Nonlinear Dynamics: Mathematical and Computational Approaches (Spring 2023)

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.

Note: the placement of the radio buttons for questions 2-4 in the downloadable pdf file for this unit test is different than their placem web version. In the former, the buttons are to the bottom left of the images from which you are to choose; in the latter, they're to the Since the pdf version is generated automatically by the website software, there's no way for me to fix this. So please be careful!

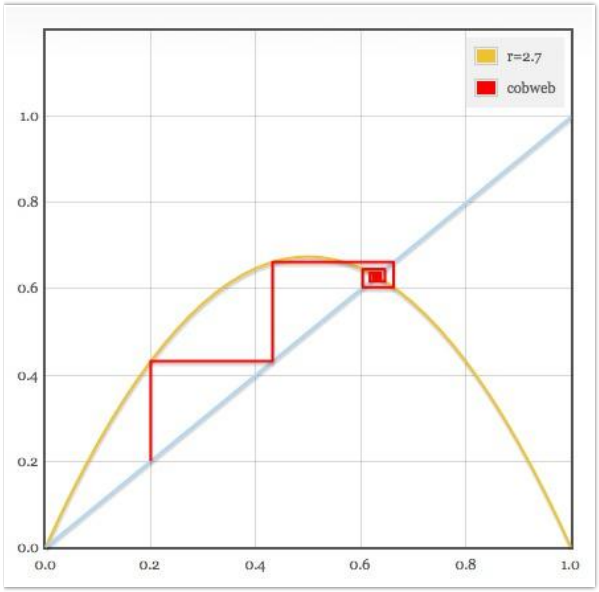
Question 2

In what range does the period-two window of the logistic map exist?

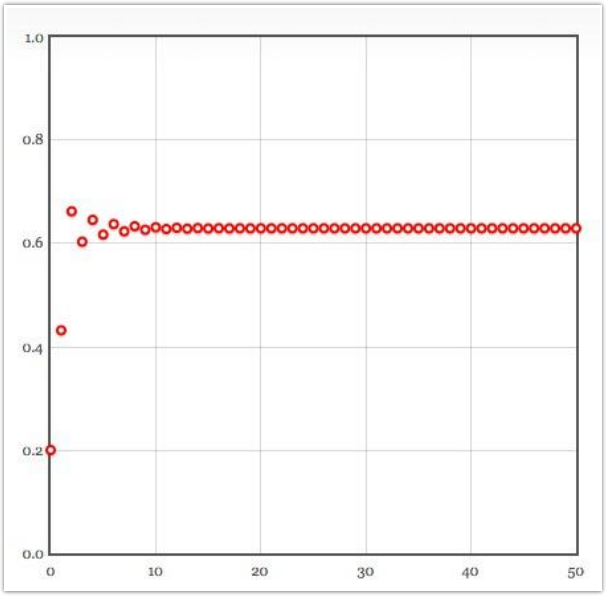
- $3 \leq r \leq 3.44$
- $0 < x_0 < 1$
- $2.9 < r < 3.5$

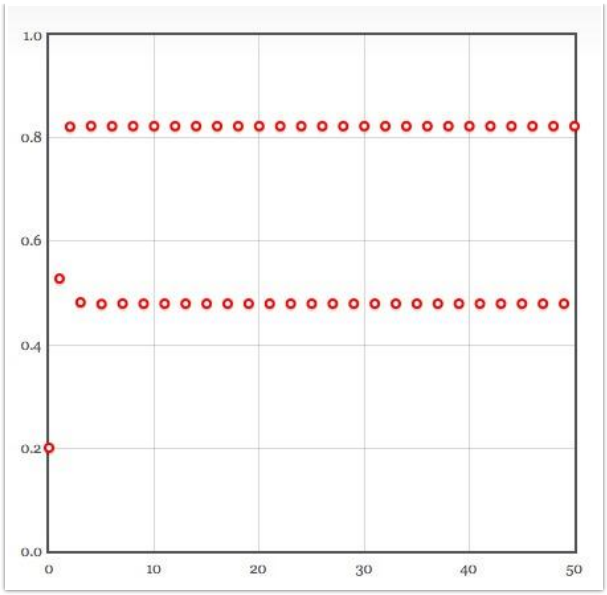
Question 3

Consider this return map:



Which of the time-domain plots below matches that behavior?

