CSE417: Review

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Complexity, I

- Asymptotic Analysis
- Best/average/**worst** cases
- Upper/Lower Bounds
- Big O, Theta, Omega
- Analysis methods
  - loops
  - recurrence relations
  - common data structures, subroutines

Graph Algorithms

- Graphs
  - Representation (edge list/adjacency matrix)
  - Breadth/depth first search
  - Bipartitness/2-Colorability
  - DAGS and topological ordering

Design Paradigms

- Greedy
- Dynamic Programming
  - recursive solution, redundant subproblems, few
  - do all in careful order and tabulate
- Divide & Conquer
  - recursive solution
  - superlinear work
  - balanced subproblems

Examples

- Greedy
  - Interval Scheduling Problems
  - Huffman Codes

Examples

- Dynamic programming
  - Fibonacci
  - Making change/Stamps
  - Weighted Interval Scheduling
  - RNA
- Divide & Conquer
  - Merge sort
  - Closest pair of points
  - Integer multiplication (Karatsuba)

Complexity, II

- P vs NP
  - Big-O and poly vs exponential growth
  - Definition of NP - hints and verifiers
  - Example problems from slides & assigned reading
    - SAT, VertexCover, quadratic Diophantine equations, clique, independent set, TSP, Hamilton cycle, coloring, max cut
  - $P \subseteq NP \subseteq Exp$
  - Definition of (polynomial time) reduction
  - SAT $\leq_p$ VertexCover example (how, why correct, why $\leq_p$, implications)
  - Definition of NP-completeness
  - 2x approximation to Euclidean TSP

Some Typical Questions

- Give O( ) bound on 17n*(n-3+logn)
- Give O( ) bound on some code
  ```
  {for i=1 to n {for j …}}
  ```
- True/False: If an alg is $O(n^2)$, then it rarely takes more than n^3 +14 steps.
- Simulate any of the algs we've studied
- Give an alg for problem X, maybe a variant of one we've studied
- understand parts of correctness proof for an algorithm or reduction
- Implications of NP-completeness