Exercises for Artificial Life (MA-INF 4201), SS24

Exercises sheet 5, till: Mon 12. May, 2025

5.5.2025

Assignment 28 (1 Point)
Describe the system called von Neumann's Universal Constructor.

Assignment 29 (1 Point)
Explain how *Chou-Reggia's Loop* is reproducing itself.
Depict the development of the first 3 steps of *Chou-Reggia's Loop*.

Assignment 30 (1 Point)
Seek for an application of Lindenmayer Systems (even one from the lecture), describe it in your own words and address the following topics:
What is the application trying to do? How is the Lindenmayer System applied to do this? What are the major results within this application?

Assignment 31 (3 Points)
Create, and specify a Lindenmayer System with exactly three rules that will create in step 5 the 32 symbol string shown below, starting with the Axiom A in step 0:

Step 5: ABBCBCCABCCACAABBCCACAABCAABABBC

Assignment 32 (3 Points)
Create 3 Lindenmayer systems (alphabet, axiom, rules, ...) and depict the results.
(Do not take examples from the lecture).
a) A Lindenmayer system that is creating a spiral in 2 dimensions. Please state how the length and the shape of the spiral can be adjusted, plot the result in a graph.
b) A Lindenmayer system (2-dim) that creates a shape resembling a natural looking tree.
c) A Lindenmayer system (with context!) that implements a 4 bit Gray coding.

Assignment 33 (2 Points)

Take the first example of a Lindenmayer System from the lecture (Mon, May 5, 2025) and prove that the number of symbols, or the length of the string produced, is generating the Fibonacci sequence.

A *simulation* is not adequate to prove this.

Assignment 34 (2 Points)

How is the space requirement $s(g)$ of Langton's Loop developing with respect to the number of generations g ?

Try to explain your answer in a scientific way.

Remark: the *O*-notation (Landau notation) is sufficient to describe the asymptotic behavior.

Assignment 35 (2 Points)

A really nice CA application is the Wahle-Schreckenberg model.

What is the application trying to do? How is the CA used to do this? What are the major result within this application?

Joachim Wahle, Michael Schreckenberg:

A Multi-Agent System for On-Line Simulations based on Real-World Traffic Data, Proc. of the 34th Hawaii International Conference on System Science 2001, p. 3037.

http://www.ais.uni-bonn.de/SS09/wahle_schreckenberg_2002.pdf