Universiteit
van Amsterdam

Complex System Simulation

Evolution of Artificial Life - Group 6 (Like a G6)

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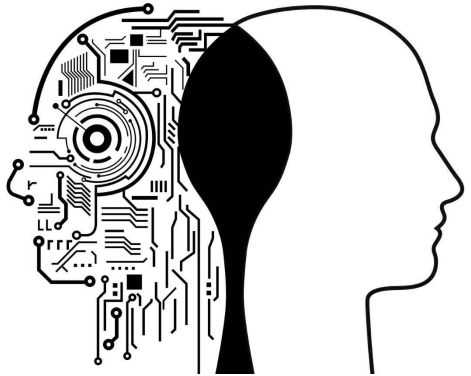


Research Question

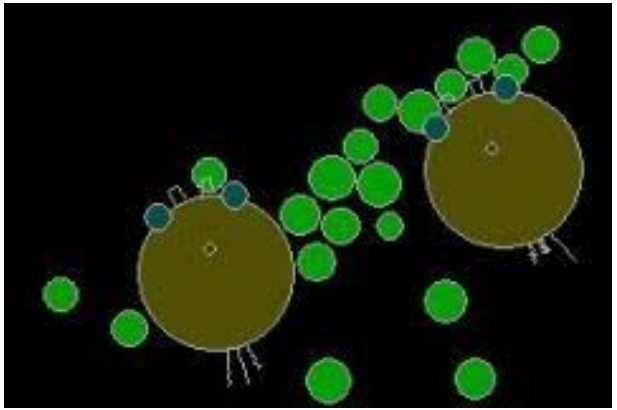
Exploring the ALiEn project:

Survivability of cell clusters in a novel artificial life environment.

- Analyzing species development
- Active movement toward nutrition

WHAT is ARTIFICIAL LIFE?

Introduction to evolution of artificial life

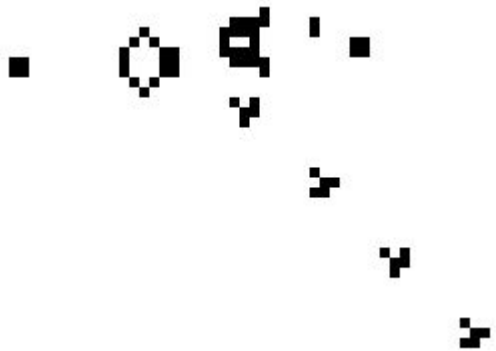


Artificial Life
Emergence | Bottom-up

Artificial Intelligence
Design | Top-down

STUDY EVOLUTION USING AL

Introduction to evolution of artificial life



Criteria

1. no explosive growth.
2. small initial patterns with chaotic, unpredictabl outcomes.
3. potential for von Neumann universal constructors.
4. rules as simple as possible,

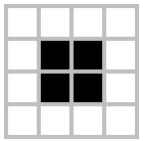
Rules

1. Any live cell with two or three live neighbours survives.
2. Any dead cell with three live neighbours becomes a live cell.
3. All other live cells die in the next generation. Similarly, all other dead cells stay dead.

