Exploring Artificial Societies Through Sugarscape

Jordan Albright
TJHSST Computer Systems Lab 2007 - 2008

Abstract

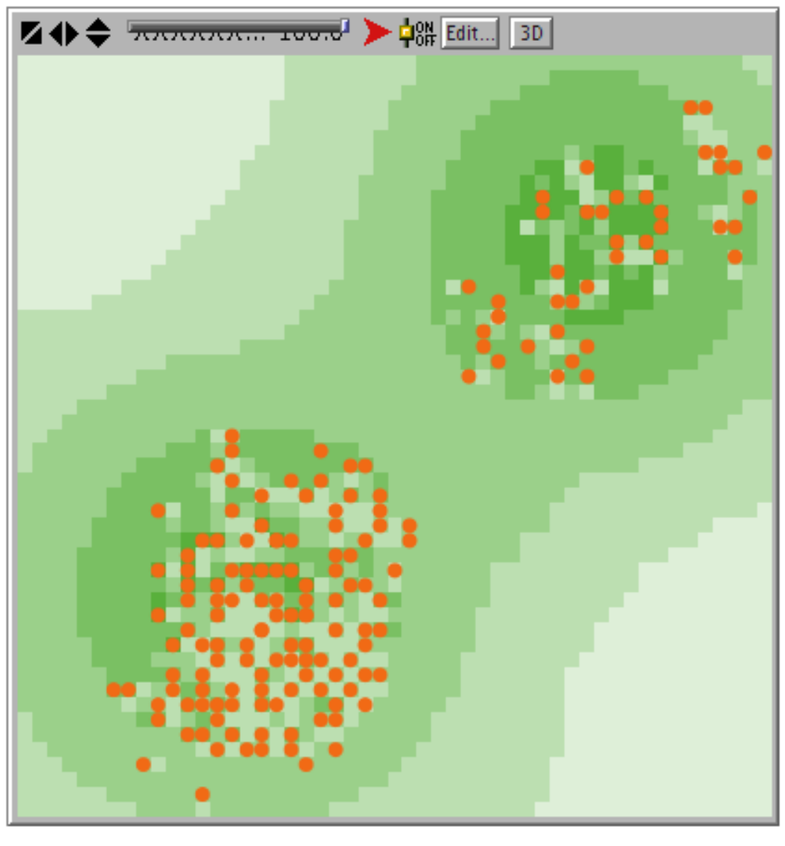
Agent based modeling is a method used to understand complicated systems through the simple rules of behavior which its agents follow. It can be used to explain simpler systems, such as the pattern in which birds fly, to more complicated systems, such as self-segregating neighborhoods (Macy, 2001). Though the systems resulting from the interactions of the agents are not perfect replicas of more complicated societies, they 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.

Introduction

The application of agent based modeling, specifically Sugarscape, to study wealth distribution and disparity has been undertaken by a number of researchers in economics and social sciences. Sugarscape does not model a typical modern society of today in which production and skill acquisition are factors in the success of agents, but rather more closely models a hunter-gather society in which gathering and trade are the way in which agents accumulate wealth in the form of sugar.

In An Agent-Based Model of Wealth Distribution, Impullitti and Rebmann used a Netlogo version of Sugarscape to look at wealth distribution from both a classical and a neo-classical approach to economics. Impullitti and Rebmann found that inheritance of non-biological factors increased wealth distribution while inheritance of biologically based factors decreased it.

Many agent based modeling problems, such as the Impullitti and Rebmann version and this particular problem using sugarscape, are programmed using Netlogo.s



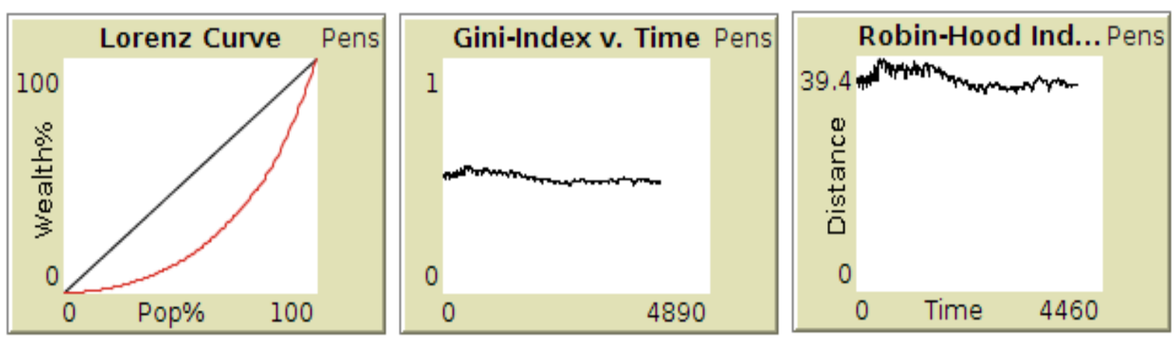
Procedure

The Sugarscape agents' behaviors are specified by a set of guidelines. One of these guidelines involves searching for food: in each timestep, each agent determines which patch or patches of the Sugarscape would be the best place to move. The agent looks north, south, east, and west, within its vision and determines the patches with the most sugar that is not already occupied by another agent and moves to one of those patches. The agent then gathers all sugar on the square, which it stores as energy.

At each timestep, the agent may also reproduce or die.

The amount of sugar in the patches adjusts to reflect the consumption by the turtles. Every other timestep, patches regrow their sugar by one increment.

This version of Sugarscape utilizes three different algorithms to analyze wealth distribution: the Lorenz curve, the Gini coefficient, and the Robin Hood index. The Lorenz curve plots the actual distribution of the wealth. The Gini coefficient represents the ratio of the area of the Lorenz curve to the area of the triangle of perfect equality (the integral of the line of perfect equality). The Robin Hood index represents the amount of wealth that would need to be redistributed – taken from the wealthy individuals and given to the poorer ones) in order for there to be perfect equality.



Results and Conclusion

The goal of this project is to provide insight into how wealth is distributed in a free trade society. The society is limited in its production and resembles more of a hunter-gatherer society in which each agent gathers as much food as it can. This model is developed using a Sugarscape society written in Netlogo, whose agents are limited by age, metabolism, and vision.

Though this project is beginning to mathematically show the relative wealth distributions, more analysis needs to be done before the data provided is meaningful. Though there is analysis of the wealth distribution of this particular Sugarscape, it may need comparison to other analyses of similar problems before the data can be useful.