- 

- 
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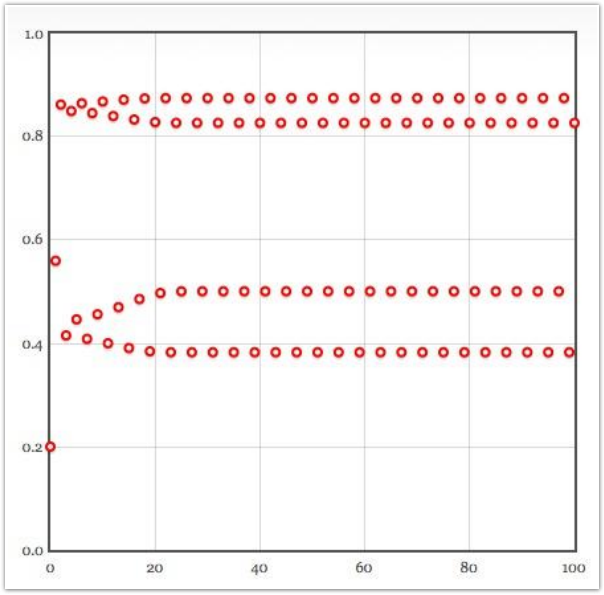
- 
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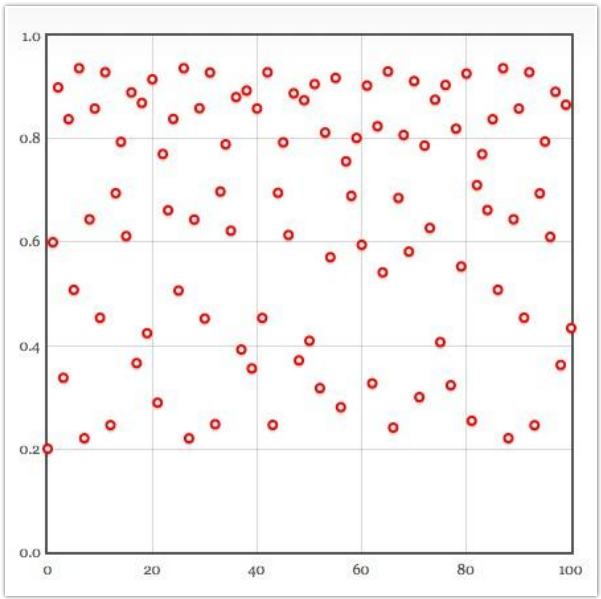
- 
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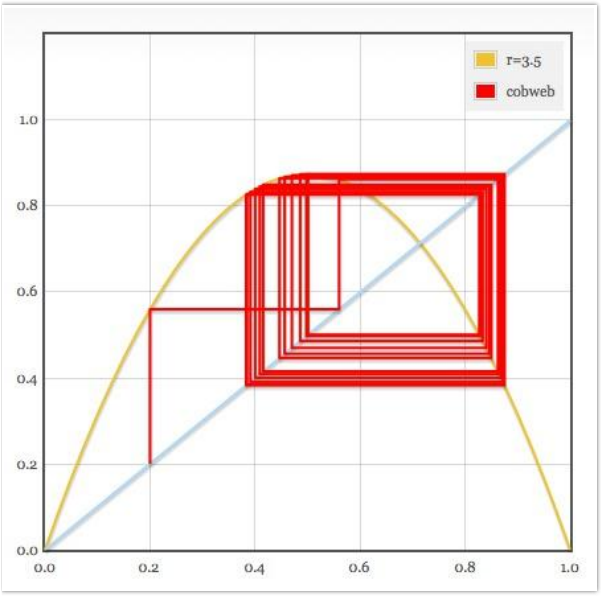
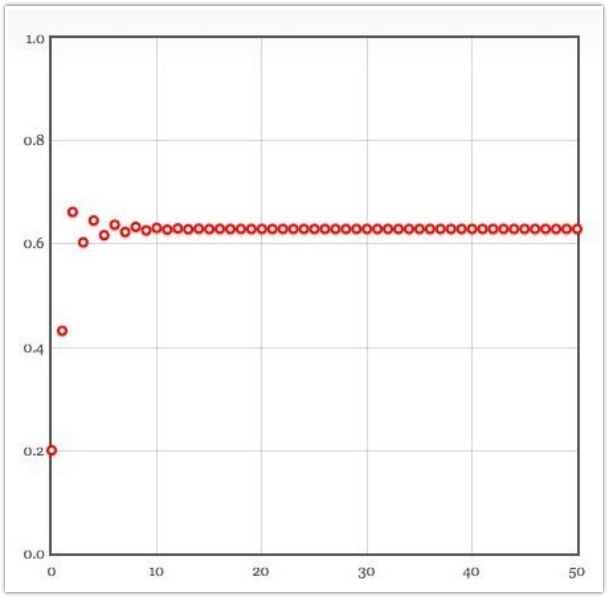
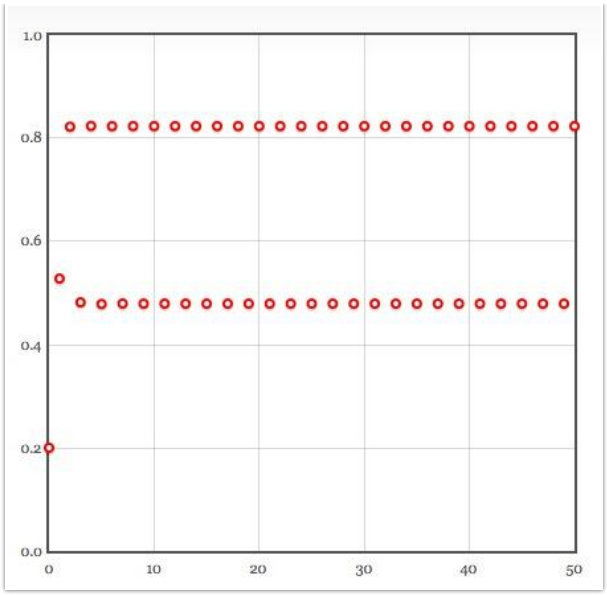
Question 4