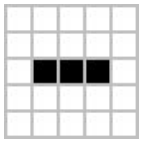
Game of Life

1970

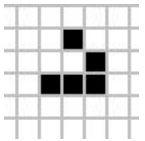
Still life



Oscillators

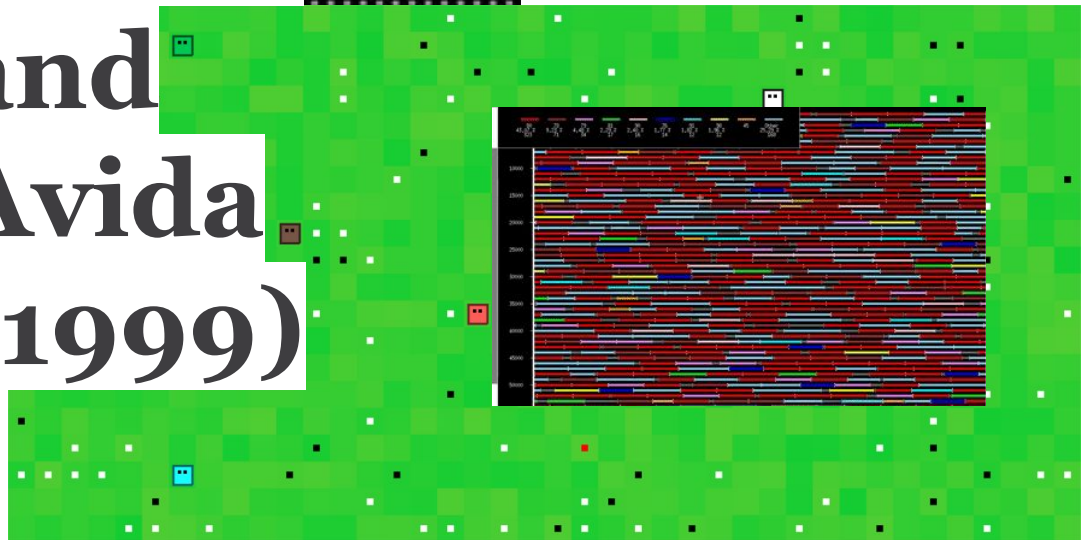


Spaceship



Tierra (1993) and Avida (1999)

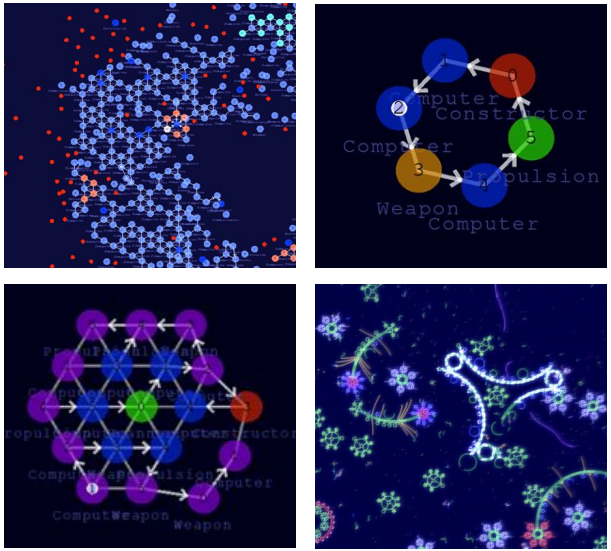
Introduction to evolution of artificial life



- Robustness
- The evolution of complexity
- The effect of high-mutation rates
- The evolution of complex organisms
- Mass extinctions
- Ecological networks

ALiEn Project

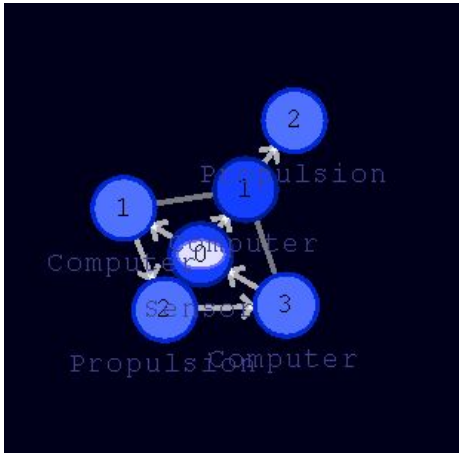
- Physics based simulation
  - C++ (75.8%), CUDA (21.9%) and other
- Different cell types with functions
  - Computer
  - Propulsion
  - Scanner
  - Weapon
  - Constructor
  - Sensor
  - Communicator
- Contact with developer

