Instructions 1

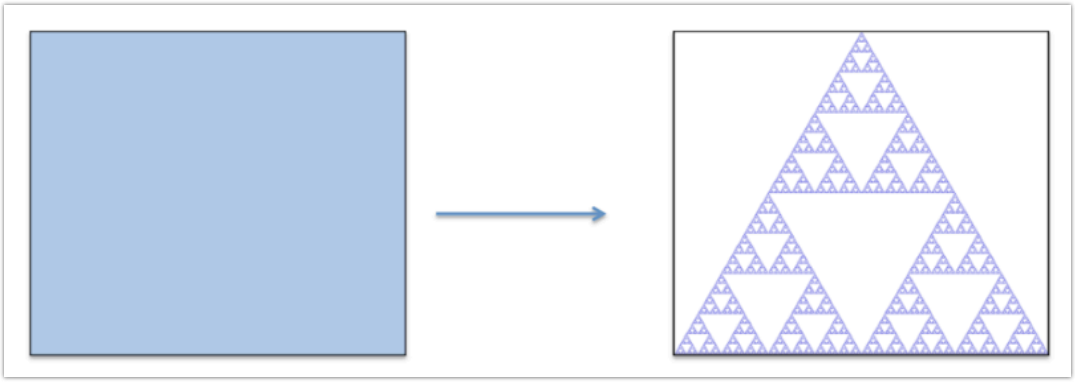
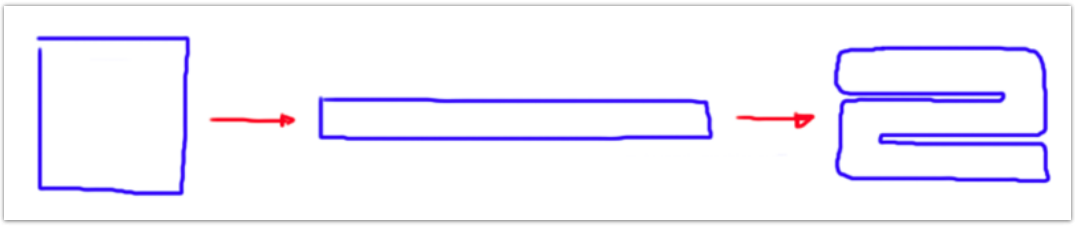
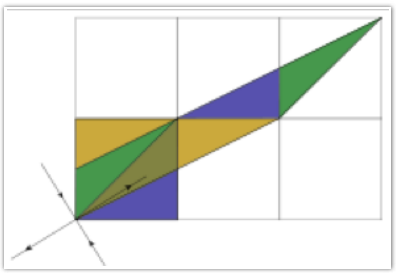
You may use any course materials, websites, books, computer programs, calculators, etc. for this test. Just don't ask another perso answers or share your answers with other people. Be aware that simply typing the question text into google is unlikely to get you dir right answer; you're going to have to read what you find there in order to extract that answer, and the course videos are probably a fa do that.

"Experts" notes clarify situations that haven't been covered in this course, but that may introduce subtleties into the exam answers. about them unless you understand the terms and issues in those notes.

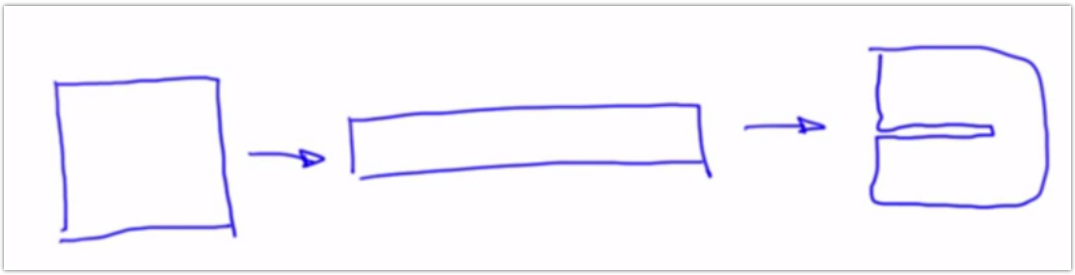
If you have questions about this test, please email us at nonlinear@complexityexplorer.org rather than posting on the forum.

