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While working on our first complex systems project, we felt a bit overwhelmed and anxious due to the lack of time and the general unfamiliarity with NetLogo. However, it was a very interesting and worthwhile project because everything was novel, and we felt that doing this project would give us more opportunities to learn about new things.

The workshop was able to teach us the fundamental basics of operating NetLogo. It also taught us the power as well as the limitations of Agent-based modeling and when we should use it. Since the behavior of ants is well documented through various studies throughout the years, we found it appropriate to use agent-based modeling for the project. The workshop, however, did not teach us the ant’s behavior, and we had to conduct research on them to gain a better understanding of how they interact within the system.

We experienced several hiccups while taking on the project, especially in the beginning, because we first had to familiarize ourselves with NetLogo’s interface and syntax before we could even start work on the problem itself. After we got used to the program, figuring out the appropriate methods and implementation to simulate the ant colony was the next step. We first observed the sample ant colony model provided within NetLogo itself to get a grasp on what the output should look like. Then, we inspected the code provided in the sample as a reference to how the simulation was developed. We also researched on how ants communicate with each other while foraging for food and found out that the ants emitted a trail of chemicals called pheromones to lead other members of the colony to the food source. We attempted to emulate this process in NetLogo. To do so, we started by setting up the environment by identifying the components of the ant colony system and explored how these components interact with one another. After that, we attempted to replicate these interactions in NetLogo.

One of the problems we encountered while working on the logic of the simulation is that the agents we modeled did not accurately simulate real-life ant behavior. While our agents were able to somewhat release and follow pheromones like in real-life, it was not able to follow the pheromone trails as accurately or efficiently as the sample module showed. At first, the agents simply went to the patch with a higher concentration of pheromones, but then they simply followed the agent carrying the food to the colony without going towards the location of the food source. This made the pheromone counterintuitive, as the agents were being led away from the food, instead of towards it. To fix this, we made it so the agents ignored the pheromones if the chemical value of the patch was beyond a certain arbitrary value so that they won’t end up following the agents that are carrying food back to the nest. As a result, the first agent to find the food signals nearby agents to the food source, but the food would eventually reach a certain ‘critical mass’ wherein the number of agents obtaining food would bring the chemical value of the patches above the arbitrary value, making them ignore the pheromones on exactly where the food is. Due to the time constraints, we were unable to resolve the issue.

While working on the project, we wanted to find out whether the distance of the food sources from the ants’ nest had any effect on their behavior. To figure out the answer to this question, we setup two food sources to be equidistant from the nest and the third food source to be slightly farther than the other two. When we ran the simulation with this setup, the agents went to the nearer food sources first before the last one. This might be because the chemical trail the agents drop dissipates faster than the other agents could reach it. Another factor might be that there is a greater chance for the agents to discover the food source since they randomly explored the environment starting from the nest.

We also wanted to know whether ants ever got stuck while looking for food due to crowding, especially if there are a lot of them. We thought that if we could find a way to prevent collisions between the agents, we might be able to compare their behavior than if there was no collision detection implemented. However, due to the lack of time allotted to work on the project, we did not implement it into our current model.

After taking on this project, we are more confident to tackle future agent-based modeling projects as this project was able to give us background and more insights into agent-based modeling. In preparation for future projects, further reading into the different modeling methods and techniques could be investigated to make the simulation more accurate, as well as displaying the results into graphs.

References:

Czaczkes, T. (2014). How to not get stuck—Negative feedback due to crowding maintains flexibility in ant foraging. Journal of Theoretical Biology 360, 172-180. Retrieved from https://doi.org/10.1016/j.jtbi.2014.07.005.