CSE355

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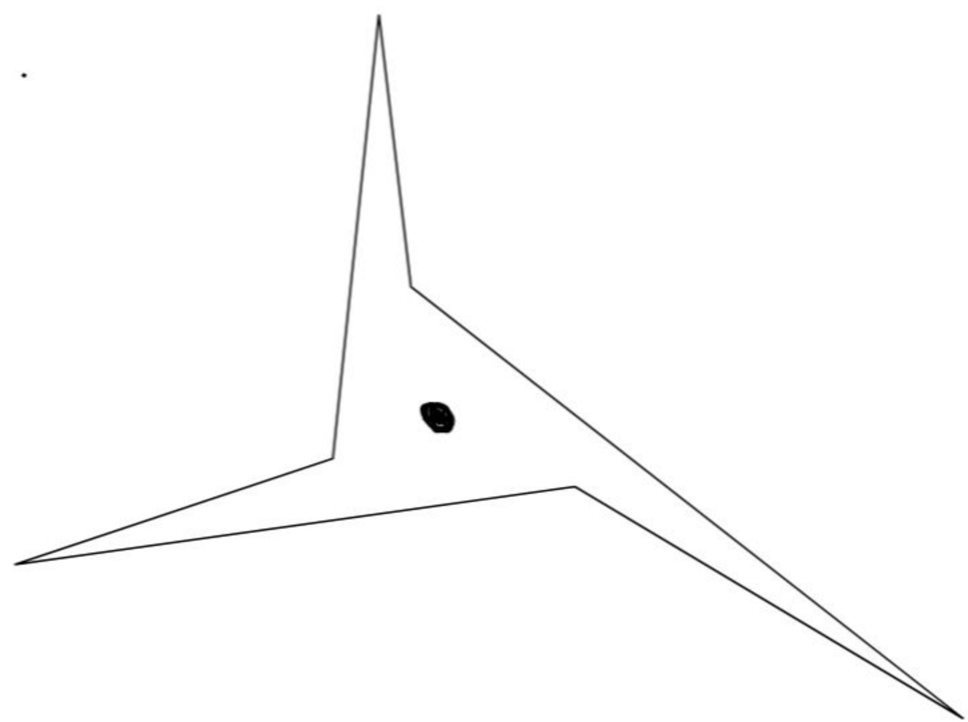