Question 2

Which of these is the Smale's horseshoe map? (Experts: please select the original horeshoe map and *not* any variation of it.)

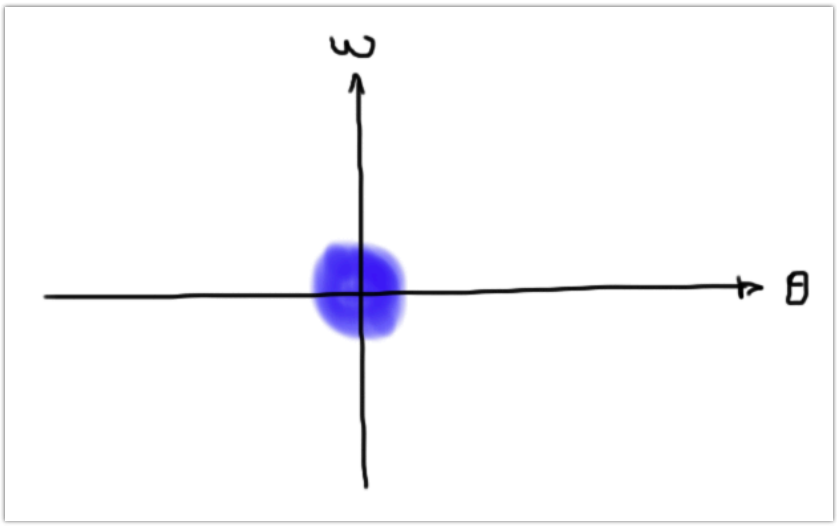
- 
- 
- 

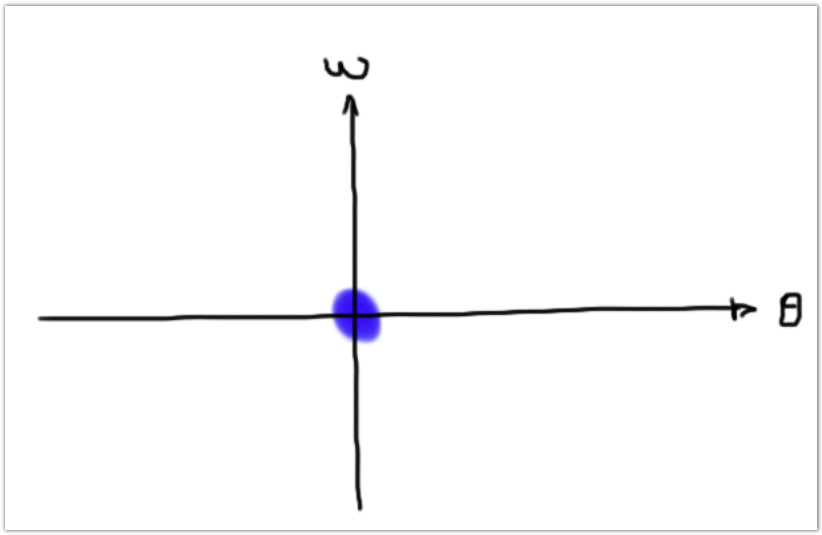
Note: the image above shows the unit square at the bottom left, then the deformed version stretched up and to the right. That deformed region then gets ma down onto the unit square in a manner depicted by the color coding (i.e., the green region maps to the green region and so on).

