

Hints for CS3230 programming assignment 2

October 22, 2023

I strongly recommend you to think about the question yourself before looking at hints. But if you're truly stuck, scroll down to the next page for hints.

There are quite a few different solutions to this problem; I will only outline one of them, feel free to use other methods.

Claim: Suppose that person i is selected as a runner, and person j is selected as a swimmer. Then $a[i] - b[i] \leq a[j] - b[j]$.

Proof: Suppose by contradiction that $a[i] - b[i] > a[j] - b[j]$ instead. Let s be the total score of the original configuration, and let t be the new score by choosing person i as a swimmer and person j as a runner instead (with everything else unchanged).

Then

$$s' = s - a[i] + b[i] - b[j] + a[j] < s \quad (1)$$

which contradicts the optimality of the original solution.

We can now sort by the athletes (what should we sort them by?), and be able to draw a boundary such that everyone on one side of the boundary is either a runner or a non-competitor, and everyone on the other side of the boundary is either a swimmer or a non-competitor.

How many possible boundaries are there? Can we afford to brute force all of them? You should be able to get a $\mathcal{O}(n^2 \log n)$ solution just by using these ideas.

To score full points, you will need some data structure speedup.