Summary of Topics for Final Exam
Asymptotics

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

• Direct Proofs

• 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-Folkerson 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