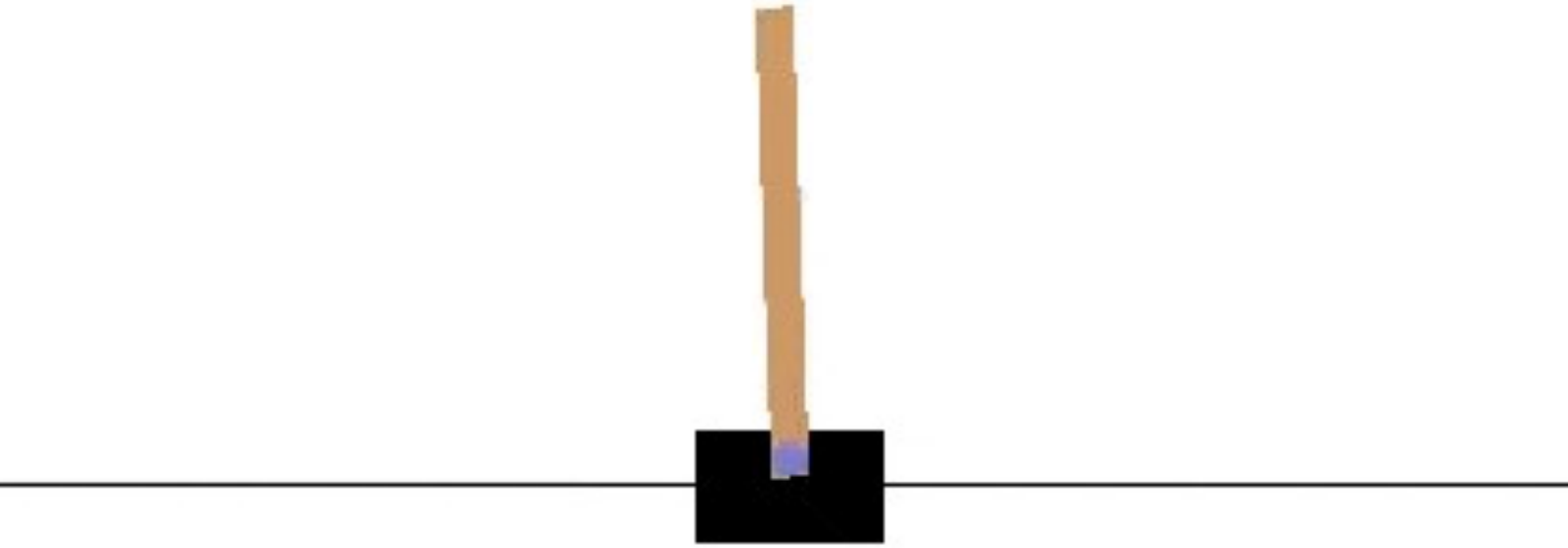
Report



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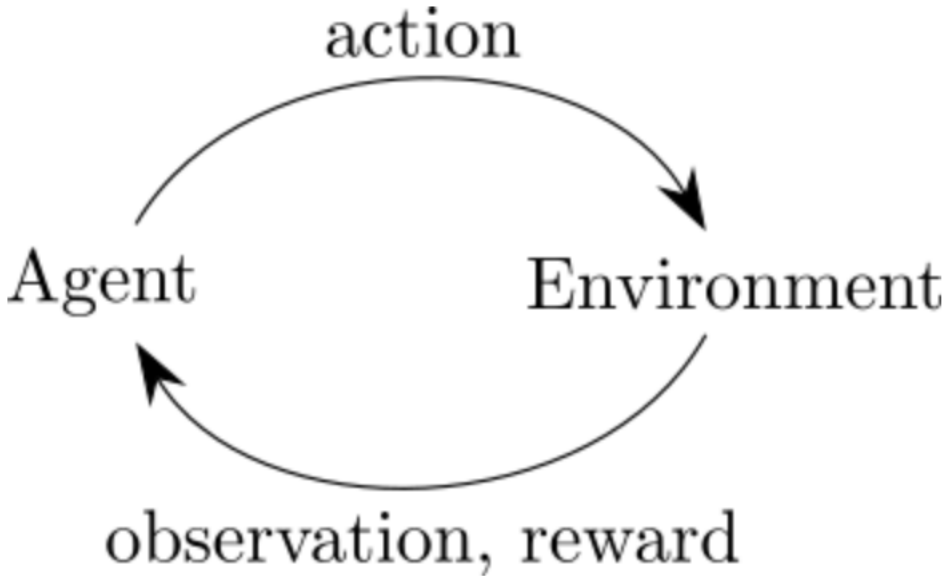
OVERVIEW

The cart has a pole that stands upright. The aim is to keep the pole straight by pushing the cart to the left or right. To tackle this problem, we will first generate some random game data, which we will then input into our GA model, which will forecast the movement of the cart (left or right) for each frame.

