NATIONAL UNIVERSITY
of Computer & Emerging Sciences, Lahore

Department of Computer Science

CS2009 – Design and Analysis of Algorithms

Fall 2022

Instructor Name: Maryam Bashir
Email address: maryam.bashir@nu.edu.pk
Office Location/Number: Civil Engineering Building, Ground Floor, C142
Office Hours: Monday, Wednesday 11:30 AM to 12:30 PM, Tuesday, Thursday 1:30 PM to 2:30 PM

Course Information

Program: BSDS **Credit Hours:** 3 **Type:** Core
Pre-requisites: Data Structures
Class Meeting Time: Monday, Wednesday: Section **BDS-5A** 10:00 AM to 11:20AM
Class Venue: CS-3

Course Description:

The objective of this course is not to fill your brains with every algorithm that you would ever need. One of the aims of this course is to teach you to reason about algorithms and describe them. In addition, many known algorithms to solve known problems will be taught. At the end of the course, you should be able to choose an appropriate algorithm from a set of algorithms for a given problem.

Course Learning Outcomes (CLOs):
1. Explain what is meant by “best”, “expected”, and “worst” case behavior of an algorithm
2. Identify the characteristics of data and/or other conditions or assumptions that lead to different behaviors.
3. Determine informally the time and space complexity of simple algorithms
4. List and contrast standard complexity classes
5. Use big O, Omega, Theta notation formally to give asymptotic upper bounds on time and space complexity of algorithms
6. Use of the strategies(brute-force, greedy, divide-and-conquer, and dynamic programming) to solve an appropriate problem
7. Solve problems using graph algorithms, including single-source and all-pairs shortest paths, and at least one minimum spanning tree algorithm

Course Textbook

- *Introduction to Algorithms* by Cormen, Leiserson, Rivest, and Stein, 3rd Ed., MIT Press, 2001.

Additional references and books related to the course:

- Jon Kleinberg, Éva Tardos, Algorithm Design, Pearson/Addison-Wesley
- Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, Algorithms, McGraw-Hill Education
- *Algorithms in C++* by Robert Sedgewick, Addison-Wesley, 1992.
- *Data Structures and Algorithms* by Aho, Hopcroft, and Ullman

Weekly Schedule

Lectures	Description	Chapters of Text
Week -1	The role of algorithms in computers, Asymptotic functions and notations (Bid-oh, big-omega, theeta) best and worst case time complexity	1, 2, 3
Week – 2, 3, 4	Divide and Conquer (maximum subarray sum, counting inversions, quicksort, merge sort) + Solving recurrences	2, 3, 6
Week – 5	Lower bound for comparison based sorting, Sorting in linear time: Count Sort	8
	Midterm – I	
Week – 6,7	Dynamic Programming (maximum subarray, rod cutting, longest common subsequence, binary knapsack)	15
Week – 8, 9	Greedy Algorithms (Activity selection, fractional knapsack and Huffman codes)	16
Week – 10	Introduction to graphs (revision of BFS, DFS) and their application (Cycle Detection, shortest paths, connected components etc.)	22
	Midterm – II	
Week – 11	Applications of DFS (topological sort, strongly connected components)	22
Week – 12	Minimum Spanning Trees (MST)(Prim's Algorithm and Kruskal's Algorithm)	23
Week 13, 14	Shortest Path Algorithms (dijkstra's Algorithm, BellmanFord and Floyd Warshall Algorithm	24
	Final Exam	Comprehensive

Tentative Grading Criteria

1. 6 Assignments (15%)
2. 4 Quizzes (12%) (3 best out of 4)
3. 2 Midterm Exam (28%)
4. Final Exam (45%)

Grading Policy

Absolute Grading

Course Policies

1. Quizzes will be announced.
2. No makeup for missed quiz or assignment.

Plagiarism in Assignments

In writing up your assignments and in answering questions in exams, be as clear, precise, and concise as you can. **Understandability will be an important factor in grading**.

Academic Integrity: All work MUST be done individually. Any copying of work from other person(s) or source(s) (e.g. the Internet) will automatically result in at least an F grade in the course. It does not matter whether the copying is done in an assignment, quiz, midterm exam, or final exam, it will be considered equally significant.