E0 208: Homework 3

Deadline: April 10th, 5pm

1. We will try to come up with a divide and conquer algorithm to compute the skyline points in 3D. Let P be a set of n points in 3D. The algorithm computes a median plane ($x = x_{med}$) such that there are equal number of points of P on either side of the median plane; call these sets P_ℓ and P_r, respectively. Recursively, compute the skyline points of P_ℓ and P_r.

Let S_ℓ and S_r be the skyline points of P_ℓ and P_r, respectively. Design a *merge* procedure which takes as input S_ℓ and S_r, and in $O(n \log n)$ time computes the skyline points of P. What is the overall running time of such an algorithm?

2. Now improve the running time of the above algorithm to $O(n \log n)$. Hint 1: Merge operation should happen in $O(n)$ time. Hint 2: Before the algorithm starts, pre-sort P based on their z-coordinate values. Hint 3: Maintain the invariant that the skyline points of any subproblem (in the divide and conquer algorithm) are *reported* in sorted order based on their z-coordinate values.

3. In the lecture on skyline points in the multipass streaming model, provide a formal proof that the points in R_i^+ are skyline points of P, where P is the input set of points. Write the proof in *your* own words.

4. Propose *any* algorithm to compute the median of n numbers in the multipass streaming model. You should use $o(n)$ space, but you are free to perform any number of passes. (Hint: do not be greedy to find the median in the first pass!)