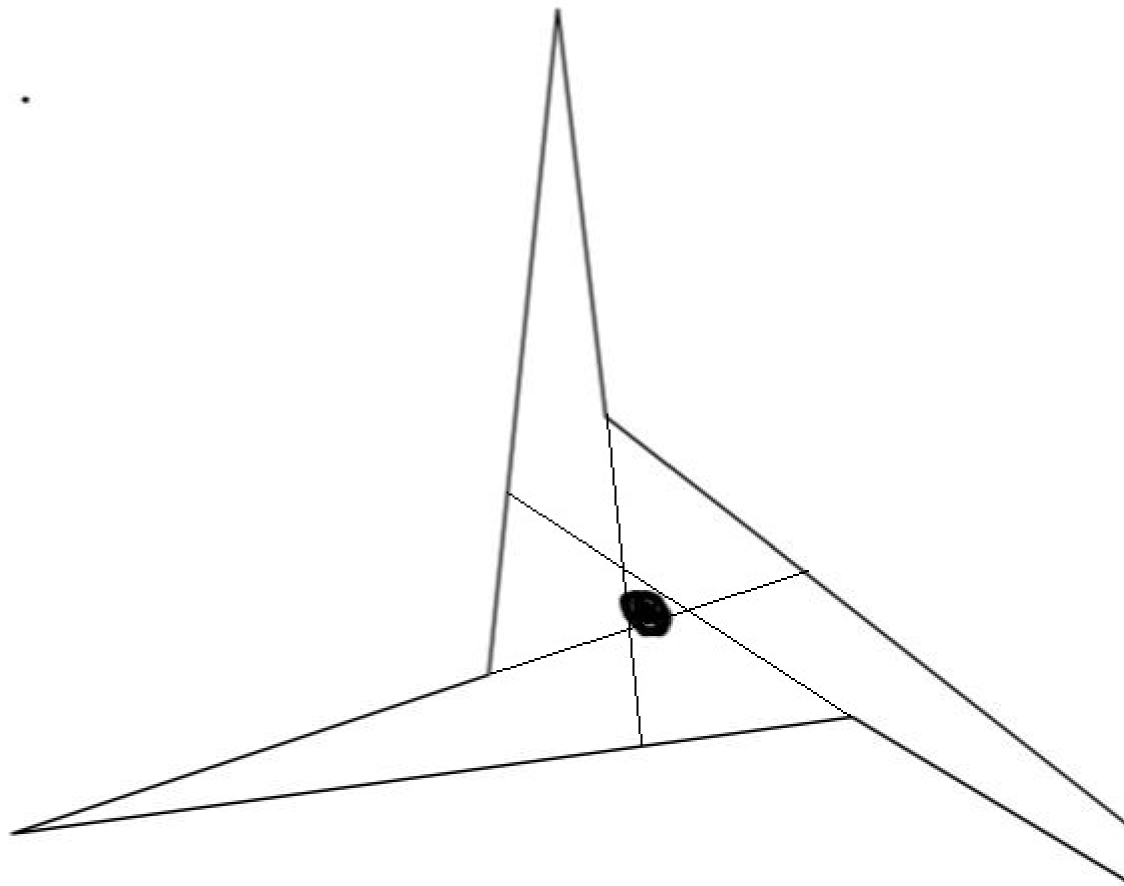
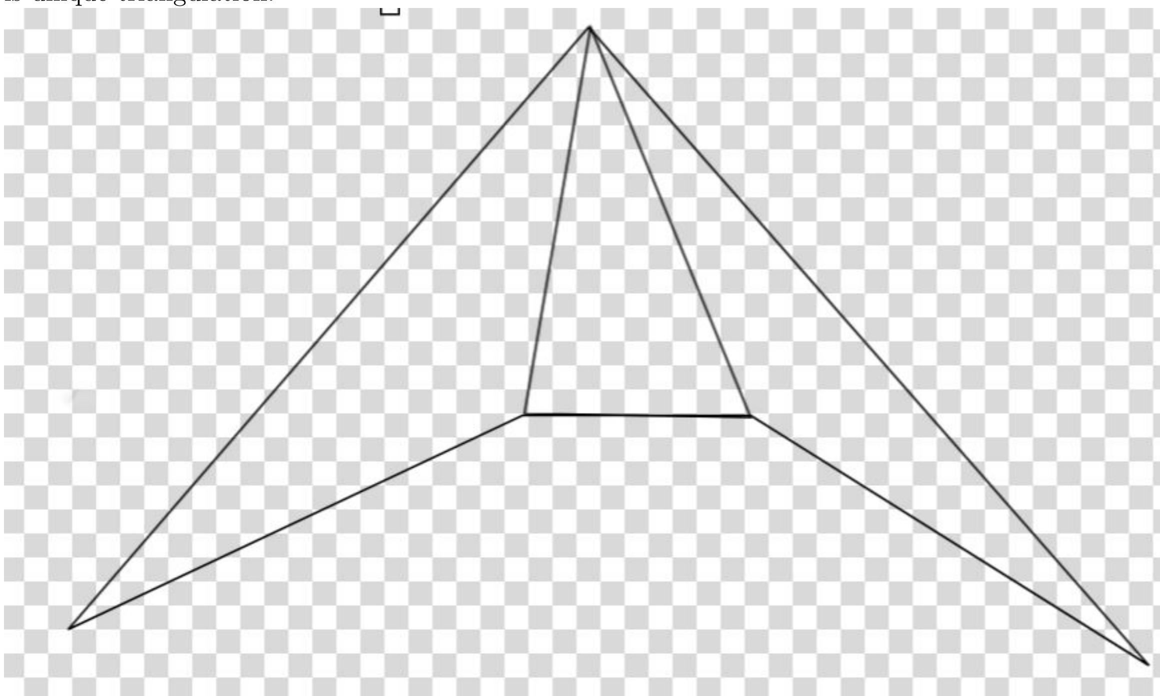
1.

