Autonomous Intelligent Systems,
Institute for Computer Science VI, University of Bonn

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Exercises for Artificial Life (MA-INF 4201), SS18

Exercises sheet 2, till: Mon 23. April, 2018

16.4.2018

	Name	11	12	13	14	15	16	17	$\sum$

Assignment 11 (2 Points)

How long would it take to print all Z possible rules for a 1-dimensional CA for the case $k = 4$ and $r = 1$ if you can manage to print 100 rules per second?
To answer this task set up a formula for the number $Z = Z(r, k)$ of possible rules as a function of the neighborhood radius r and the number of states k.

Assignment 12 (1 Point)

Prove or disprove the following sentence for 1-dim, $k = 2$, cellular Automata:
All totalistic rules are legal, because they are symmetric and have a silent state.

Assignment 13 (1 Point)

Find and name a simulation tool for 1-dimensional cellular automata, that is operating under Unix/Linux, or Android, or iOS, or Windows, or one that is operating from a web browser. Give the detailed web address, and write a personal comment about the simulation tool.

Assignment 14 (2 Points)

Develop and implement a formula for a classical spreadsheet program that implements the 1-dimensional cellular automaton with: $d = 1, k = 2, r = 1$, totalistic rule $\mathbf{150}_D$, (Rule number following the Wolfram notation) and print the result for at least 20 timesteps.

Assignment 15 (2 Points)

Please write down formulas that calculate the number Z of possibles rules for a 1-dimensional CA with respect to the neighborhood radius r and the number of states k for the case of:
a) all possible rules $Z =$
b) rules that are peripheral $Z_p =$
c) rules that are totalistic $Z_t =$
d) rules that have a silent state $Z_s =$.

Assignment 16 (4 Points)

A rule of a Cellular Automaton can be visualized as a table.
Depict the tables for the (*d=1,r=1,k=2*) rules defined by the following (decimal) Wolfram Numbers, and classify for each rule if it is *legal, symmetric, totalistic, or peripheral*:
`( 0, 17, 42, 51, 110, 165, 204, 243 ).`
Your solution shall show, how the Wolfram number and the table are connected to each other.

Assignment 17 (3 Points)

Imagine you would have to explain the 4 behaviours of CAs (Wolfram's classification) to someone who has not listened to the Artificial Life lecture and no experience in cellular automata.
Name these 4 behaviours of CAs (Wolfram's classification) and describe their characteristics in your own words (maximum two sentences each).

Programming Assignment: A (5 Points, due date **Mon 23.4.2018**)

Implement a 1-dimensional cellular automaton with the $k = 2$ states $\{0, 1\}$, with a neighborhood radius of $r = 1$ or $r = 2$, and 84 cells.
The boundary cells $j = 0, j = 1, j = 82, j = 83$ shall be fixed to the content $a_j = 0$. The programm shall depict in every line the complete state of all 84 cells as `text console ASCII` output.

Implement two possible starting conditions for the CA:
S: a seed (all cells are empty but cell no 42, $a_{i=42} = 1$), and
R: random starting condition, each cell is set with a probability of $p = 0.5$.
Let the user enter at runtime: the neighborhood radius r, the rule for the CA (Wolfram Notation), and the starting condition (S or R).

Please use C, C++, or Java to implement your program.
Send an E-Mail to your tutor containing the **documented** source code, **a description how to compile and run your program** (e.g. give the commands), and a file containing at least 10 lines of result.