CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Nicholas Kotsianas

Project Number
S1308

Project Title
ALife 101: Computer Simulation of Artificial Life Organisms

Abstract

Objectives/Goals
The objective of this research is to design, implement, simulate, study, and improve a life-cycle model of Artificial Life agents. Artificial Life, or ALife, is the most recent and promising topic of Artificial Intelligence, covering the bottom-up approach of AI versus the top-down approach of earlier methods. The short-term objective of this project is to synthesize, validate, and calibrate a family of customizable agent models resulting in stable, sustainable populations under varying environmental conditions.

Methods/Materials
Life is simulated in a configurable, closed Universe populated by Agents, which are organized in Orders. Agents are the basic units of life, possessing mobility and metabolic characteristics: Health and Energy levels, Food Conversion Efficiency (FCE), maximum Lifespan, and Reproductive cost. Agent AI consists of local environment comprehension, goal identification, path planning, and obstacle avoidance algorithms. The Universe consists of a square cell grid, includes walk-able and Barrier cells, and has a supply of renewable localized and distributed nutritional resources. The Agent#s goal is to identify nutritional resources, navigate and move, consume, metabolize, and reproduce. In order to survive, Agents must compete with others for resources, and make efficient use of space and time. This project was implemented in C#, using Microsoft Visual Studio.

Results
An Agent life-cycle model was implemented successfully, leading to an energy balanced Universe and population stability over time. Lower population sizes at equilibrium were observed for Orders with less efficient food metabolism and for higher Reproductive costs. Also, Orders with more efficient metabolism may lead to dominance and cause extinction of less efficient Orders. The A* algorithm was found effective in guiding Agents along the optimum path to food while avoiding collisions.

Conclusions/Discussion
The ALife model implemented leads to realistic simulated behavior of Agent populations and exhibits an inverse relationship between FCE and population size and between Reproduction cost and population size.

Summary Statement
An Artificial Life Agent model is synthesized, validated, and implemented, and is utilized to study the relationship between metabolic rate, reproductive cost and population size during time simulation of artificial organism colonies.

Help Received
Mentor helped in comprehnsion of programming language and board assembly.