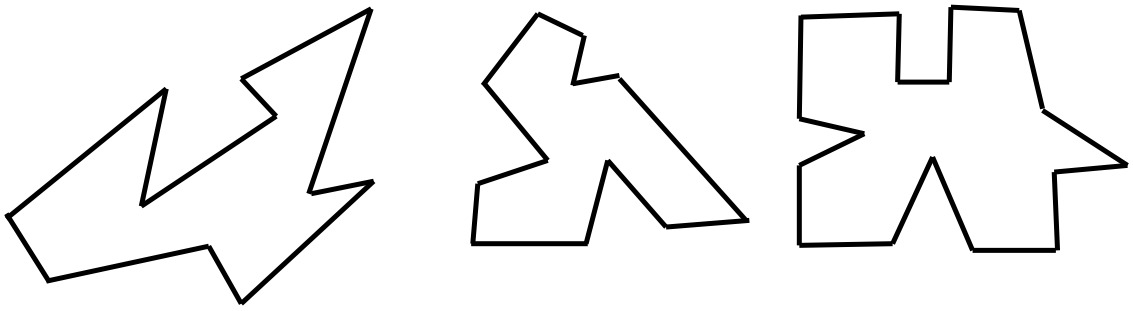
DEPARTMENT OF MATHEMATICS

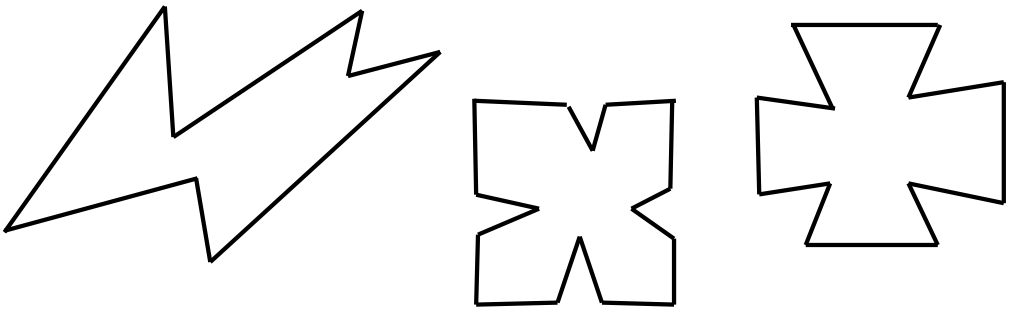
MATHS 190 Tutorial 7

Discuss the following situations with two or three other students and try to work out together a solution to each question. Make sure everyone in the group contributes to the discussion. When you have an answer to a question that everyone agrees with, make some notes outlining how you worked out the answer. Then try to explain your answer to your tutor.

1. (Mindscape 7, §4.2 of text) For each of the following floor plans, place guards at appropriate vertices so that every point in the museum is within view of at least one guard.



2. (Mindscape 9, §4.2 of text) Divide each of the following art gallery floor plans into triangles by adding straight lines between some vertices of the gallery which do not cross each other.



3. For each of the triangulations you found in question 2, colour the vertices of the gallery red, blue or yellow so that every triangle has all three colours. What can you say about the number of guards needed to guard each of these galleries?

4.

Write up your answer to this question and hand it in with your answers to Assignment 3 (due September 29th). Don't forget to write down the names of the people in your tutorial group, so that you can acknowledge your collaborators in your report.

Draw the floor plan of a gallery with eleven corners which needs exactly one guard so that the entire gallery can be viewed. Draw another gallery (with eleven corners) that needs two guards. Draw another gallery (with eleven corners) that needs three guards. Show the placement of guards in your drawings.
Is it possible to draw a gallery with eleven corners that needs at least four guards? If so, draw the gallery and show the placement of guards. If not, explain why not.

5. Consider the following 12-sided tile (which we could call the "plus").

Show how to tile the plane with such tiles.

Determine all the basic rigid symmetries of this tiling (i.e., all shifts, flips and rotations). Do all three cases arise?

Does this tiling have any symmetries of scale?

6. (Mindscape 12, §4.4 of text) Figure 1 on the extra page shows a Pinwheel Pattern on one side. For each of the shaded tiles, outline the surrounding tiles that create the 5-unit super-tile, the 25-unit super-super-tile and the 125 unit super-super-super-tile. There is only one correct answer.

7. (Mindscape 15, §4.4 of text) Figure 2 on the extra page shows pictures of the square and equilateral triangle patterns. For each of the shaded tiles, outline surrounding tiles that create the 4-unit super-tile and the 16-unit super-super-tile. In each case, show that there is more than one correct answer.

