1. Suppose we are given a set S of n line segments in the plane, each of which is either horizontal or vertical. Each horizontal segment $h \in S$ is specified by its left x-coordinate $h.l$, its right x-coordinate $h.r$, and its y-coordinate $h.y$. Each vertical segment $v \in S$ is specified by its x-coordinate $v.x$, its bottom y-coordinate $v.b$, and its top y-coordinate $v.t$. Assume that all x- and y-coordinates are distinct.

   Describe and analyze an algorithm to compute the number of pairs of segments in S that intersect. (Because all coordinates are distinct, if two segments in S intersect, one must be horizontal and the other vertical.)

   [Hint: You can do better than blindly applying Homework 9.]

The remaining problems are for you play with on your own.
Discussion in office hours or on Discord is welcome, but don't submit solutions!

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2. Suppose we are given a set S of n line segments in the plane, each of which is either horizontal or vertical. Each horizontal segment $h \in S$ is specified by its left x-coordinate $h.l$, its right x-coordinate $h.r$, and its y-coordinate $h.y$. Each vertical segment $v \in S$ is specified by its x-coordinate $v.x$, its bottom y-coordinate $v.b$, and its top y-coordinate $v.t$. Suppose we are also given two points s and t in the plane, each specified by their x- and y-coordinates. Assume that all x- and y-coordinates are distinct.

   (a) Suppose neither s nor t lies on any segment in S. Describe and analyze an algorithm to decide whether there is a path from s to t in the plane that does not intersect any segment in S. (Think of the segments in S as *walls*.)

   (b) Suppose both s and t lie on (different) segments in S. Describe and analyze an algorithm to decide whether there is a path from s to t in the plane that lies entirely in the union of segments in S. (Think of the segments in S as *roads*.)

   *(c) Solve both of these problems in $O(n \operatorname{polylog} n)$ time.

3. Suppose you are given a set R of axis-aligned rectangles in the plane. Each rectangle $r \in R$ is specified by its left x-coordinate $h.x$, its right x-coordinate $h.r$. Assume all coordinates are distinct.

   (a) Find a point p that lies in the largest number of rectangles in R.

   (b) Find the largest nested sequence of rectangles in R.