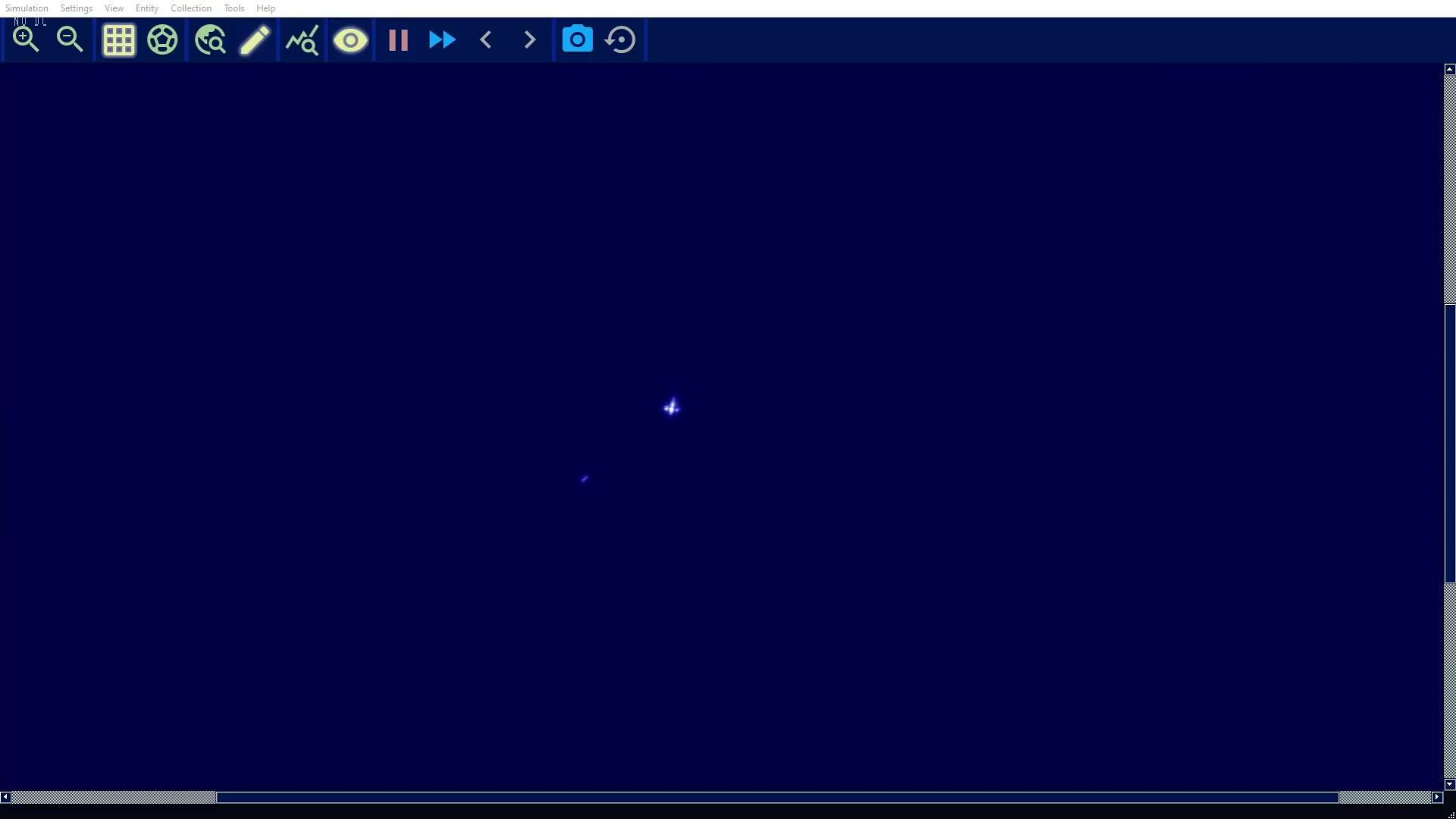


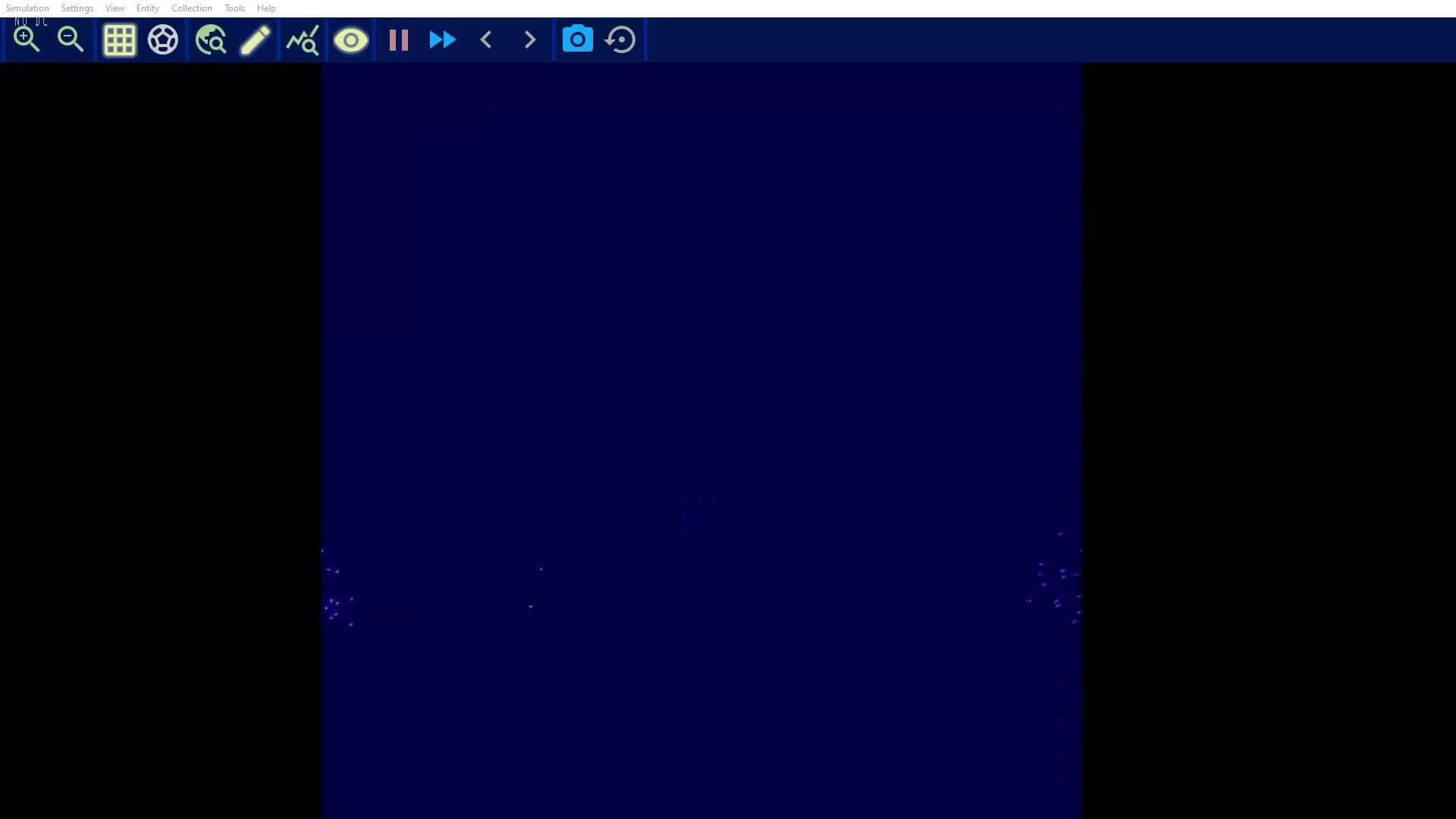
URL: https://alien-project.org/

Cluster/Organism Composition Movement

```
if SENSOR_OUT=SENSOR_OUT::CLUSTER_FOUND
  mov PROP_IN, PROP_IN::BY_ANGLE
  mov PROP_IN_ANGLE, SENSOR_INOUT_ANGLE
  sub  PROP_IN_ANGLE, 160
  mov PROP_IN_POWER, 50
else
  mov PROP_IN, PROP_IN::DAMP_ROTATION
  mov PROP_IN_POWER, 20
endif
```




Simulation
Settings
View
Entity
Collection
Tools
Help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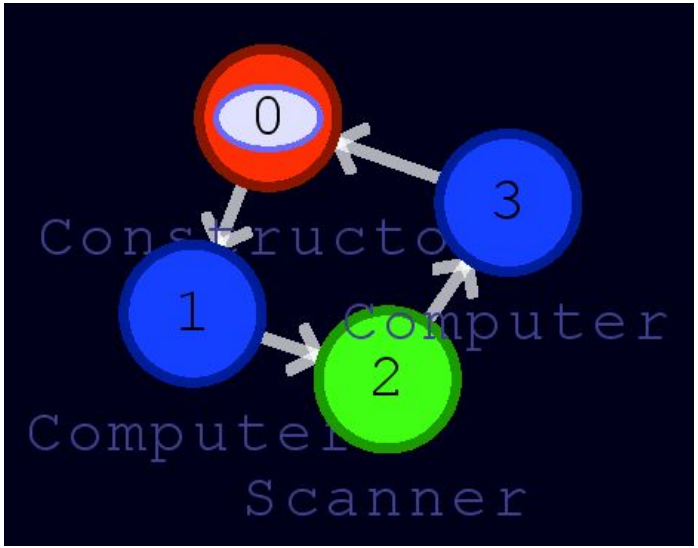
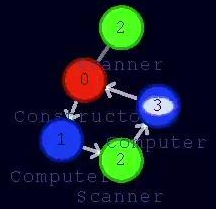
Cluster/Organism Composition Replication

```
if CONSTR_OUT = CONSTR_OUT::SUCCESS
  add i, 1
  if i = 4
    mov i, 0
    mov CONSTR_INOUT_ANGLE, 0x2a
  endif
  mov CONSTR_IN_OPTION, CONSTR_IN_OPTION::STANDARD
endif
mov j, 0x81
if CONSTR_OUT = CONSTR_OUT::SUCCESS_ROT
  mov j, CONSTR_INOUT_ANGLE
endif
mov SCANNER_INOUT_CELL_NUMBER, i
if i = 3
  mov CONSTR_IN_OPTION, CONSTR_IN_OPTION::FINISH_WITH_TOKEN_SEP_RED
```

