CSE355

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1.

a).

Since the parabolas are expressed as a function form, we are not allowed to make it concave left or concave right. So it it impossible to find 4 intersections between two parabolas.

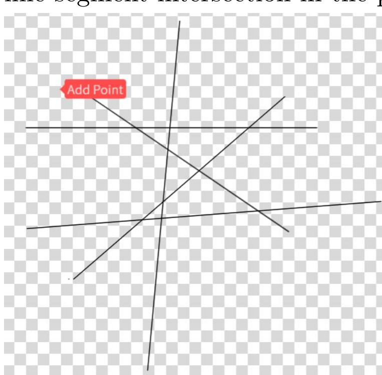
The only possible parabolas are concave up or concave down. So we could easily determine the minimum intersections of two parabolas are zero and maximum intersections are 2. If we draw a picture of intersected parabolas, we can see the intersection is 2 when n = 2.

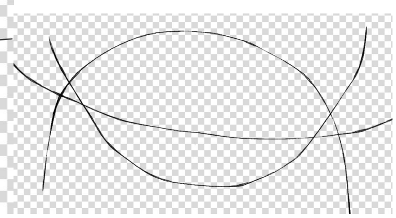
intersection is 6 when n = 3.

Intersection is 12 when n = 4.

Intersection is 20 when n = 5.

We can also think about the concept introduced in the lecture, the maximum line segment intersection in the plane is $\binom{n}{2}$.





So the maximum possible value of $k = 2 * \binom{n}{2}$, because each time we doubled the intersections like we did as straight line segment arrangement. As the pictures show above, we can find the similarities between line segment arrangement and quadratic function intersections.

Thus the maximum possible value of $k = 2 * \binom{n}{2}$

b).

We start from leftmost position of the plane, then the vertical line sweeps rightward. Fristly, we need to add all of them in the stack and we indicate the sequence of all quadratic parabolas from top to bottom.

Event handling: Once the sweeping line reaches an intersection of two qudratic parabolas, one counter variable increases by two if the intersection is not at vertex and we will ignore any intersections between current two parabolas in the following sweeping procedures because they are symmetrical. Then the sweeping line starts to scan more intersections between other quadratic parabolas. If the intersection occrus at the vertex, then the counter variable is incremented by one instead of two. The stack will also pop the previous scanned segment lines.

2.

We can use sweeping line method. When the vertical test line sweeps from leftmost position to rightward. The triangles will partition the vertical line into many line segments. Suppose we have n intersected triagnle to sweeping line, then we can deduce the sweeping line is partitioned by at most $2 * n + 1$ segments.

Event handling:

Case 1:

If the point in P is scanned by the sweeping line, we could test this point by the current line segments that are partitioned by intersected triangles. We can check if this point locates any intervals between segments endpoint. If it satisfies our assumption, we can say it is inside the corresponding triangle by those intervals. The counter variable increment by one.

Case 2:

If the sweeping line encounters a new vertex on the triangle, we need to check whether it is on the leftmost side or on the rightmost side of the triangle. Because we may insert new internal on the sweeping line segment or we need to delete unnecessary intervals. For the leftmost vertex on the triangle, we add new interval on the sweeping line. For the rightmost vertex, we delete the corresponding interval. For the other vertex, we just ignore them.

The time complexity for this algorithm is O(nlogn) because we handle the events by O(logn) and n points by O(n).

3.

To my understanding, the intersection of half plane is actually an upper hull. We can divide the convex hull into separated triangles and add each of them together.

4.

We may try the line point duality.

The line segments can be recognized as acute triangles.The stabler line can be converted to a dual point. In the intersected dual plane of acute triangles, we can check whether the point locates inside area or outside the plane.