

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

1. Find a RR for the number regions,  $a_n$ , that are created when  $n$  lines are drawn in the plane. The lines are not parallel and no three lines cross each other. What are the initial conditions for this RR? Note that also infinite regions are counted. How many such regions are there for 100 lines? Maybe you can solve the RR by hand but do it also with RSolve and plot with command Plot the first 10 values of  $a_n$ .

2. Plot a stable 5-periodic orbit in the logistic map. Give the five  $x$  values for the orbit. Try to find the  $a$  value for which it goes through a period doubling and loose stability.

3. Run the totalistic rule 1815 1500 times starting with one grey (1) cell and also with a random initial state. Your string can be 800 cells. Use 3 colors (0-white, 1-black, 2-black) and consider only the region with the nearest neighbors. You have to modify the program a little bit. Read about CellularAutomaton, see details. Totalistic means the rule only depends on the sum of the cells, even the one in the middle. Since there are three colors you have to work in base 3. Write 1815 in base 3, use BaseForm, and try to figure out how the rule works. To do this run the CA just a few iterations so you can clearly see the individual cells. Has the CA starting with one grey cell a period? **OP**

4. Find an infinite pattern (initial state) such that after one iteration of Game of Life the whole plane (all cells) are black. What happens after one more iteration? Run this configuration 1 time. Of course you have to make a cut off but use PlotRange to only show the interesting parts.