In order to use CartPole-v1 I need to create a gym environment. By running the environment with each timestep, the agent chooses an action, and the environment returns an observation and a reward.



INTRODUCTION

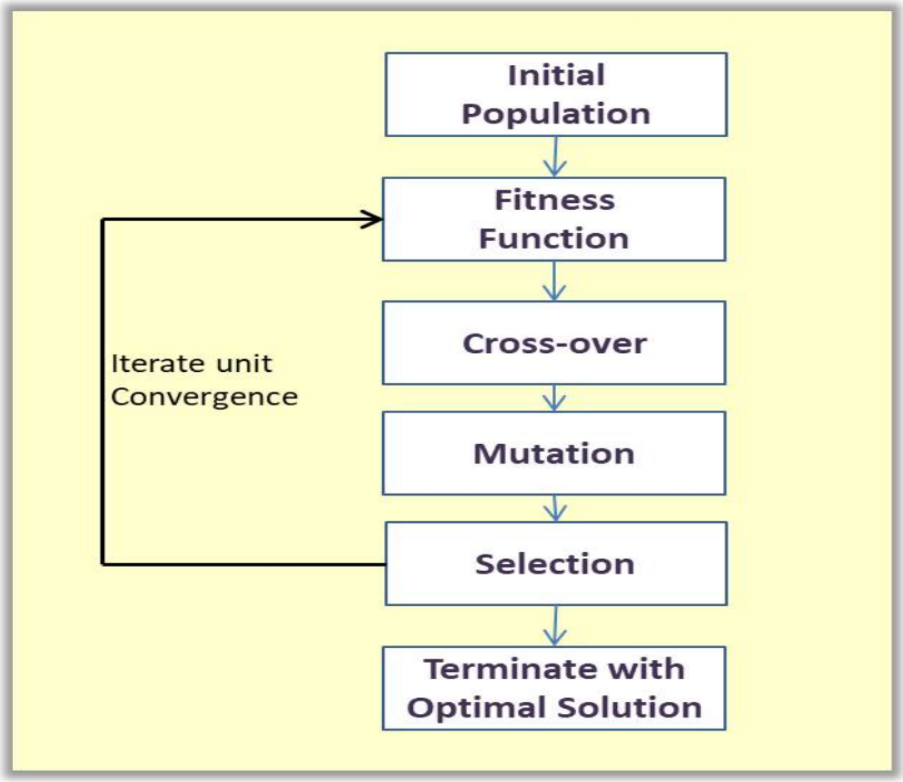
I can now go to the concept of agents. I need to figure out how to link genotypes to agents. My new agent will apply neural networks to determine actions, therefore it seems reasonable to have the genes represent the weights and biases of the neural network.
The agent will map the number of inputs (observations from the environment) to the number of outputs (in this case, a single action).

I'll use the set gene function to map a list of floats (the genes) of length num_genes to a set of weights and biases. This algorithm will produce a continuous output. As a result, I'll use thresholding to convert the integer to a discrete output (0 or 1). To maximise reward, I now need a mechanism to manipulate our Genetic information and for that I will employ a Genetic Algorithm.

How They Work

As we noticed the population on hillclimbers presented good results because we reached the value of 500 for the maximum population fitness but the mean value of the fitness of a population after 1000 epochs reached around 65-73 percent accuracy. For the purpose of optimisation, I decided to build an agent which uses Genetic Algorithms to solve the Pole Cart Problem from the Open AI.

