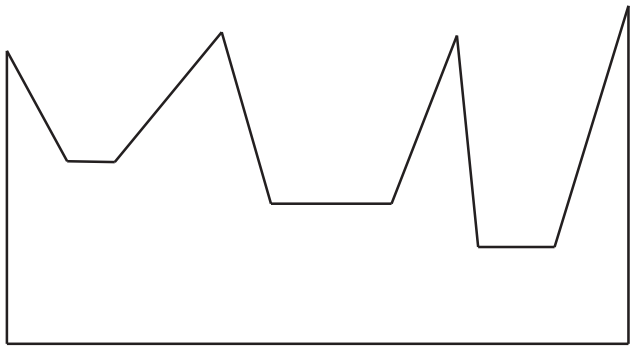
Department of Mathematics

Maths 190 Assignment 3

September 21, 2009 Due: 4pm, September 30th, 2009

- Put your completed assignment in the appropriate box in the basement of the Mathematics/Physics Building **before** 4pm on the date due.
- Late assignments or assignments placed in the wrong box will not be marked.
- Your assignment **must** be accompanied by a blue Mathematics Department coversheet. Copies of the coversheet are available in the basement.

1. (7 marks) The following picture shows the floor plan for an art gallery.



   (a) Find the minimum number of guards required so that when the guards are placed at appropriate vertices, each point of the gallery can be viewed by at least one guard. Your answer should include a drawing that shows one possible way in which this minimum number of guards can be used to keep watch on the whole gallery.

   (b) Say how the number of guards you used compares with the prediction of the Art Gallery Theorem discussed in class and in the text book.

   (c) Is it possible to draw the floor plan of an Art Gallery with 10 straight sides so at least four guards, standing at vertices, are required to ensure that each point of the gallery can be viewed by at least one guard? Give a reason for your answer.

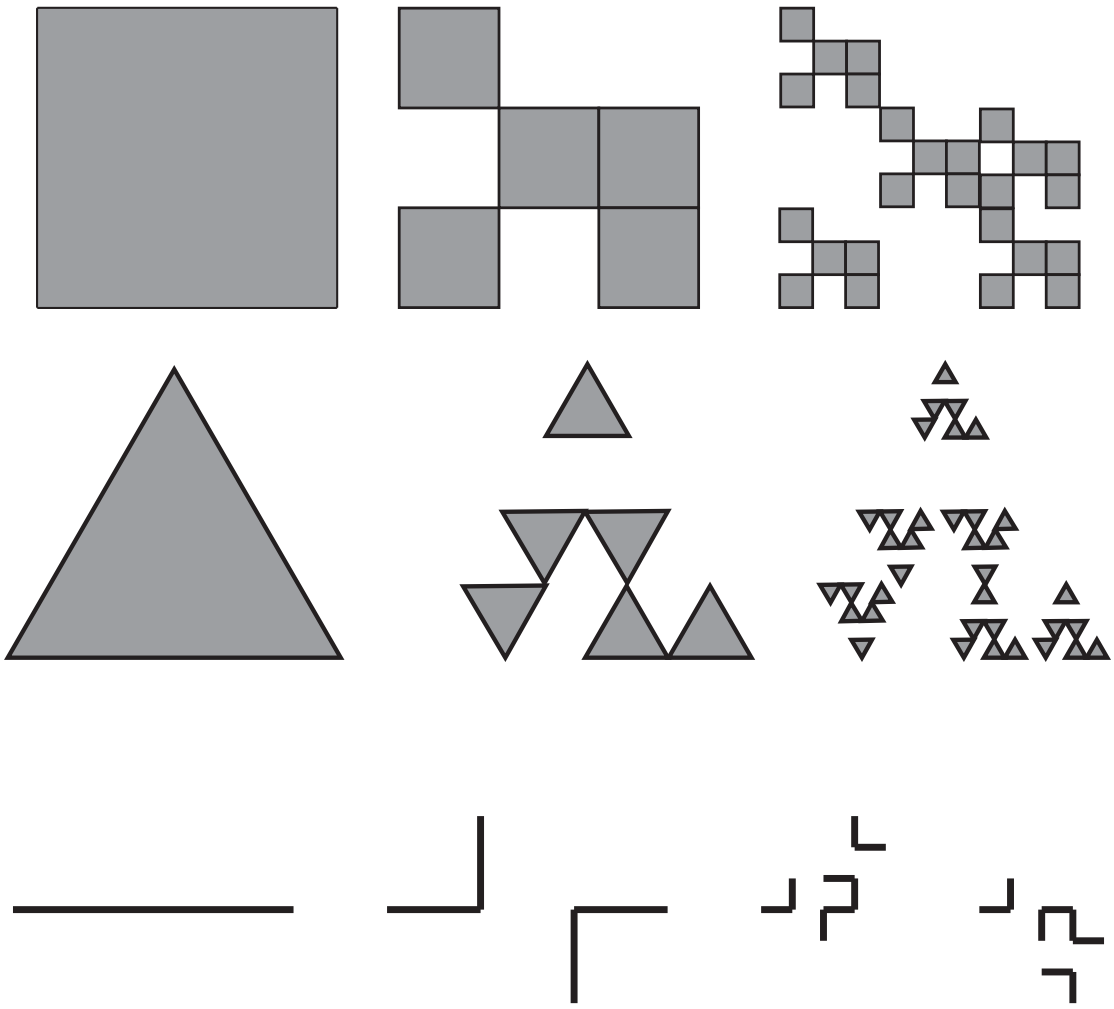
2. (7 marks)

   (a) Carefully explain the difference between rigid symmetry and symmetry of scale for patterns in the plane. Illustrate your explanation with appropriate pictures.

   (b) Create an imaginative shape that could be used to tile the plane. Your tile should have at least 12 sides, with not all of them being straight. Draw the pattern you would get if you used this shape to tile the plane. Hint: One way to create a tile like this is to start with a pattern of squares (or hexagons or other regular shapes that tile the plane). Change one edge of one tile by indenting it in an interesting way. You will then have to change one edge of the neighbouring tile so that the tiles still fit together. And of course, a change to one tile will mean that every other tile needs to be changed in the same way. Repeat this process until you have the pattern that you want.

(c) Say whether your pattern has rigid symmetry or symmetry of scale.

3. (6 marks) Compute the fractal dimensions of the fractals constructed by the processes shown in the pictures below.



Tutorial write up: Remember to hand in with your assignment your written solutions to Question 5 on Tutorial 6 (5 marks), Question 4 on Tutorial 7 (5 marks) and Question 5 on Tutorial 8 (5 marks).