Exploring Wealth Distribution Through Sugarscape

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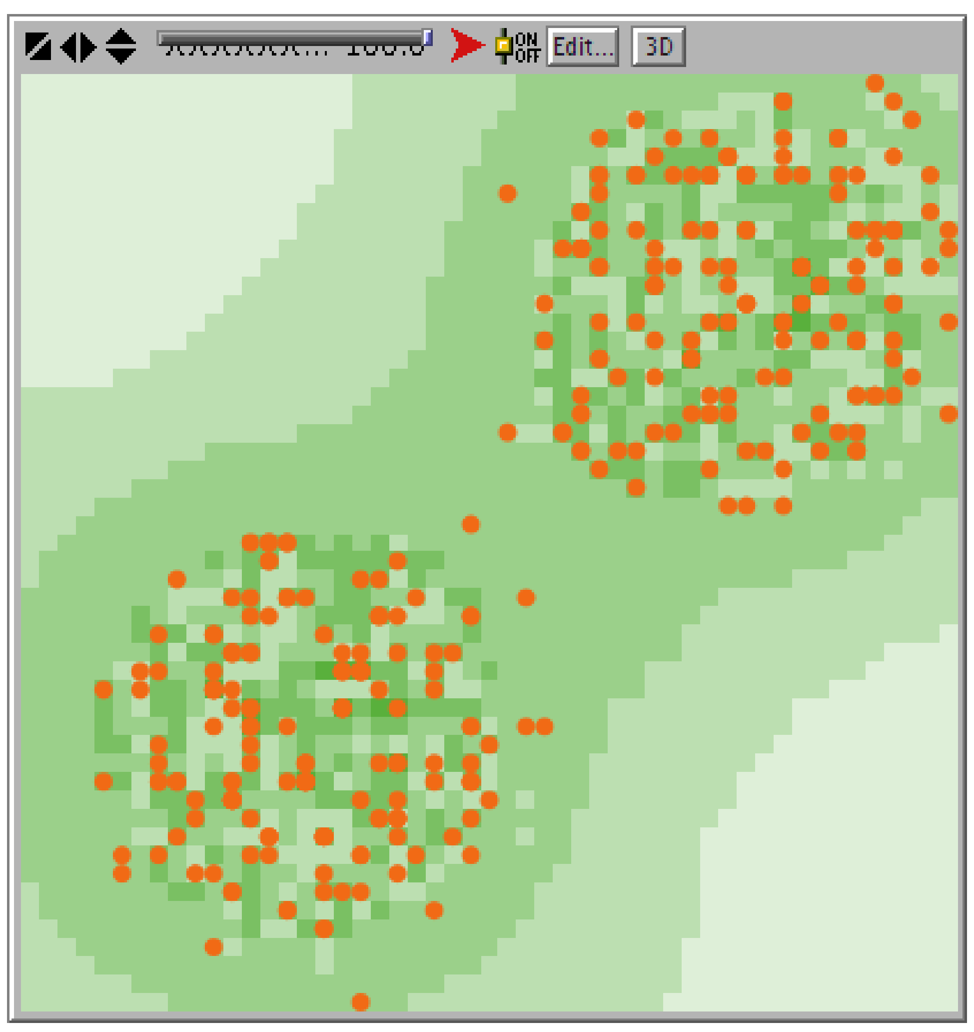
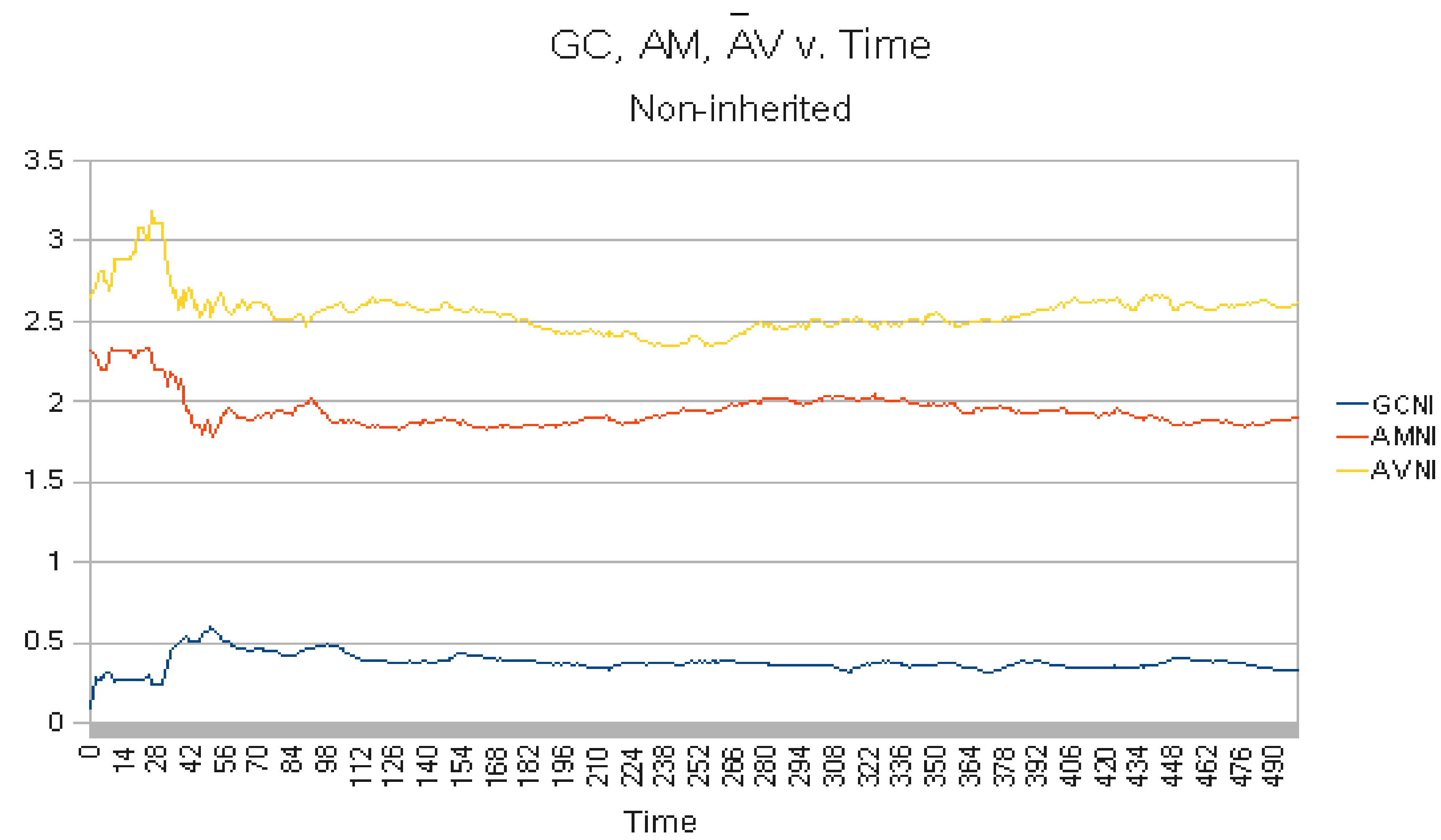
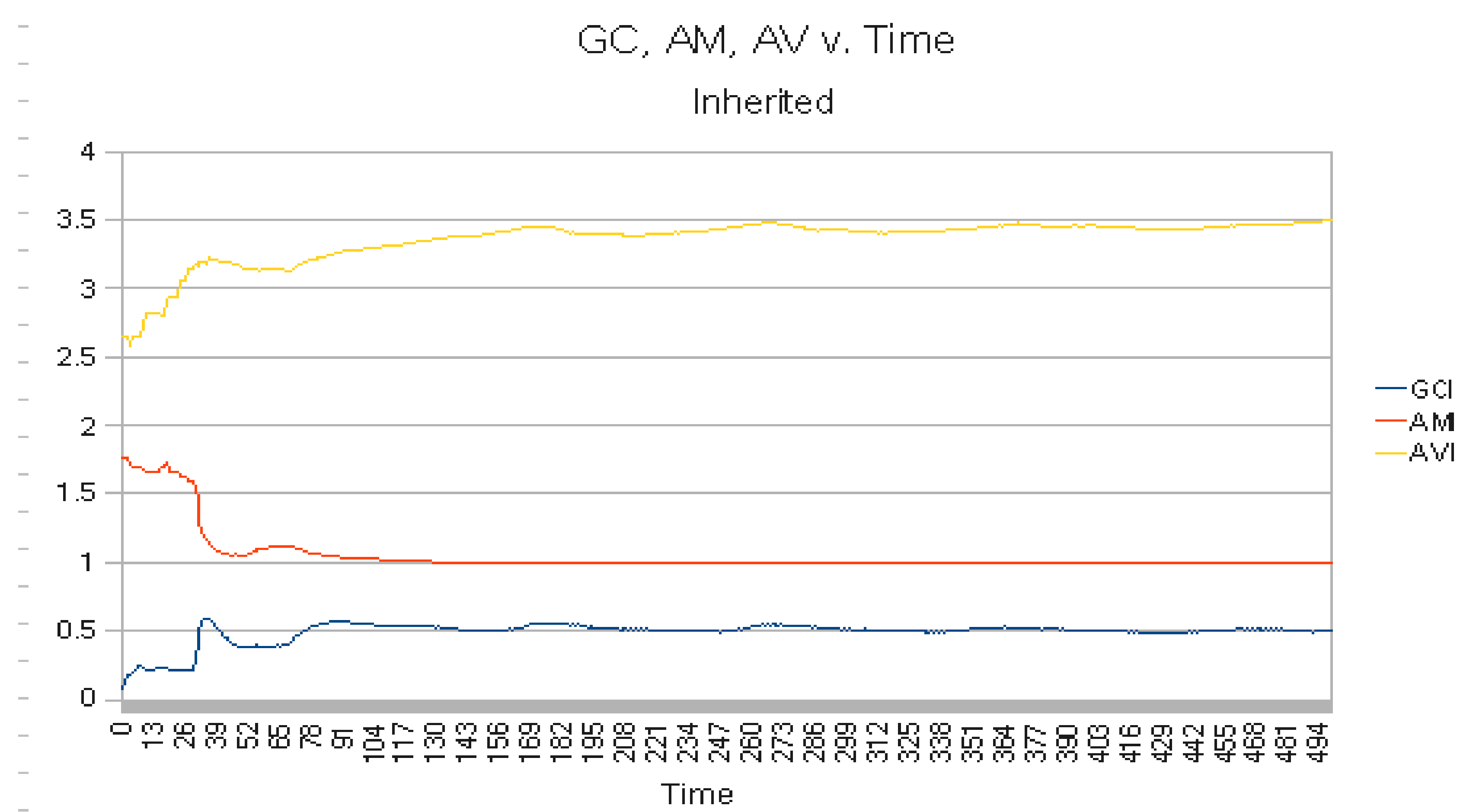
Abstract

