CMPS 3130 Computational Geometry – Spring 20

1/30/20

3. Homework (undergrad)

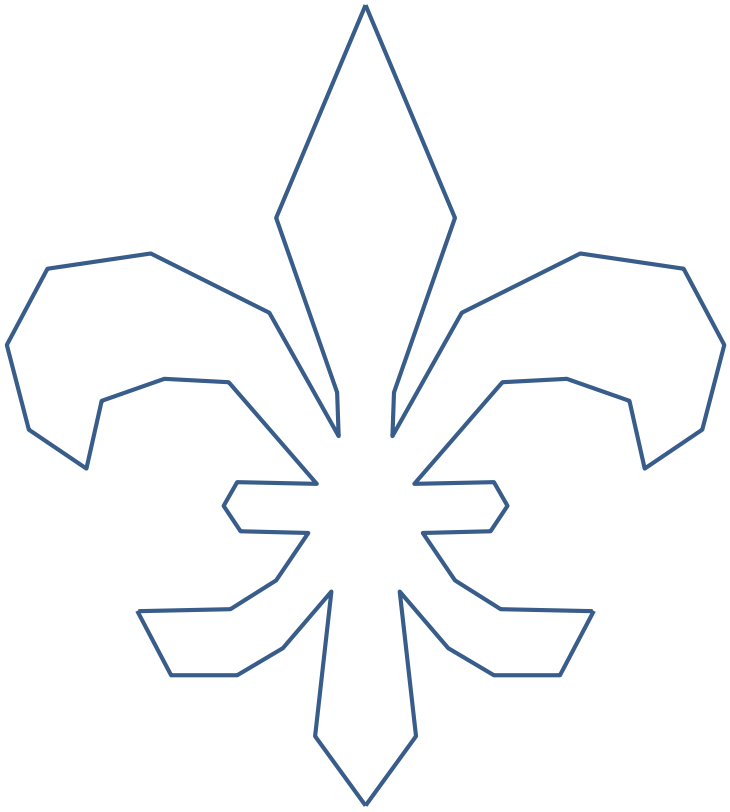
Due **2/6/20** before class

1. **Guarding the Fleur-de-Lis (9 points)**
   For the simple polygon P below:

   (a) Apply the method employed by the 3-coloring-based proof to obtain a set of at most $\lfloor \frac{n}{3} \rfloor$ **vertex guards** that guard P.

   (b) By inspection, obtain the minimum number of **vertex guards** necessary to guard P. Justify your answer.

   (c) By inspection, obtain the minimum number of **point guards** necessary to guard P, i.e., guards are allowed to be anywhere in the interior or on the boundary of P. Justify your answer.



2. **Guarding Boundary vs. Interior (5 points)**
   Give an example of a polygon together with a placement of vertex guards, such that the whole polygon **boundary** is guarded but **not the whole interior**.

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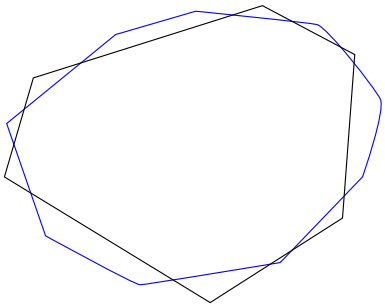
3. **Intersecting Convex Polygons (10 points)**

Let P and Q be two convex polygons with m and n vertices, respectively. Such as the two polygons on the right. Each polygon is given as a list of vertices in counter-clockwise order. Give a sweep-line algorithm that outputs all intersection points between the boundary of P and the boundary of Q in $O(n+m)$ time. Make sure to describe what you store in the sweep line status, what your events are, and how you handle the events (pictures help). And then analyze the runtime.



(Note: Since the runtime is $O(n+m)$ the sweep line status will not be a binary search tree.)