TJHSST Computer Systems Lab Senior Research Project
Examining Leadership Dynamics in Agent Based Modeling
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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 intelligista will be interested in the results.

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

1 Introduction - Elaboration on the problem statement, purpose, and project scope

1.1 Scope of Study

I plan to develop an alternate system of combat for Sugarscape. This system will rely on several new traits that will be determined at birth. I then plan

to create group dynamics based on leaders, attracting followers or accepting followers based on these new traits. If I am able to fulfill these goals, I plan to create subordinate followers who help the leader and allow leaders to have greater control over the group's agenda. Perhaps the subordinate followers could be acheived by chains of groups and group leaders. In addition, I could add reproduction, heridity, lineage, culture, and trade to the simulation.

1.2 Expected results

I expect to obtain results regarding the original layout of stats. I suspect that Morale lead groups will be the most common, Wealthy groups will be the largest, and Intelligent groups will be the best able to survive.

I plan to explore group dynamics and leader dynamics with these traits. In specific, I will analyze the prevelance of each trait among the leaders, the success of each leader based on his traits, the traits of the followers, the size of the groups, the wealth of the groups, the wealth of a group versus an individual, and many other components of the group dynamic. This research could contribute to neo-classical theory regarding leadership, wealth, and charisma.

2 Background and review of current literature and research

This area is dominated by the book *Growing Artificial Societies*, which was written about Sugarscape by the creators of Sugarscape. The Sugarscape model is the state of the art model in agent based modeling currently. I could also adapt features from the many agent based modeling programs created in Swarm or MASON. However, I still need more research that is not directly related to Sugarscape.

3 Procedures and Methodology

I will need to finish disabling all the extraneous functions of my current Sugarscape model, like reproduction and trade. In addition, I will have to create a method of combat intiation, which will likely be adapted from Sugarscape. It will also be necessary to create three new traits, possibly four

if I don't decide to use Sugar as Wealth for all the agents. I will also need to create an algorithm for followers to seek a group, for leaders to seek followers, and for followers to join leaders.

The extraneous functions can possibly be turned off inside the Sugarscape UI, however, I am having trouble getting this to run, so currently I am removing the functions from Agent.java and Sugarscape.java anyways.

Combat initiation will likely be a system of competition. An agent will move to the square with the most sugar within its vision and if it is occupied by a weaker non-ally agent and the weaker unprotected by any stronger members its group , then it will initiate combat. I plan to add an element of intelligence to the initiation; the farther away the other square is compared to the agent's vision (and therefore, intelligence), the harder it is to accurately determine whether the occupying agent is weaker than the attacker or whether the group members are weaker than the attacker, or if there are any group members at all. In addition, I might implement more of a mob mentality in combat for agents in groups by assessing the sum of attacker's nearby group vs. the defender's nearby group.

As for Combat itself, that will be determined primarily by the opposing strength of the two. Morale will likely give a significant boost, and Wealth and Intelligence might play a small role as well. In addition, group attacks might be made possible.

The four traits I plan to use are Strength, Intelligence, Wealth (Sugar), and Morale. Strength determines one thing, effectiveness in combat. Intelligence determines vision and assists the agent in judging the stats of other agents. Wealth is currently equivalent to Sugar, however, it might become its own seperate variable; similar to real life's Gold. No matter what, it could be used to buy the loyalty of followers and will be necessary for any leader, as the leaders will be responsible for keeping all group members fed. Morale determines an agent's ability to attract followers and in a follower, the follower's loyalty to its leader. In addition, it will likely play a significant role in combat. Morale, Strength, and Intelligence will be determined at birth, however, it is possible that Strength made increase by fighting and Intelligence may increase with age.

Group attracting will likely be determined by several traits. Wealth and Morale will both play a significant role in attracting followers. Strength and Intelligence may also be a factor if the joining agent is intelligent enough. Wealthy leaders can seek followers by offering them Sugar in exchange for loyalty; Morale leaders can attract followers on their own. Members of a

group will stay in a group based on their Loyalty. All followers demand a certain amount of sugar per day from the leader. Their Loyalty will be determined by how much Wealth they have, by their Morale, and by the leader's Morale. They demand Sugar from the leader based on their loyalty to that leader, the higher the loyalty, the lower the cost. Once the Loyalty reaches a certain low point, the follower will leave the group. Agents with low wealth are more likely to join a group, agents with high wealth are more likely to accept followers. Intelligence determines the selection of followers.

I can gather input by measuring the follower relationships to each leader, by analyzing the deaths of followers, by looking at the overall wealth of a group, and by looking at the key stats of the leader. These can be turned into a number of different groups, for instance, it could measure wealth disparity among groups such as Sugarscape did for individuals.

I can use dynamic testing by randomly generating statistics and position for the modified Sugarscape agents and then allow them to carry out the rules for the specified amount of time. I can also tweak the methods that I am using for combat and the like in order to obtain more realistic results.

4   Expected Results

I except that leaders whose stats are primarily oriented toward morale will be the most common leaders, while intelligent leaders will be the most successful leaders, especially if greater control over the group agenda is allowed. Strong agents will often become wealthy agents due to their ability to steal the wealth of others. Wealthy leaders will be extremely effective if they are able to make use of subordinate followers and will probably own the most numerically large groups. I suspect that strong or morale follwers will be the most desirable, whereas intelligent or morale subordinates will be preferential.

These particular results could easily end up differently than what I have hypothesised, as Strength agents could kill off all the Intelligent agents earily in. For that reason, the results could end up in opposition to normal thought about group-leader dynamics.