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

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1 Implementation

1.1 Assumptions

1.1.1 Assumptions for the Implementation of grass and of it's growth

There can be either 1 or 0 unit of grass per cell. At each simulation tick *GrassGrowthRate* (default 50) units of grass are added to empty cells **if possible**. This value is user defined and modifiable throughout the simulation.

1.1.2 Assumptions for the Implementation of the movement of Rabbits and of collisions

At each tick each alive rabbit tries to move to a random cell picked among the 4 cells adjacent to it's location. If it tries to move to a cell where another rabbit is present, **if the cell is empty it moves to it, if it is already occupied it doesn't move for this turn**. Regardless of whether it actually moved or not the rabbit loses 1 energy unit per tick.

1.1.3 Assumptions for the Implementation of feeding, energy and reproduction

Each rabbit has an energy value $e \in [0, 20]$ this value drops by a unit of 1 every turn. At each tick, rabbits "eat" grass after moving (in the new cell they moved to if they succeeded in moving). If there exists a unit of grass on the cell it's on the energy of the rabbit "eats" it (clearing the cell of grass) and the rabbit's energy increases by a value *GrassEnergy* (default 5) that is user-set and editable throughout the simulation. At each tick (before movement and feeding) if a rabbit has an energy value $e \geq$ *BirthThreshold* it gives birth (this means if a rabbit has gathered enough energy through eating it will give birth at the start of the next turn). *BirthThreshold* (default 20) is user set and editable throughout the simulation.

1.1.4 Assumptions for the Implementation of birth and death

When giving birth, **the parent rabbit gives a random proportion of it's energy to it's child**, meaning it losses some random amount of it's energy. The child inherits the exact amount of energy the parent lost when giving birth and appears on a random empty cell on the grid (the cell can have grass but no rabbit). The repartition of energy between parent and child is the following : $e_{parent} + e_{child} = e_{parent\ before\ birth}$. At each tick, after movement, feeding, and reproduction rabbits whose energy is ≤ 0, die: they are removed from the simulation.

1.1.5 Assumptions for the initialization of the sim

The model is initialized with a user-set *NumInitGrass* (default 100) number of grass cells (if this amounts can possibly fit on the grid, if it cannot then there may be less grass in the simulation). A user set *NumInitRabbits* (default 30) defines the initial number of rabbits in a similar way to the grass. Initial rabbits are given a random amount of energy $e \in [0, 20]$.

1.2 Implementation Remarks

In our model implementation energy is stored as a *double* value. The way the placement of new grass units and rabbits is handled is by picking a random position repeatedly until an empty cell is found, this operation can be repeated a finite number of times to avoid infinite loops in the case where no cell is free. This solution runs the risk of not finding a free spot in edge cases when there may actually be one but has the advantage of being relatively computationally inexpensive (in the most common case) compared to going through every single free cell every time. An alternative solution could be the storage of a separate list of every free cell but such an implementation would be quite memory-intensive for large size simulations.

2 Results

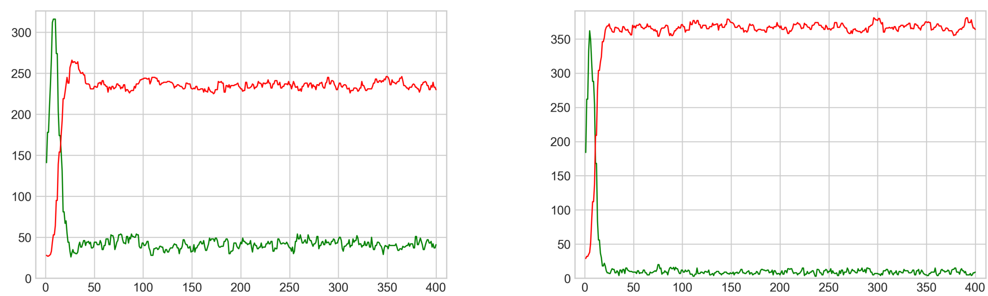

Figure 1: Plot of the rabbits (in red) and grass (in green) populations over the first 400 ticks of the reference simulation:

2.1 Experiment 1 : reference run

2.1.1 Setting

Default run : this will be our reference run. We will study the evaluation the simulation properties around those reference parameters.

2.1.2 Observations

2.2 Experiment 2

2.2.1 Setting

2.2.2 Observations

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2.3 Experiment n

2.3.1 Setting

2.3.2 Observations