NJIT

Department of Computer Science

CS 435-004: Advanced Data Structures and Algorithm Design-Spring 2025

Class Location: KUP 107 **Recitation:** KUPF 204	**Class Time:** TR, 2:30 PM - 3:50 PM **Recitation:** F, 2:30 PM - 3:30 PM

Instructor: Marzieh Eskandari

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Zoom: https://njit-edu.zoom.us/my/meskandari

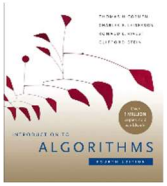
Office: GITC 4313	**Office Hours:** TR 1:00 PM- 2:20 PM, MF 1:00 PM-2:20 PM: Online

Prerequisites:

1. CS 241 (Discrete Math)
2. CS 288 (Intensive Programming)

Textbook:

T.H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein,
Introduction to Algorithms,
Third Edition¸ MIT Press, 2009
ISBN-13: 978-026203384-8



Evaluation:

Assignments: 25%
Attendance: +5% (Extra)
Class Activity: +5% (Extra)
Midterm Exam 1 (**Feb 25th**): 20%
Midterm Exam 2(**Apr 8th**): 20%
Final Exam (**May**): 35%

Note 1: NJIT Picture ID required for all exams. All exams are closed books and closed notes.

Course Description:

This is a senior-level course on data-structures and algorithms, with an emphasis on algorithm design techniques and analysis of algorithms. Topics include analysis of algorithms, worst-case and average-case analysis, induction, recursion, recurrence relations, divide-and-conquer design technique, priority queues, hash tables, binary-search trees, balanced search trees (AVL trees and red-black trees), sorting and selection algorithms; other design techniques such as greedy-method and dynamic-programming, and graph algorithms and basic Machine Learning Algorithms.

Course Objectives (what you are expected to get out of this course):

1. Master basic techniques for analyzing algorithm performance.
2. Explore key algorithm design paradigms, including divide-and-conquer and dynamic programming.
3. Understand recurrence relations and their role in algorithm analysis.
4. Compare and analyze sorting algorithms and their complexities.
5. Learn about search trees, balanced trees, and hashing techniques.
6. Understand fundamental graph algorithms and their applications.
7. Gain an introduction to basic machine learning algorithms and their use cases.

Grading:

The grading scale is: A: 94–100%, B+: 86–93%, B: 78–85%, C+: 70–77%, C: 60–69%, D: 50–59% F: 0–49%.

Academic Integrity:

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf

Schedule of Assignments & Due Dates:

Assignment	Subject	Date
Homework 1	Lectures 1-3	Jan 28-Feb 3
Homework 2	Lectures 4-7	Feb 11- Feb17
Midterm Exam 1	**Lectures 1-9**	**Feb 25**
Homework 3	Lectures 8-13	Mar 6-Mar 12
Homework 4	Lectures 14-16	Mar 25-Apr 2
Midterm Exam 2	**Lectures 10-16**	**Apr 8**
Homework 5	Lectures 17-21	Apr 13-Apr 19
Homework 6	Lectures 22- 24	Apr 24-Apr 30
Final Exam	**Lectures 15-28**	**May**

Course Outline:

Lecture(s)	Date	Topic
1	Jan 21	Introduction: Percolation Problem
2,3	Jan 23, 28	Algorithm Analysis Techniques, Asymptotic Notation.
4,5	Jan 30, Feb 4	Recursive Algorithms, Recurrence Relations
6,7	Feb 6, 11	Priority Queues, Heaps, Heapsort
8,9	Feb 13, 18	Review of Sorting Algorithms: Insertion-Sort, Bubble-Sort, Selection-Sort, Merge-Sort, Quicksort. Integer Sorting: Bucket-Sort, Radix Sort (MSD, ...), Counting Sort
10	Feb 20	Dictionary ADT and Hash Tables
11	**Feb 25**	**Midterm Exam 1: Lectures 1-9**
12, 13	Feb 27, Mar 4	Trees(review), Tries, Balanced Search Trees: AVL and Red-Black trees
14	March 6	Graphs: Representations and Traversals, Topological Sorting
15, 16	March 11, 13	Divide-and-Conquer: Strassen's Matrix Multiplication, Large Integer Multiplication (Karatsuba), ...
	Mar 18, 20	**Spring Recess- No class**
17, 18, 19	Mar 25, 27, Apr 1	Greedy method (Fractional Knapsack, Task Scheduling, Task Scheduling with deadline, Huffman Coding, MST Algorithms: Kruskal)
	Apr 3	**Wellness day- No class**
20	**Apr 8**	**Midterm Exam 2: Lectures 10-16**
21	Apr 10	Greedy method (MST Algorithms: Prim, Single-Source-Shortest-Paths: Dijkstra, ...)
22, 23, 24	Apr 15, 17, 22	Dynamic Programming: Introduction, Binomial coefficients, All-Pairs-Shortest-Paths (Floyd), Matrix Chain Multiplication, Optimal Binary Search Tree, ...
25,26,27	Apr 24, 29, May 1	Machine Learning Algorithms
28	May 6	Review, Problem Solving Prep: Final Exam Readiness