Consider this return map:



Which of the time-domain plots below matches that behavior?



- 
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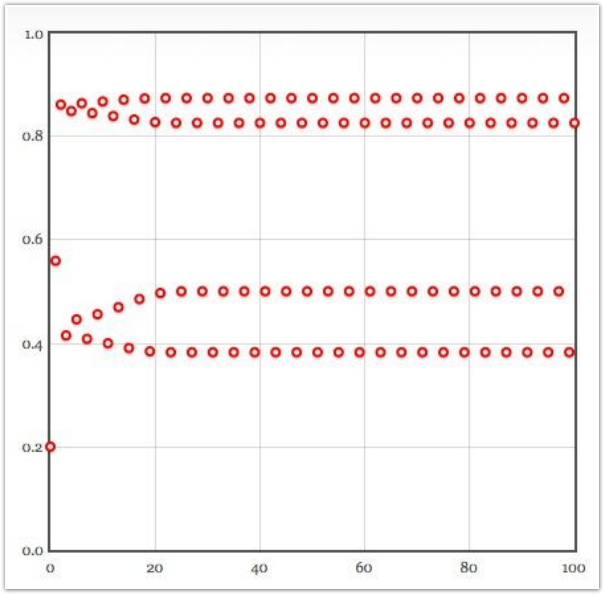
- 
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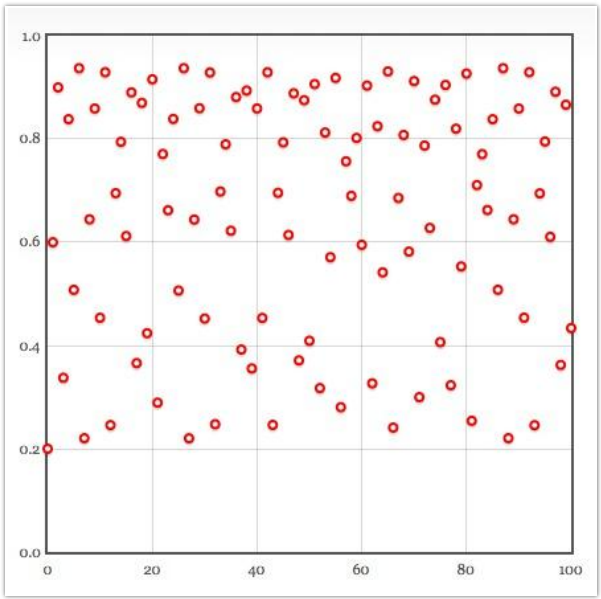
