Computational Geometry: Homework 1

Problem 1.

a) If a line ***L*** does not intersect a diagonal of a convex polygon ***P*** then ***L*** can intersect only one of the two subpolygons defined by that diagonal. *Proof this.*

b) Suggest an ***O(1)*** time method for recognizing which of the two subpolygons may intersect ***L***. Your method should detect also a trivial case when the line ***L*** cannot intersect any of the subpolygons. *Hint:* Consider the distances between ***L*** and three vertices of the polygon: closest to ***L*** end-vertex of the diagonal and two neighbors of this vertex on ***P***. The distance between a point ***(x′,y′)*** and line ***Ax+By+C=0*** is proportional to ***|Ax′+By′+C|***.

c) Design an algorithm which finds the intersection of a line ***L*** with a convex polygon ***P*** in ***O(logn)*** time. *Hint:* Use a), b) and binary search.

Problem 2.

Design an ***O(logn)*** time algorithm which finds the leftmost and rightmost vertices of a convex polygon.
Hint: Use binary search.

Problem 3.

Problem 5 in the textbook Preparata & Shamos (p.94).

Apply the locus approach to solve the following problem (fixed-radius circular range search): given ***N*** points in the plane and a constant ***d>0***, report (possibly, with logarithmic-time overhead) the points that are at most at distance ***d*** from a given query point ***q***.