

Lecture 12: Quiz

Name:

Problem 1

We have first looked at a definition of dynamical system. What is the goal of the theory?

- a) Solve differential equations explicitly.
- b) Predict the future of a system.
- c) To understand complexity.
- d) To see "nature find its way" (Jurassic park)

Problem 2

The map $T(x) = x^2 - 1$ defines a dynamical system. For $x = 0$ for example, we get $T(x) = -1$. The next number is $T(T(x)) = 0$. We get a sequence of numbers which are called an **orbit** which is in this case $0, -1, 0, -1, 0, \dots$. One of the following sequences is an orbit of T . Which one?

- a) $-2, 3, 8, 63, \dots$
- b) $0, 1, 0, 1, 0, \dots$
- c) $2, 3, 9, 70, \dots$
- d) $1, 1, 1, 1, 1, \dots$

Problem 3

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 get different visible results after

- a) about 6 iterations
- b) about 60 iterations
- c) about 600 iterations
- d) about 6000 iterations

Problem 4

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 triangle number.
- d) Divide by 2 if even and triple plus 1 if odd.

Problem 5

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 6

What is an example of a billiard dynamical system?

a) The game of life

b) The Sitnikov system

c) The Bunimovich Stadium

d) The Collatz system.

Problem 7

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

a) The Ulam map

b) The Feigenbaum map

c) The Kepler system

d) The Newton method

Problem 8

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

a) Kepler

b) Newton

c) Poincaré

c) 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

In which movie was the concept of "strange attractors" discussed briefly?
(we have seen a short clip of that).

a) Amelie (2001)

b) Jurassic park (1993)

c) Butterfly dreaming (2008)

d) Silence of the lambs (2001)

