Study of group behaviors on computer controlled agents

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Abstract. Achieving group behavior on computer controlled agents is a subject of mass study in Artificial Intelligence. Using an iterative divide and conquer approach, the authors of this article tried to achieve that goal using the features and environments provided by the Lablove platform. Although results were promising, at the time of writing there were no positive results.

Keywords: Group behaviors, Lablove, evolutionary computing.

1 Introduction

The objective of this research is to make agents, controlled by the computer, develop group behavior in order to accomplish tasks that are otherwise too difficult for a single agent to perform.

The approach used in order to achieve this objective is evolutionary computing, in other words, a population of agents will be left to “evolve” into a population capable of having group behavior. The task for the agents to overcome is as simple as shooting a target whose toughness is greater than a single agent's projectile.

This kind of research is interesting for realistic simulation of crowds where the agents do not act as a hard coded flock of sheep. This research is also relevant for video games because of the uprising demand of realism due to the advances in technology. Nowadays video game players look for games that offer multiplayer components because of the competitive feeling that they provide. The results of this research could lead to one step closer in achieving realistic computer controlled agents where the player is eluded to think that he is playing against another human and not a machine.

This article will be divided in four sections: In section two there will be stated the preliminary study that led to the research subject of this article as well as a brief introduction of the state of the art of evolutionary computing. In the third section it will be about the platform that made the research possible: Lablove. It will comprehend a description of this platform as well as it's weaknesses and strengths. The next section will be about the hypothesis of the study and the results of the approach used by the author's of this article. Finally, in the last section, there will be some last remarks about this article and a brief text about future work.

2 Related Work

In order to have the necessary basis for the work, some preliminary study was made. The study focused on evolutionary computing: basics of genetics and Darwin's evolutionary theory, the evolutionary computing methodology, some known algorithms and some basic problems that are solved using this programming method (see reference 1).

Evolutionary Computing is a programming methodology that strives for optimal solutions for a given problem. An optimal solution is not necessarily the best solution. In this methodology the program is left to evolve potential solutions from a pool, called population. In order to keep variety, the individuals in a given population are often crossed and mutated. The problem that the program tries to solve is modulated by a function that is called fitness.

There are a few video games that already use algorithms for agents to learn group behaviors. An example of this is NERO, a video game where the player controls an army of robots. The objective of the player is to make the robots learn strategies by means of creating an obstacle course and choosing the robots that are best fit for the strategy at hand. This game uses an algorithm called NEAT to evolve neural networks of the robots (see reference 5).

3 Lablove

This platform was chosen because it is cross platform, modularly written and provides the necessary tools to develop artificial intelligence using evolutionary computing. It also comes with pre-made experimental setups that can be used to simulate group behavior.

Lablove is an open-source platform, developed by Telmo Menezes (a former student), used to simulate evolutionary multi-agent environments.

The environment is a 2D world where the study subjects are represented as triangles. These study subjects, or agents, are simulated as living creatures and therefore must consume energy to be kept alive during their average life span.

The agents are controlled by an artificial model called the grid brain (also developed by Telmo). The grid brain consists of a main component called the Beta Grid where the logic is processed so that decisions can be made. In order for the Beta Grid to work the model has another type of grid: the Alpha Grid. Alpha Grids can be more than one, unlike the Beta Grid, and represent the sensations acquired by the agent at a given time. Each grid is composed of nodes and links. Each node can be one of several existing types: Input/Output, Operator (can be arithmetic, Boolean, etc..), agreggator (minimum,maximum and average) and Memory (where past information is stored). Nodes can be connected to each other by means of a link. The existence of a link between two nodes means that the output of the first node is fed back to the input of the second node. Links can exist between nodes of the same grid and nodes of an Alpha Grid and the Beta Grid. Figure 1 shows the Lablove platform running.

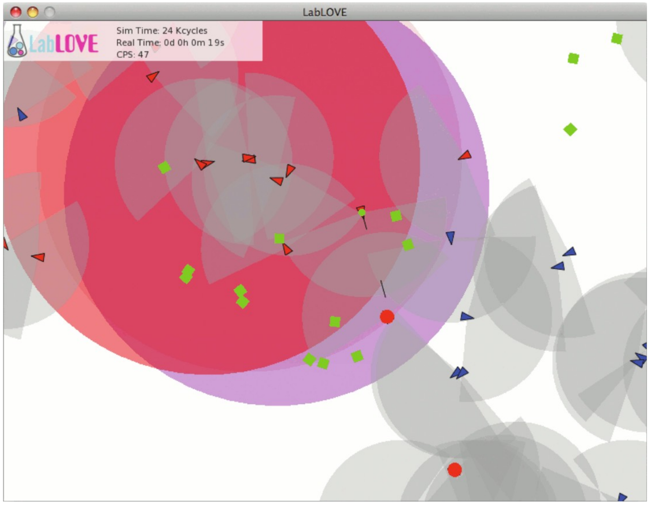

Fig. 1. Picture taken from the lablove website (see reference 4). This shows a screen-shot of the lablove simulator running an experiment. The figure shows two species of agents (*red and blue triangles*) as well as food items (*green squares*). It also shows the agent's vision range (*gray semi-circles*) and emitted sounds (*large colored circles*).

One of the main strengths of this platform is the ability for the user to develop a script that specifies an experimental setup. The user can specify the starting grid components, the mutations and respective probability that are used, the selection algorithm, the agent's average lifespan, etc.. Since Lablove is open-source anyone can contribute for the improvement of the program.

Despite it's strengths, Lablove has two weaknesses that have proven to be minor obstacles for this research: there is no way to save scenarios in disk so that they can be rerun later at a given point and the fitnesses are hard coded which means that when the user needs to change the fitness for an experimental setup, the user has to alter the source code and recompile the platform again.

4 Ongoing Work

The hypothesis of this research is to make the agents achieve a group task using a simple fitness, in this case: number of targets shot. In order to support a simplistic fitness, the agents first learn basic actions from a simple environment. The environment then increases it's challenges so that the agents can develop more complex behaviors, in our case group behavior.

The setup used for this experiment is a tweaked version of a setup that came with Lablove called “targets”. In this scenario the only way for the agents to gain energy is to shoot moving targets that roam the simulation world. These targets walk in a straight line and only change direction when they hit a wall. To this scenario the action Sound (gives the agent the ability to make a sound) was added to the list of possible actions. The reason for this is that the authors of this article believe that the making a sound is the best way for the agents to coordinate their actions with each other. A tweak in the scenario targets was also made: The targets start with a slow speed and low toughness so that a single agent can shoot it. This gives the agents an opportunity to learn how to shoot. The targets gradually increase their speed and toughness in order to be difficult for a single agent to shoot them. This may be seen as an environment obstacle that the agents need to overcome in order to reassure their population's survival.

The results were not as expected. After several runs the agents seemed to develop an accurate shooting but no group behavior whatsoever. This led to a weak population because the agents could not destroy the targets in order to get energy to reassure survival.

5 Conclusions

The given results once again prove that with machine learning, the researcher has difficulty in controlling what is learned and what is not. We still believe that we should not give up on this approach, as it is close to the way natural evolution works, which Nature has proven, time and time again, successful.

Evolving a population of agents to develop group behavior to overcome a difficult task offers a great deal of possibilities. When perfected, agents can develop behaviors for the same task the differ from simulation run to simulation run. This is interesting in video games where the challenge resides in creating unexpected situations for the player. It is also relevant for A-Life games where usually the player is presented with a population of infants that need to learn how to overcome certain obstacles.

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