

Project Proposal

Sugarscape: An Application of Agent Based Modeling

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1 Purpose

I plan to first recreate Sugarscape as it was created by Epstein and Axtell in *Growing Artificial Societies*. I will be starting completely from scratch, so while my code will be nothing like theirs (they do not actually provide it in their book), it will implement all of the functionality in the original Sugarscape. Most importantly, it will be easily extensible, allowing users to easily create their own rules to test hypotheses.

2 Background

Agent based modeling comes from the idea that simple interactions can lead to complex behavior. In agent based models, there are relatively simple rules that govern the behavior of agents; complex behaviors emerge from the interactions of these agents. One of the earlier agent based models was *Boids*, which simulated the behavior of flocking birds. In general, each agent tries to avoid crowding the other agents, while staying near them and flying in the average direction of nearby agents. From these simple rules, flocks of agents that travel across the "map" arise. Sugarscape is one of the most complex agent based models that has ever been created. It is meant to model simple human societies and make sociology more of a "hard" science, like chemistry

or physics. The basic underlying structure of Sugarscape is the scape, which consists in its simplest form of a grid of cells, each of which contains a certain amount of sugar. Agents travel around the map, collecting the sugar that they need to survive and interacting with each other. More complex versions of Sugarscape also include spice, which the agents can trade amongst themselves. Agents can have children together, fight with each other, and transmit their cultural attributes.

3 Procedures

3.1 Programming Language

I will be writing my program in Java, because it is an object oriented programming language. This is ideal for an agent based model.

3.2 Algorithms

At each tick of the clock, the program cycles through the agents. For each agent, the movement rule and any other agent rules are applied. After each agent has moved, environment rules such as pollution creation and sugar growth rules are applied.

3.3 Example Rules

1. Sugarscape Growback Rule $G(A)$: At each location on the scape, sugar grows back at the rate of A units every unit of time until the amount of sugar is the maximum allowed at that location.
2. Agent Movement Rule M : Each agent looks as far as it can in the four permissible directions: north, south, east and west. The agent then moves to the closest unoccupied location with a maximal amount of sugar and collects the sugar at that location.

4 Testing and Analysis

Growing Artificial Societies will be useful for testing. If my program is working correctly, I should be able to recreate the results obtained in the book.

This is how I will know that the program is running correctly.

5 Results

Many of the results that I will be obtaining will be the same as the results found in *Growing Artificial Societies*. My program is not meant to obtain new results as much as make it easier for others to extend it and do their own research.