Fox vs. Rabbit:

A multi-species ecological simulation

Description

In class this week we created an animated simulation of rabbits grazing in a field of grass and roaming from patch to patch. It was an idyllic world with no inter-species competition. Now let's increase the complexity by introducing foxes which feed on rabbits but leave the grass alone.

Our two competitors are the Cotton Tail Rabbit (*Sylvilagus floridanus*) and the common Red Fox (Vulpes vulpes). In this simulation, rabbits must east continuously, and if they find grass, they give birth to 1 or 2 offspring. The fox moves faster, reproduces less frequently, has at most one offspring (in this model) and can go without finding food for a while, but not too long or else it will starve! Will our foxes and rabbits find harmony within a stable symbiotic ecosystem? Only a robust simulation will reveal the answer!

Species Comparison (These animal features are *entirely* made up!)

Species	Offspring	Move Distance	Pixel Color	Food Consumption Frequency	Image
Red Fox (Vulpes vulpes)	1 only	0 to 2 (random)	Red	1+ rabbits per k=10 cycles (Try other k.)	
CottonTail Rabbit (*Sylvilagus floridanus*)	1 to 2	0 to 1 (random)	Blue	1 grass every cycle.	

Directions

1. Modify the artificial life rabbits-in-a-field simulation presented in class to foxes eating rabbits. Foxes can go without food for up to k=10 cycles. When they eat, they reproduce and both parent and child are now hungry. If they don't eat, they starve.

2. Visualize the field using a custom color map (look up how to do this). Use the following color scheme:
   a. Grass (Green)
   b. Unoccupied (a neutral color of your choice – white or tan might look good – i.e., bare ground)
   c. Cottontail rabbits (Blue)
   d. Foxes (Red)

3. Animate your simulation with support for user-defined field sizes, initial rabbit populations, and simulation speed adjustments. Your code should support a variety of *documented* command-line options so that the TAs can test your code. Use the argparse library for defining command-line arguments. At minimum, arguments should include: a) the grass growth rate, b) The fox k value, c) the field size, and d) the number of initial foxes and rabbits in the field.

4. After, say, 1000 cycles (generations), plot the population of rabbits vs foxes vs grass.
5. Report your conclusions.

   a. Which species is better able to survive?
   b. Does your outcome depend on the size of the field or the rate at which grass grow or the fox k value? If so, how?

Submit

- Code (.py)
- Visualizations (.png)
- Insights, conclusions 1-page (.pdf)