- 
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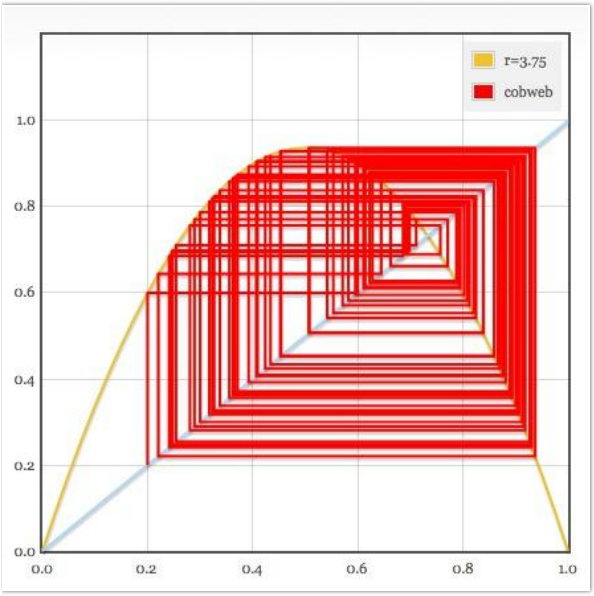
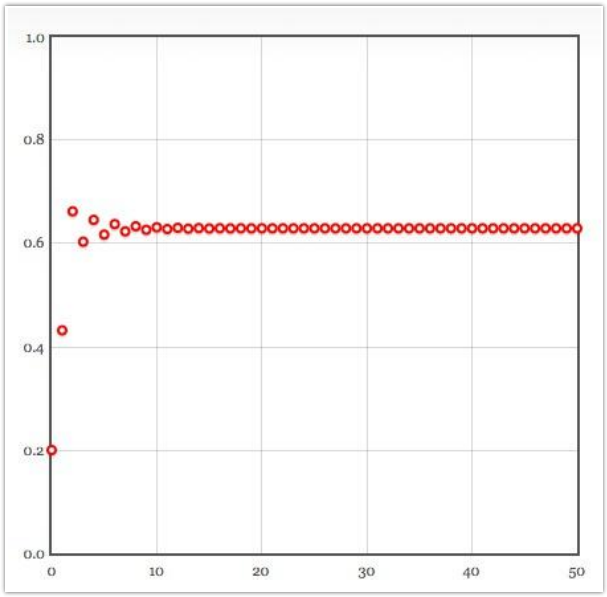
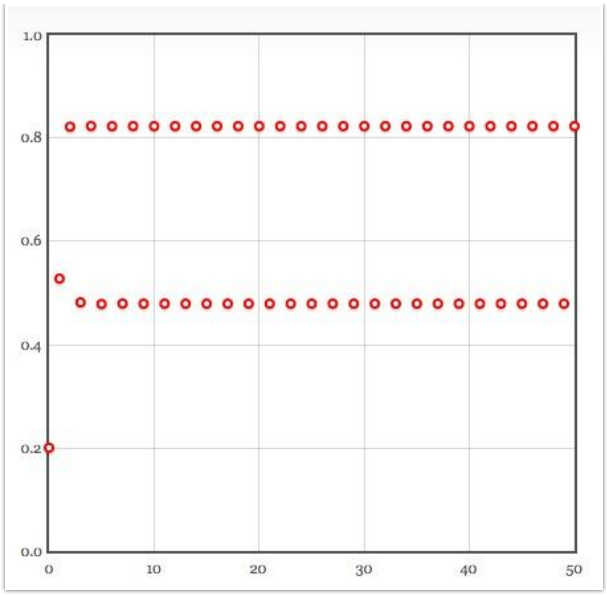
Question 5

Consider this return map:



Which of the time-domain plots below matches that behavior?