For example, the shape of polygons can be designed as shown in the figure. Let guards to stand on the prongs, they will be able to secure all the walls and corners. But the space in the center corridor will not be watched. So we can prove that there will be at least one interior point to P not seen by any guard while the guards can secure all the boundary ∂P.



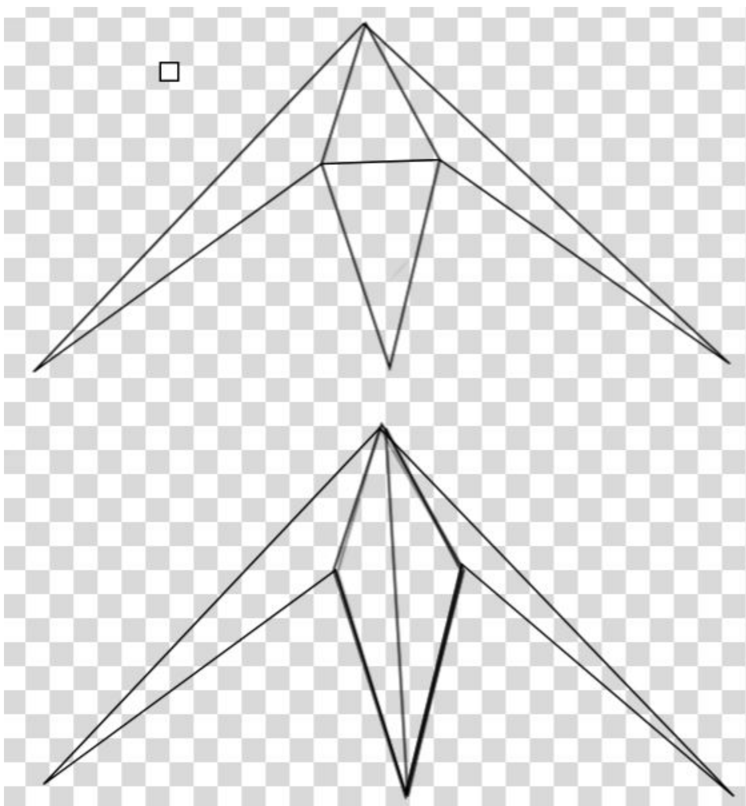


2.
Polygons can have unique triangulations. For example, the figure shown below is unique triangulation.



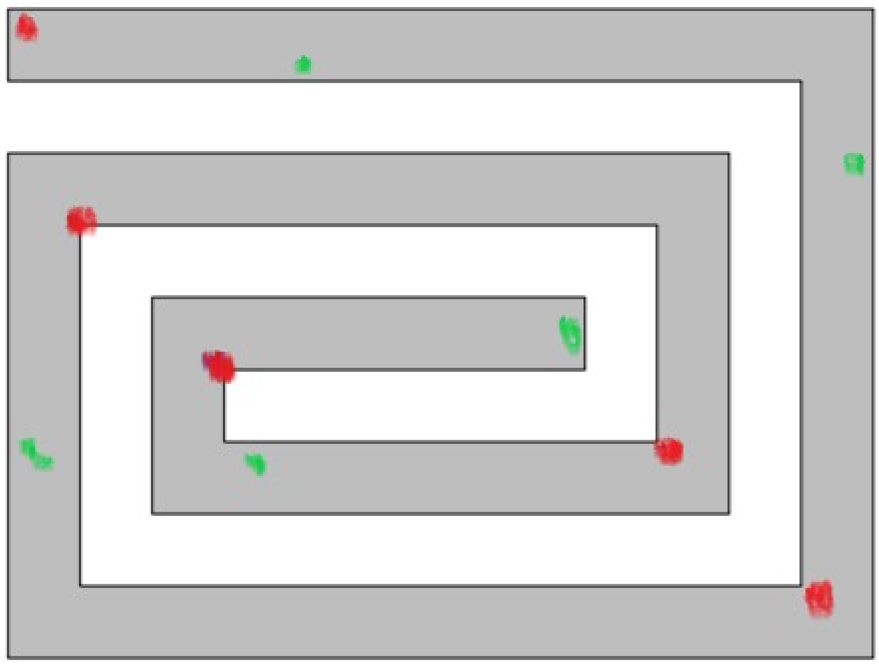
Convex polygons have the largest number of triangulations. All the interior angles of convex polygons are less than 180 degree and this makes they have more possibility to build diagonals inside the boundary in a symmetrical way.

Polygons can have exactly two triangulations. The figure shown below is exactly two triangulations.



3.

