Fudan Summer Course: Assignment 1 (Due Day: 11:59pm, 7 Aug)

Problem 1. Consider the following two problems:

- *Batched range counting*: Let R be a set of axis-parallel rectangles in $\mathbb{R}^2$, and P be a set of points in $\mathbb{R}^2$. We want to report, for *every* rectangle $r \in R$, the number $|r \cap P|$, namely, the number of points in P that are covered by r. Define $n = |R| + |P|$.

- *2-sided range counting*: Define a *2-sided rectangle* as a rectangle of the form $(-\infty, x] \times (-\infty, y]$, namely, the left and bottom edges of the rectangle are "grounded" on the boundary of the data space. Let R be a set of 2-sided rectangles in $\mathbb{R}^2$, and P be a set of points in $\mathbb{R}^2$. We want to report, for each rectangle $r \in R$. Define $n = |R| + |P|$.

Prove: If the second problem can be solved in $f(n)$ time, then the first problem can be solved in $O(n) + O(f(n))$ time.

Problem 2. Describe an algorithm to solve the 2-sided problem in $O(n \log n)$ time.