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

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September 23, 2020

1 Implementation

1.1 Assumptions

• The grass amount in each cell is unbounded, infinite grass can grow on each cell.
• Any rabbit on cell with certain grass amount, comsumes all grass in that cell within the same simulation step.
• Rabbits can reproduce only once in a simulation step, and lose half of their energy during reproduction.
• Rabbits can only try to move once in a single simulation step and in case block is unavailable, rabbit remains in same cell.
• Grass energy is considered as 1 block of energy, rabbits do gain energy as much as the grass amount in a certain block.
• Rabbits lose 1 block of energy at each simulation step, and die in case of 0 block of energy.
• All rabbits start with a certain constant amount of energy.

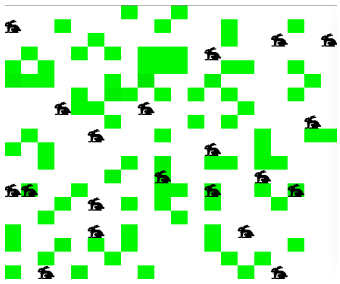

Figure 1: Simulation

1.2 Implementation Remarks

• When a new rabbit is being added, the implementation makes a limited number of random attempts to find an empty cell. This limit is 10 times the area of the grid (e.g. 10*20*20 for grid size 20).
• Rabbits and grass are summoned randomly on grid. New born rabbits are not necessarily placed into neighboring grids to their parents as well.
• Initial rabbit energy amount is the same for each rabbit and is set to 15. Instead of changing initial rabbit energy with a parameter or randomly selecting it, we decided to only leave birth threshold as interactive parameter for the sake of experimentation.
• Rabbit population has been plotted with a 5 times larger scale than actual amount.

2 Results

Table 1: Default Settings

Initial Rabbit Energy	*Grid Size*	*Initial Rabbit Amount*	*Initial Grass Amount*	*Grass Growth Rate*	*Birth Threshold*
15	(20x20)	20	100	50	30

2.1 Experiment 1

2.1.1 Setting

In this experiment, we investigate the effect of alteration in birth thresholds. All other parameters are fixed at default values depicted in Table 1. Birth threshold values for this experiment setup are picked as 80, 30, 15 and 5.

2.1.2 Observations

Initially, there are not too many rabbits, which allows the grass to grow freely. When the birth threshold is high, the rabbits slowly reproduce and reach a stable number where the grass and rabbit populations oscillate very little. When the birth threshold is a bit lower, the initial abundance of grass causes the initial rabbits to quickly reproduce and overshoot the stable range, which causes a big decline in the grass, and these oscillations slowly dampen over time. When the threshold is very low, each rabbit can quickly reproduce after being born which causes instability. If the threshold is lower than initial rabbit energy, we get an edge case where the rabbits fill the grid and survive forever.

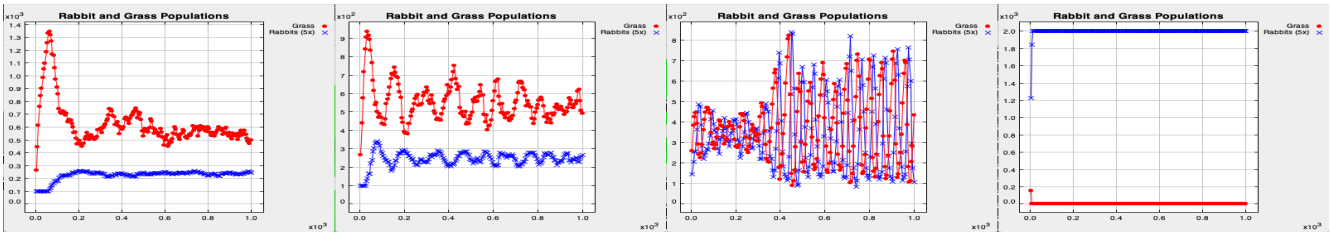

Figure 2: From left to right, birth thresholds are 80, 30, 15, 5.

2.2 Experiment 2

2.2.1 Setting

In this experiment, we investigate the effect of altering grass growth rate. Other parameters are fixed at values depicted in Table 1. Birth threshold values for this experiment setup are picked as 80, 50, 20.

2.2.2 Observations

First observation would be grass growth rate is proportional to rabbit population after stabilization. Plots in Figure 3 directly indicate that the rabbit population, as well as the grass population, oscillates more with low amount of grass growth and reduces significantly. Given higher grass growth rate, rabbits can find grass more easily and therefore, die less in a simulation. Lastly, inverse proportion between the grass amount and rabbit population is noticable, since grass amount decreases when rabbit population increases and vice versa is depicted as well.

