Algorithms and Data Structures 2020/21
Week 10 tutorial sheet

Below are a list of *suggested* exercises. You should also see the tutorial as a resource to get answers to questions you have, don't feel compelled to stick to the sheet.

1. Given a point $p_0 = (x_0, y_0)$, the *right horizontal ray* from p_0 is the set of points $\{p = (x, y_0) : x \geq x_0\}$, that is, it is the set of points due right of p_0. Show how to determine whether a right horizontal ray from a given p_0 intersects a line segment $\overline{p_1 p_2}$ in $O(1)$ time, by reducing the problem to that of two line segments intersecting.

   This is Ex. 33.1-6 of [CLRS].

2. Show how to determine in $O(n^2 \lg n)$ time whether any three points in a given set of n points are co-linear.

   This is Ex. 33.1-4 of [CLRS].

3. In the *online convex hull problem*, we are given the set Q of n points, one point at a time. After receiving each point, we are to compute the convex hull of the points seen so far. Obviously, we could run Graham's scan algorithm once again for each new instance with the new additional point, with a total running time of $O(n^2 \lg n)$. Show how to improve this slightly, by showing we can solve the online convex hull problem in $O(n^2)$ time.

   This is Ex. 33.3-5 of [CLRS]. Ex. 35.3-5 of [CLR].