Exercise 1.
Implementing a first Application in RePast: A Rabbits Grass Simulation

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1 Implementation

1.1 Assumptions

Default parameters:

- Size of space is 20×20, as specified in assignment
- Number of rabbits at start is 10
- The initial energy spread into the map is by default 10000
- The growing rate (the additional energy spread on the map) is 1000
- Cost of reproducing a new rabbit is 30
- The initial energy is 30 after birth
- For the rabbit, the cost for one step movement is 10 units of energy
- When the energy of a rabbit is no less than the threshold, 50 unit of energy, it will reproduce another rabbit

1.2 Implementation Remarks

Based on the Repast tutorial given, we followed the instruction and implemented the model.

On the grid, the background color is white, the color of rabbit is blue, and while the color of grass is green.

In the initial process, *numInitRabbits* rabbits will be located on the grids. And *numInitGrass* will be spread randomly on the grid. Namely, we only control the initial total energy instead of the number of grass.

When stepping to the next tick, *grassGrowthRate* units of energy will be spread to the map. And the rabbit will check whether it is possible for itself to move. If it is surrounded by other rabbits, there is no chance for it to move. In this circumstance, it will stay in the same cell. After checking and making sure that it can move, it will move to the reachable cells with equal probability. After the movement, it will take all the energy in this cell.

If the energy of rabbit is no less than the *birthThreshold*, it will reproduce: it will lose *initialEnergy* units of energy, give it to the offspring. A new rabbit will be produced and placed randomly in the cell available.

2 Results

In the following part, we will run different simulations, try to figure out the influence of the variables. Some of them are very evident, while some of them are not very obvious. Here, we only select some of them for study.

See Figure 1 for a typical simulation run with the default parameters.

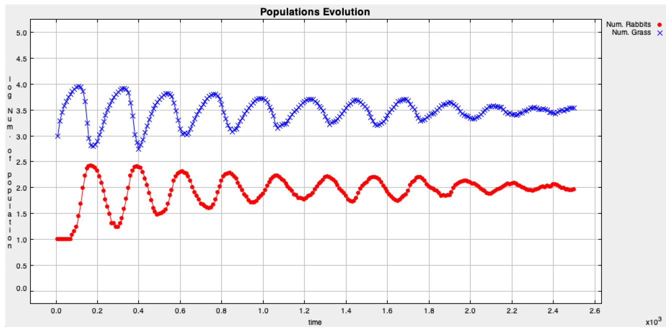


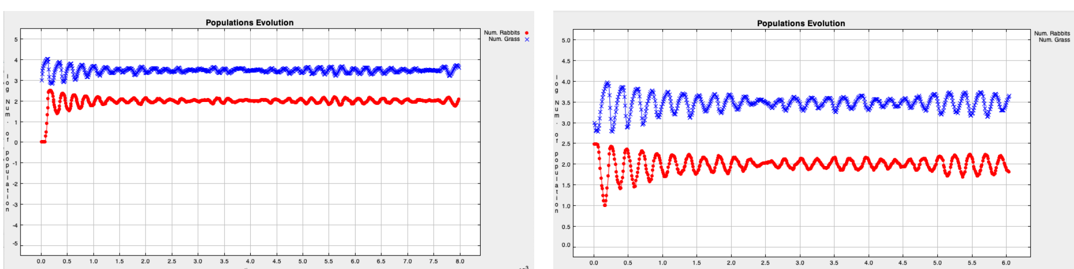
Figure 1: Population graph for default parameters

2.1 Experiment 1: varying initial rabbits

2.1.1 Setting

We select two different value for the initial number of rabbits. We select two relatively extreme values, 1 and 300. Other parameter are the same as default.

