Molecular Networks

WS 12/13

Exercises 1

Problem 1
Given n finite sets $X_1, \ldots, X_n$, $X_i = \{0, \ldots, p_i\}$, $p_i \in \mathbb{N}$, their cartesian product $X := X_1 \times \cdots \times X_n$ and a function $F : X \to X$. Define a (general) cellular automaton that represents F.

Problem 2
Formulate the Game of Life on an infinite 2-d board as cellular automaton with ordered architecture.

Problem 3
Given a 1-d CA with three cells and ordered architecture, attribute set $\{0, 1\}$, the neighbourhood template yielding the two nearest neighbours and the cell itself, and periodic boundary conditions. The local update function $\mathcal{R} : \{0, 1\}^3 \to \{0, 1\}$ is given by the table

x	(1,1,1)	(1,1,0)	(1,0,1)	(1,0,0)	(0,1,1)	(0,1,0)	(0,0,1)	(0,0,0)
$\mathcal{R}(x)$	1	0	1	1	1	0	0	0

Draw the state transition graph and determine the attractors. Is the CA reversible, totalistic, outer totalistic?

Problem 4
Given a 1-d finite CA with ordered architecture, $\mathcal{L} := \{1, \ldots, N\}$, $\mathcal{E} := \{0, 1, \ldots, K\}$ arbitrary interaction neighbourhood template, and periodic boundary conditions.

(a) Assume N is prime, what can you say about the increase of the rotation symmetry on an arbitrary trajectory?

(b) Think about other concepts of symmetry.