Examining Leadership Dynamics in Agent Based Modeling Research Paper

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Abstract

The project attempts to explore leadership dynamics in Sugarscape. The goal is to discover which methods are most frequently used in group formation, which leadership traits form the best groups, and which traits are valuable in followers. This topic was not addressed entirely by Sugarscape, and thus is a good topic for a Syslab project. In addition, Sugarscape spends very little time on combat, and this project intends to fill this gap as well. Socio-economists and other members of the intelligentsia will be interested in the results.

Keywords: agent, Sugarscape, leadership, group dynamics, decentralized

1 Introduction

In the renowned Sugarscape simulation, one element was missing. The decentralized rise of leadership dynamics. This trend is prominent within the world's history, in nations such as the Holy Roman Empire during the 17th century, where a disjointed patchwork of nations conducted their own business with very little central interference. However, it is very hard to create leadership dynamics that remain decentralized, as the very presence of leadership often can lead to greater degrees of centralization in the simulation. This problem can be solved by treating groups as if they were agents; by making the group attempt to gain as much wealth as possible. In addition, the loyalty of the group to its leader is partially determined by the wealth of the group, which prevents the leader from keeping perfect control over his followers, retaining decentralization at all levels.

The goal of the project is to implement these leadership dynamics into Sugarscape. The first step toward achieving this would be to implement more complete system of combat into Sugarscape. I chose to use combat because it offers a diverse array of traits that could be used to distinguish different leaders from each other. Physical Strength, Intelligence, and Wealth are all heavily effected by combat and each has a purpose in the conduct of war. However, it is more in keeping with the idea of Sugarscape to take existing traits and expand those traits to cover the added traits.

Strength is determined entirely by Metabolism. Metabolism determines the agents' effectiveness in combat. This has the side effect of making survival difficult for strong agents, those who have alternate sources of sugar due to the bonus from killing other agents.

Intelligence has been incorporated into Vision. Vision determines the area that the agent can see. In addition, the higher an agents' vision is, the better it is able to judge the combat effectiveness of an opponent before fighting.

Although Charisma and Morale are huge factors in leadership, they do not lend themselves to concrete values and purposes. Thus, they have been cut from the project.

Wealth is the food and the gold of the simulation. Agents covet it, gathering as much as they possibly can. Every action in Sugarscape is derived from the same desire; to gather more sugar. An agent joins

a group because it is economically advantageous; the leader gains power while the agent gains wealth. Loyalty is directly based upon the group's economic value to the agent, if the agent could personally gain more sugar by leaving the group, they will. The decisions of the group, like the decisions of the agents, will be completely determined by the gain in sugar from these actions. This means that the group seeks to do the actions that gain the most sugar for the group as a whole, which can sometimes conflict with the actions that gain the most sugar for the individual agent.

2 Background

The premier project in this field is Sugarscape, which is the basis for this project. The main area of social science that Sugarscape did not cover was leader dynamics. In addition, the Sugarscape system of combat was far less complete and realistic then the other aspects of the project. This project attempts to address these shortcomings. While the project will incorporate an alteration of the Sugarscape method of combat initiation, the rest of the additions are wholly new. It will be necessary to implement common group theory, such as flocking, however, the rest of the project goals have not been covered from a decentralized prospective.

3 Shaving down Sugarscape

This project hopes to achieve these goals by altering a version of Sugarscape that was made on MASON for my project. However, the intent was to start simply, to use only sugar consumption and the aforementioned system of combat, but the MASON version came with the full trappings of the earlier project. Thus a considerable amount of time has been spent temporarily removing the extraneous features. This has been accomplished by commenting out all the variables and methods that are not needed in Agent.java and Sugarscape.java. Currently, this is complete after it was realized that this version of Sugarscape already incorporates methods to exclude the more advanced functionalities of Sugarscape.

4 Combat

Development is nearly complete on a combat system for Sugarscape. The current model is Metabolism * 4 + Wealth, with ties going to the defender. Agents initiate combat as part of a desire to gain the maximum amount of sugar. They look at their visible squares and if they are occupied, they add 2 to the value of the sugar on that square, unless the occupant is perceived as being stronger than the searching agent. This is determined by vision, the occupant's combat effectiveness is multiplied by the Vision and divided by 4. Since the max value of Vision is 4, an agent with 4 vision will be able to perfectly perceive the strength of of opponents. On the other hand, an agent with a Vision of 1 will underestimate every opponent severely and will end up attacking almost indiscriminately. The searcher will move to the square that gives the highest amount of sugar and is perceived as safe. If the square is occupied, then combat ensues. The loser dies and the winner gains 2 sugar. This function is nearly complete, however, several difficult bugs remain in the detection and movement code.

5 Preliminary Results

Preliminary Results are pending the correction of the bugs in the combat system. After they are dealt with, tests will be done on the combat system to judge the combat algorithm, specifically whether the ratio of metabolism to wealth is correct or whether wealth deserves an influence in combat at all.

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