

Cellular automata

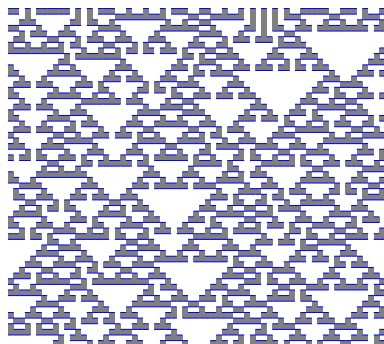
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Elementary cellular automata

- 1-d lattice of cells with states $x_i \in \{0, 1\}$
- time-discrete dynamics

$$x_i(t+1) = f[x_{i-1}(t), x_i(t), x_{i+1}(t)]$$

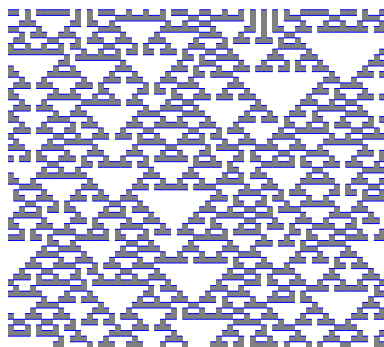


General CA: higher lattice dimension, larger neighbourhood range, more than 2 states.

Elementary cellular automata

- rule 22

x_1	x_2	x_3	f
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0



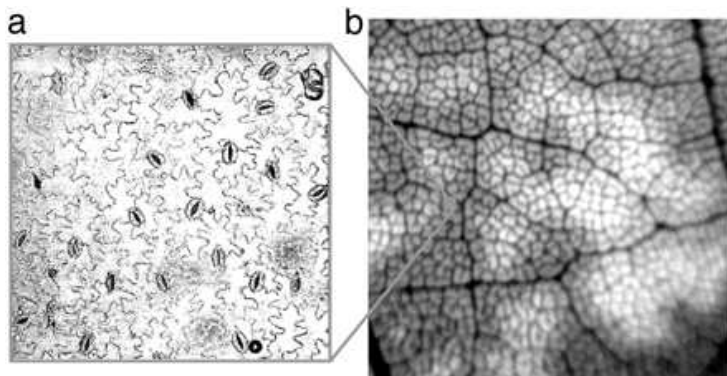
General CA: higher lattice dimension, larger neighbourhood range, more than 2 states.

Purpose

- Computer Science: Models of computation, e.g. “Game of Life” and “rule 110” are Turing-complete.
- Artificial Life: Study of self-reproducing structures
- Physics: Abstractions of spatio-temporal dynamics, pattern formation

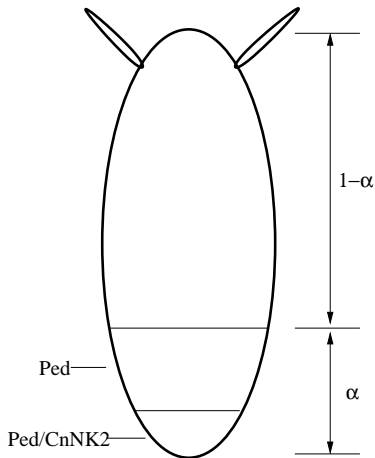
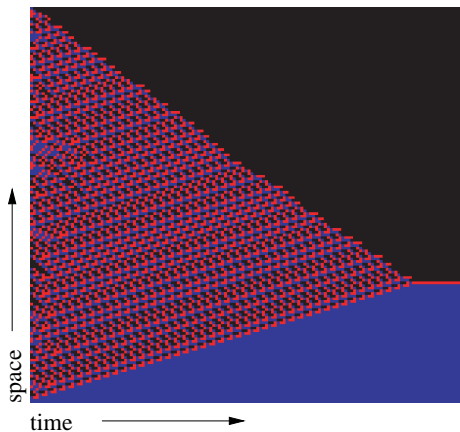
Motto: Simplest rules may yield most complex patterns / computations.

Putative CA dynamics on plant leaves



Peak et al., PNAS (2004)

CA model for morphogenesis in Hydra

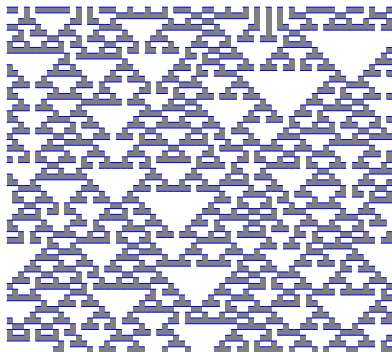


Rohlf & Bornholdt, JSTAT (2005)

Seashell



Seashell and elementary CA rule 22



Seashell and elementary CA rule 30

