Introduction to Agent-Based Modeling

Fall 2023

Modeling evolution of trust game https://ncase.me/trust/

Similar to lab 8

Final Project Proposal Form

Use the questions below to help guide your model design process. Note that **your model must be dynamic** (it must change over time and/or space).

For more information on the final project, see Lecture 13.

For the following problems, choose one of the questions from Problem 3 on your Topic Review and Selection Form as an example to work with. If you decide to change to a different question or topic later, that's fine! You are not beholden to what you write here, we just want you to go through these exercises to ensure that you're familiar with the process of conceptualizing a model.

Looking at how different levels of cooperation (big groups, smaller groups, individuals) can survive against the same type of predator and how it can change over time and what group survives the best. Can take inspo from meerkat and had some groups sacrifice an individual for survival or not sacrifice anyone.

1. Choose one of the research questions from Problem 3 on your Topic Review and Selection Form, or formulate a new question. Restate the question, then **briefly** describe a modellable process that you think could be helpful in addressing this question. You will refine your idea in subsequent problems.

YOUR ANSWER HERE

Process: The model will simulate the behaviors of groups and individuals in response to a predator threat, drawing inspiration from meerkat societies. It will explore strategies such as sacrificing an individual for group survival versus no sacrifice.

This will be similar to the predator and prey model but introduces the concept of cooperation.

2. Will your model be a cellular automata (1D or 2D), grid-based non-cellular automata (1D or 2D), free-motion, network, or a combination?

It will be free-motion

3. What will the agents in your model represent?

The agents will be the prey in the overall model.

4. If applicable, describe in detail the environment and/or layout that the agents operate in. For this question, the environment consists of any elements of your model that are not agents. Spatial constraints (ex. terrain), pathways, and connections are a small subset of the many types of elements that you could include in the environment.

The agents will operate in a 2D, free-moving environment. There will be food resources which agents need to consume to sustain themselves. There will also be predators that prey upon the agents.

5. What information can agents in your system access/sense? This could be information about an agent's environment (global or local), states of neighboring agents, states of all agents, global averages, local averages, etc.

The agents should only be able to perceive/sense objects and environment within their radius of perception. The agent's environment is global, where w

6. Do agents in your system interact with each other? Do they interact with their environment or vice-versa? If so, how does this interaction occur? Is it direct or indirect?

- Example of direct interaction: wolves eat sheep when they come into contact
- Example of indirect interaction: deciding not to go to a bar/restaurant because it is too crowded

They do interact with each other. They have direct and indirect interactions by eating food sources with direct interaction, which includes the prey eating grass and the predators eating the prey. Then, there is indirect interaction by forming packs based on cooperation and moving the same direction with each other, similar to boids.

7. What is the initial state of your model? To answer this question fully, you'll need to answer the following sub-questions:

- What is the starting state of the environment (if any)?
- What is the starting state of agents (initial location, initial preferences, initial type, etc.)?
- Is your initial condition always exactly the same or does it vary between runs?

There should be agents that are randomly located in the space within the area. Food resources will also be randomly located throughout. Predators will also be randomly placed throughout and should vary between runs. In the absence of perceptible food resources and predators, agents should be moving randomly in search of food resources.

8. If applicable, is the environment/layout of your model fixed or dynamic (does it change)?

The layout of our model is dynamic because the agents consume food which will then affect the health of the agents. Their location changes based on where the food source is and then based on if there is prey nearby.

9. Is randomness built into your model? If so, what aspects of your model are designed to be random? Why is randomness used? If not, a simple "no" will suffice.

Some common justifications for the use of randomness:

- To reproduce variability
- To cause model events/behaviors to occur with a specified frequency

Randomness is built into our model. In initial conditions, agents will be randomly located, food sources and predators will also be randomly located. We will be using randomness to cause the preys to cooperate with each other and randomly have the food sources and the predators to induce movement of the pack. There also will be randomness in reproduction rates of the prey, to show the effects of more or less prey on the agents. There will be randomness in speed and direction based on the attraction/ cooperation of the agents.

- Reproduction rates
- Speed (taken in consideration with attraction factor)
- Direction(taken in consideration with attraction factor)

10. Does your model feature agents or environments that adapt/learn over time? If so, explain below. If not, a simple "no" is sufficient here.

No.

11. In your model, is there a realistic concept of time? If so, how much time does one timestep represent? If your model doesn't have a realistic concept of time (which is an equally valid design choice), explain why this isn't a necessary/desirable feature in the context of your model.

There is a realistic concept of time by having each timestep be around 10 minutes. This is valuable because we can see how the flocking

12. In your model, is there a realistic concept of distance/space? If so, how much distance does one unit represent? If your model doesn't have a realistic concept of distance/space (which is an equally valid design choice), explain why this isn't a necessary/desirable feature in the context of your model.

Yes, there will be a realistic concept of distance and space where one unit is 10 ft. This is because it is important to accurately show the size of the groups of agents and how attraction/ cooperation affects the speed and direction of the agents based on other agents.

13. Do the agents in your model update synchronously (all at once), or asynchronously (one at a time)?

For example, agents (land plots) in the forest fires model update all at once, while agents (individuals) in the Schelling model move one at a time.

The agents in the model should update synchronously.

14. In order of occurrence, detail exactly what happens in a single time step of your model. In other words, how does your model update? Answer in the form of a numbered list.

- If an agent comes into contact with other agents, they may form a group and adjust their behavior based on the group's dynamics to move in the same direction.
- Agents might continue as a group based on the current environmental conditions and individual strategies.

15. What parameters will be present in your model? Which ones would you need to adjust to design an experiment that's relevant to your chosen question from Problem 1? How does varying these parameters address your question? Recall that in the context of your experiment, the input parameters are the independent variables.

Note that in addition to numerical parameters like the ones we explored on the Labs, things like underlying model structure can be treated like a parameter and changed in your experiment.

Key parameters can include group size, resource availability, and predator frequency. All of the parameters listed before are adjusted because group size changes based on the cooperativity and how close other predators and other agents are within the radius. What we will be looking at is how many predators end up clustering with each other based on the cooperativity level. Additionally, the food sources and prey that are nearby affects the clustering behavior and how many end up staying with each other when prey appears near the predators. So the independent variable is the visual range of the predators and how they cluster together based on the cooperativity level. Varying the cooperativity level addresses our question because it allows us to see if animals have better survival in groups compared to smaller packs.

- Reproduction rates
- Energy/Health level for each agent
- Speed (taken in consideration with attraction factor)
- Direction(taken in consideration with attraction factor)
- Visual range

16. What specific quantity/quantities will your experiment measure? In other words, what are the dependent variables in your experiment? How will you measure the dependent variable/variables? How are the dependent variables related to your question?

The Specific quaniti

- Reproduction rates
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- Visual range

Hey team,

I’ve graded and left comments on everyone else’s project proposals. Before you submit yours, here are a few common pitfalls that I want to make sure you avoid:

1. Have one group member review the proposal and produce the final edit to avoid contradictory or disjoint information
2. Make sure that you’re not including any extraneous features that are irrelevant to your research question
3. Make sure every concept that you mention is explicitly defined in the context of the model, and discuss how you’ll represent that concept in the computer (ex. a list, a decimal between 0 and 1, etc.). Also discuss how concepts interact with other elements of the model. For example, if agents have a “utility” score, state how that’s calculated and how this score influences and interacts with the rest of the model.

Coding:

- Have three separate classes?
- How can we compare them to each other

How the cooperativity affects survival.