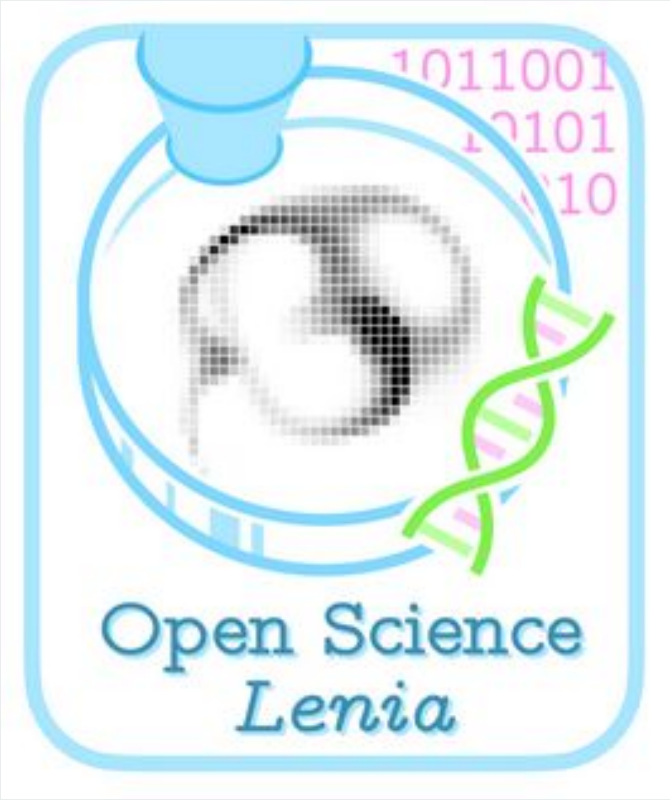
Latest Developments in Cellular Automata

Cellular automata is based upon simple rules that are able to exhibit powerful behaviours such as artificial life, self-organization, and more.

The implications and applications of which are wide-ranging.

Lenia: Biology of Artificial Life



Introduction

- System of continuous cellular automata
- Generalization of GoL by extending and normalizing the space-time-state dimensions
- It can support a greater diversity of complex autonomous patterns, or “life forms”

Path to Lenia

- Game of Life
- Convolutional kernel for neighbors
- Incremental update instead of conditional
- Larger-than-Life: extended kernel to given radius
- Primordia:
  - Multiple states
  - normalize kernels, states, and growth functions - leads to continuous states and time
- Lenia:
  - Continuous space
  - Ring kernel and growth function smoothed with bell function

Extensions and Variants

- Efficient Calculations with Fast Fourier Transform
- Extension of kernel to multiple rings with kernel peaks
- Multiple kernels and multiple growth functions by converting neighbor sums, kernels, and growth values into lists
- Multiple channels such as RGB for flexibility and expressability within full color spectrum
- Asymptotic update by changing growth function to target function giving smoother patterns and can be applied to specific channels in the channel extension case
- Soft clip instead of hard clip function giving smoother patterns with long-range sensing

Discussion and Future Directions

- Artificial Life
- Artificial Intelligence
- Theoretical Biology
- Computer Science
- Mathematics and Physics
- Digital Art

Demo

https://chakazul.github.io/Lenia/JavaScript/Lenia.html