

Computational Geometry Homework Set 0, 28. 10. 2014

Solutions to this homework set will not be evaluated, the homework set is treated in the first small tutorial.

Exercise 0 (Register): Register to this course by sending an email with your name and matriculation number to mhsaar@gmail.com.

Exercise 1 (Guards): For each polygon in Figure 1, find the minimum number of guards necessary to cover it.

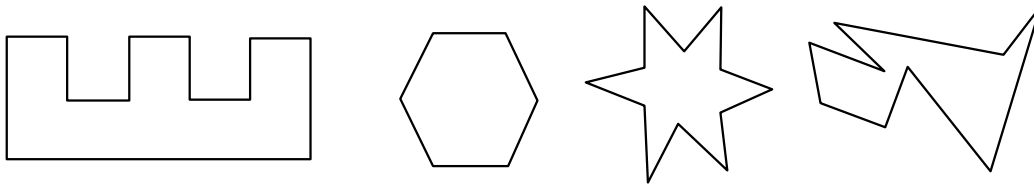


Figure 1: Polygons that need to be guarded.

Exercise 2 (Unique Triangulations): For each $n > 3$, find a polygon with n vertices that has a unique triangulation.

Exercise 3 (Blocking Guards): Suppose that guards themselves block visibility so that a line of sight from one guard cannot pass through the position of another. Are there polygons for which the minimum of our more powerful guards needed is strictly less than the minimum needed for these weaker guards?

Exercise 4 (Lower Bound for Polygons with Holes): Consider the following theorem due to Shermer:
 $\lfloor \frac{n+h}{3} \rfloor$ guards are sometimes necessary for a polygon of n vertices and h holes.

- Prove the necessity for $n = 8, h = 1$.
- Expand your proof from a) to arbitrary n and h with $n \gg h$.

Exercise 5 (Triangulation Dual):

Is the triangulation dual of a monotone polygon necessarily a path?

Exercise 6 (Diagonals):

Prove the following statement:

A diagonal exists between any two nonadjacent vertices of a polygon P if and only if P is a convex polygon.

Exercise 7 (Triangulation of Polygons with Holes):

Prove the following theorem:

Every polygon with n vertices and h holes can be triangulated.

Hint: induction.

Exercise 8 (Number of Triangles):

Prove the following theorem:

The triangulation of a polygon with n vertices and h holes has exactly $n + 2h - 2$ triangles.

Hint: consider the sum of interior angles or Euler's formula.