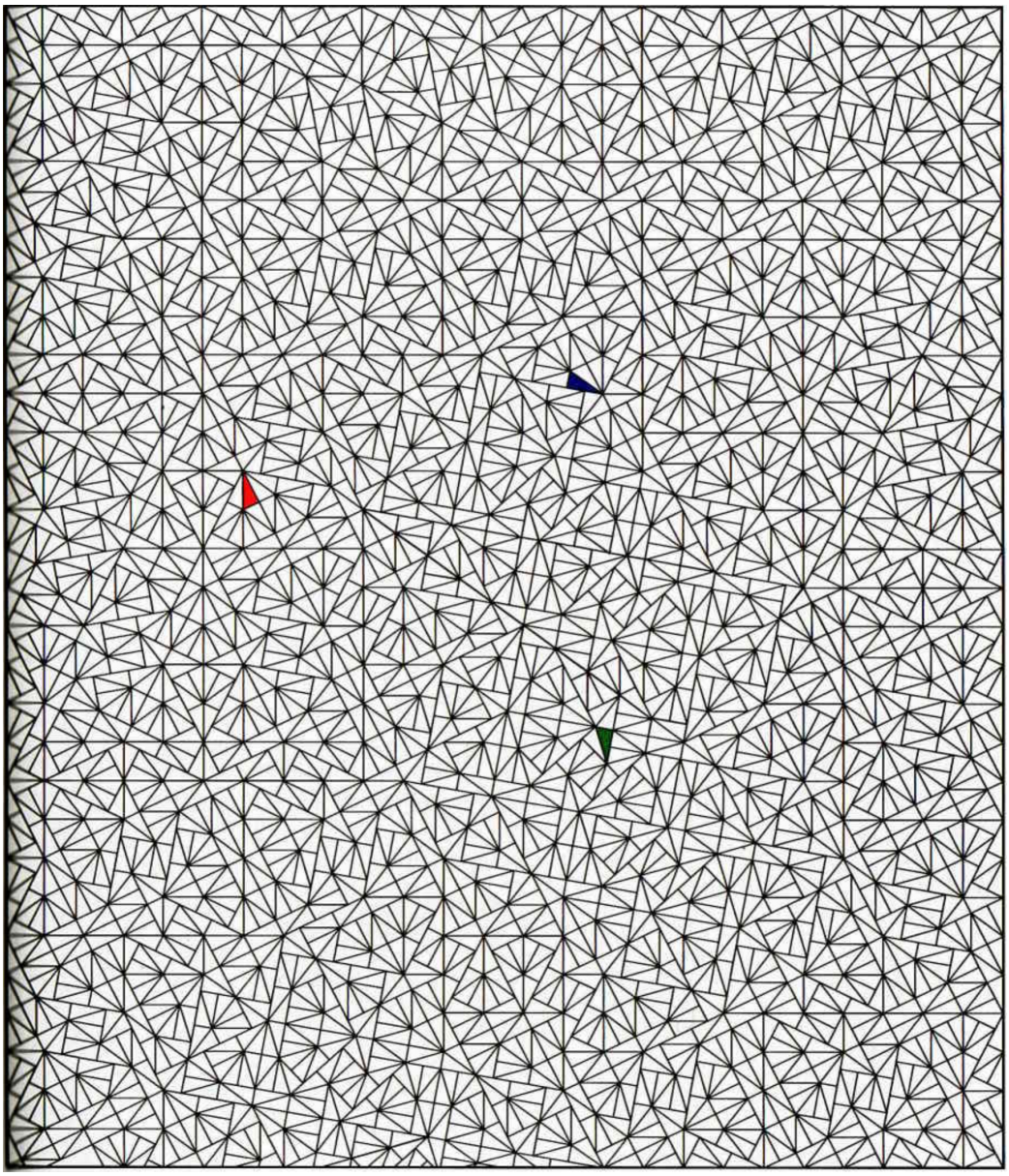
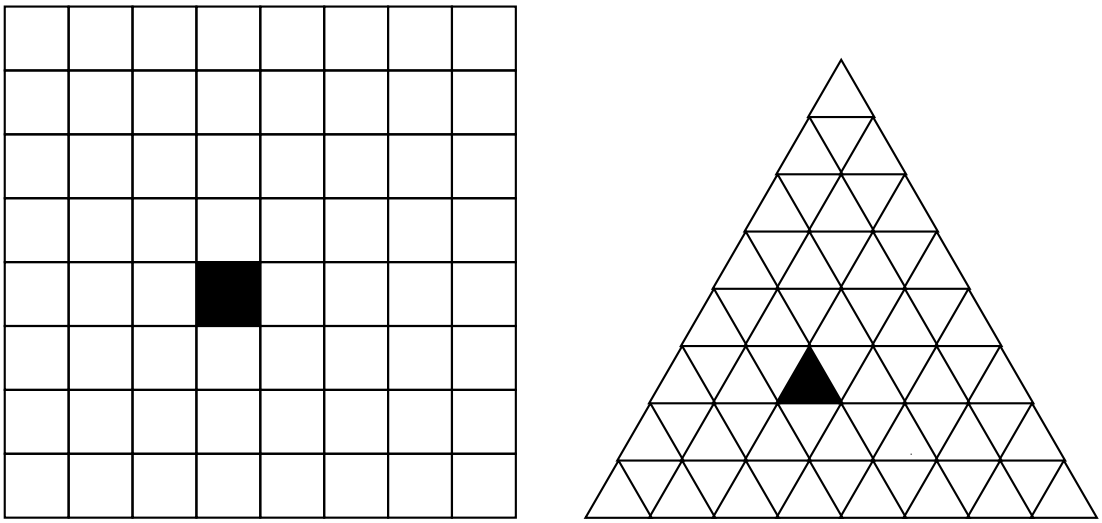


Figure 1: A random piece from the Pinwheel Pattern, see ex. 6.



(a) Square tiling

(b) Equilateral triangle tiling

Figure 2: Tiling patterns for ex. 7.