CS200 - Midterm Review Questions

1. All of the following questions are regarding the closest points in 2D algorithm.

   (a) What if we changed the Closest Points algorithm to, in the combine step, use a region within 2δ of the midline. Would the algorithm still be correct? How would our analysis change?

   (b) If we used a region within $\delta/2$ of the midline, would our algorithm be correct?

   (c) What if, in our analysis of points in the region within δ of the midline, we created imaginary squares that are $\delta \times \delta$ large. How would our analysis change?

   (d) What if we imagined squares that are $\delta/3 \times \delta/3$ large?

   (e) Why is it important to presort the arrays?

   (f) Why do we need to maintain separate arrays sorted by X and Y coordinates?

2. Prove the following algorithm is correct.

Algorithm 1: `Maximum`(A, s, f, x)

Input : Array A of unique integers. Start index s and final index f.
Output: Maximum value in array.

1 **if** $f - s == 0$ **then**
2 $\quad$ return $A[s]$;
3 **end**
4 $g = \lfloor (s + f)/2 \rfloor$;
5 $m_1 =$ `Maximum`(A, s, g);
6 $m_2 =$ `Maximum`$(A, g + 1, f)$;
7 return $\max\{m_1, m_2\}$;

3. Probability Questions

   (a) Review Quiz

   (b) If you have a coin that has 1/4 probability of heads and 3/4 probability of tails, what is the sample space? What is the expected number of heads? (Use indicator random variables).

   (c) Problem 2b from the homework, but what if there are two elements with value x in the array?

   (d) Explain why the probability of comparing z_i and z_j in Randomized QuickSort is $2/(|j - i| + 1)$