Mathematics — Discrete Mathematics
1ma162
Linneaus University — spring 2018

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

1. Find a RR for the number of *derangements*, D_n, of n numbers. A derangement is a permutation of 1,2,3,...,n where no element is at its original place. So $D_2 = 1$ since 2,1 is the only derangement of 1,2. Hint: One way to find the RR is to use the inclusion-exclusion principle for some small n. see also internet for good explanations. Solve it with RSolve and plot the first few D_n. Since Mathematica wants to be exact real initial values is a good idea.**OP**

2. Try to find a stable 3-cycle in the map with $g(x) = a \sin \pi x, 0 \leq x \leq 1, 0 < a \leq 1$. Note: you have to change the function in the program. The program will protest somewhat when you use the command Solve but you can trust the output.

3. Run rule 90 and the seed is ■ inserted in middle of a background of ■■□ blocks. Iterate 500 times and your seed can be 1000 cells long. That means 333 blocks + 1 for the black cell. What is happening? Start with a smalle string and fewer iterations. Useful commands here for construction of the seed area: ConstantArray, Flatten, Insert. Or if you use a For-loop, use AppendTo command, but ConstantArray is better.

4. Run the R-pentomino (see next page) in Game of Life. Run the Movie! Read about it on internet. Interesting generations are 69 and 1103. Present an illustrative plot. What happens after 1103 iterations?

Out[187]=

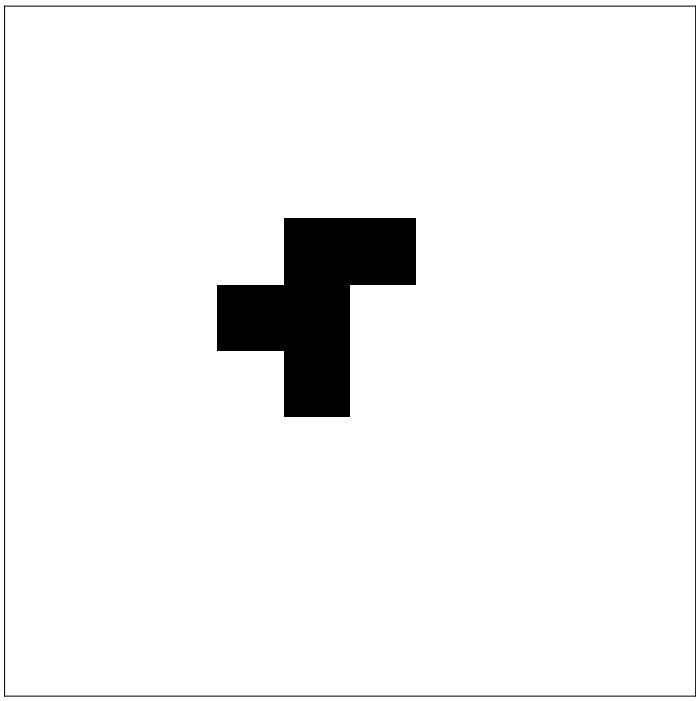

Figure 1: Your initial state to Game of Life.