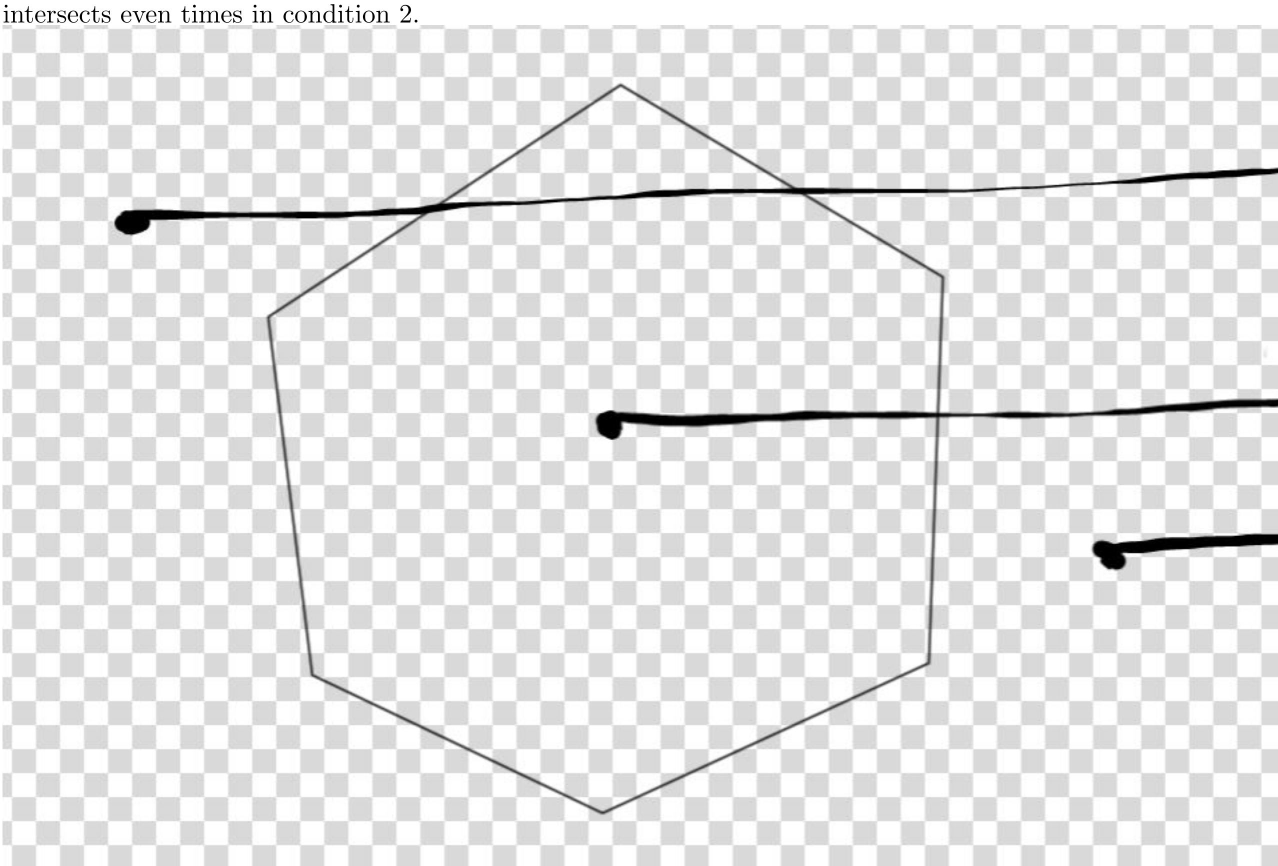
The minimum number of guards is 5 in the polygon. We can determine the optimal solution by giving the figure below, which shows a set of k witnesses that require at least k guards.



Red points indicate guards. Green points indicate witnesses.

4.

Assume a polygon P has n vertices in CCW order along the boundary ∂P.
To check the point if inside this polygon P, we can design algorithm by using right-directional line to test the intersection between line and boundaries.
For example, we will meet two conditions: 1.Inside the boundary. 2. Outside the boundary.
As we can see,the test line intersects odd times in condition 1, and the test line intersects even times in condition 2.



The minimum edges of polygon P are n, because we have n vertices. To determine the time complexity of algorithm, we may consider the worst case. The worse case is the test line will intersect n-1 edges of polygon P. So we can realize that the time complexity of this algorithm is O(n). The following figure will present my understanding.