- 
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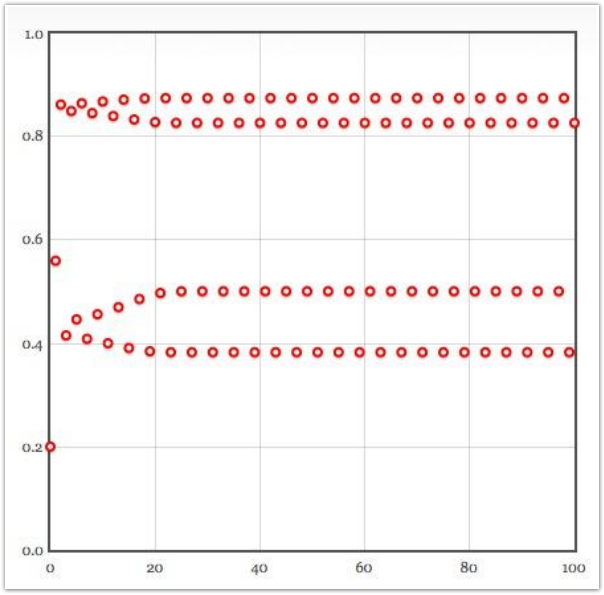
- 
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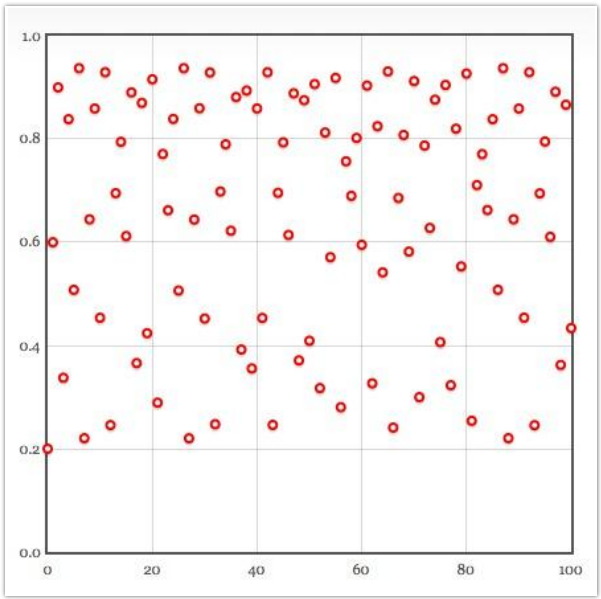
- 
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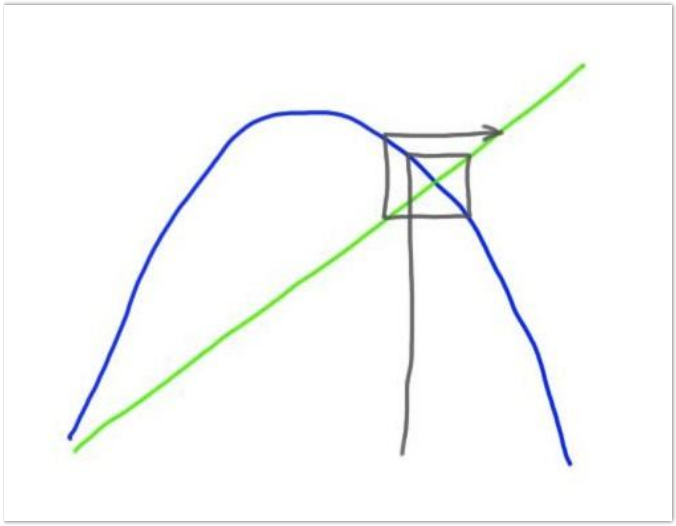
Question 6

