Introduction to Complexity (Fall, 2014)

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.

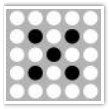
Question 2

Which one of these was an original inventor of the field of cellular automata?

- A. John Conway
- B. John Holland
- C. John von Neumann
- D. Stephen Wolfram

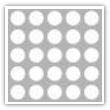
Question 3

Suppose the following is the initial pattern given to the Game of Life:

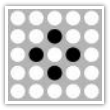


What does the lattice look like after one time step?

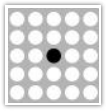
- A.



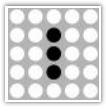
- B.



- C.

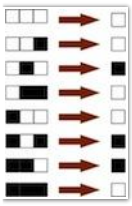


- D.



Question 4

Consider the following cellular automaton rule:



If the lattice at $t = 0$ is

What does the lattice look like at $t = 1$? Assume the lattice of 11 cells wraps around at the edges (i.e., is circular).

- A.

- B.

- C.

- D.

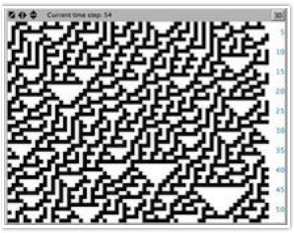
Question 5

What is the Wolfram number of the rule given in question 3?

- A. 110
- B. 100
- C. 50
- D. 38
- E. 19

Question 6

Consider the following behavior from an elementary cellular automaton:



Which Wolfram class does this rule appear to be in?

- A. Class 1
- B. Class 2
- C. Class 3

Question 7

What is the "lambda" value of elementary CA rule 100?

- A. 1/8
- B. 2/8
- C. 3/8
- D. 4/8
- E. 5/8

Question 8

Consider the elementary CA (i.e., 3-cell neighborhoods) that does "local majority voting" --- that is, the center cell updates to the col majority in its neighborhood. For example, a white cell with two black neighbors would update to black, since black is the majority c neighborhood. What is the Wofram number of this CA?

- A. 122
- B. 24
- C. 53
- D. 232

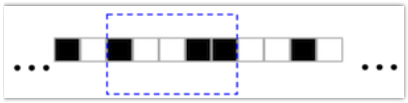
Question 9

Which of the following is a true statement?

- A. All two-dimensional cellular automata are universal computers.
- B. At least one elementary cellular automaton is a universal computer.
- C. All elementary cellular automata are universal computers.
- D. Von Neumann proved that the Game of Life is not a universal computer.
- E. Wolfram hypothesized that all class 2 CAs are universal computers.

Question 10

Consider one-dimensional cellular automata in which each cell is either black or white, and each cell's neighborhood consists of its two nearest neighbors on either side (i.e., the neighborhood size is 5):



How many possible cellular automaton rules of this type are there?

- A. 32
- B. 128
- C. 2^{128}
- D. 2^{32}
- E. 256^2

Question 11

One difference between elementary cellular automata and the logistic map is:

- A. The logistic map is deterministic and elementary CAs are not.
- B. The logistic map has fixed points, and elementary CAs do not.
- C. The logistic map has continuous state and elementary CAs have discrete states.
- D. Elementary CAs iterate in discrete time steps and the logistic map does not.