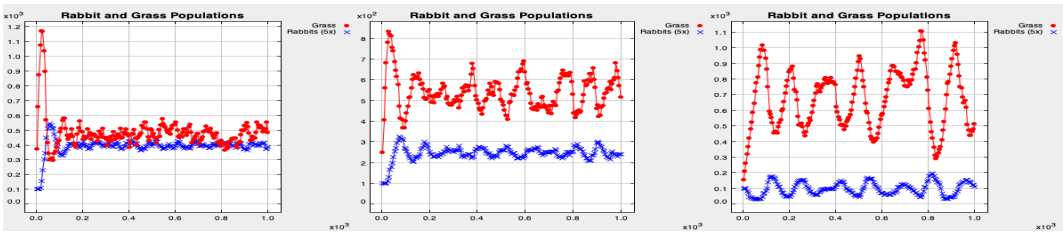

Figure 3: From left to right, grass growth rate are 80, 50, 20.

2.3 Experiment 3

2.3.1 Setting

In this experiment, we investigate the effect of altering grid size. All other parameters are fixed at default values depicted in Table 1. Birth threshold values for this experiment setup are picked as 30, 20, 10.

2.3.2 Observations

Effects of grid size to the simulation are obvious, in which given the rest of parameters are constant, larger grid size affects rabbit population negatively, and grass amount in a positive manner. In a larger grid, it is harder for rabbits to find grass due to larger search space. In a small grid, rabbits can find grass easily and therefore, can continue on living whereas the grass amount is low due to the continuos consumption.

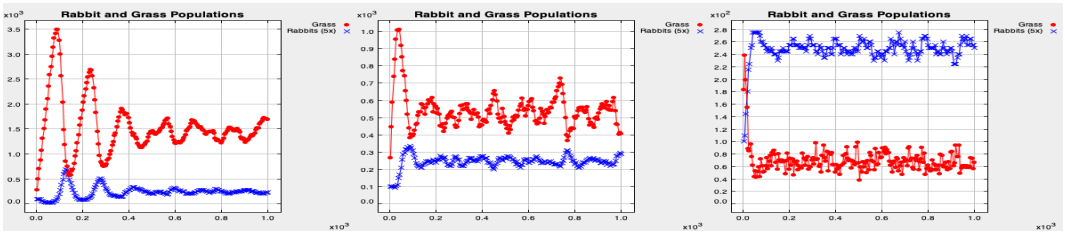

Figure 4: From left to right, grid sizes are 30, 20, 10.

2.4 Experiment 4

2.4.1 Setting

In this experiment, we investigate the effect of alteration in initial rabbit amount and initial grass amount. All other parameters are fixed at default values depicted in Table 1. Initial rabbit amount values for this experiment setup are picked as 1, 50 and initial grass amount are picked as 0, 200.

2.4.2 Observations

As long as grass grows at a sufficient rate, initial grass number does not affect the rest of the simulation after the first few ticks. The initial number of rabbits also does not affect the stable regions of the simulation, it only affects the size of the initial oscillation.

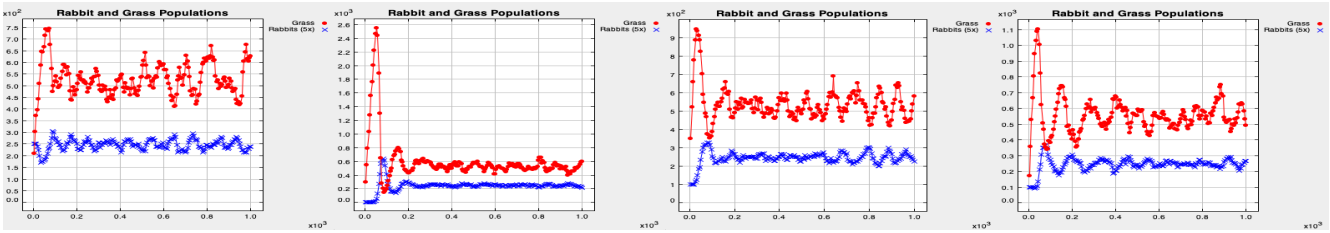

Figure 5: Left Most 2 Image: left to right, initial rabbit amounts are 50, 1; Right Most 2 Image: left to right: initial grass amounts are 200, 0