Summary of Topics for Midterm
Asymptotics

- Relationship between polynomial, exponential, logarithmic time
- Big-Oh notation
Basic Proof Ideas

• Proof by Contradiction (Stable Matchings)

• Pigeon hole principle

• Algorithm Design by Induction

• Reductions
Graphs

• Relationship between degree and number of edges
• Cycles, trees
• Graph search (BFS, DFS)
• Algorithm for coloring (bipartite graphs)
• Directed graphs (topological sort)
Greedy Algorithms

• Interval Scheduling
• Interval Partitioning
• Minimum Spanning Trees and Cycle/Cut Properties
• Shortest Path Algorithms (Dijkstra)
• Union Find Data Structure
Divide and Conquer Algorithms

- Recurrences (Master Theorem)
- Binary Search, Merge-sort
- Approximation the Root of a Function
- Finding Closest Points
- Integer Multiplication
- Finding the k-th smallest element
Approximation Algorithms

- Write the cost of the solution of algorithm in terms of OPT
- Vertex Cover
- Set Cover
Dynamic Programming

• Design the recurrence using subproblems then write the program
  • Always characterize the optimum solution
• Weighted Interval Scheduling
• Sequence alignment
• Knapsack
• RNA secondary structure
• Longest path in a DAG
• Longest Increasing Subsequence
• Bellman-Ford Algorithms
Network Flows

• Ford-Fulkerson Algorithms
• Max-Flow Min-Cut Theorem
• Notion of Reduction in Max-Flow applications
• Maximum Matching in Bipartite Graphs
• Hall’s Theorem
• Edge Disjoint Paths
• Image Segmentation
• Project Selection
NP

• Polynomial Time Reductions
  • Vertex Cover
  • Independent Set
  • Clique
  • Set Cover

• Class NP

• NP-hard and NP-Completeness