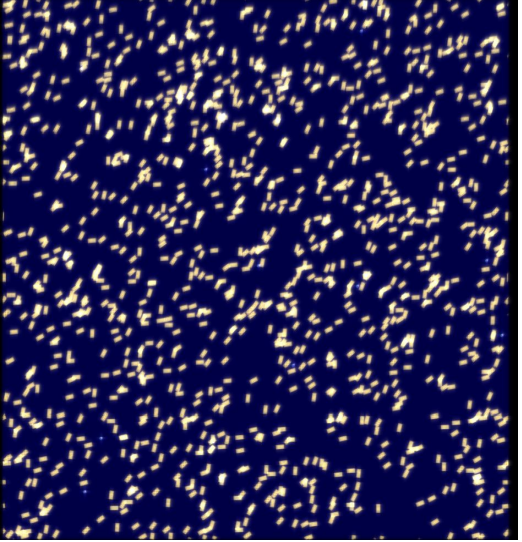


Simulation Settings View Entity Collection Tools Help

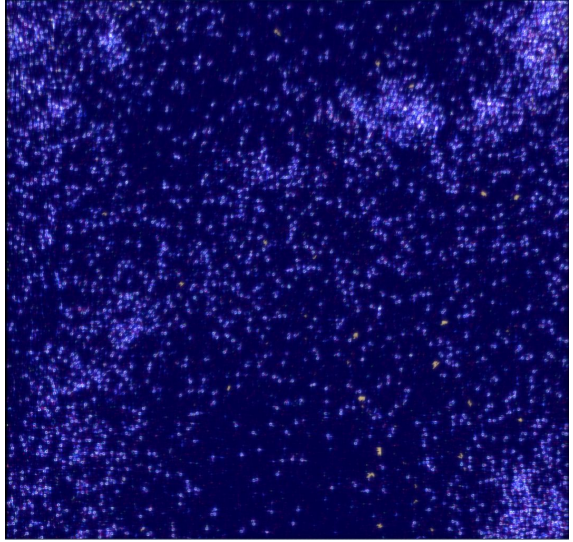


Results

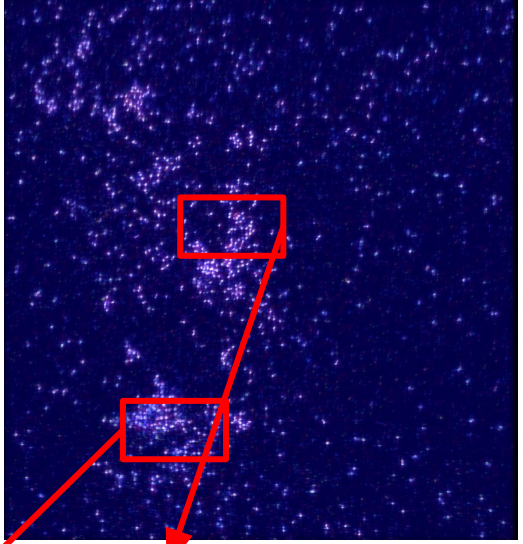
- Set up
  - 500 x 500 grid
  - 10 Small replicators
  - 1250 (4x8) blocks of nutrition
- 150.000 iterations
  - Cached data every 200 msec
  - Pattern data every 5000 iterations



