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

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1 Implementation

1.1 Assumptions

- The parameters `minEnergy` and `maxEnergy` decide the maximum and minimum energy that a rabbit can start with. Once a rabbit is created, its energy is chosen randomly in $[minEnergy, maxEnergy)$. If the minimum is bigger than the maximum, the value is chosen in $[1, maxEnergy)$ instead.
- The parameter `grassCal` decides the amount of calories of every grass tile created. Once a grass tile is eaten by a rabbit, the rabbit gains the calories as energy.
- Rabbits that die are removed at the beginning of the following tick. Which means if the rabbit consumes its last unit of energy, its corpse stays on the field for one tick and then gets removed during the next tick before any rabbit takes a step.
- If a rabbit gets enough energy to reproduce, its own energy is randomly reset between `minEnergy` and `maxEnergy` and a new rabbit is added in a pending queue, the new rabbit is added only at the beginning of the next step.

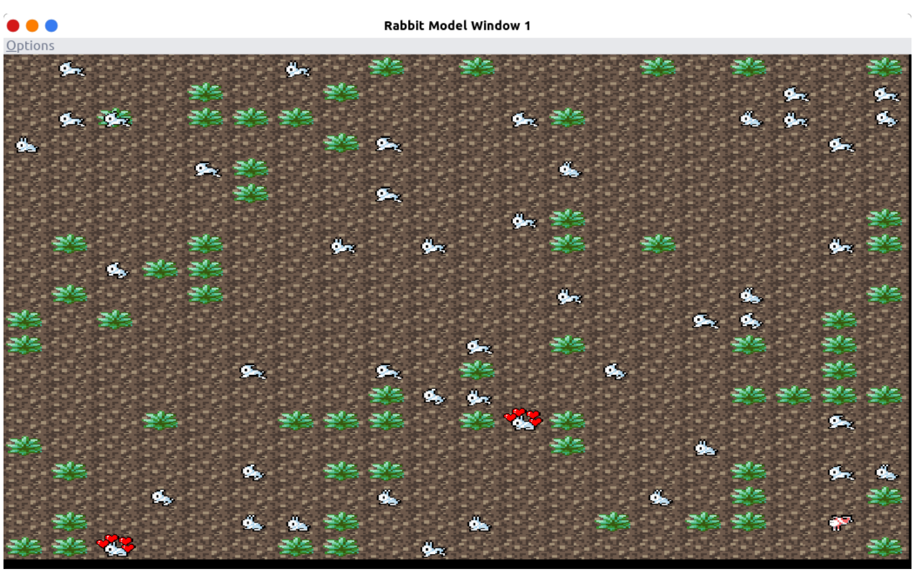

Figure 1: Graphical interface of the model

1.2 Implementation Remarks

First of all we have added Sprites to enhance the graphical interface. This makes death and births clearly visible. The sprites and corresponding code is included in the jar. However the code managing the sprites is commented out in the source file, and we use basic colors instead in order to avoid any issues while loading the sprites. Other than that we largely sticked to the tutorial found at `liapc3.epfl.ch/repast/main.htm`.

2 Results

2.1 Experiment 1

2.1.1 Setting

Variable	Value
GridSize	20
NumInitRabbit	5
NumInitGrass	10
GrassGrowthRate	5
BirthThreshold	30
GrassCal	10
MinEnergy	10
MaxEnergy	30

2.1.2 Observations

In this setting (and most others that we tried) we see that after some intial perturbations, the system converges quickly to a state of equilibrium. This is intuitive as the amount of calories that are added each step (controlled by `grassCal` and `GrassGrowthRate`) means that the environment can only support a given number of bunnies on average. Indeed we can compute that 50 calories are added to the model each round, and Figure 2 shows that the equilibrium is reached around that number. (Some offset might be due to the energy ”created” when rabbits are born due to our model assumptions)

