

## Exercises for CSCI5010

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**Problem 1.** Let  $R$  be a set of axis-parallel rectangles and  $P$  be a set of points, all in  $\mathbb{R}^2$ . We want to find report all the rectangle-point pairs  $(r, p) \in R \times P$  such that  $r$  covers  $p$ . Design an algorithm to do so in  $O(n \log n + k)$  time, where  $n = |R| + |P|$  and  $k$  is the number of pairs reported.

(Hint: Both planesweep and divide-and-conquer will work).

**Problem 2.** Let  $R$  be a set of axis-parallel rectangles and  $P$  be a set of points, all in  $\mathbb{R}^d$  where the dimensionality  $d$  is a constant. We want to find report all the rectangle-point pairs  $(r, p) \in R \times P$  such that  $r$  covers  $p$ . Design an algorithm to do so in  $O(n \text{ polylog } n + k)$  time, where  $n = |R| + |P|$  and  $k$  is the number of pairs reported.

**Problem 3\*.** Solve the dominance screen problem in 3D space in  $O(n \log n)$  time.

(Hint: Planesweep).

**Problem 4\* (Maxima in 3D).** Let  $P$  be a set of  $n$  points in  $\mathbb{R}^3$ . Describe an algorithm to find all the maximal points of  $P$  in  $O(n \log n)$  time.

**Problem 5\* (Maxima in general).** Let  $P$  be a set of  $n$  points in  $\mathbb{R}^d$ , where  $d \geq 3$  is a constant. Describe an algorithm to find all the maximal points of  $P$  in  $O(n \log^{d-2} n)$  time.