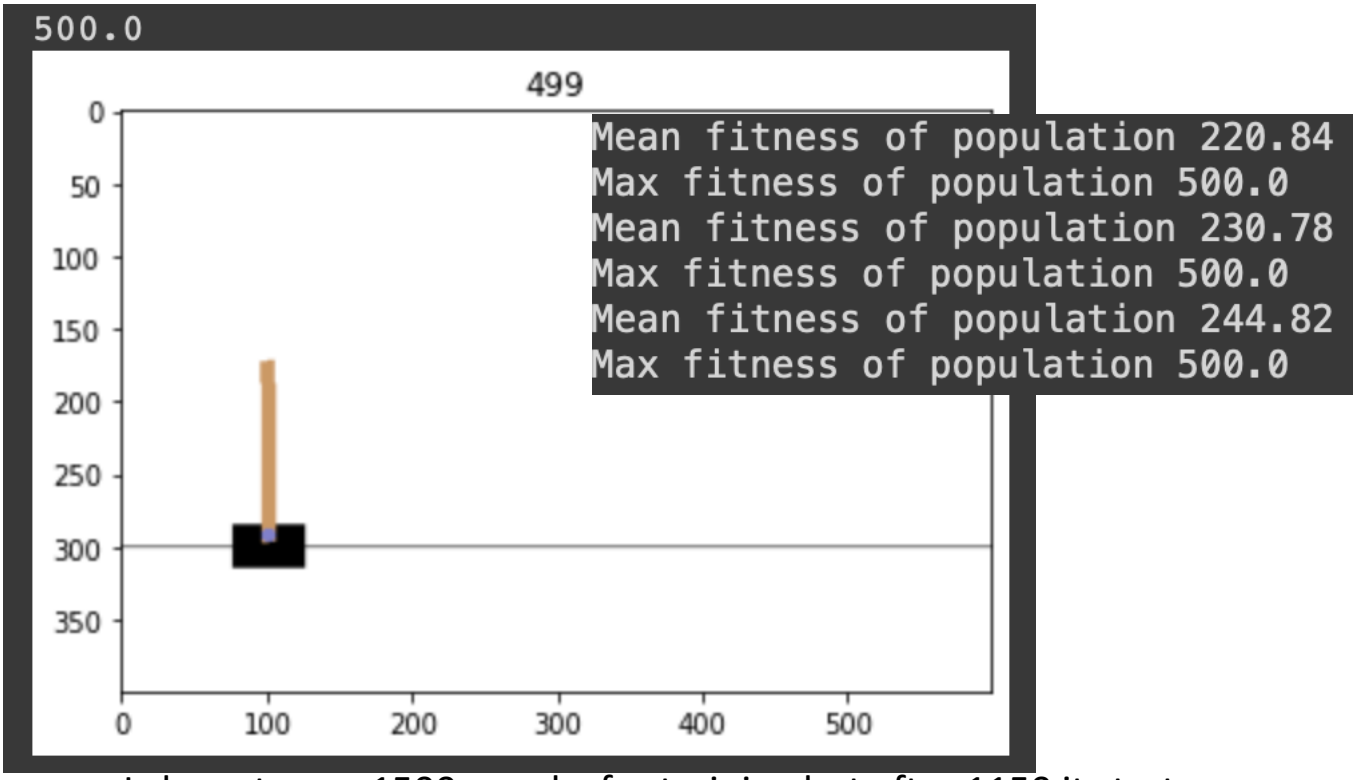
A genetic algorithm is a type of search strategy based on Charles Darwin's idea of natural evolution. This algorithm reflects the natural selection process, in which the fittest individuals are chosen for reproduction to generate children of the following generation.



