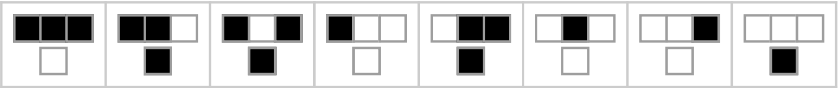
What is...a cellular automaton?

Or: From simple rules to life

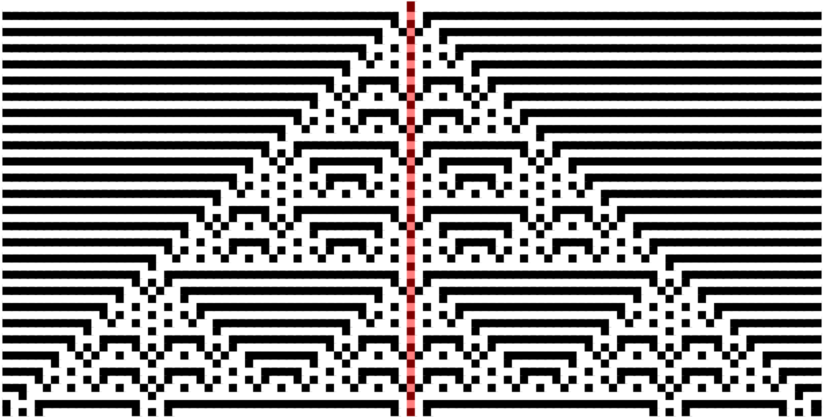
An easy rule creates a regular pattern

rules:



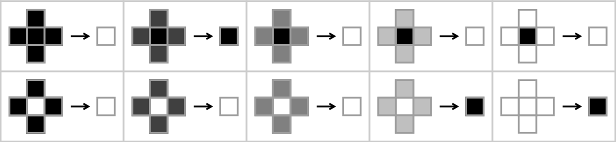
seed: $\{..., 0, 0, 1, 0, 0, ...\}$

output:



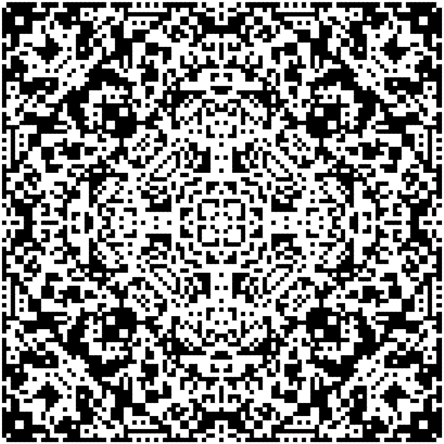
An easy rule creates complex patterns

rules:

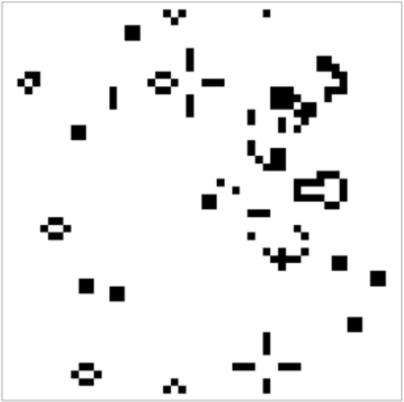


seed: $\{\{0,2,0\},\{2,1,2\},\{0,2,0\}\}$

output:



Conway's game of life



(a) Any live cell with fewer than two live neighbors dies, as if by underpopulation.

(b) Any live cell with two or three live neighbors lives on to the next generation.

(c) Any live cell with more than three live neighbors dies, as if by overpopulation.

(d) Any dead cell with exactly three live neighbors becomes a live cell, as if by reproduction.

For completeness: The formal statement

There are 88 non-equivalent elementary cellular automata Rules

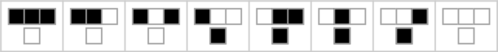
	111	110	101	100	011	010	001	000
110	0	1	1	0	1	1	1	0
black↔white	1	0	0	1	0	0	0	1
left↔right	0	1	1	1	1	1	0	0

Types

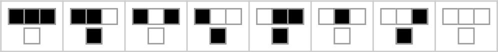
- Convergence to a uniform state Example 223
- Convergence to a repetitive state Example 95
- Remain in a random state Example 150
- Mixtures Example 110

Applications everywhere

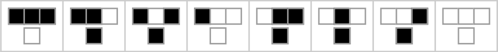
- Rule 30 serves/served as a random number generator



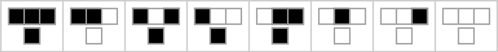
- Rule 90 is used in number theory (*e.g.* via Sierpiński triangle)



- Rule 110 is Turing complete



- Rule 184 is used to model *e.g.* traffic



Thank you for your attention!

I hope that was of some help.