

Lecture 12: Quiz

Name:

Problem 1

The map $T(x) = 2x^2 - 1$ defines a chaotic dynamical system. For $x = 0$ for example, we get $T(x) = 2 \cdot 0^2 - 1 = -1$. The next number is $T(T(x)) = 1$. We get a sequence of numbers which are called an **orbit**. From the following 4 choices, two are an orbit. Which ones?

- a) 1, 2, 3, 4, ...
 b) 1, 1, 1, 1, 1, ...
 c) 2, 7, 97, ...
 d) 0, 0, 1, -1.

Problem 2

We have seen in lecture that if we iterate $T(x) = 4x(1 - x)$ or $S(x) = 4x - 4x^2$ and start with $x = 0.4$, then we we get different visible results after

- a) about 10 iterations
 b) about 100 iterations but not 10 iterations
 c) about 1000 iterations but not 100 iterations
 d) about 10000 iterations but not 1000 iterations

Problem 3

What is the Ulam-Collatz system?

- a) A differential equation showing chaotic behavior.
 b) Produce the pedal triangle from a given triangle.
 c) Take the sum of the denominators from a given triangle.
 d) Divide by 2 if even and triple plus 1 if odd.

Problem 4

Which of the following dynamical systems is called the **Lorentz system** which produces the Lorentz attractor?

- a) $\ddot{x} + x + (x^2 - 1)y = 0$.
 b) $\dot{x} = 10(y - x), \dot{y} = -xz + 28x - y, \dot{z} = xy - \frac{8z}{3}$.
 c) $x'(t) = x(t)$.
 d) $x''(t) = -x(t)$.

Problem 5

Which of the following dynamical systems have a discrete time?

- a) The game of life
 b) Three body system
 c) The Kepler problem
 d) Ulam-Collatz system.

Problem 6

What is an example of a billiard dynamical system?

- a) The pedal map in triangles
 b) The game of life
 c) The Stadium
 d) The Collatz system.

Problem 7

Which dynamical system is used to find the roots of a function:

- a) The Feigenbaum map
 b) The Ulam map
 c) The Newton method
 d) The Kepler system

Problem 8

Which mathematician was the first to establish that low dimensional systems can exhibit chaotic behavior?

- a) Kepler
 b) Newton
 c) Poincaré
 d) Mandelbrot

Problem 9

Which mathematicians pointed out the concept of a strange attractor?

- a) Poincaré-Bendixon
 b) Hardy-Littlewood
 c) Ruelle-Takens
 d) Douady-Hubbard

Problem 10

Which movie features the "butterfly effect" and "strange attractors"?

- a) Jurassic park (1993)
 b) Butterfly dreaming (2008)
 c) Silence of the lambs (2001)
 d) Amelie (2001)