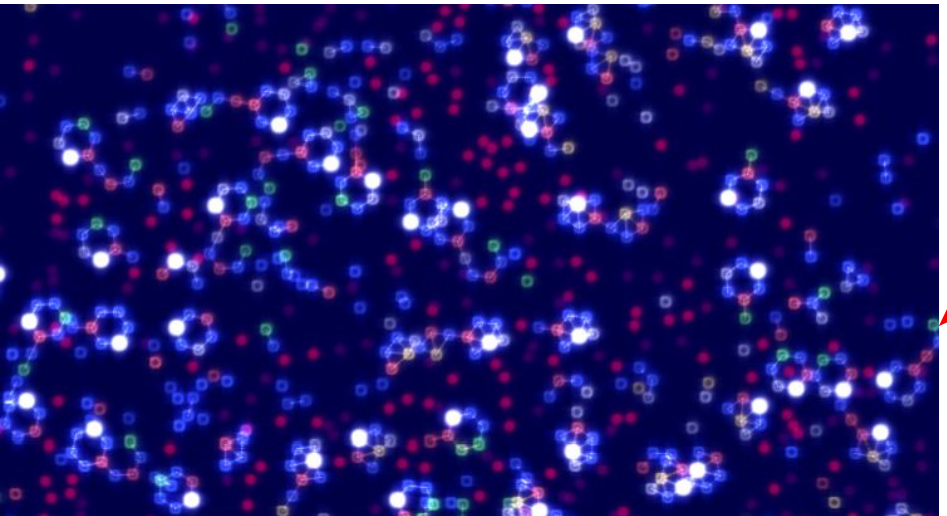
start

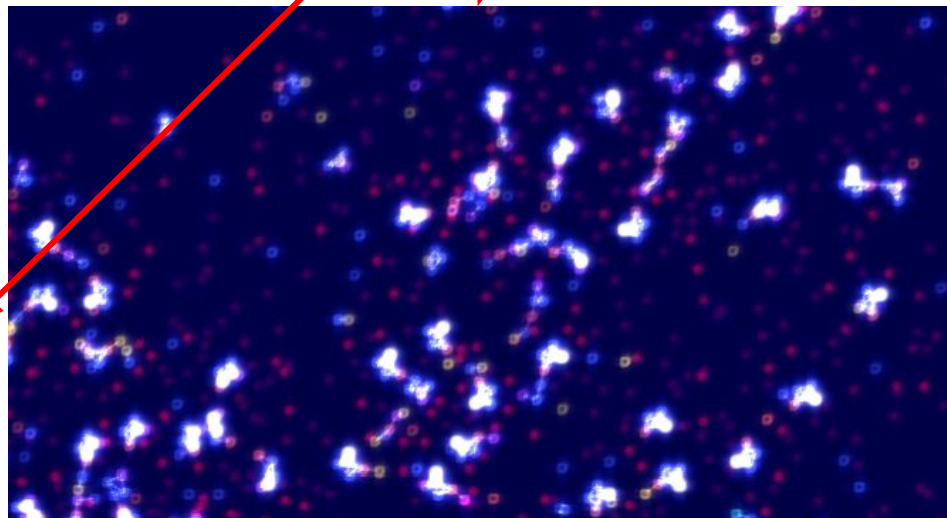


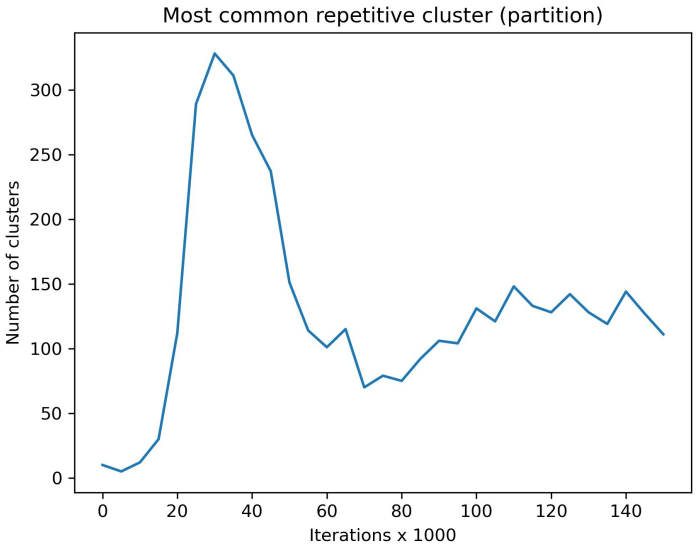
30k

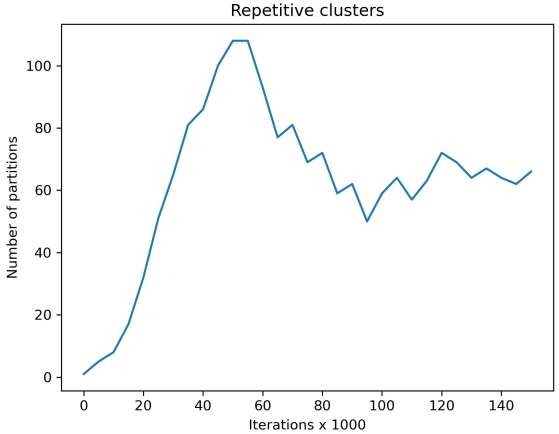


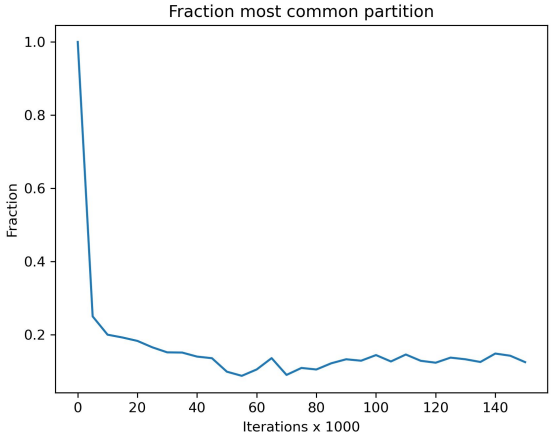
104k

