Teng Li, Ryan Huang, Eric Wu, Anthony Gemma

DS3500, HW5 Insights and Conclusion

Dr. Rachlin

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Fox vs. Rabbit: Insights and Conclusion

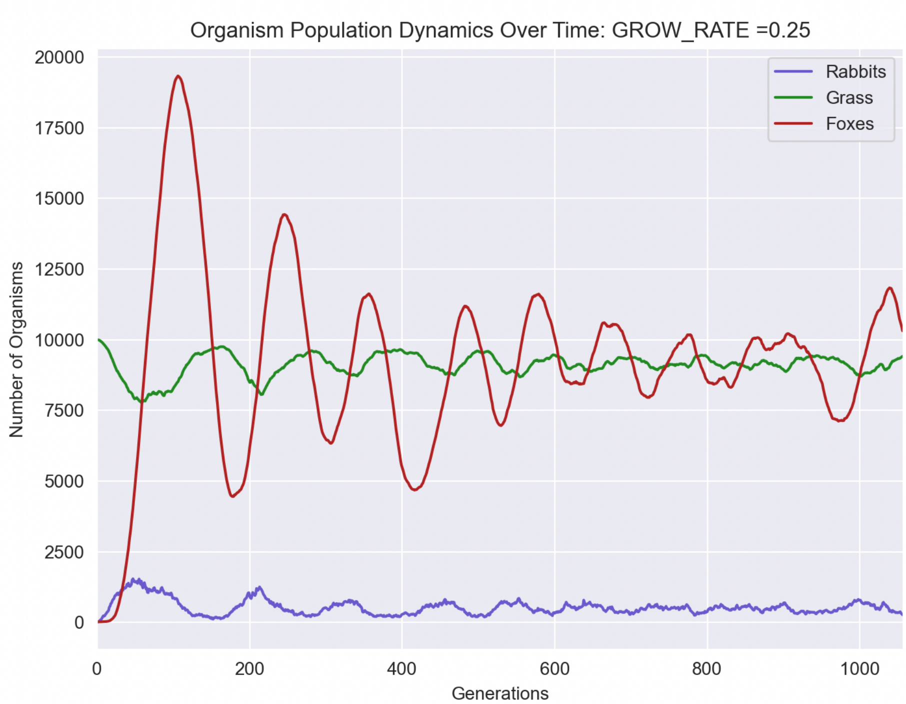
After refurbishing the simulation with an additional fox organism introduced to the grass field, the field was no longer at peace, one could argue chaotic at first. Intriguing observations can be drawn based on various factors, including the grass grow rate, the number of steps (k) foxes can go without eating rabbits, the quantity of rabbit offspring produced simultaneously, the distance covered by foxes in a single stride, and lastly the size of the initialized grass field.

When the specified parameters in the homework guidelines are applied, the poor foxes struggle to survive beyond 10 steps in a vast matrix exceeding 100x100 dimensions. Given that foxes were initially programmed to cover a maximum of two blocks per step, they often fail to catch any rabbits and subsequently face extinction. Therefore, two captivating insights surfaced that significantly influence the outcome of our simulation: 1) Parameter sensitivity and 2) Spatial dynamics.

In the context of the predator-prey simulation, several parameters, such as the grass growth rate, the initial number of rabbits and foxes, and their respective reproduction rates, play a critical role in determining the outcome of the model. Small changes in these parameters can lead to significant shifts in the balance between the predator and prey populations, and subsequently affect their survival rates and long-term coexistence.

Furthermore, spatial dynamics refer to the interactions and movement of organisms within their environment and the impact of these factors on the overall ecosystem. In the predator-prey simulation, the limited distance that foxes can cover per step represents an essential aspect of spatial dynamics since the ability of predators to move and hunt within their environment greatly influences their success in catching prey, which in turn affects the balance of the predator-prey system.

Hence, after realizing the above two crucial factors that affect the outcome of the simulations, several adjustments were necessary for the simulation to achieve an ecological equilibrium. After exploring many combinations of parameter and spatial settings, we identified a set that enabled the coexistence of rabbits and foxes for over 1000 generations. The modified parameters include a 200 by 200 grass field, one initial rabbit spawn, 20 initial fox spawns, a k value of 50, and a grass growth rate of 0.25. The plot below visualizes the changes in population of foxes vs. rabbits vs. grass over a thousand generations.



What is interesting is that foxes consistently maintain a high population level, relentlessly hunting rabbits, while rabbits have the lowest population levels. Furthermore, all three organisms' population display an interconnect, yet distinct patterns. By inspection, one full cycle of grass corresponds to about two full cycles of foxes. As their population levels interact, they may rise or fall at distinct intervals. In contrast, the rabbit population level displays a pattern that is opposite of that of grass but not of foxes. This interplay between foxes, rabbits, and grass demonstrates the complex interactions and dependencies within the ecosystem, highlighting the importance of understanding and preserving the delicate balance between these species.

This observation is fascinating and logical because the interdependence between foxes, rabbits, and grass serves as a classic example of predator-prey relationships and resource dynamics within an ecosystem. As fox populations increase, and grass cycles continue, a period of relative stability is maintained, indicating an adequate food supply for both predator and prey. During this time, the rabbit population experiences a decline due to the intensified predation pressure from the foxes.

On the other hand, when the fox population decreases, it signifies a reduction in the availability of prey, leading to a decline in predator numbers. This shift allows the rabbit population to recover as predation pressure diminishes, enabling them to effectively utilize the available grass resources for growth and reproduction. The alternating patterns of population levels illustrate the intricate balance and interconnectedness of species within an ecosystem, emphasizing the importance of preserving this delicate equilibrium for the overall health and sustainability of the environment.