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

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1 Implementation

1.1 Assumptions

Our world model works as follows :

- At the start, we spawn NumRabbits on different cells, and we plant a total of GrassRate portions of grass, dispatched randomly all around the grid (one cell being able to hold up to MaxShades portions).

- Then, at each update of the world, we do the following things for each rabbit successively (we shuffle the list of rabbits each time so their are no VIRs (Very Important Rabbits)) :

    - We move the rabbit in one of the 4 directions (NSEW) at random. If there is already a rabbit in the desired location, then the movement is cancelled.
    - We transfer all the grass in the cell of the rabbit to its energy, with a ratio of 1:1.
    - We reduce the energy of the rabbit by ExhaustRate.
    - We check if the resulting energy of the rabbit is superior to BirThresh, in which case we drastically reduce it and spawn a new rabbit in the world.
    - We check if the energy of the rabbit is less than 0, in which case we kill it.

- After having gone through all the rabbits one by one, we replant a total of GrassRate portions of grass, still with respect to the MaxShades limit.

You can also note that cells are colored brown when there is nothing in the cell and greener the more portions of grass there is, while they are grey when a rabbit is in the cell.

Here are a few points we could have done if we had more time and motivation (but added nothing interesting regarding the assignment) :

- Plant a different number of portions of grass each time, with a high amount at the start to quickly reach a balance.

- Experiment another function for exhaust (instead of a continuous loss, we could have reduce the loss if the rabbit ate a lot this round).

- Make the exhaust due to reproduction more flexible than a constant in the code.

- Spawn each rabbit with a random amount of energy.

- Control the amount of grass eaten (in our implementation, a rabbit eats all the grass in its cell).

1.2 Implementation Remarks

The key points in the code are :

- We use a linear scale for coloring the cells depending on the amount of grass in it, which explains the shared variable MaxShades in the **Model** and maxRate in the **Space**.

- When adding a portion of grass, we first check if there isn't already too much grass in the cell, in which case the portion of grass is simply lost.

- However, when trying to spawn a new rabbit, if there is already a rabbit in the chosen cell, we choose a new cell at random (no memory), up to 10x(20x20) tries (depending on the grid size, 20x20 by default).

- When moving a rabbit, the rabbit **Agent** sends a request to the space to be moved in a direction the **Agent** chose, but if there is already a rabbit there, the **Space** denies the movement.

- When doing the actions of the rabbits, we need to check whether he was just born or not, because if he is spawned with more energy than BirThresh, it will spawn a new rabbit, then another one,... Hence the variable newlyBorn.
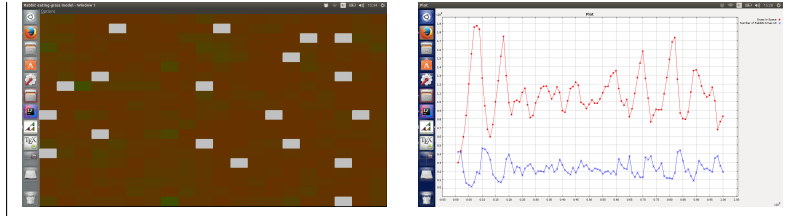
2 Results

2.1 Experiment 1

2.1.1 Setting

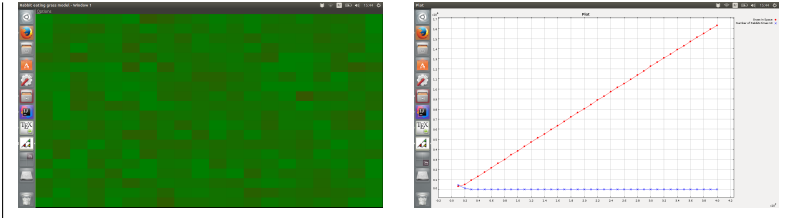| Parameters	Value
BirThresh	42
ExhaustRate	2
GrassRate	42
GridHeight	20
GridWidth	20
MaxShade	50
NumRabbits	42

2.1.2 Observations

This is a set of parameters that allows us to reach a balanced state. After around 200 ticks of transition state, numbers of rabbits and grass start oscillating, the maximums of one corresponding to the minimums of the other. This is logic considering that if we have more rabbits alive, they eat more grass.

2.2 Experiment 2

2.2.1 Setting

| Parameters	Value
BirThresh	42
ExhaustRate	3
GrassRate	42
GridHeight	20
GridWidth	20
MaxShade	50
NumRabbits	42

2.2.2 Observations

This is a set of parameters where all rabbits die quite fast. After the rabbits died, grass start groing at a linear rate (textscGrassRate per tick).

2.3 Experiment 3

2.3.1 Setting

Parameters	Value
BirThresh	38
ExhaustRate	2
GrassRate	42
GridHeight	20
GridWidth	20
MaxShade	50
NumRabbits	42

2.3.2 Observations
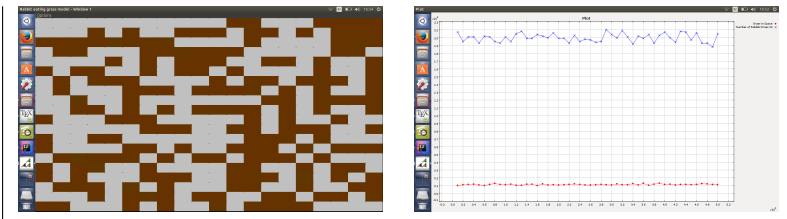
This set of parameters is choosed so that the newborn rabbits have enough energy to reproduce right at their second tick of life. This cause that the space is fast overcrowded by rabbits and grass don't have any room to grow.