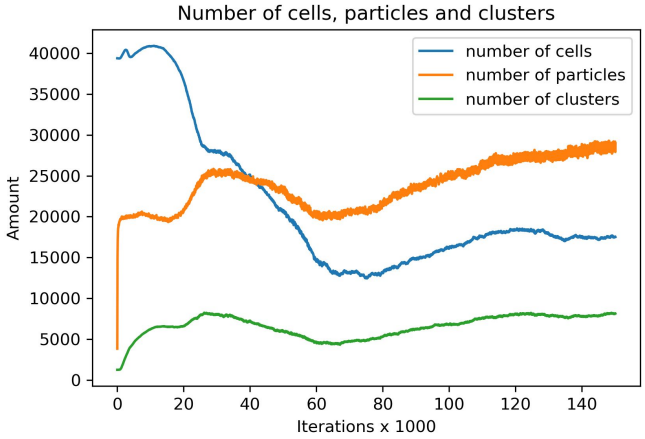


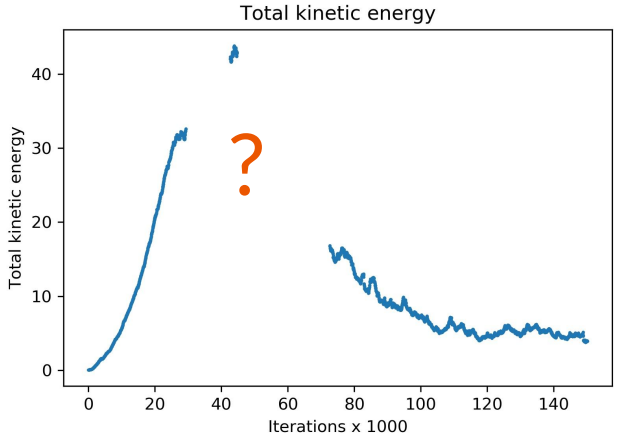


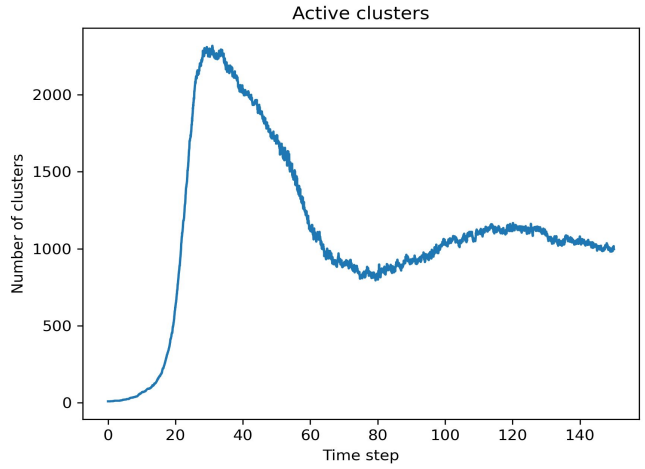

Most common repetitive cluster (partition)
Number of clusters
Iterations x 1000
0
50
100
150
200
250
300
0
20
40
60
80
100
120
140

