Artificial Intelligence in an Agent-Based Model

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Abstract

Agent-based modeling is an extremely diverse field of research, and much analysis and research into the effectiveness of agent-based modeling. Agent-based modeling is valued for its ability to model scenarios in a level of detail that would be prohibitively complicated in an equation based model. I will investigate the possible value of detailing agent behavior beyond simple rules, to the level of basic artificial intelligence for each agent. This project will yield a deeper understanding of multi-agent modeling. A modeling of a simple predator-prey interaction with implementation of advanced decision-making mechanisms for agents should yield different results depending on the level of intelligence each agent has.

Keywords: modeling, agents, artificial intelligence

1 Introduction

1.1 Project Scope

Clearly, implementing a scenario that investigates all artificial intelligence in agent-based modeling is beyond the scope of the resources available. As a result, this project will attempt to analyze the results of implementing varying levels of artificial intelligence for agents in a simple simulation between predator and prey. Multiple cases of the scenario will be set up, and the rules for each agent will be varied between cases. The cases will be compared to yield results concerning the effect of the artificial intelligence.

1.2 Problem Goal

Ideally I will gather information about the impact of modeling a scenario with artificial intelligence in contrast with simpler setups. The existing research into the effectiveness of artificial intelligence in agents is considerably sparser than the investigation into the rest

of this area, and this project will hopefully provide a starting point for further research.

2 Background

Research has been done on the effectiveness of agent-based modeling versus equation-based modeling. A specific example compared traditional equation-based models of interactions to agent-based modeling, and attempted to determine whether agent-based modeling provided advantages over equation-based modeling. The subject under examination was the interrelation of wealth versus education over the generations, and the comparison yielded similar results in the increasing disparity of wealth over generations due to the education of the respective children. However, the agent-based modeling yielded more information than the equations, showing that the classes which a family runs in do change over the generations, a result that the equation-based model was unable to show. In addition, another experiment investigated the necessary level of detail for rules that govern agents in a model, and determined that clearly a basic level of modeling agents is not sufficient when the results do not match results found in the actual scenario being modeled.

3 Program Setup

The code can be seeded by the compiler, allowing simulations to be repeated, but this is set inside the code, meaning no user input is allowed currently. The user can adjust the sliders to set the initial values for each kind of agent, while the reset button resets the simulation using the current seed. The new sim button allows the user to get a new seed for the simulation, using the current parameters defined in the user interface.

4 Basic Intelligence Scenario

Each agent moves and interacts according to methods that are defined separately. At the end of the first quarter, only the interaction between predator and prey had been defined, as the predator growing and the prey dying. However, by this time, I have implemented interactions among agents of the same type, allowing for reproduction within a species. In additon, I have implemented functionality to display the populations of each type of agent over time on screen, allowing the user to view the value of each population as a function of time. Also, the program is now capable of outputting the populations over time to a file for later graphing. Eventually this scenario could be verified for value by comparison to an equation-based model of the scenario written in a program such as Stella, to confirm basic functionality of the model without using artificial intelligence for the agents.

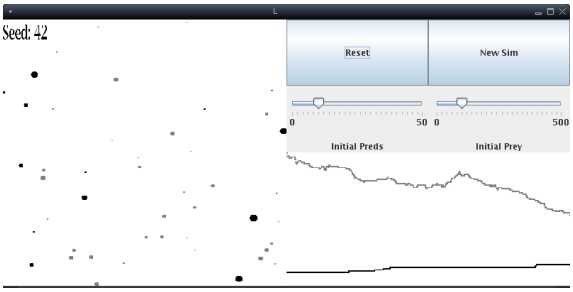

Figure 1: Program during runtime

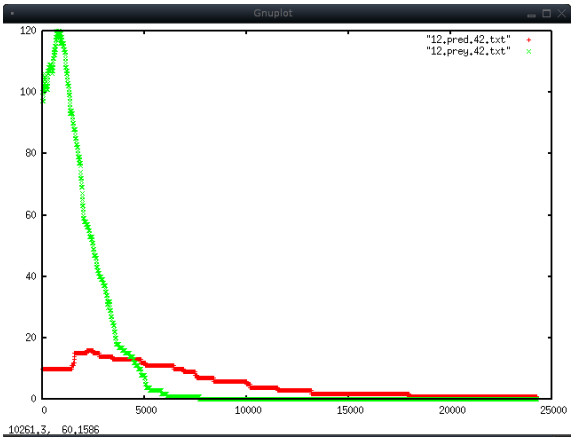

Figure 2: Graph of program results

5 Advanced Intelligence Scenarios

Until I am able to implement a more accurate basic intelligence scenario, the advanced intelligence scenario is on hold.

6 Results and Discussion

Using the data output I implemented, I plan to construct charts and graphs that detail and explain the data generated by the simulation, and compare the results from different scenarios. I will have the program output its results to a file, based on the seed used for the program, and graph that data separately for presentation. Also, I will create in-program graphs that display population over time of each kind of agent, possible food sources, and population of each agent with a given AI. The results could be useful to someone considering modeling a population of agents in a more detailed way, incorporating more specific aspects of a given scenario's agents.

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