Systems Biology – Exercises

Week 5: Artificial Life

Artificial Life

- Artificial Life is also called A-Life or alife. This is a field of simulated scenarios that mimic various traits of biological life. The term life has no deep philosophical meaning (especially what is means to be alive) in this particular context.

- The algorithms are usually simplified and represent a specific characteristic of interacting lifeforms. Last week, we saw one simulation called the Conway's Game of Life. We have now come from simple and complex structures to emergence to artificial life. Simulations can include cellular automata, which we cover the coming week, or neural networks and genetic algorithms, which we will talk about later this semester.

Exercise 1

- **Exercise:** Following the code below, write a list of conditions that checks for different patterns of Conway's Game of Life. Check them first against arrays from your previous homework.

```python
57  import numpy as np
58  import matplotlib.pyplot as plt
59
60  universe = np.zeros((5, 6))
61
62  beehive = [[0, 1, 1, 0],
63            [1, 0, 0, 1],
64            [0, 1, 1, 0]]
65
66  universe[1:4, 1:5] = beehive
67
68  plt.imshow(universe, cmap='binary')
69  plt.show()
70
71  if beehive[0][1] and beehive[0][2] and beehive[1][0] and beehive[1][3] and beehive[2][1] and beehive [2][2]:
72      print("Pattern is of type \"Beehive\".")
```

- After running a few successful comparisons, consider optimizing the code using NumPy arrays[1].

```python
80 import numpy as np
81 universe = np.zeros((5, 6))
82 beehive = np.array(
83     [[0, 1, 1, 0],
84      [1, 0, 0, 1],
85      [0, 1, 1, 0]])
86 universe[1:4, 1:5] = beehive
87 if (beehive==universe[1:4, 1:5]).all():
88     print("Pattern is of type \"Beehive\", in numpy , too.")
```

Array comparison using NumPy.

Homework

Due next Wednesday (17:00, 3th, Nov.) electronically to manaba+R.

• File format: YourStudentID_Week05_n. py/gif (ID without hyphen, e.g., 12345678901_Week05_1.py).

• Your code must include your own comments for all code sections. Go line-by-line. Comments in your program must be full sentences and reflect your understanding of the code.

Q1. . Extend your animation code from last week so that it can detect the oscillator automatically (output/print the detection result, e.g. the name of oscillator; Please also indicate the name of oscillator in the comments of the code).

Q2. Extend your animation code of Q1 to write the animation to a .gif file to your hard-disk (same folder as the Python script)[2]

Q1 → YourStudentID_Week05_1.py file, Q2 → YourStudentID_Week05_2.py file and YourStudentID_Week05_2.gif file

2. https://matplotlib.org/api/animation_api.html#module-matplotlib.animation

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Week 6: Cellular Automaton