# Modeling the Tragedy of the Commons Using Agent-Based Modeling

**TJHSST Computer Systems Lab 2008/2009**
**Josh Lee**

**Abstract**

The "Tragedy of the Commons" is an experimental economics social scenario, wherein a community of autonomous individuals share a pool of resources. Conventional economic wisdom dictates that each member of the community should act selfishly, for his/her own benefit. However, the Tragedy demonstrates this to lead to unforeseen negative consequences - in some cases, the collapse of the entire community. Agent Based Modeling Simulations (ABMS) can be programmed to model the Tragedy of the Commons. This research aims to create an ABMS model of the Tragedy using the programming language NetLogo, and then demonstrate how individual agent behavior and environmental conditions may be altered to find a more optimal solution to the scenario.

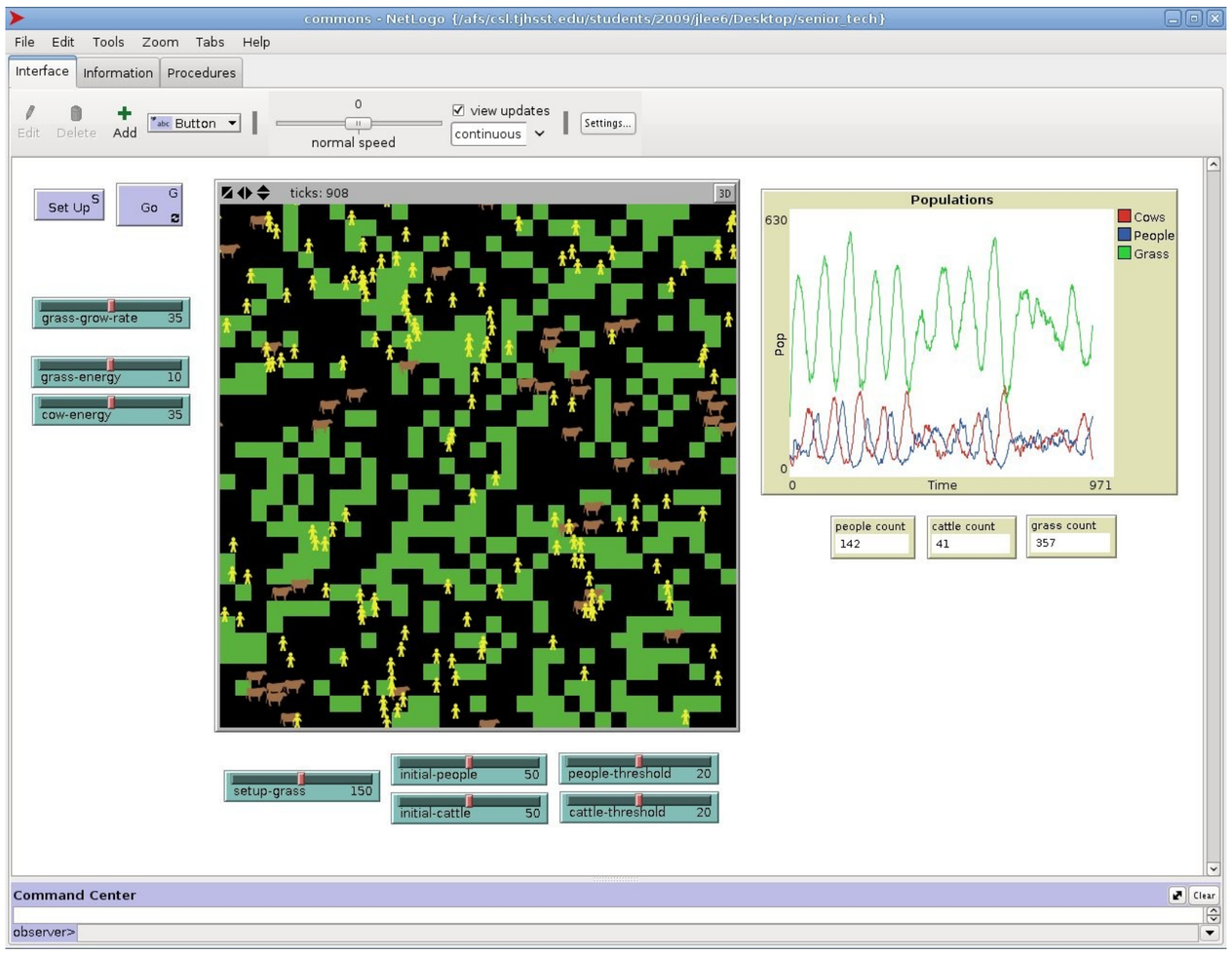


**Fig. 1: A demo of a typical run of the program**

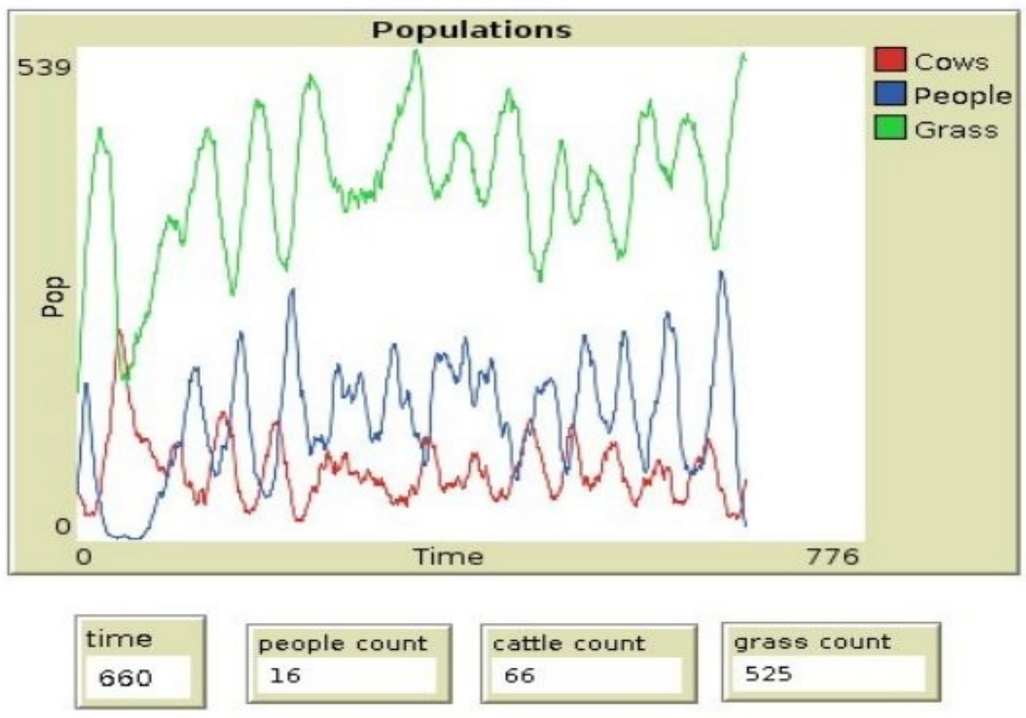


**Fig. 2: Oscillating population trend lines**

## Overview

The Tragedy of the Commons is a real life problem, instances of which may be observed throughout the world. It exists in any scenario consisting of autonomous individuals who stand to personally benefit by taking from a shared resource pool. Finding a potential solution to the Tragedy would have far reaching benefits.

## Development

This research involved the programming of a Tragedy of the Commons model, engineered such that the model would possess those qualities key to a Tragedy of the Commons situation. These qualities include a characteristic instability in the population pools involved in the model, and how they may become more or less stable over time. This particular model consisted of grass, cattle, and people, in imitation of one the original ABMS Tragedy of the Commons models, the Tragedy of the Sahel.

