Congratulations! You passed!

TO PASS 1% or higher

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GRADE
100%

Interview Questions: Analysis of Algorithms (ungraded)

TOTAL POINTS 3

1. **3-SUM in quadratic time.** Design an algorithm for the 3-SUM problem that takes time proportional to n^2 in the worst case. You may assume that you can sort the n integers in time proportional to n^2 or better.

   1 / 1 point

   Note: these interview questions are ungraded and purely for your own enrichment. To get a hint, submit a solution.

   Correct

   Hint: given an integer $\mathtt{x}$ and a sorted array $\mathtt{a}[]$ of n distinct integers, design a linear-time algorithm to determine if there exists two distinct indices $\mathtt{i}$ and $\mathtt{j}$ such that $\mathtt{a}[\mathtt{i}] + \mathtt{a}[\mathtt{j}] == \mathtt{x}$.

2. **Search in a bitonic array.** An array is *bitonic* if it is comprised of an increasing sequence of integers followed immediately by a decreasing sequence of integers. Write a program that, given a bitonic array of n distinct integer values, determines whether a given integer is in the array.

   1 / 1 point

   - Standard version: Use $\sim 3 \lg n$ compares in the worst case.
   - Signing bonus: Use $\sim 2 \lg n$ compares in the worst case (and prove that no algorithm can guarantee to perform fewer than $\sim 2 \lg n$ compares in the worst case).

   Correct

   Hints: Standard version. First, find the maximum integer using $\sim 1 \lg n$ compares—this divides the array into the increasing and decreasing pieces.

   Signing bonus. Do it without finding the maximum integer.

3. **Egg drop.** Suppose that you have an n-story building (with floors 1 through n) and plenty of eggs. An egg breaks if it is dropped from floor T or higher and does not break otherwise. Your goal is to devise a strategy to determine the value of T given the following limitations on the number of eggs and tosses:

   1 / 1 point

   - Version 0: 1 egg, $\leq T$ tosses.
   - Version 1: $\sim 1 \lg n$ eggs and $\sim 1 \lg n$ tosses.
   - Version 2: $\sim \lg T$ eggs and $\sim 2 \lg T$ tosses.
   - Version 3: 2 eggs and $\sim 2\sqrt{n}$ tosses.
   - Version 4: 2 eggs and $\leq c\sqrt{T}$ tosses for some fixed constant c.

   Correct

   Hints:

   - Version 0: sequential search.
   - Version 1: binary search.
   - Version 2: find an interval containing T of size $\leq 2T$, then do binary search.
   - Version 3: find an interval of size $\sqrt{n}$, then do sequential search. Note: can be improved to $\sim \sqrt{2n}$ tosses.
   - Version 4: $1 + 2 + 3 + \ldots + t \;\sim\; \frac{1}{2}t^2$. Aim for $c = 2\sqrt{2}$.