

# Assignment 6

## Cellular Automata

Write a report on the tasks given below. Upload *pdf* file.

### Task 1 (5 points for each)

1. Run *Mini-Life.nlogo* several times with random initial patterns (use “randomize”). Let Life run until it settles down on a set of fixed or oscillating small patterns. Make a record of the different patterns that you see.

2. In the Code tab of *Mini-Life.nlogo*, change the rules of Life to be:

if a cell has less than 4 black neighbors, then turn black, otherwise turn white.

Try this new rule out on some random initial lattices (vary "percent black" to see if you can get interesting behavior). What is the effect of this rule change on the behavior of the cellular automaton after several time steps? Does this variant of Life still produce interesting behavior?

3. Make another change of your own choosing to the Game of Life rule and experiment with the behavior of your rule on several random initial lattices.

4. In the Code tab of *Mini-Life.nlogo*, change these two lines in the *go* procedure:

```
[ask cells [count-black-nbrs]]
```

```
[ask cells [change-color]]
```

to the following single line:

```
ask cells [count-black-nbrs change-color]
```

This is now an asynchronous system, where cells (in random order, once per generation) change their colors immediately upon counting their neighbors, without waiting for them to finish their own counts. Is this new system deterministic: does it always calculate the same resulting patterns from the same initial conditions? How does this new system’s behavior compare with that of the original Game of Life cellular automaton?

### **Task 2 (5 points for each problem)**

1. What is the Wolfram code number in base 10 of the elementary CA rule  $1\ 0\ 1\ 0\ 0\ 1\ 0\ 1$ ? What “Wolfram class” is it in?
2. What is the Wolfram code number in base 10 of the elementary CA rule  $0\ 0\ 1\ 0\ 1\ 1\ 0\ 0$ ? What “Wolfram class” is it in?
3. What is the Lambda value of ECA rule 90?
4. Langton’s hypothesis was that an ECA with Lambda close to  $1/2$  should typically have more complex behavior than an ECA with a much lower Lambda value. Is this true when you compare the typical behavior of rule 32 and rule 90? How about when you compare rule 24 and rule 30?
5. Choose five different Elementary CAs that have  $\text{Lambda} = 1/2$ . Test each of these on several initial configurations (using *ElementaryCAs.nlogo*). Which ones have “chaotic” looking behavior (Wolfram class 3)?

### **Task 3 (30 points)**

Open *Segregation.nlogo* model from the Models Library. Analyze it!

Show that you can independently understand the model, formulate the problem, form hypotheses, conduct experiments, describe findings.

Write detailed report on analysis of this model.