## Testing and Analysis

The model allows for real time alteration of a selection of crucial parameters. The crucial parameters are those which most directly affect the likelihood that any given cattle or people agent will find resources at each time step. The BehaviorSpace feature was used to test the crucial parameters. BehaviorSpace can be configured so that NetLogo will run multiple iterations of the model, modifying a specific variable within a specific range with each successive iteration, exporting detailed data for the model at each time step.

## Conclusion

Ultimately, what conclusion this model yields is the fact that for any given level of resources within an environment, an appropriate balance of population size and reproduction rate must be struck, in order for there to be minimal competition and maximum stability within the environment.

References
[1] Mark Garofalo, "Modeling the 'El Farol Bar Problem' In NetLogo", http://users.coditel.net/garofalo-sechi/MG/ElFarolNetLogo Draft.pdf,2006.
[2] Mordechai Gersani, Joel Brown, ErinO'Brien, Godfrey M. Maina and Zvika Abramsky, "Tragedy of the commons as a result of root competition",
[3] Garrett Hardin, "The Tragedy of the Commons," http://www.sciencemag.org/cgi/content/abstract/1622006.
[4] Marco Janssen and Elinor Ostrom, "Empirically Based, Agent-Based Models", http://www.ecologyandsociety.org/vol11/iss2/art37/m2006.
[5] Steven de Jong, Karl Tuyls, and Katja Verbeeck, "Artificial agents learning human fairness", http://portal.acm.org/citation.cfm?id=1402298.14023