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

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1 Implementation

1.1 Assumptions

Our model made the following assumptions:

- The world is modelled as 2D grid where warping occurs at each edge, making it behave as a torus.
- Agents can only give birth once per step.
- If an agent tries to move to a cell that is currently occupied it will remain motionless during this time step instead.
- The total amount of grass in a cell is bounded.
- When a rabbit reaches a cell with grass, it will consume the total amount present in this cell.

1.2 Implementation Remarks

- The torus behaviour of the grid is implemented with the help of modulus operations on the position coordinates.
- At each time step of the simulation, each rabbit is checked to see if it has sufficient energy to reproduce. If that is the case then a new agent is added in a random position in the grid and the energy levels of the genitor rabbit are decreased by a preset amount.
- At each time step each rabbit gets a random direction with the help of an enum encoding each cardinal direction (N,S,E,W). The potential new position of the rabbit is computed and then we check whether it would cause a collision. If a collision would indeed occur then the rabbit does not move during this time step.
- At each time step a predefined amount of grass is added to the world and spread randomly. The amount of grass in a cell is implemented as an integer value. The bounding of the grass amount is simply implemented by taking the minimum of the maximum amount of grass in a cell and the updated value.

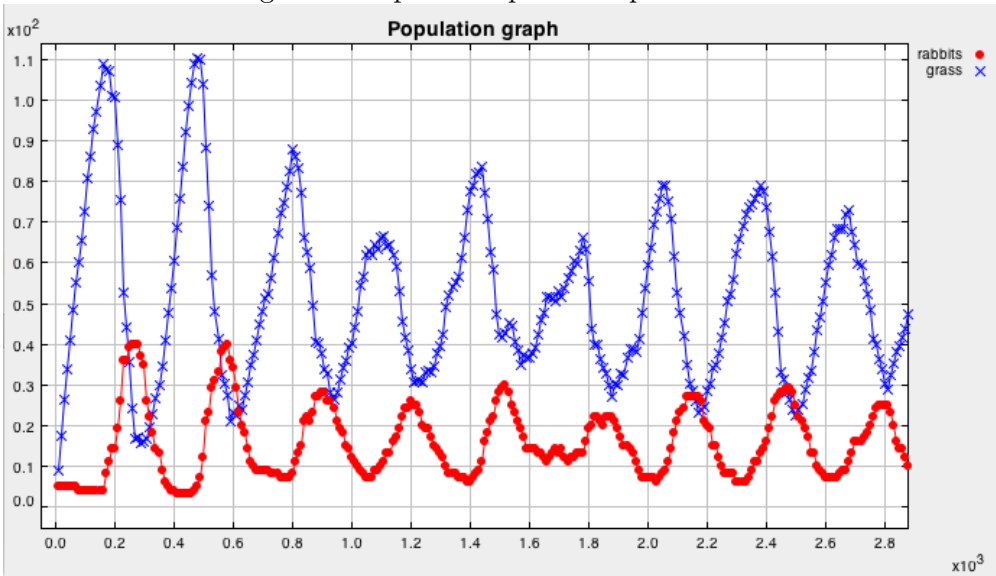
2 Results

2.1 Experiment 1

2.1.1 Setting

- Birth threshold: 80 units of energy
- Grass growth rate: 10 units of grass per time step
- Grid size: 20×20 units
- Initial number of agents: 5

Figure 1: Population plot of experiment 1



2.1.2 Observations

With these parameters the population follows the damped oscillations that are a characteristic of prey predator models as described by Lotka-Volterra equations.

When the population of rabbits is low the grass has all the space to grow freely. When the grass is abundant enough the rabbits have enough resources to thrive and reproduce at a higher rate. This increase in rabbit population makes the grass amounts decrease to a low until multiple rabbits start to starve. As soon as the rabbit population drops down the grass can develop again and the cycle restarts.

2.2 Experiment 2

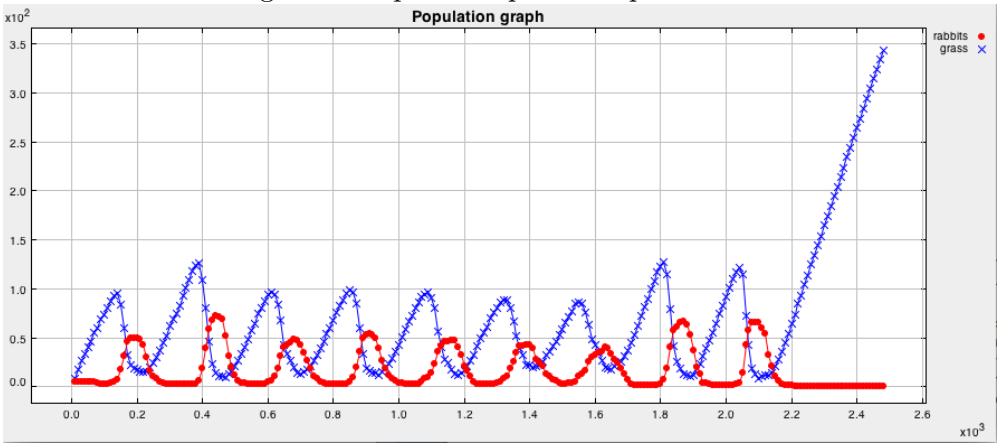
2.2.1 Setting

Same as Experiment 1 but the birth threshold was changed to 60 units of energy.

2.2.2 Observations

Since the birth threshold is lower, the population of rabbits increases much more quickly. Overpopulation makes the competition for resources intense up until the point where there is almost no grass left and the rabbits go extinct.

Figure 2: Population plot of experiment 2

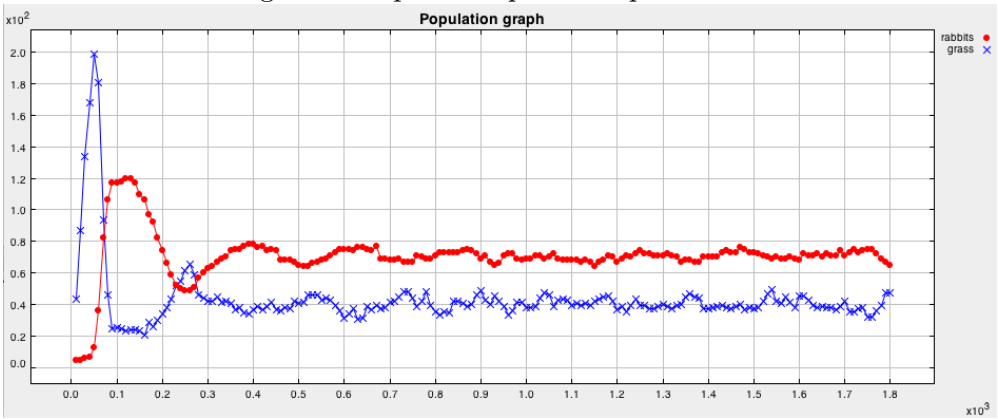


2.3 Experiment 3

2.3.1 Setting

Same as experiment 1 but the grass growth rate was doubled.

Figure 3: Population plot of experiment 3



2.3.2 Observations

In this setting the grass is consumed at the same rate at which it grows. The rabbits' deaths and births are also balanced. This results in population numbers with almost no fluctuation.