

# CS 346U: Exploring Complexity in Science and Technology

## Week 3 Assignment

Due Monday, October 21

**I. Watch videos** for Unit 3 on <http://complexityexplorer.org> (due Wednesday by class time)

### II. Reading:

- Textbook, Chapter 7 (due Wednesday by class time)

**III. Exercises** (Ungraded and not turned in):

- All quizzes in Unit 3. Do these **before** you do the Unit 3 test.
- The Exercise in Unit 3.5

**IV. Unit 3 test** (complete and submit online). Do Unit 3 quizzes first!

### V. Assignments to turn in

1. Design your own fractal (on paper), different from the ones described in the videos and quizzes. Give the initial (level 0) figure, and the rule for iterating the fractal. Draw what your fractal at each of levels 0 – 4. If possible, give the fractal dimension of your fractal.

2. Download BoxCountingDimension.nlogo from the Course Materials page.

- 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 (using the button on the right-hand side). Record the Box Counting Dimension you obtain.

Repeat this procedure for initial box length 10 and initial box length 20. (Remember to reset and iterate the Koch curve before running box-counting.) Write a few sentences giving your results and comparing them to the Hausdorff dimension for the Koch curve. Which parameter setting gives the best approximation? Give a hypothesis about why this is true.

3. Repeat Assignment 2, but this time iterate the Koch curve to six levels. Give your results, and a hypothesis for any differences you see between these results and those of Assignment 2.

4. Repeat Assignment 2, but for the Cantor Set fractal. Describe and give a hypothesis about your results.

5. Download [BoxCountingApplied.zip](#). Unzip the file, and open BoxCountingApplied.nlogo.

- Open the “coastline” picture. Try a few settings of initial box length and increment, running box-counting for 15 iterations. Describe in a sentence or two which of these settings gives the best approximation to the published value of the fractal dimension for the coastline of Great Britain (~1.25).
- Find a line-drawing picture of another coastline, and run box counting on it with the best settings you found for the British coastline. Say in a few sentences the box-counting dimension you measure, and how it compares to the one you measured for the Great Britain picture. Do your measurements match your intuitive sense of which coastline has greater fractal dimension?

6. Download KochCurve.nlogo from the Course Materials page. Modify the code to produce the fractal described in Quiz 2 of Unit 3.5. (We will work together on this in class.)

**What to turn in:** Complete and submit the Unit 3 test online. Email a pdf document with your typed answers to Assignments 1-5, along with your NetLogo model from Assignment 6, to [mm@cs.pdx.edu](mailto:mm@cs.pdx.edu).