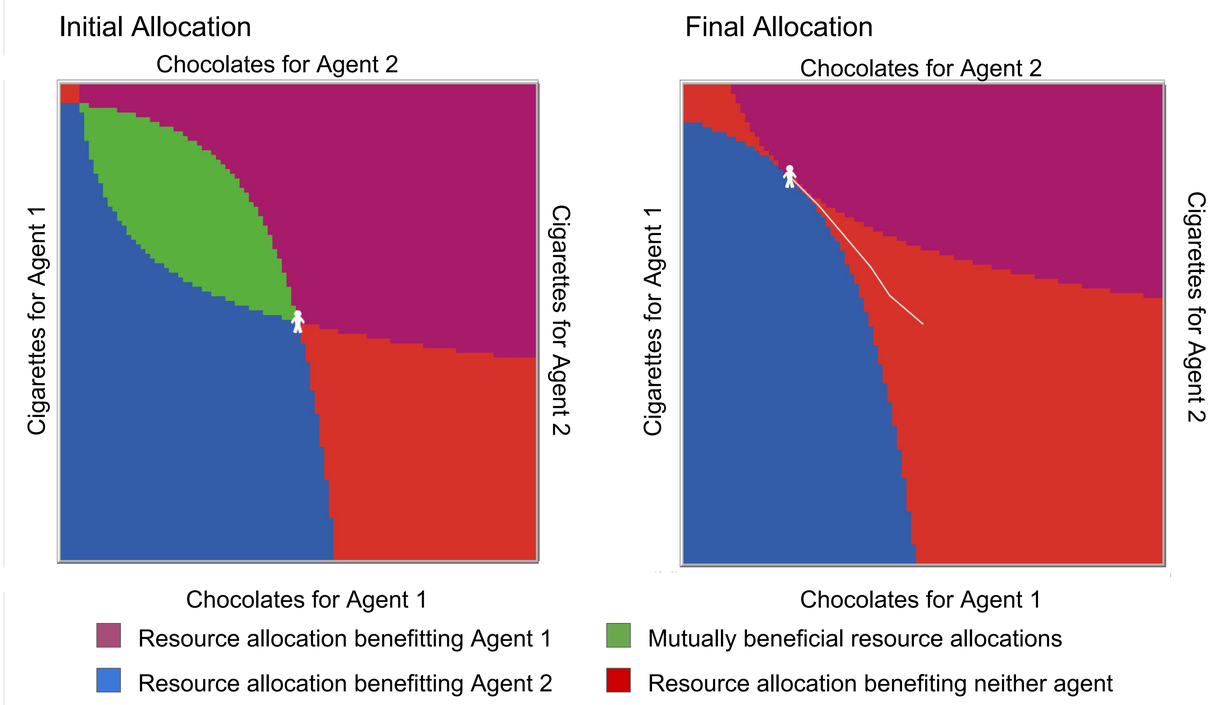
Simulating Trade Networks Using the Edgeworth n-Agents Model

The Edgeworth Box is an economic model that allows for the visualization of a general equilibrium in a two-resource and two-consumer economy. The development of the Edgeworth n-Agents model project sought to shrink and adapt the Edgeworth Box model into a method for an instance of negotiation within an agent-based model of a larger economy. Each "transaction" is the result of a series of Pareto efficient micro-exchanges, where agents aim to maximize their respective utility from the transaction as a whole.

Trading between Two Agents

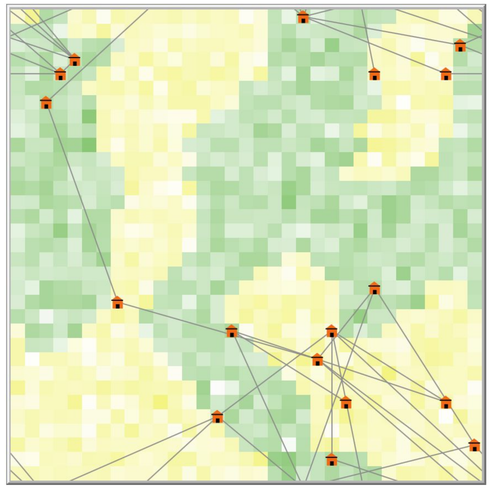


The charts above shows:

- Indifference curves for both agents appear at the borders between these sections
- The white line represent a path of negotiation which travels through the green area
- The partners can reach the optimal exchange quantities organically through negotiation

Trading between >2 Agents

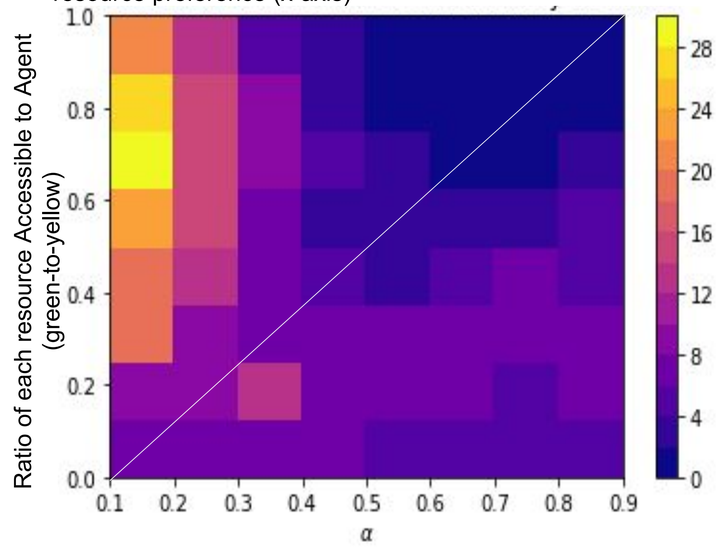
Trade network in two-resource 17 agent economy



The agents are capable of harvesting resources from their surroundings, and must consume quantities of each resource at each time-step. Due to this requirement, agents cannot survive on the interior of a resource blotch without trade.

Heat Map of Agents' observed transaction volumes

Plotted against resource accessibility (y-axis) and resource preference (x-axis)



In theory, an agent whose alpha is equal to the ratio of accessibility to each resource should not need to trade. Trade activity should symmetrically increase with distance from the white line because agents whose diets differ from their resource accessibility can compensate by trading with others. However, the model resulted in a clear bias that needs to be explored further.

The primary goal throughout development was creating methods and processes to replace Neo-Classical economic formulae. The project was successful in adapting the Edgeworth Box as a method for negotiation, however, this method still relies on the assumption of Cobb-Douglas utility functions. Replacing utility functions with inductive or deductive processes is a far more important and daunting endeavor.

$$U_i(x, y) = x^{\alpha} y^{(1-\alpha)}$$

Cobb-Douglas Utility Function

Future research implementing the Edgeworth n-Agents model could study arbitrage in decentralized and illiquid markets, as well as the emergence of currency (a heavily traded but lightly consumed resource).