iub.edu.pk

Prerequisite: An undergraduate course in data structures or algorithms

Course Outline: A tentative list of topics to be covered and an approximate distribution of 30 75-minute class sessions is given below:

Algorithm Analysis (8 Sessions): Algorithm Definitions, Algorithm Efficiency Measures and Classes, Function Bounds, Recurrences, Combinatorics, Probabilistic Analysis, Amortized Analysis, Empirical Analysis, Proof of Correctness.

Algorithm Taxonomy (1 Session): Problem Types vs. Design Techniques.

Brute Force (2 Sessions): Sorting, String Matching, Closest Pair Problem, Convex Hull Problem, Exhaustive Search.

Divide-and-Conquer (3 Sessions): Mergesort, Quicksort, Binary Search, Matrix Multiplication, Closest Pair Problem, Convex Hull Problem.

Decrease-and-Conquer (3 Sessions): Insertion Sort, Depth-First Search, Breadth-First Search, Topological Sorting, Combinatorial Object Generation.

Transform-and-Conquer (2 Sessions): Presorting, Gaussian Elimination, Heapsort, Polynomial Evaluation.

Dynamic Programming (3 Sessions): Binomial Coefficients, Warshall's Algorithm, Floyd's Algorithm, Knapsack Problem, Memory Functions.

Greedy Technique (3 Sessions): Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees.

Limitations of Algorithm Power (5 sessions): Classes P and NP, NP Completeness, Some NP-Complete Problems, Approximation Algorithms for NP-Hard Problems.

Textbooks:

(1) A. Levitin. *Introduction to the Design and Analysis of Algorithms*. Pearson Education, 2003.

(2) T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. D. Stein. *Introduction to Algorithms*. MIT Press, second edition, 2001.

Grading:

Assignments: 5%

Quizzes (announced): 10%

Midterm Exam : 30%

Final Exam: 50%