Mathematics — Discrete Mathematics
1ma462
Linneaus University — spring 2018

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

1. A particle moves horizontally to the right. For $n \in \mathbf{Z}^+$, the distance the particle travels in the $(n+1)$st second is equal to twice the distance it travels during the nth second. If $x_n, n \geq 0$, denotes the position of the particle at the start of the $(n+1)$st second, find a recurrence relation for x_n, where $x_0 = 1$ and $x_1 = 5$. Solve it.

2. Plot the value of the derivative of $g(x) = ax(1-x)$ at the two fix points for $0 < a < 4$. Formulate a criteria for the stability of a fix point.

3. Consider rule 170. Run it for the seed ...WWWWBWBWBWWWW..... 3 times. This is an example of a reversible CA, that is, each state has a unique predecessor. Try to understand that!

4. Iterate Game of Life 3 times with the initial state below. What do you observe? Outer square is 8 times 8 and inner square is 4 times 4.

Out[419]=

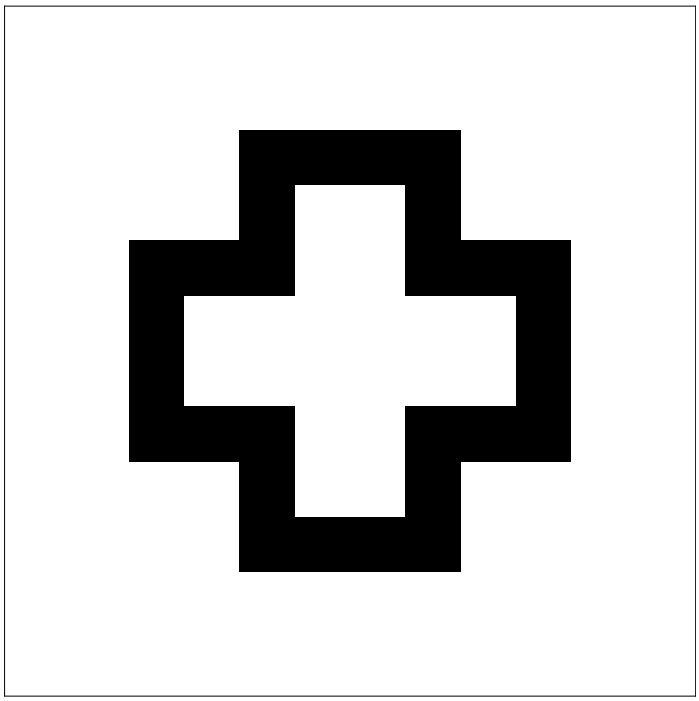

Figure 1: Your initial state to Game of Life.