Exam 1 Study Guide

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The exam will focus on understanding of basic concepts and critical thinking. It will have a combination of multiple-choice, short-answers and longer-answers problems. Any problem from Labs 1-5 and Assignments 1-4 is fair game.

1. Worst case, best case running times.

    - e.g. Binary search runs in $\Theta(\lg n)$ worst case and $\theta(1)$ best case.

2. Asymptotic growth of functions (O, Ω, Θ). Used to express efficiency (running time, space).

    - Insertion sort runs in $O(n^2)$ time and $\Omega(n)$ time.
    - Mergesort runs in $\Theta(n \lg n)$ and uses $\Theta(n)$ additional space.

3. Summations (arithmetic, geometric)

4. Recurrences: using recurrences to analyze algorithms, solving recurrences by iteration.

5. Comparison-based sorting

    - Quadratic sorts: Insertion sort, Bubble sort, Selection sort
    - Mergesort, Heapsort, Quicksort, Randomized quicksort
    - Comparison-based sorting lower bound: Any sorting algorithm that uses only comparisons to order the elements must take $\Omega(n \lg n)$ in the worst case.

6. Sorting without comparisons

    - For limited inputs (usually the keys to be sorted are integers in a small range).
    - Counting sort, Bucket sort run in $O(n + N)$ time and use $O(n + N)$ space, where N is the range

7. The binary heap

    - Implements the priority queue ADT
    - Operations on heaps: FindMin in $O(1)$ time; DeleteMin, Insert, Buildheap in $O(n)$ time.
    - A max-heap is defined symmetrically

Resources:

- lecture notes on the class github page

- lab 1-5 and assignment 1-4

- quizzes on canvas

- (add here anything that you found useful)