Agent based modeling is a method used to understand complicated systems through the simple rules of behavior which its agents follow. It can be used to explain simpler systems, such as the pattern in which birds fly, or more complicated systems, such as self-segregating neighborhoods. The systems lend insight into the way in which they develop. One common application of agent based modeling, Sugarscape, developed by Epstein and Axtell, creates an environment where agents follow simple survival rules within their society. Sugarscape allows for analysis of a variety of trends resulting from the agents interactions, among which is wealth distribution.







Background

Agent based modeling, a bottom-up method of modeling complex situations, has become a useful method for simulating problems in the field of social science. The agents, the main building blocks of the model, are designed to follow a set of rules or guidelines. Their interactions result in a more sophisticated global result. This approach programming lends itself naturally to social sciences because of simplistic way in which it creates societies through its components which are guided by rules directed at individual interactions rather than the group. One common simulation using agent based modeling is sugarscape, which is comprised of a set of agents who make calculated moves through a sugarscape a landscape that varies in the amount of sugar, a renewable source of energy for the agents, available at each square in the grid.

Methods and Procedures

The Sugarscape agents behaviors are specified by a set of guidelines based on the rules laid out by Axtell and Epstein. The agents have vision, metabolism, and energy, and can reproduce or die at any timestep.

Each timestep, the amount of sugar in the patches adjusts to reflect the consumption by the turtles.

The wealth of the agents is analyzed using the Gini coefficient at each timestep.

It is also possible for vision and metabolism to be inherited or determined randomly. This choice is specified by the user in the panel.

Results and Conclusions

If metabolism and vision are inherited, the Gini coefficient varies by an average of 0.8, with the average Gini coeffienct over 800 timesteps of the non-inheriance simulation at 0.37 and the average Gini coefficient over 800 timesteps of the inheritance simulation at 0.44. This reflects a much greater inequality when the agents are able to inherit the "genes"–good or bad–of their parent agents. It is important to note, however, that the wealth distribution during inheritance simulations is much more stable than the wealth distribution of the non-inheritance simulations.

When the vision of each individual is displayed on the individual, which can be controlled by a switch in the display pannel, it is possible to observe the movement of agents based on their vision. When vision is not inherited, the agents with higher vision tend to find the highest mound first, but no particular patterns beyond that emerge. However, when vision is inherited from the parent agent, there tends to be a bottleneck of visions. For instance, on the southwestern mound, it may be that only agents with a vision of 4 and 3 survive, while agents with a vision of one or two may survive on the other mound. From this point on, agents with a vision of four or three tend to populate the southwestern corner, while agents with one or two will populate the northeastern mound. This genetic bottleneck tends to continue for a hundred or more timesteps. The wealth distribution of certain regions will be different than that of other regions; if agents with a vision of four populate an area of the map, while agents with a vision of two populate another corner, then the area with the agents with a vision of four, who are able to search a wider radius for food, will have a higher average Gini coefficient than the area with a lower vision. The same idea is true for metabolism.