

CSE 101 Homework 5

Winter 2023

This homework is due on gradescope Friday March 3rd at 11:59pm on gradescope. Remember to justify your work even if the problem does not explicitly say so. Writing your solutions in L^AT_EX is recommended though not required.

Question 1 (Gameshow Again, 30 points). *Dirk's gameshow from Homework 4 decides to change their rules again. Now Dirk can attempt at most k challenges but cannot attempt the same challenge more than once. Give an $O(n \log(n) + kn)$ algorithm to find the strategy that optimizes Dirk's expected winnings.*

Hint: Based on the solution to part (a) from the previous problem you can note that whatever challenges Dirk attempts to try, he should always attempt them in decreasing order of $p_i R_i / (1 - p_i)$ (with the order not mattering if there are ties). You can assume this without proof.

Question 2 (Interval Cover Redux, 30 points). *Consider the interval cover from before, but with weights assigned to each interval. You are given a collection C of n intervals in the real line, each with an associated positive weight. Your goal is to find a set S of intervals from C so that no two elements of S overlap and so that subject to this, the sum of the weights of these intervals is as large as possible. Give an $O(n \log(n))$ time algorithm for this problem.*

Question 3 (Pitstop Planning, 40 points). *Jake is a racecar driver. In the current race, he needs to take n laps around the course. Unfortunately, his car's performance slowly gets worse each lap he performs without taking a pitstop. In particular, a lap will take time T_ℓ if Jake has gone ℓ laps since his last one. Unfortunately, Jake's pit crew has only materials to let him perform at most k pitstops over the course of the race.*

Give an $O(kn^2)$ time algorithm to determine which laps Jake should take pitstops in so as to minimize his total time to complete all n laps.

Question 4 (Extra credit, 1 point). *Where have I been getting the character names for assignments this quarter from?*