2.1.2 Observations



(a) Population graph for 1 initial rabbit (b) Population graph for 300 initial rabbits

Figure 2: Experiment 1

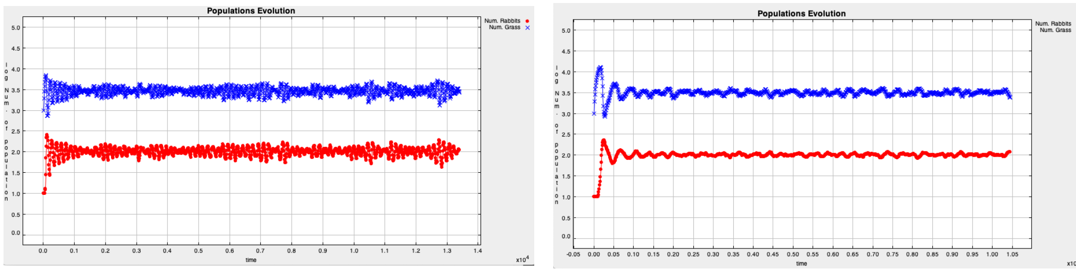
As shown in Figure 2, we observe that the initial value of the rabbits won't affect the steady state of rabbit and grass. However, during our tests, when the initial number of rabbits is smaller, rabbits are more likely to be extinct.

2.2 Experiment 2: varying birth threshold

2.2.1 Setting

In this experiment, we fiddled with *birthThreshold*, setting it first to 10 (Figure 3a), then to 100 (Figure 3b). Other parameter are the same as default.

2.2.2 Observations



(a) Population graph for *birthThreshold* = 10 (b) Population graph for *birthThreshold* = 100

Figure 3: Experiment 2

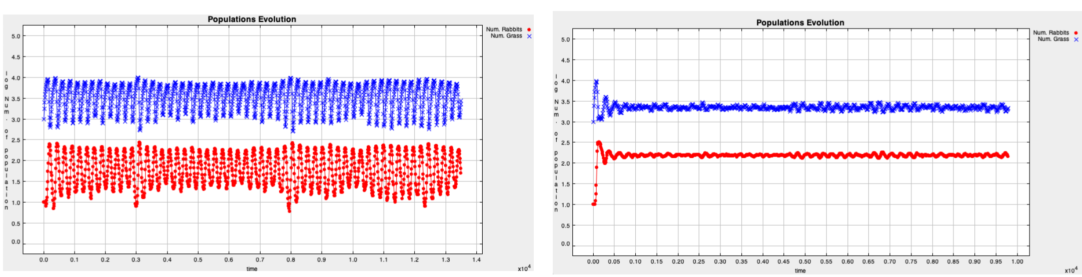
From Figure 3, we can observe that *birthThreshold* can affect the variation of rabbit number. The lower *birthThreshold* encourages rabbits to reproduce, in the meanwhile, they are taking risk of death. However, the higher *birthThreshold* makes the number of rabbits more stable. Even though they are less likely to reproduce, they could survive during the poor natural environment (e.g. continuous visited cells without grass). For the former situation, the robustness of the system is the result of the capacity of reproduction, while the latter is from the capacity of survival.

2.3 Experiment 3: grass growth rate

2.3.1 Setting

In this part, we will configure on the value of grass growth rate. The default value of grass growth rate is 1000. We find that under the default setting, the result of division between grass growth rate (1000) and the stable rabbit number (100) is 10, which is close to the move cost. Therefore, we could have the assumption that the number of rabbit in the stable condition is proportional to the energy input during each step. The values that we selected are 800 and 1500.

2.3.2 Observations



(a) Population graph for *grassGrowthRate*=800 (b) Population graph for *grassGrowthRate*=1500

Figure 4: Experiment 3

In the Figure 4, we can verify our assumption above. When the energy input is less, the capacity of rabbit in steady state is smaller, and vice versa. However, we selected two extreme case, *grassGrowthRate*=500 and *grassGrowthRate*=2000. For the first one, the rabbits will become extinct. For the second one, the rabbits will occupy all the cells. Under this circumstance, the bottleneck of rabbit number is no longer energy, but the living space.