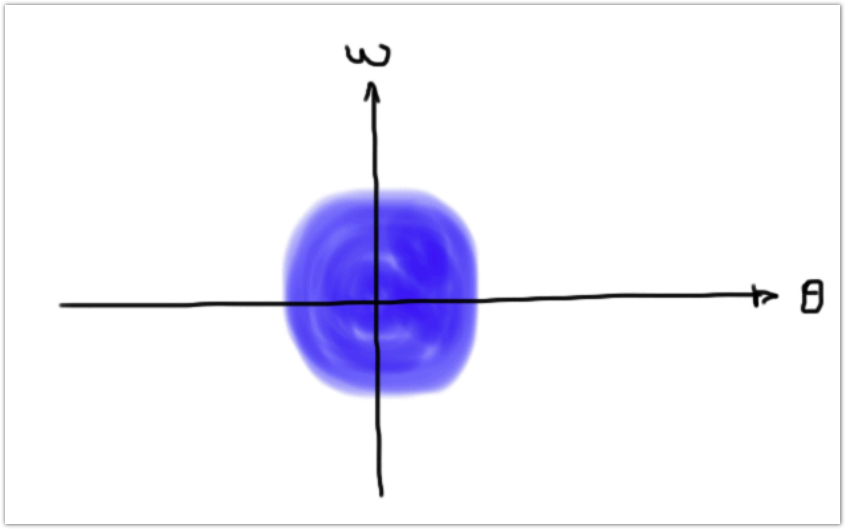
- 

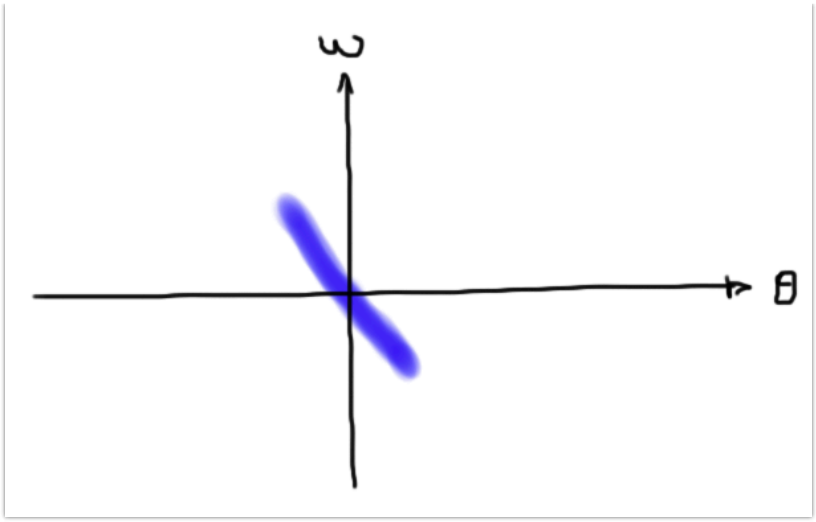
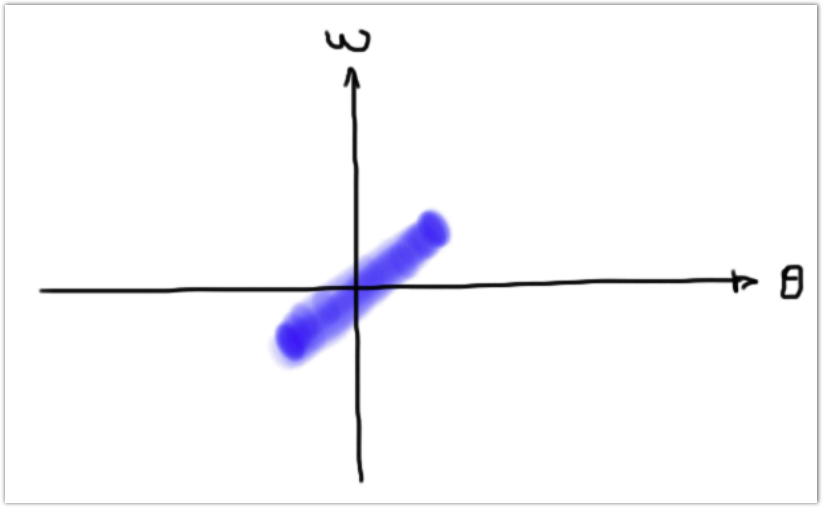
Question 3

Which of the pictures below shows the shape of the blue ball of initial conditions evolved forward in time under the influence of the c
pendulum dynamics?