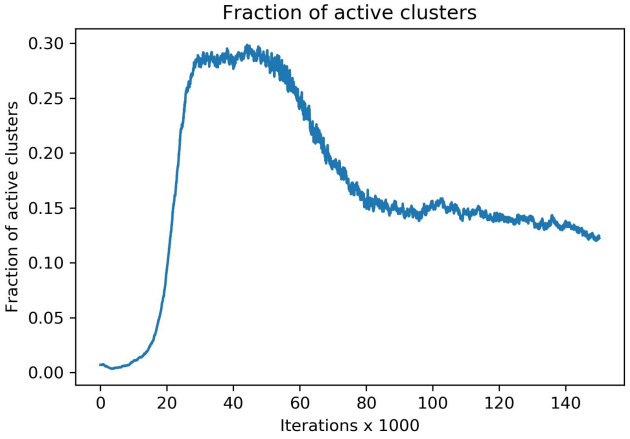

Repetitive clusters
Number of partitions
Iterations x 1000
0
20
40
60
80
100
0
20
40
60
80
100
120
140


Fraction most common partition
Fraction
Iterations x 1000
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
120
140


Number of cells, particles and clusters
number of cells
number of particles
number of clusters
Amount
Iterations x 1000

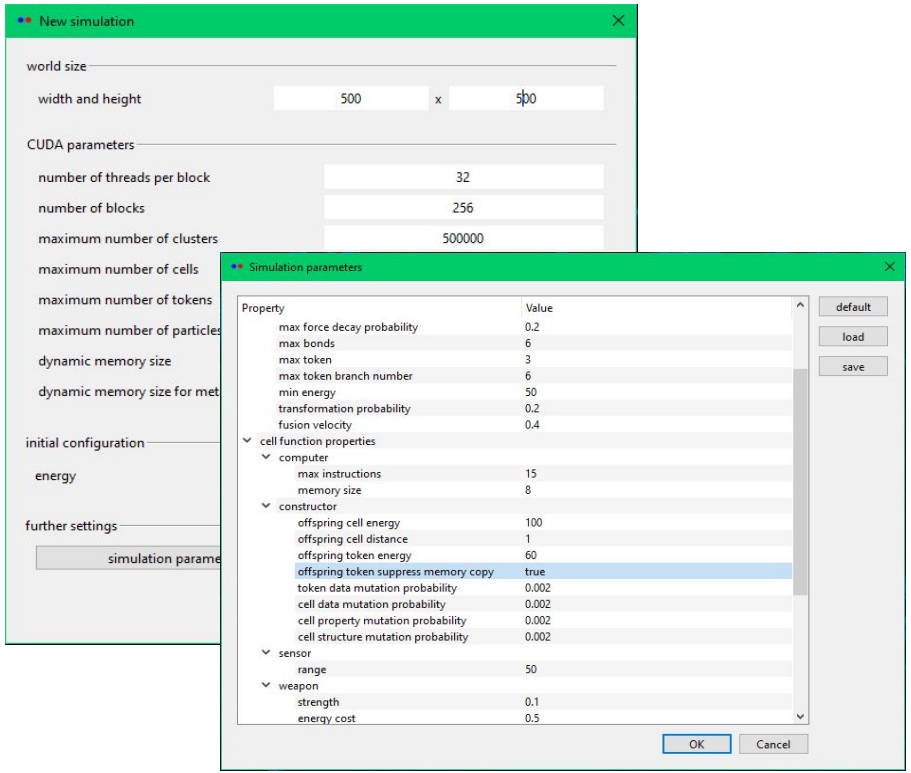

Total kinetic energy
?
Total kinetic energy
Iterations x 1000


Active clusters
Number of clusters
Time step


Fraction of active clusters
Fraction of active clusters
Iterations x 1000

Future research

- More complex cluster composition
- Simulation Setup
  - Presence of nutrition
  - Influence of radiation
  - Probabilities of mutation
- Add extra output
  - Analyse species development



Questions?