OVERVIEW OF TOPICS

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CS 140 – Spring 2024

Final exam topics

Math foundations

- log properties
- properties of exponentials

Proofs by induction (weak, strong, and structural)

Big-O (theta and omega)

- Proving and disproving
- Categories and function ordering

Final exam topics

Recurrences

- Generating (i.e., given a function/algorithm, write the recurrence)
- Solving: recurrence tree, substitution, master method

Divide and conquer

Sorting

- Insertion sort, Selection sort, Mergesort, Quicksort
- Runtimes, properties

Order statistics: median/selection

Final exam topics

Data structures

- stacks/queues, extensible arrays
- BSTs, red black trees
- binary heaps, binomial heaps
- disjoint set data structure
- hashtables
  - collision resolution by chaining
  - open addressing
  - hash functions
- Run-times and functionality basics

Amortized analysis

- Aggregate and accounting methods

Final exam topics

greedy algorithms

- proving correctness (by contradiction, stays ahead)
- developing algorithms
- comparing vs. dynamic programming

Dynamic programming

- Defining recursively
- Identifying and constructing solution
- memoization

Final exam topics

graphs

- different types of graphs
  - directed/undirected
  - weighted/unweighted
  - trees, DAGs
  - cyclic
  - connected
- terminology
- representing graphs (adjacency list/matrix)

Final exam topics

graph algorithms

- Traversal: BFS, DFS
- MST: Prim's, Kruskal's
- Topological sort
- Connectedness
- Detecting cycles
- Single-source shortest paths: Dijskra's, Bellman-Ford
- All-pairs shortest paths: Floyd-Warshal, Johnson's
- Run-time, why the work, when you can apply them

graph misc

- min-cut property (proving correctness of MST algorithms)

Final exam topics

flow networks

- Ford-Fulkerson algorithm
- calculating residual graphs
- min-capacity cut
- flow across cut
- bottleneck edges

flow network applications

- bipartite matching

Final exam topics

NP-completeness

- proving NP-completeness
  - NP
  - NP-Hard
- reductions
- Why is proving problems NP-complete important?