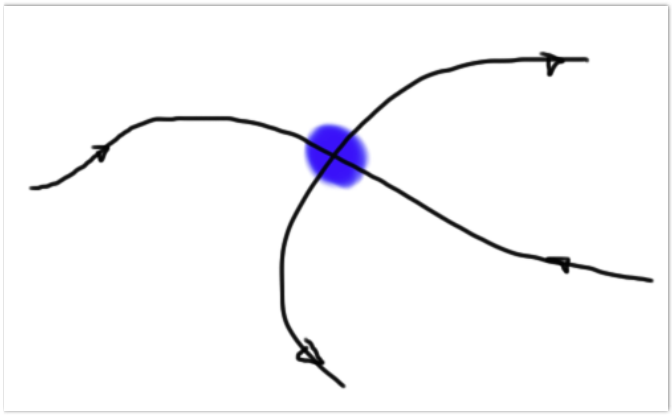




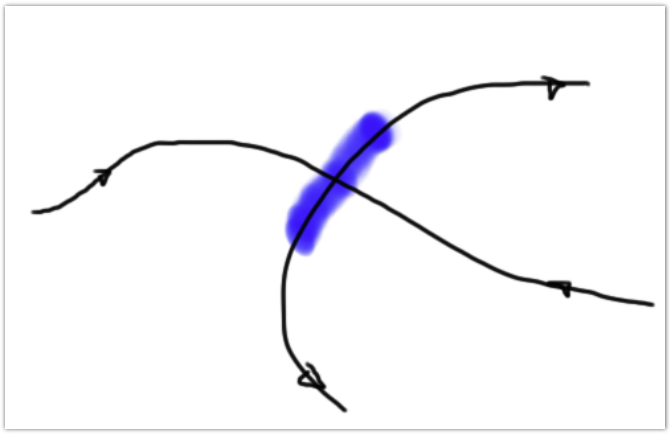
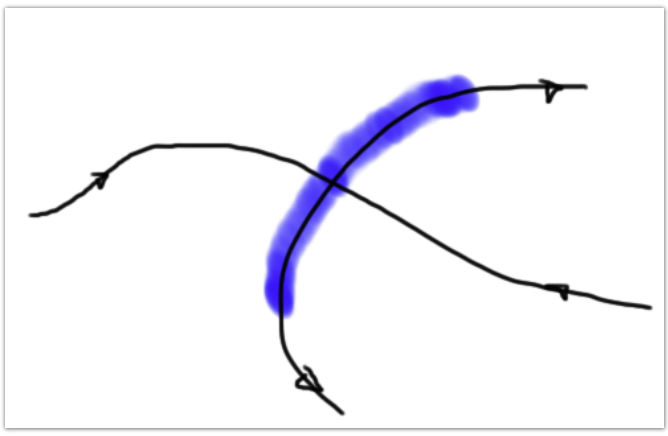
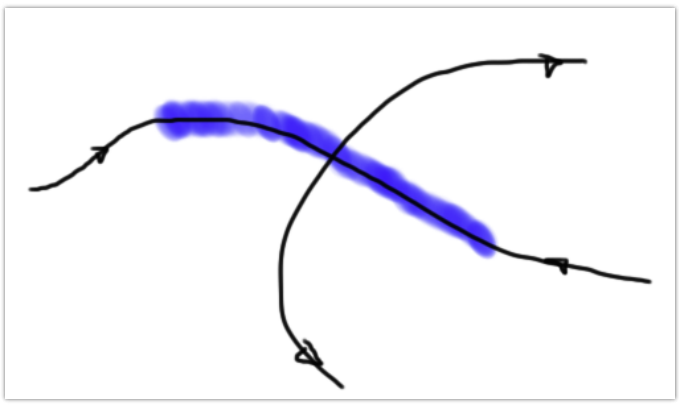


- 
3
θ
- 
3
θ

Question 4



If the positive λ is much bigger than the negative λ, which of the pictures below accurately reflects where the blue ball of initial cond go under the influence of the dynamics?

