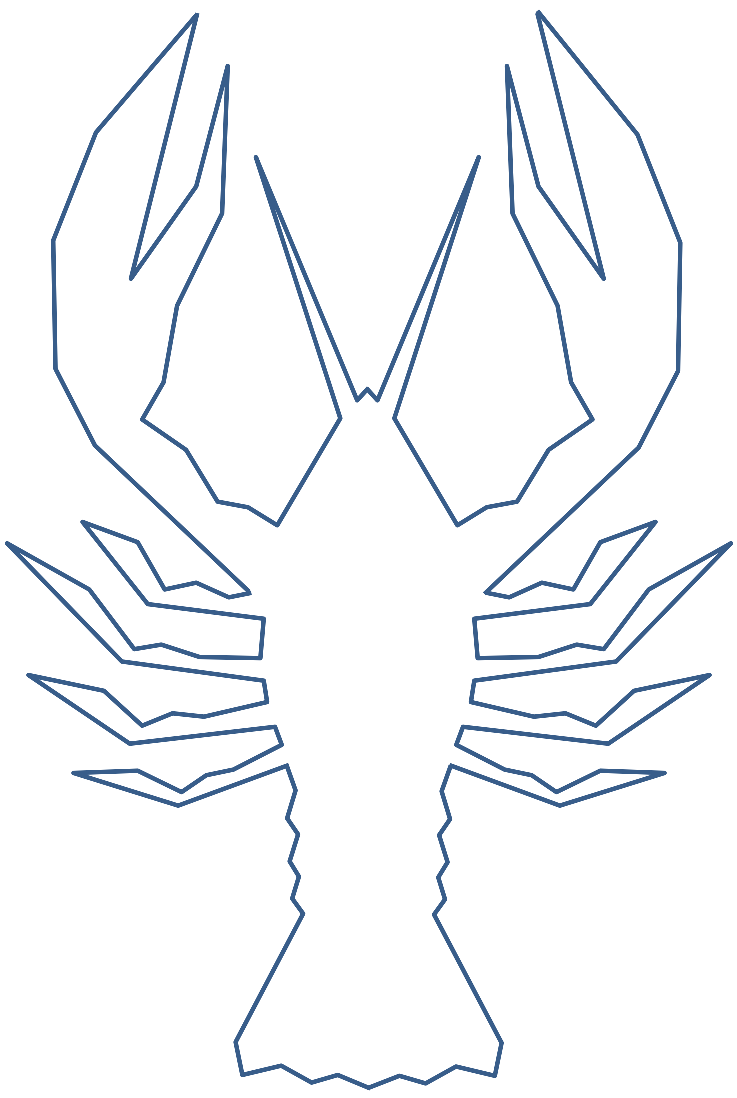
CMPS 3130/6130 Computational Geometry – Spring 15

2/5/15

1. Homework

Due **2/19/15** before class

1. **Crawfish Guards (12 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.



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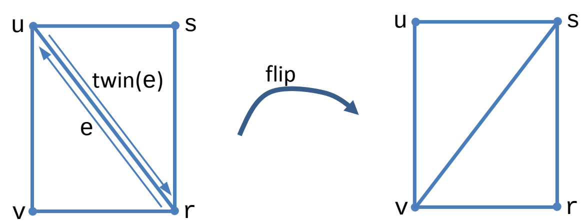
2. **Guarding Boundary vs. Interior (8 points)**
   Give an example of a polygon together with a placement of vertex guards, such that the whole polygon boundary is guarded but not the whole interior.

3. **Triangulation in Quadratic Time (10 points)**
   Give an algorithm for triangulating a simple polygon that is based on the ear-cutting theorem. Your algorithm should run in $O(n^2)$ time, where n is the number of vertices of the polygon. Show that your algorithm has indeed this runtime.

4. **Edge Flip (10 points)**
   An *edge flip* is an operation that switches the diagonal of a quadrilateral. Assume the quadrilateral below is given in a DCEL, and you are given a reference to e. Give code that flips e and updates the DCEL accordingly.



5. **Stabbing Number and Triangulation (graduate; 10 points)**
   The stabbing number of a triangulated simple polygon P is the maximum number of diagonals intersected by any line segment interior to P. Give an algorithm that computes a triangulation of a convex polygon that has stabbing number $O(\log n)$. Prove that the computed triangulation has indeed stabbing number $O(\log n)$.