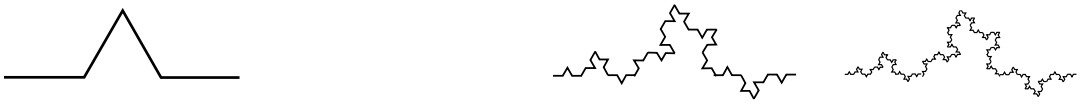
DEPARTMENT OF MATHEMATICS

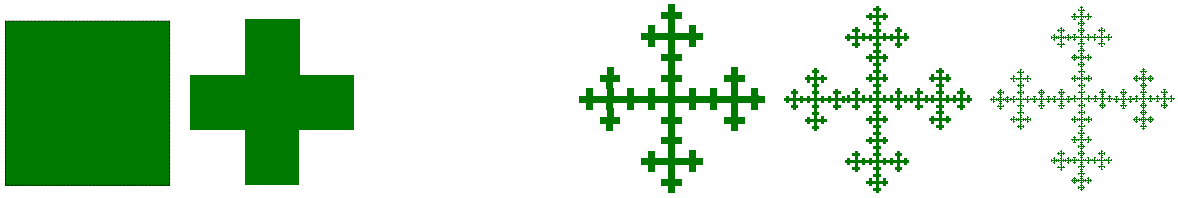
MATHS 190 Tutorial 8

Tutorials in Maths 190 are **collaborative tutorials**. You should work in groups of 3 or 4 students, discussing the situations and puzzles listed below, or issues arising from lectures. Part of your final mark depends on your participation in tutorials.

1. The following fractal is a variation on the Koch Curve. Draw the missing step in its construction.

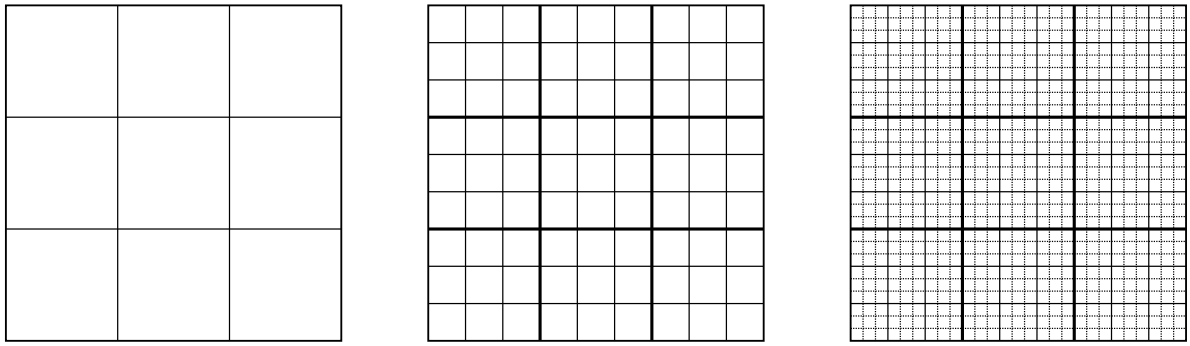


2. A step in the construction of the following fractal is missing. Draw it.

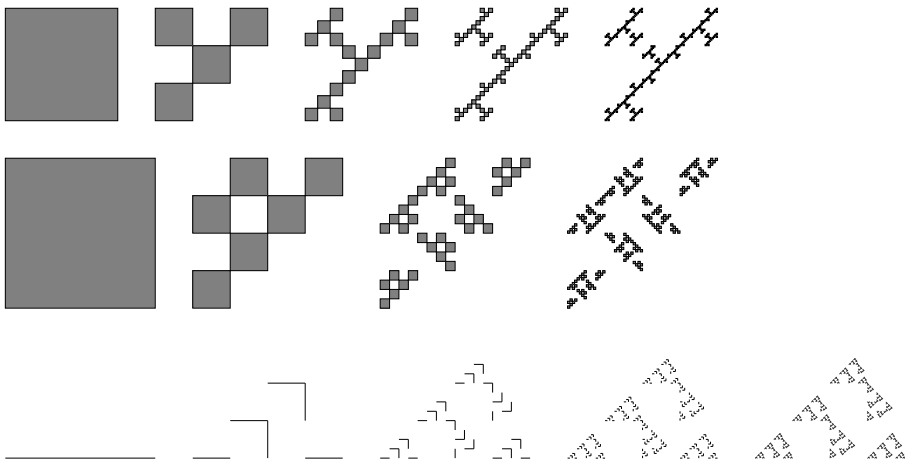


What is the dimension of the fractal being constructed?

3. Colour in 6 squares in the grid on the left below. Use this pattern to generate the next two steps towards a fractal of dimension $d = \frac{\ln 6}{\ln 3}$.



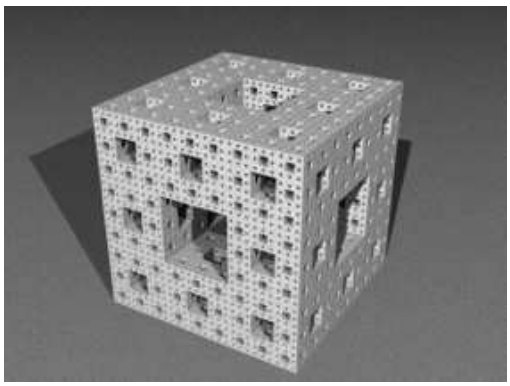
4. What are the fractal dimensions of the fractals being constructed in the following diagrams?



5. **Write up your answer to this question and hand it in with your answers to Assignment 3.** See below for instructions on writing tutorial reports. 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.

   Design a fractal with dimension $d = \frac{\ln 7}{\ln 4}$. Draw the zeroth, first and second steps in its construction.

6. The image below shows the Menger Sponge — a 'solid' fractal with zero volume. It is constructed iteratively — the whole sponge is made of copies of itself. There is a hole all the way through the sponge (in three directions).



   (a) How many copies of the sponge would you need to make a sponge 3 times larger?

   (b) What is the fractal dimension of the Menger sponge?

Writing up tutorial questions

A written solution for question 5 should be handed in for marking with Assignment 3 (due May 12th). Instructions on how to hand in your assignment are on the Assignment 4 question sheet.

In your solution, you should include:

- the names of the people you discussed this with in your tutorial group;
- a clear statement of your solution to the puzzle;
- a clear explanation (in one or two paragraphs) or how you arrived at this solution; and,
- a statement of any assumptions you had to make in obtaining your answer.