- 
- 
- 

Question 5

The action of a dissipative dynamical system contracts the state space *everywhere*.

In this question, and the ones that follow, please use the specific restricted definition of dissipation that was given in the course videc

- True
- False

Question 6

The action of a nondissipative dynamical system preserves the state space volume everywhere.

- True
- False

Question 7

Each stable and unstable manifold in a dynamical system has (Experts: at least) one associated Lyapunov exponent.

- True
- False

Question 8

Each unstable manifold in a dynamical system has (Experts: at least) one associated Lyapunov exponent whose value is negative.

- True
- False

Question 9

In a dissipative system, the sum of the Lyapunov exponents must be negative.

- True
- False

Question 10

In a dissipative system, there must be at least one negative Lyapunov exponent.

- True
- False

Question 11

In a dissipative system, there cannot be *any* positive Lyapunov exponents.

- True
- False

Question 12

A system with a chaotic attractor has at least one positive λ and at least one negative λ.

- True
- False

Question 13

Why are projections and sections useful?

- A. Because they reduce dimension.
- B. Because they make it easier to see the period of a periodic orbit.
- C. Because they make it easier to see bifurcations.
- D. All of A-C above.
- E. None of A-C above.
- F. Only some of A-C above.

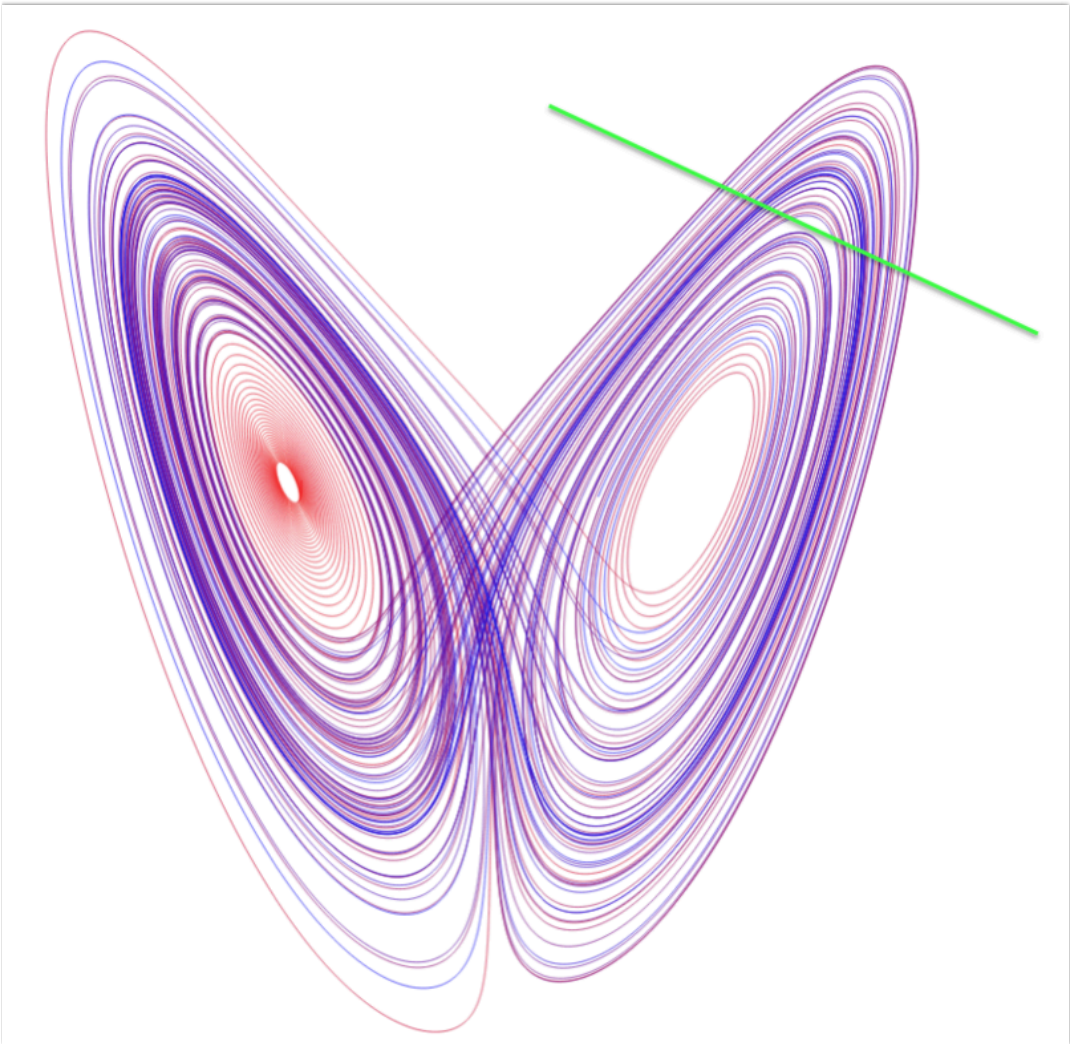
Question 14

Constructing temporal sections — e.g., with a strobe light — discretizes time, converting a flow into a map.

- True
- False

Question 15

If we section the Lorenz attractor (seen in the figure) across the green line, what will we see?



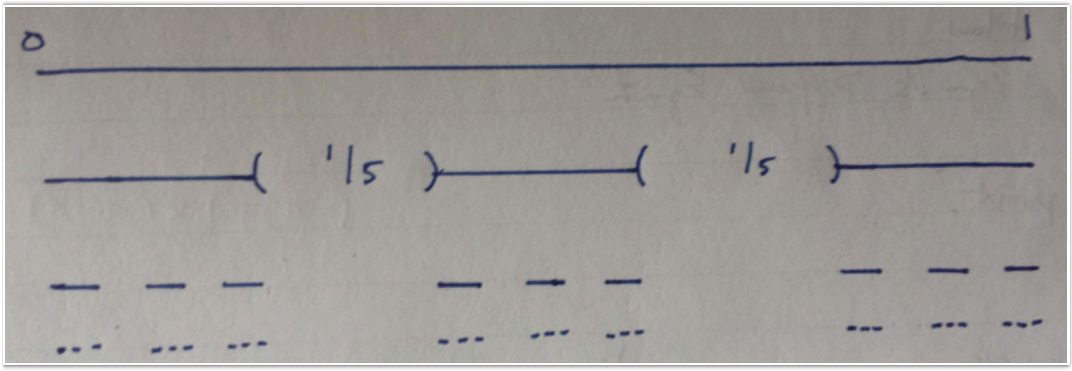
- A straight line (if the trajectory is infinitely long).
- A copy of the Logistic bifurcation diagram.
- A Cantor set.
- A copy of the Lorenz attractor.

Question 16

What is the capacity dimension of the unit line segment?

- 0.63
- 0
- 1
- 0.876

Question 17



What is the capacity dimension of this cantor set (which we will call $C_{2/5}$)?

- 0.6309
- 0.8614
- 0.6826
- 0.4572

Question 18

Let $C_{2/5}$ to be the Cantor set defined in Question 16, and define $C_{1/5}$ and $C_{1/3}$ to be the middle-fifth- and middle-third-removed Cant respectively. Finally define "$\leftarrow$" to be the "less than" operator on how much space an object fills as approximated by capacity dimens a point $\leftarrow$ a line, by this definition). Which of the following string of inequalities is true?

- $C_{2/5} < C_{1/3} < C_{1/5}$
- $C_{1/3} < C_{2/5} < C_{1/5}$
- $C_{1/5} < C_{1/3} < C_{2/5}$
- $C_{1/5} < C_{2/5} < C_{1/3}$