Introduction to Complexity (Fall 2016)

Instructions 1

You may use any course materials, websites, Netlogo models, calculators, etc. for this test. Just don't ask another person for the an share your answers with other people.

Question 2

Suppose that level 0 of the Koch curve starts with a line segment of **length 10 centim**eters. What is the length of the curve at level 4 centimeters)?

- A. 10^4
- B. $10 \times (4 / 3)$
- C. $10^4 \times (4 / 3)$
- D. $10 \times (4 / 3)^4$
- E. $(4 / 3)^{10}$

Question 3

Suppose that level 0 of the Cantor set starts with a line segment of **length 10 centimeters.** What is the length of the figure at level 8 (centimeters)?

- A. $10 \times (3 / 2)^8$
- B. $(3 / 2)^{10}$
- C. $(2 / 3) \times 10^8$
- D. $(2 / 3)^{10} \times 8$
- E. $(2 / 3)^8 \times 10$

Question 4

Consider the fractal defined in the picture below. At each level, the square is replaced by four squares, each of which has side equal length of the side at the previous level. What is the fractal (Hausdorff) dimension of this fractal?

- A. log 3 / log 4
- B. log (3/4)
- C. log 4 / log 3
- D. log $(4 / 3)^3$
- E. log 3^2 / log 4^2

Question 5

The Sierpinski "carpet" fractal is defined as follows:

Start with a black square, with side length L. At each succeeding level, replace each black square with 8 black squares, arrayed as s each with side length 1/3 of the side length at the previous level.

How many black squares are there at level 10?

- A. 8^{10}
- B. 80
- C. 128
- D. 800
- E. None of the above

Question 6

What is the fractal (Hausdorff) dimension of the Sierpinski carpet fractal from Question 4 ?

- A. log 4 / log 3
- B. log 9 / log 3
- C. log 8 / log 3
- D. log 64 / log 8
- E. log 64 / log 3

Question 7

Which of the following variants of the Koch curve has higher fractal (Hausdorff) dimension than the original Koch curve?

- A. A version where each line segment at level T is replaced by four line segments, each 1/4 the size of the line segment at level T.
- B. A version where each line segment at level T is replaced by four line segments, each 1/5 the size of the line segment at level T.
- C. A version where each line segment at level T is replaced by five line segments, each 1/3 the size of the line segment at level T.
- D. A version where each line segment at level T is replaced by 3 line segments, each 1/3 the size of the line segment at level T, with no space between them.

Question 8

Suppose you are calculating the box-counting dimension of a given figure. You find that the boxes obey the following relationship:

$$\log [\textit{number of boxes}] = 1.78 \log [\ 1 \ / \ \textit{box-size}].$$

What is the box-counting dimension of this fractal?

- A. log 1.78
- B. 1.78
- C. 1.78 × log [number of boxes] / log [1 / box-size]
- D. 1 / log (1.78)

Question 9

Who invented the term “fractal”?

- A. Helge von Koch
- B. Benoit Mandelbrot
- C. Waclaw Sierpinski
- D. Georg Cantor
- E. Al Gore