Assignment 3

Fractals

Write a report on the tasks given below. Up to 25 points may be awarded for proper formatting.

Task 1 (15 points)

1. Design your own fractal, different from the ones described in the videos and quizzes. Compute the fractal dimension of your fractal.

2. *Study question:*

What are the optimal parameter settings for box counting, including initial box length and increment, to obtain the most accurate approximation of the Hausdorff dimension for the Koch curve and Cantor Set fractals? Additionally, how does increasing the iteration levels of the fractals affect the accuracy of the Hausdorff dimension approximation? Finally, which settings yield the closest approximation to the published fractal dimension of the coastline of Great Britain using box counting applied to the coastline image?

Short instructions:

1) Open *BoxCountingDimension.nlogo*.
   - Set initial box length to 5 and increment to 0.5.
   - Iterate the Koch curve to four levels.
   - Run box counting on this curve for about 15 iterations, and find the best-fit line for the points. Record the Box Counting Dimension you obtain.

   Repeat this procedure for initial box length 10 and initial box length 20. Which parameter setting gives the best approximation to the Hausdorff dimension?

2) Repeat (1), but this time iterate the Koch curve to six levels. Do you get a better or worse approximation to the Hausdorff dimension?
3) Repeat for the Cantor Set fractal.
4) Open *BoxCountingApplied.nlogo*. Open the *coastline.png* picture. Try a few settings of initial box length and increment, running box-counting for 15 iterations. Which of these settings gives the best approximation to the published value of the fractal dimension for the coastline of Great Britain (~1.26)?

Task 2 (25 points)

Consider a variation on the Koch curve. Start with a line segment of length L. The iteration rule is illustrated below, where each segment is replaced by five segments, each of length 1/3 the original segment

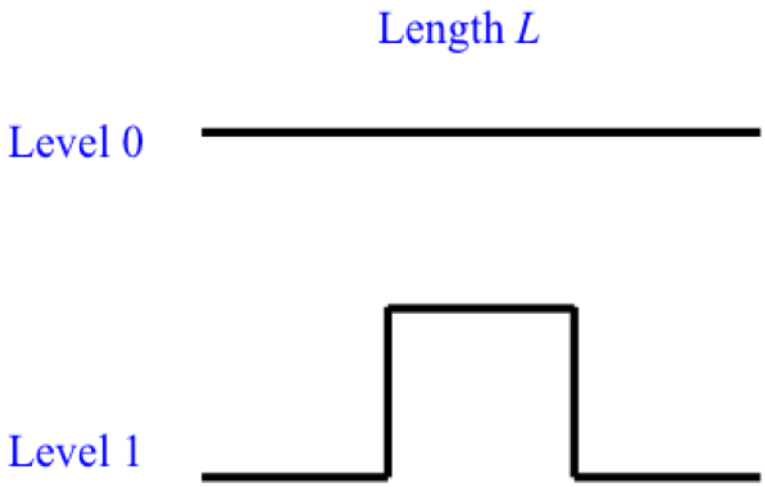

Figure 1. The principle of constructing the investigated fractal.

Study question:

How does the box-counting dimension of the variation on the Koch curve, where each segment is replaced by five segments of 1/3 the original length, compare with its Hausdorff dimension? Additionally, what modifications are necessary to implement this variation in the provided NetLogo code for box counting and how do the results differ from the original Koch curve?

Short insructions:

1) Open *KochCurve.nlogo*. Modify the code to iterate the fractal above.
2) Open *BoxCountingDimension.nlogo*. Modify the code to include this fractal, and compare the results from computing its box-counting dimension with its Hausdorff dimension.

Task 3 (35 points)

Implement a NetLogo model that allows users to generate, iterate, and draw a fractal that has not been implemented before (any fractal).

Here is a website about L-systems:
http://www.cs.unm.edu/~joel/PaperFoldingFractal/L-system-rules.html

Some links to websites about iterated function systems:
http://ecademy.agnesscott.edu/~lriddle/ifs/ifs.htm
http://www.stsci.edu/~lbradley/seminar/ifs.html