Exercise List 4

Problem 1 (Polygon Intersection). Let P_1 and P_2 be two convex polygons. The vertices of each polygon are given to you in clockwise order in an array. Let n be the total number of vertices of P_1 and P_2. Suppose that each edge of P_1 shares at most one common point with an edge of P_2. Describe an algorithm to compute the intersection points of the edges of P_1 and P_2 in $O(n)$ time.

Problem 2 (Polygon Intersection, Again). Consider the setup in Problem 1 again. The intersection of P_1 and P_2 is a convex polygon, which we denote as P. Describe an algorithm to output the vertices of P in clockwise order. Your algorithm must use $O(n)$ time.

Problem 3 (Point in Polygon) Let P be a convex polygon of n vertices, which are given to you in clockwise order in an array. Given an arbitrary point q, describe an algorithm to decide whether q is inside or outside P in $O(\log n)$ time.

Problem 4 (Convexity Detection). Let P be a polygon of n vertices, which are given to you in clockwise order in an array. P is not necessarily convex. Describe an algorithm to decide whether P is convex in $O(n)$ time.