Report #1 - Cellular Automata

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1) Cellular automaton is:

a) reversible if a function has time-reversed behavior. That implies that for each current configuration there exists one past configuration and that reversible functions are bijective.

b) computationally complete if it reached set boundary conditions, a finite number of cells, initial configurations.

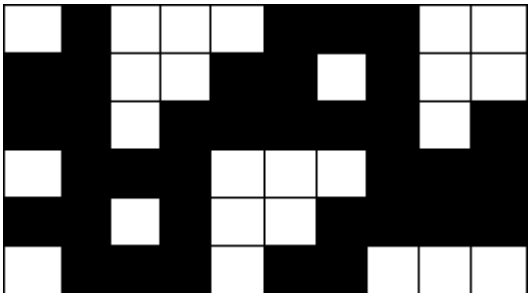
c) totalistic if the state of each of its cells is represented by a number. That cell value depends exceptionally on the sum of all cell values in its neighborhood at the certain time.

d) elementary if it would be one-dimensional, have two states, have only left and right neighborhood and 256 possibilities.

2) ID number: 150284

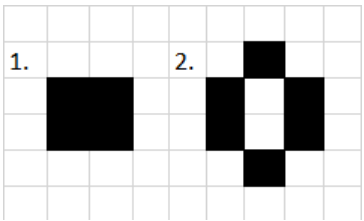
Binary representation of decimal 284 = 100011100

Iterations	0	1	0	0	0	1	1	1	0	0
1.	1	1	0	0	1	1	0	1	0	0
2.	1	1	0	1	1	1	1	1	0	1
3.	0	1	1	1	0	0	0	1	1	1
4.	1	1	0	1	0	0	1	1	1	1
5.	0	1	1	1	0	1	1	0	0	0



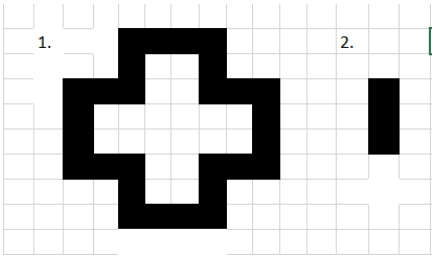
3) Structures in Game of Life:

Stable:



Periods: 1), 2) – stable, i.e. have no period

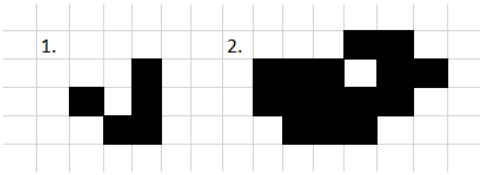
Oscillating in place:



Periods: 1) 3

2) 2

Oscillating with translation:



Periods: 1) 4

2) 4

4) Rules:

a) Class 1: Almost all initial configurations relax after some period to the same fixed configuration.

Class 2: Almost all initial configurations relax after some period to some periodic cycle of configurations OR to some fixed point.

Class 3: Almost all initial configurations relax after some period to chaotic behavior.

Class 4: Some initial configurations result in complex localized structures.

1. B3/S23:

b) Class 4 (It leads to some stable configurations and not growing long-living configurations as well)

2. B135/S135:

b) Class 3 (It has chaotic behavior starting with any pattern)

3. B36/S234:

b) Class 2 (It leads to complex always growing long-living structures)

4. B2/S:

b) Class 3 (It has chaotic behavior starting with any pattern)

5. B36/S125:

b) Class 4 (It leads to some stable configurations and not growing long-living configurations as well)

6. B13456/S01356:

b) Class 3 (It has chaotic behavior starting with any pattern)

7. B3/S234:

b) Class 2 (It leads to complex always growing long-living structures)

8. B018/S018:

b) Class 2 (It leads to complex always growing long-living structures)

9. B257/S27:

b) Class 1 (It leads to the same fixed configurations)

10. B34/S34:

b) Class 2 (It leads to complex always growing long-living structures)

c) Considering the data above, the superiority of frequency of Class 2 can be clearly seen. It accounts to 4 cases out of 10, whereas for Class 3 it is equal to 3, Class 1 – 1, Class 4 – 2. Therefore, Class 1 is the rarest one.

5) The reason why patterns emerging from simulations of cellular automata often resemble patterns that can be found in biology and nature is that such systems are able to perform complex computations with a high level of efficiency and reliability, as well as to model the behavior of complex systems in nature. For the same reasons it has been largely studied in the natural sciences, mathematics and computer science.