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
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
NP

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

- Class NP

- NP-hard and NP-Completeness