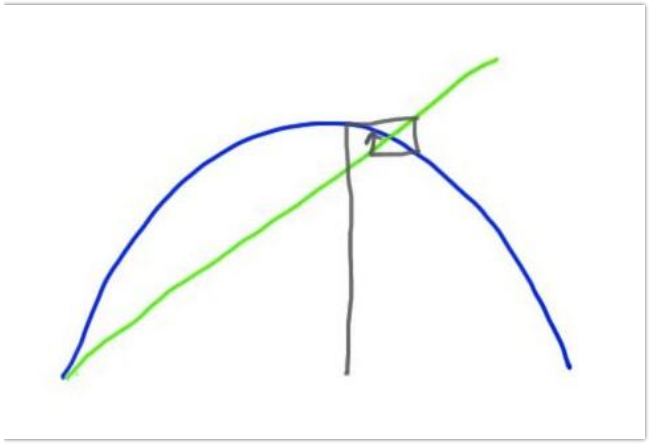
Does this cobweb plot depict a stable fixed point?



- Yes
- No

Question 7

Does this cobweb plot depict a stable fixed point?



- Yes
- No

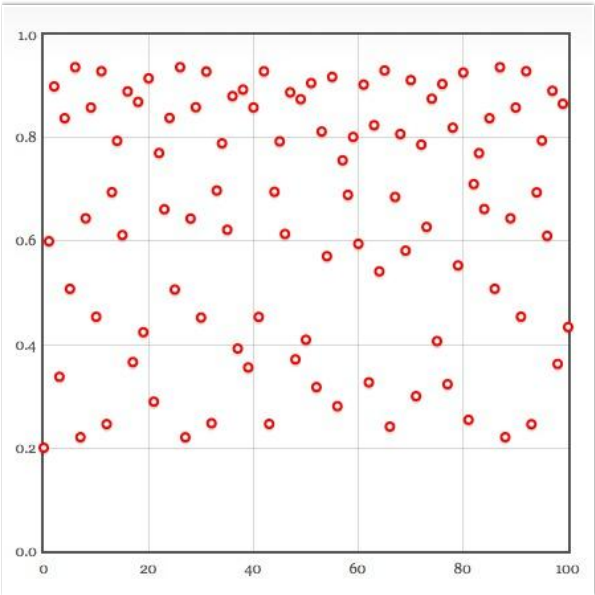
Question 8

What geometric feature(s) of the cobweb diagram dictate(s) whether or not a fixed point is stable?

- The slope of the $x_{n+1} = x_n$ line
- The value of x_0
- The height of the apex of the parabola that corresponds to the logistic map: $rx_n(1 - x_n)$
- The slope of the parabola at its intersection with the $x_{n+1} = x_n$ line.

Question 9

The trajectory in this plot is ...



- converging to a fixed point
- diverging
- probably chaotic

Question 10

If you increase R in the logistic map slowly and smoothly beginning at 2.8, what dynamically interesting event happens? (Here I'm ta the first such thing that happens as you turn up that value.)

- The orbit diverges to infinity
- A bifurcation to chaos
- A bifurcation to a two-cycle

Question 11

The bifurcation diagram of the logistic map is fractal.

- True
- False

Question 12

The bifurcation diagram of the logistic map is self-similar.

- True
- False

Question 13

The Feigenbaum number holds for all maps.

- True
- False

Question 14

The Feigenbaum number holds for all flows.

- True
- False

Question 15

If you ran your bifurcation diagram code from problem 1 of homework 2.2 for $2 < r < 3.9$ with $x_0 = 0.2$, an Δr of 0.1, while discarding at each step and plotting the next 200, would you get good results?

- Yes
- No; you haven't discarded enough transient points to make the plot look good
- No; you haven't plotted enough points at each step to bring out the structure.
- No; that's not a good initial condition.

Question 16

Run your bifurcation diagram code from problem 1 of homework 2.2 to zoom in on the range $3.84 \leq r \leq 3.8571$ and $0.4 \leq x \leq 0.6$

Compare the structure that you see in this region to that in the overall plot.

- They are similar.
- They are absolutely identical.
- There is no resemblance.

Question 17

What word goes in the ... in this statement? "... chaotic systems have fractal structure"

- Some
- All
- No