

Mathematica Problems on Recurrence Relations (RR) and Cellular Automata (CA)

1. Find a RR for the number of bit strings of length n , a_n , that contain two consecutive zeros. More zeros are allowed. Somewhere in the string there must be a 00 sequence. What is the initial condition? Solve the problem on the computer. How many such strings of length 30 are there? Plot with command Plot the first 10 values of a_n . Hint: split the total number of strings of length n into strings with and without 00. **OP**

2. Plot a stable 4-periodic orbit in the logistic map. Give the four x values for the orbit. Try to find the a value for which it goes through a period doubling and loose stability.

3. Consider rule 30 and start with one black cell in the middle. Your string can be 1000 cells long. Run it for 500 iterations. Plot the value in the middle cell, $b(n)$, where n is generation n . $b(0) = 1$ since you start with one black cell. Black is equal to 1 and white is 0 in the list. Does it look random? Equally many black and white cells?

4. Investigate the rule B25/S4. B denotes birth and S survival. Game of Life is B3/S23. What is the rule number for B25/S4? Try random seeds and seeds that are Still Life, Oscillators and Gliders in Game of Life (see Wikipedia article about Game of Life). **OP**