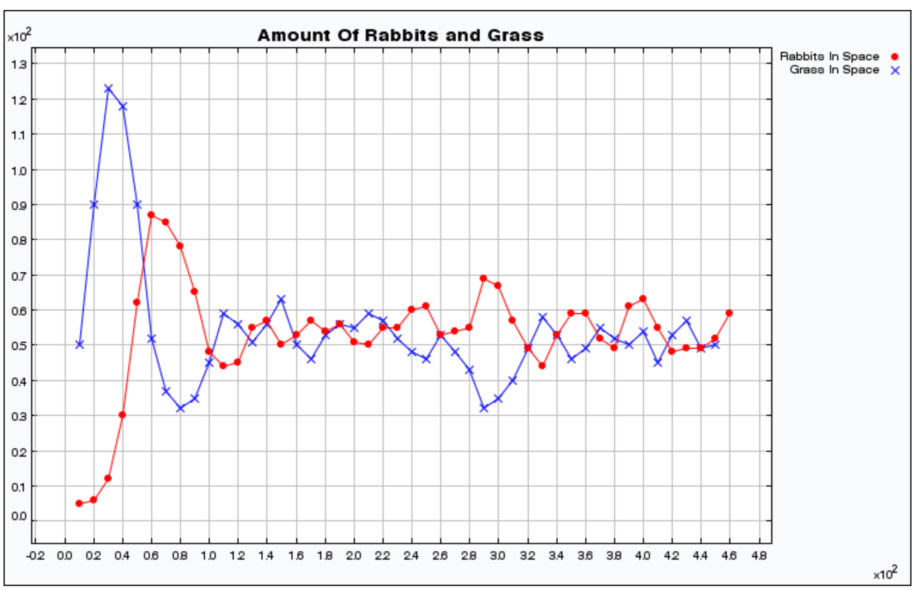

Figure 2: Results of experiment 1

2.2 Experiment 2

2.2.1 Setting

Variable	Value
GridSize	20
NumInitRabbit	5
NumInitGrass	200
GrassGrowthRate	2
BirthThreshold	30
GrassCal	5
MinEnergy	10
MaxEnergy	30

2.2.2 Observations

In this experiment, we chose to reduce the growth rate and the amount of calories that the grass has, so that it becomes harder for the rabbits to survive and reproduce. While in theory the calories added can support 10 rabbits, we observed that the rabbit population oscillates widely and is out of phase with the amount of grass present in the model. Eventually one generation of rabbits can become too numerous, eat all the grass and the entire population will die off as seen in Figure 3. We conclude that if the sustainable number of rabbits is too low compared to the size of the grid, the rabbits will have trouble finding the grass and thus risk going extinct.

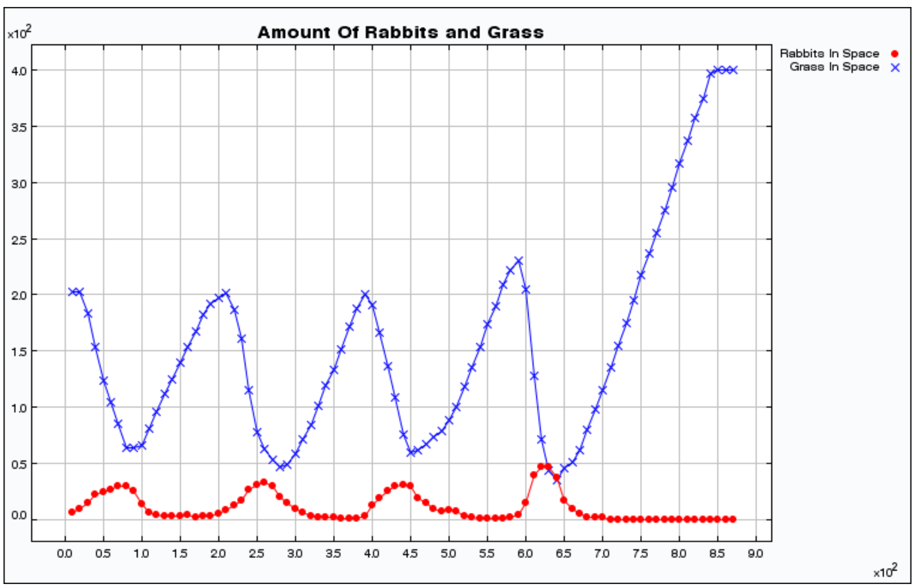

Figure 3: Results of experiment 2