Multi-Agent Modeling of Civil Disobedience and Violence

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Abstract

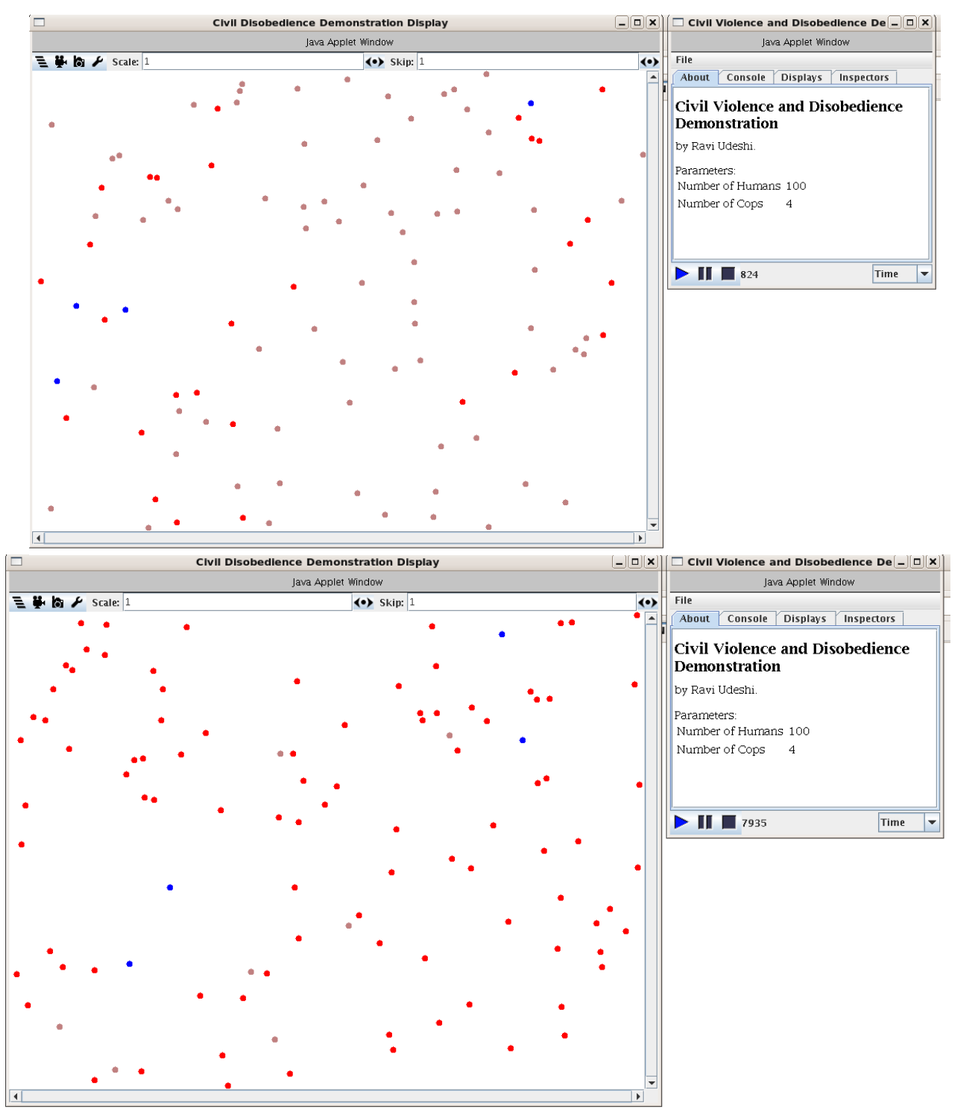
This project was intended to simulate the dual conflicts that arise in a globally typical situations of conflict that arise due to disagreement over power. Rudimentary research in the field of modeling civil disobedience has occurred, but a comprehensive and thorough analysis of the spectrum of human variables that play into such conflicts has not yet been tested. This project was to implement individual agents with unique attitudes toward central authorities and opposing factions, utilizing the Multi-Agent Simulator of Neighborhoods (MASON) library, to simulate default societal and human characteristics. Rules of human behavior were based on past theoretical studies in the field, and extensions of these analyses would have occurred with further time permitted. This project, though incomplete, provides compelling reasons to encourage further study within this field.

Introduction

Multi-agent modeling utilizes agents, considered individual components with the ability to learn from their environment and change their behavior in response, to simulate real-life situations in an increasingly complex world. Interdependencies and relationships between individuals are very difficult to reproduce using human subjects with predispositions and human tendencies that are impossible to compensate for efficiently, and thus multi-agent modeling serves as an effective means to approximate their behavior, provided sufficient background information about each unique agent.

