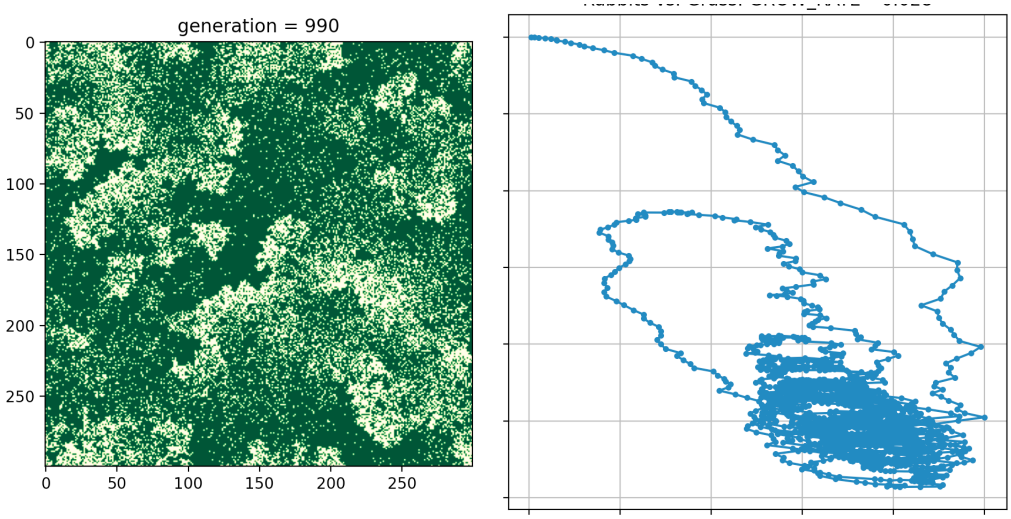
DS 3500: Advanced Programming with Data
Prof. Rachlin, Northeastern University

Homework 4

Rabbit vs. Rabbit:

A multi-species ecological simulation



Description

In class 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 up the complexity by introducing two species of rabbits.

Our two competitors are the Columbian Pygmy Rabbit (*Brachylagus idahoensis*) and the CottonTail (*Sylvilagus floridanus*). In this simulation, the Pygmy rabbit is slower but produces more offspring. The Cottontail is fast – capable of moving up to two spaces in any direction instead of just one – but its ability to explore and discover new grass may be offset by a lower rate of reproduction. Does one species eventually wipe out the other or will they reach some sort of symbiotic peaceful co-existence? Only a robust simulation will reveal the answer!

Species Comparison (These rabbit features are made up!)

Species	Offspring	Hop Distance	Pixel Color	Environmental Status	Image
Columbia Pygmy Rabbit (*Brachylagus idahoensis*)	1 to 2	1 to 1	Blue	Endangered	
CottonTail Rabbit (*Sylvilagus floridanus*)	1 to 1	1 to 2	Red	Common	

Directions

1. Modify the artificial life rabbits-in-a-field simulation presented in class to support two species of rabbits. Rabbits move and reproduce according to the table above.

2. Visualize the field using a custom color map. I demonstrated how to define custom color maps in the simulation of Langton's Ants. 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. Pygmy rabbit (Blue)
    d. Cottontail rabbit (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.

4. After some number of generations, plot the population of pygmy vs cottontail. I'll be really impressed if you can show this as a second animated subplot! (I might award this a bit of extra credit.) Also create a 3-dimensional plot of grass -vs- pygmy -vs- cottontail population.

Report your conclusions

- Which species is better able to survive?
- Does your outcome depend on the size of the field or the rate at which grass grows?

Submit

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