

CS 1510 Midterm 1: Greedy Algorithms
Fall 2003

1. (40 points) Consider the following problem. The input consists of n skiers with heights p_1, \dots, p_n , and n skies with heights s_1, \dots, s_n . The problem is to assign each skier a ski to minimize the average difference between the height of a skier and his/her assigned ski. That is, if the i th skier is given the $\alpha(i)$ th ski, then you want to minimize:

$$\frac{1}{n} \sum_{i=1}^n |p_i - s_{\alpha(i)}|$$

So for example, if $p_1 = 10$, $p_2 = 20$, $p_3 = 30$, $s_1 = 100$, $s_2 = 200$, and $s_3 = 300$. Then the matching $\alpha(1) = 3$, $\alpha(2) = 2$, and $\alpha(3) = 1$, which matches the first person to the third ski, the second person to the second ski, and the third person to the first ski, would have average difference

$$(|10 - 300| + |20 - 200| + |30 - 100|)/3 = 180$$

- (a) Consider the following greedy algorithm. Find the skier and ski whose height difference is minimized. Assign this skier this ski. Repeat the process until every skier has a ski. Prove or disprove that this algorithm is correct.
- (b) Consider the following greedy algorithm. Give the shortest skier the shortest ski, give the second shortest skier the second shortest ski, give the third shortest skier the third shortest ski, etc. Prove or disprove that this algorithm is correct.