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

Dr. N. Goerke
Friedrich-Hirzebruch-Allee 8, 53115 Bonn, Tel: (0228) 73-4167
E-Mail: goerke@ais.uni-bonn.de
www.ais.uni-bonn.de

Exercises for Artificial Life (MA-INF 4201), SS25

Exercises sheet 4, till: Mon 5. May, 2025

28.4.2025

Assignment 20 (2 Points)

Take the 2 dimensional forest fire CA from the lecture with a low rate for sponatenous growth $p << 1.0$, with a large induced growth rate $q = 1.0$. Discuss the effect of the rate for spontaneous fire for very small, medium and large values with respect to Z the number of trees.

Assignment 21 (2 Points)

Characterize the rule of Conway's Game of Life with respect to the following rule properties: silent state, totalistic, symmetric, peripheral, legal.

Assignment 22 (1 Point)

What has been proven by the development of Gosper's Glider Gun?

Assignment 23 (2 Points)

What class, or kind of behaviour (Wolfram's classification) is the *r-pentomino* showing? Support your answer with scientific arguments.

Assignment 24 (2 Points)

Imagine an exam question asking to depict a 5-cell configuration for Conway's Game of Life CA, that has been produced by Gosper's Glider gun.
How many correct configurations exist?
Please support your answer by an explanation.

Assignment 25 (2 Points)

Are there applications for cellular automata?
Seek for one that has not been mentioned in the lecture, and explain the idea in 1 or two sentences. Provide a scientific acceptable reference to it.

Assignment 26 (2 Points)

What is the smallest possible configuration for Conway's Game of Life (i.e., using the fewest number of living cells) that will completely die out in a single update?
To make this question nontrivial, at least one cell must die from overcrowing (from having four or more neighbors).
(*Adopted from Problems 1.1, C. Adami, Introduction to Artificial Life, Springer 1999*).

Assignment 27 (1 Point)

Discuss which criteria of *living* are not fully met by Conway's Game of Life?

Programming Assignment: B (10 Points, due date **Mon 12.5.2025**)

Implement (in Python) a two-dimensional (d=2) (Cellular) Automaton on a 101×82 sized, rectangular grid. Use a torus toplogy to manage the boundary of the grid. If you use console output (ASCII-art) take characters that are aligned with the content they represent and that are easy to distinguish from each other.

You can **choose** which of the three paradimgs to implement (only one please):
Langton's Ant, **(x)or** Conway's Game of Life **(x)or** the probabilistic Cellular Automaton called "Forest Fire".

Langton's Ant:
Make it possible to choose the initial configuration of the grid from the following list of 5 possibilities: all white, all black, checker board, horizontal stripes, random setting and make the user chose the starting position and orientation for the ant.
Write the total number of cells living for each time step into a file (one ASCII value per line).

Conway's Game of Life:
Make it possible to choose the initial pattern to start with, from the following list of 5 possibilities: blinker, glider, r-pentomino, Gosper's Glider Gun, and a pattern (class 3 or 4) of your own choice.
Write the total number of cells living for each time step into a file (one ASCII value per line).

Forest Fire Model:
Make it possible to set the probability parameters p, f, q. Start with an *empty* field (all cells are in state *Ashes*).
Write the number of cells for each state (Ashes, Tree, Fire) for each time step into a file (three values per line, ASCII format, separated by blanks).

Dear students,
This semester we require all programming assignments to be handed in as a Jupyter Notebook (.ipynb file). Please use the python version 3.10. We are going to use the standard Google colab session to correct your code.
You can find this google product at (https://colab.research.google.com/). Obviously you do share personal data when using a google product. You can use any other program allowing to create an ipynb-file. However, we are only going to grade the Code on a Google colab basis.

Best regards,
Your tutors

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To make this question nontrivial, at least one cell must die from overcrowing (from having four or more neighbors).
(*Adopted from Problems 1.1, C. Adami, Introduction to Artificial Life, Springer 1999*).

Are there applications for cellular automata?
Do you have found one, that has not been mentioned in the lecture? perhaps with a scientific acceptable reference?

Discuss which criteria of *living* are not fully met by Conway's Game of Life?