READY PLAYER A

Integration of Artificial Neural Networks in Multiplayer Games.

Goal and Motivation

The rapid advancement of artificial intelligence has demonstrated its immense potential in solving complex problems. This project explores how machine learning algorithms can be applied to multiplayer games – a unique challenge due to the lack of labeled data. Instead of relying on pre-classified data, the algorithms must learn through exploration and feedback.

The goal was to develop, implement and compare two approaches – a Genetic Algorithm and the Actor-Critic Method – to train artificial neural networks in two games: Pong (a simple tennis-like game) and Footsies (a 2D fighting game). By analyzing their performance, the project aimed to understand how ANNs adapt to different levels of game complexity.





Pong

Pong is a classic arcade game where players control paddles to hit a ball past their opponent. Its simple mechanics – vertical paddle movement – and and minimal interaction with the enemy make it an ideal test for AI learning. The ANN has full control over the paddle and tries to hit every ball.

Footsies

Footsies is a minimalist 2D fighting game that strips down combat to basic moves like attacks, blocks, and footwork. Unlike Pong, it requires strategic decision-making, timing, and adaptation to an opponent's actions, making it a more complex challenge for AI, while still having very short rounds and a small moveset.

Artificial Neural Networks

An Artificial Neural Network is a computational model inspired by the brain's structure. It consists of interconnected layers of neurons that process inputs, apply weights and biases, and generate outputs through activation functions. Artificial Neural Networks learn by adjusting these parameters during training, allowing them to approximate complex behaviors—such as mastering a game — without explicit programming.



Learning Algorithms

Genetic Algorithm

- Mimics natural selection: A population of ANNs evolves over generations.
- Fitness is determined by in-game performance (e.g., hits in Pong or wins in Footsies).
- High-performing ANNs are "bred" via crossover and mutation.

Actor-Critic Method

- Actor: A policy network that selects actions.
- Critic: A value network that evaluates actions.

Results

Both algorithms achieved near-perfect performance in Pong. The Actor-Critic Method initialy learns faster than the Genetic Algorithm but as it gets closer to 100% accuracy its rate of progress slows down compared to the Genetic Algorithm.

In Footsies, results were mixed. While both algorithms showed clear improvement, neither developed advanced tactics. They tend to get stuck and stop improving.

Experimenting with parameters showed that larger neural networks learned faster than minimal ones, even when smaller networks could solve the task.

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 Learns via rewards/penalties, updating both networks in real time, and uses the evaluation of the Critic to imrove the Actor.

I programmed all of the Algorithms - except for the games, they are opensource - from scratch in C#.



Sourcecode: https://github.com/leon-rossi