Review for Midterm Exam 1

CS 624 — Analysis of Algorithms

March 5, 2024

UMass Boston

Midterm Exam 1

The midterm exam is Thursday, March 7, in class.

- Probably 4–5 questions. Assume every topic will be covered.
- Written exam. Bring a pen or pencil.
- You may bring up to 20 pages of **handwritten notes**.
  (That is, 20 pieces of paper, up to letter size.)
  No printouts, no photocopies.
- No other resources: no books, no computers, no cellphones/smartphones/tablets, no friends.
- The exam will make up 20% of your final grade.

Exam Topics

- correctness of algorithms
  - proof by loop invariant
- asymptotic analysis / function growth
  - the definitions of O, Θ, Ω
  - solving recurrences to find bounds
    - using substitution + induction
    - using recursion trees
    - using master theorem
- sorting algorithms
  - InsertionSort, MergeSort, HeapSort, QuickSort
  - implementation of sorting algorithms, auxiliary algorithms
  - sorting as binary decision tree
- heaps
  - heap definitions, invariants
  - algorithms for heap operations
  - using heap operations
- medians and order statistics
  - algorithm based on QuickSort
- binary search trees
  - BST definitions, invariants
  - algorithms for BST operations
  - using BST operations
- general math knowledge and techniques
  - algebraic manipulation
  - proofs by induction
- invention of simple algorithms

Exam Topics

Not covered:

- generating functions
- specific summation formulas
- bucket-sort
- median-finding algorithm with $O(n)$ worst-case time
- dynamic programming

Kinds of Questions

- prove/argue that an algorithm is correct
- prove/disprove a claim about aymptotic complexity (O, Θ, Ω)
- prove a proposition using induction
- solve a recurrence for asymptotic bounds
- invent/adapt an algorithm to solve a problem
- analyze an algorithm to find its running time
- prove/argue that an algorithm has some property
- demonstrate an algorithm on a specific example

How to Answer “Invent an Algorithm” Questions

- What are the variables? What operations are performed, in what order?
- What do variables *mean*?
- What *properties* do operations *establish*?

Examples in Homework 2 review.

Homework 2

See solutions.