

Exam 1 Study Guide

Exam1: Friday 10/11, during the lab.

Exam format

The exam will consist of a combination of multiple-choice, short-answers and longer-answers problems and will cover everything up to and including Friday 10/4. The focus of these first four weeks is analysis and understanding fundamental algorithms. The problems will be similar to problems you have seen in labs 1-5 and assignments 1-4. Coming up with solutions to completely new problems is hard, so we'll keep those creative questions to a minimum.

Exam is closed notes, but you can bring one double-sided hand-written sheet.

Topics

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 (time, space).
 - Compare growth of functions: e.g. $\lg^3 n = O(\sqrt{n})$
 - Insertion sort running time is $O(n^2)$ and $\Omega(n)$
 - Mergesort runs in $\Theta(n \lg n)$ and uses $\Theta(n)$ additional space.
3. Summations (arithmetic, geometric)
4. Recurrences
 - Use recurrences to analyze recursive algorithms
 - Solve 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.
 - In-place sorting, stable sorting
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: PeekMin in $O(1)$ time; DeleteMin, Insert in $O(\lg n)$ time; Buildheap in $O(n)$ time.
 - A max-heap is defined symmetrically
 - Heaps vs binary search trees
8. Selection: Select(A,k) finds the k th smallest element in A.
- Idea: partition and recurse.
 - Quick-Select runs in expected $O(n)$ time assuming random pivot.

Resources

What can you do to prepare?

- Read the lecture notes
- Go thoroughly through Labs 1,2,3,4,5 and Assignments 1,2,3,4. Close the notes and try to solve the problems (again) without help.
- If you are not sure of the correct answer for a problem, message us and we'll send you the solution.
- And last but not least: Relax. This is just an exam. Its purpose is to give you feedback on your learning so that you know what needs to change going forward.