

Syllabus for Midterm Exam 2

CS/ECE 374-B Introduction to Algorithms and Models of Computation

University of Illinois Urbana-Champaign

Spring 2024

The second midterm exam will test material covered in lectures 9 through 15.

Specific skills that may be tested include (the following list may not be exhaustive):

1. Divide and Conquer Paradigm

- (a) Solving recurrences characterizing the running time of divide and conquer algorithms
- (b) Familiarity with specific Divide and Conquer Algorithms and the running times: Binary Search, Merge Sort, Quick Sort, Karatsuba's Algorithm, Linear Selection
- (c) Ability to design and analyze divide and conquer algorithms for new problems

2. Dynamic Programming Algorithms

- (a) Using the dynamic programming methodology to design algorithms for new problems
- (b) Ability to analyze the running time of dynamic programming algorithms

3. Graphs

- (a) Basic definitions of undirected and directed graphs, DAGs, paths, cycles.
- (b) Definitions of reachable nodes, connected components, and strongly connected components
- (c) Understand the structure of directed graphs in terms of the meta-graph of strongly connected components
- (d) Understand the structure of DAGs: sources, sinks, and topological sort
- (e) Solving dynamic programming problems using problems on DAGs

4. Graph Search

- (a) Understand properties of the basic search algorithm and its running time
- (b) Understand properties of DFS traversal on a directed and undirected graph
- (c) Understand properties of the DFS tree
- (d) Algorithms based on search for finding connected components in undirected graphs, checking whether a graph is a DAG, topological sort for DAGs, knowledge of a linear-time algorithm to create the meta-graph, finding a cycle in a graph, etc
- (e) Algorithms for DFAs/NFAs using graph algorithms

5. Paths in Graphs

- (a) Understand properties of the BFS trees
- (b) Understand properties of BFS traversal on directed and undirected graphs to find distances in unweighted graphs