

OVERVIEW OF TOPICS

David Kauchak  
CS 140 – Fall 2024

1

### 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

2

### 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

3

### Final exam topics

Data structures

- stacks/queues, extensible arrays
- BSTs, red black trees
- binary heaps, binomial heaps
- disjoint set data structure
- Run-times and functionality basics

Amortized analysis

- Aggregate and accounting methods

4

### 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

6

### Final exam topics

#### graphs

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

7

### Final exam topics

#### graph algorithms

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

#### graph misc

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

8

### Final exam topics

#### flow networks

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

#### flow network applications

- bipartite matching

9

## Final exam topics

### NP-completeness

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

10