CS133 Assignment 3

Due date: Thursday 5/9/2019

Intersection Problems

1. (2 points) Given a line segment $\overline{p_1 p_2}$ and a horizontal line $y = y_0$, answer the following questions:
   a. How to test if the horizontal line (having an infinite length) intersects the line segment? Express the test as a logical expression.
   b. If the line segment intersects the line, how do you calculate the intersection point? Write down the formula for the coordinates of the intersection point.
2. (4 points) Given a convex polygon represented as a list of point in CCW order, how do we find the top-most point (with the largest y coordinate) in $O(\log n)$ time? For simplicity, assume that there is only one point with the largest y. Write a pseudo code for your algorithm and analyze its running time.
3. (4 points) Given two polygons P and Q, not necessarily convex, extend the intersection algorithm given in class to compute the union of the two polygons. The union of two polygons consists of the area that is covered by at least one of the two polygons. See the figure below for an example. Make sure to handle the three cases, (1) P and Q boundaries overlap, (2) $P \subseteq Q \vee Q \subseteq P$, and (3) P and Q are disjoint.

   You can use a subroutine that computes all line segment intersections.

   Explain your answer with a supporting figure. **No need** to write a pseudo code for your algorithm. Analyze the running time of your algorithm.