This project builds upon the general theories and equations of civil disobedience and violence advanced by Joshua M. Epstein. His work builds upon previous traction made in this field of study by offering a novel and promising approach to "understanding the complex dynamics of decentralized rebellion and interethnic civil violence." While he analyzes simple tests of the cops, agents, and opposing groups, he fails to extrapolate more upon his data or use his findings to investigate hypothetical traits not considered in his initial research, a goal of this project.

This project uses currently existing simulation software to model a variety of situations in which one group of people become antagonized with a centralized authority. By implementing past theories and research into the human psychology that influences people to act in such situations, the underlying causes and nature of such conflicts were understood and built upon. The Multi-Agent Simulator of Neighborhoods (MASON) was utilized as an environment within which to create a simulated ecosystem that could harbor individual agents with unique traits that could act independently in light of an oppressing regime. This research is important because it helps shed light on group interaction in situations of tense conflict; these could include a coup d'état, warring tribes, or the primary test situation for this project – a jail break, involving prisoners fighting against each other and their jailors.



Procedure

To create a hierarchical system of authority, multiple types of agents were necessary. The two categories of actors composed of Agents and Cops, with Cops instructed to arrest Agents who appeared to be rebelling.

Agents

In this simulation, in accordance with Epstein, grievance is represented in two variables: hardship (H) and legitimacy (L).

Hardship is designed to represent an agent's predisposed troubles – it is a value that was randomly assigned in my simulation, but can be manipulated to better represent a group of people. The value is a decimal from 0.00 to 1.00, and uniformly distributed.

Legitimacy represents the *perceived* legitimacy of the central authority. Although different people may perceive the legitimacy of any regime differently, it is expected that these represent standard deviations from the true legitimacy of the controlling body. Thus, for the purposes of this simulation, this value is uniform over the distribution of agents.

For the purposes of this simulation, the following equation is used to represent G, an agent's grievance: $G=H(1-L)$.

Predisposed traits, whether through nature or nurture, must also be accounted for. Accordingly, we simplify this part of an agent's personality into a single variable: R, an agent's level of risk aversion. This variable is drawn from the uniform distribution of values from 0 to 1, and allows for more personal traits to be imbued in each agent.

After each agent's individual traits have been determined, it is important to recognize the interactions that occur between different agents just as they do in the real world. One of the most important factors an agent must consider before turning "active" – public acts of grievance – is their arrest probability. Represented as P, it can be defined as: $P=1-e^{-k(C/A)v}$

Defining V as the agent's vision – the number of positions the agent can see in each direction – and K as a constant – to ensure a plausible estimate even when Cops (C) and Agents (A) within view each equal 1. Thus, $(C/A)_V$ represents the cop-to-agent ratio within view, an important factor in deciding whether the agent goes active. For example, if there 5 cops within view and no other agents around, the initial Agent is highly unlikely to choose to go active at that time. However, if those 5 cops are overseeing 1000 active agents, the initial Agent's arrest probability will not be very high and he is much more likely to go active. Thus, the agent's behavior can be predicted by defining his net risk (N): $N=RP$.

The sum of these formulas defines the agent's ultimate actions: if an agent's grievance (G) exceeds its net risk (N) by some arbitrary standard, the agent will go active. Active agents publicly rebel against the authority and remain "active" until they are jailed or no longer aggrieved.

Cops

Cops, fortunately for the program, are infinitely simpler than Agents. Because cops are trained to inspect all sites within their local vision and arrest law-breaking ("active") agents, their behavior is simplistic in nature. This should not be viewed as a lack of personal traits on the part of the Cops – they are simply trained to do their job, and their job is to arrest miscreants. It is important to note that the Cops' vision, V, is uniform; however, it need not be identical to the vision of the Agents. Presumably, Cops need to be more aware of their surroundings and so they likely have a greater sense of vision.

Conclusion

This simulation of human behavior, although rudimentary, has depicted a variety of situations which allow us to model civil disobedience and violence. The program, in its current incarnation, proved to accurately, if simplistically, imitate human behavior that arises in such situations. Based on the testing, it is clear that, given additional time and development, this multi-agent model could evolve into a useful tool for analyzing – and predicting – instances of generalized rebellion.

This program has provided for an accurate model of human behavior. By utilizing a variety of human traits and factors – including hardship, legitimacy, risk aversion, arrest probability, vision, and net risk – we have been able to visualize instances of rebellion. Regretfully, additional factors such as jail terms, population densities, deceptive behavior, free assembly, relative stability, and corruption were not able to be included. Such items would have allowed for further insight and created a more comprehensive model. It is impossible to draw absolute conclusions from this model currently, but including such ideas would allow for a more believable simulation.

As it stands now, the program unfortunately only confirmed known principles in instances of civil disobedience and violence. Increasing "problems" – such as hardship and illegitimacy – incited agents to rebel quicker. When agents began to go active, others followed suit – the bystander effect in action. Future iterations of this program may instead reveal ideas and principles not obvious already.