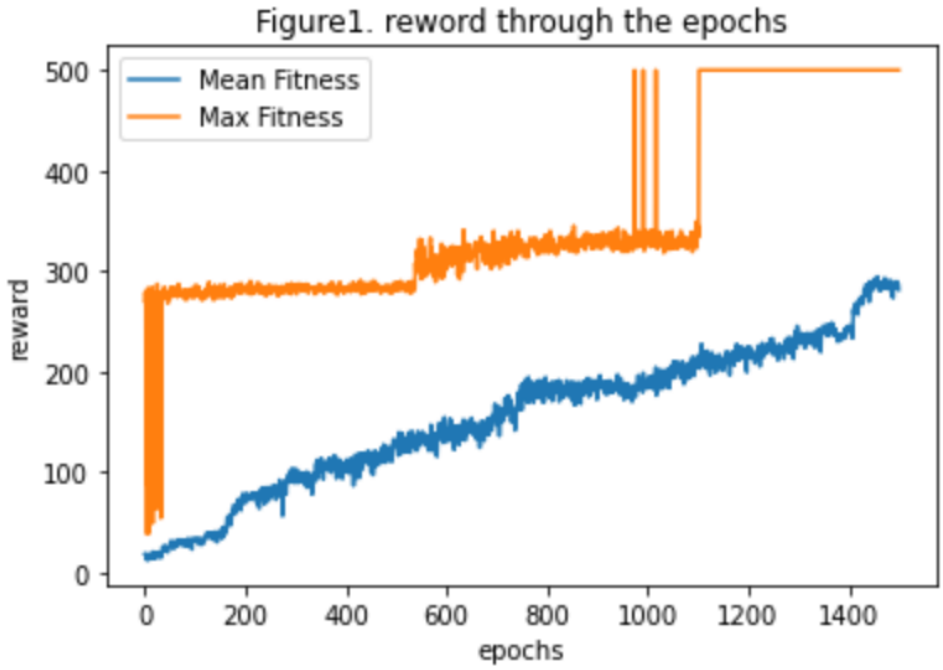
Genetic Algorithm Phases

After a random initialisation my algorithm in order to perform will select the fittest individuals as parents for example solution with the highest fitness value. I will use cross over function to produce off springs. Now, to diversify the upcoming populations I will mutate few off springs by adding some noise to randomly selected gene individuals selected for mutation.

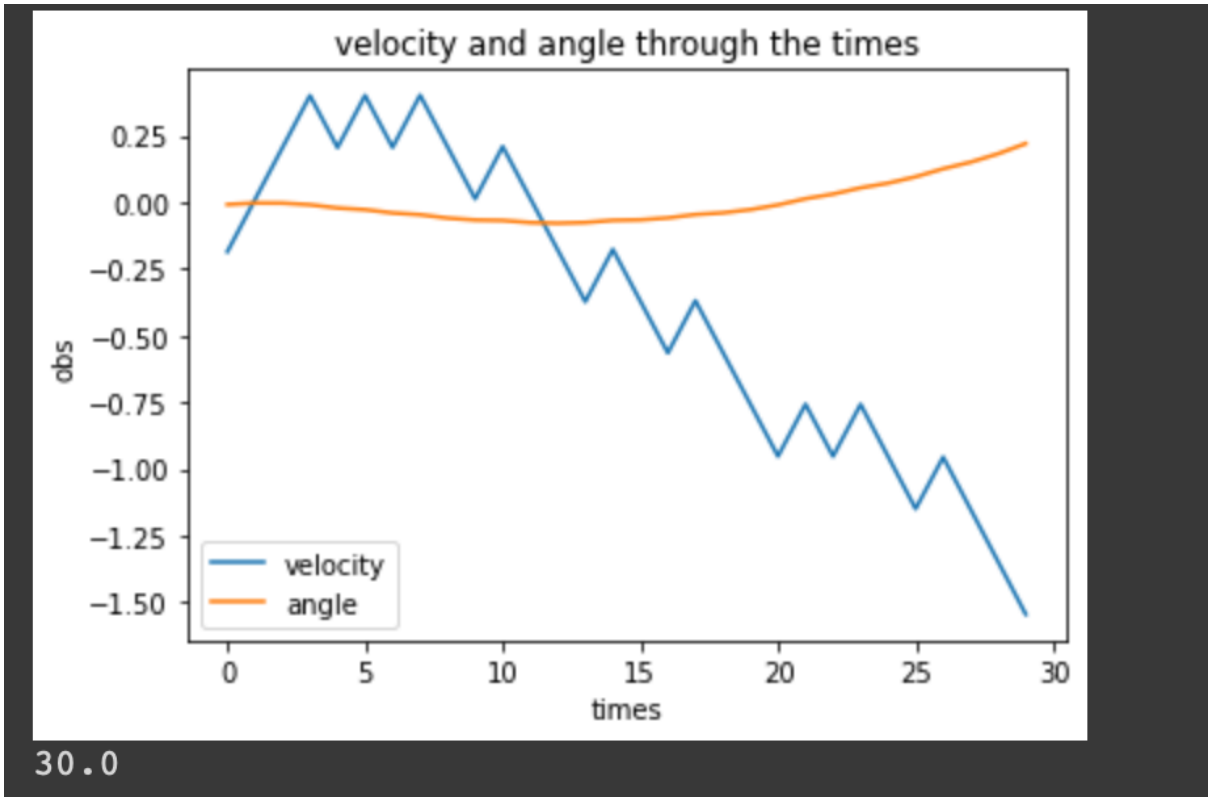
So, everything is set and good to go. We will feed our model with training data and then run the game environment 1500 times. Initially, we will decide a random move and based on that our model will go further.



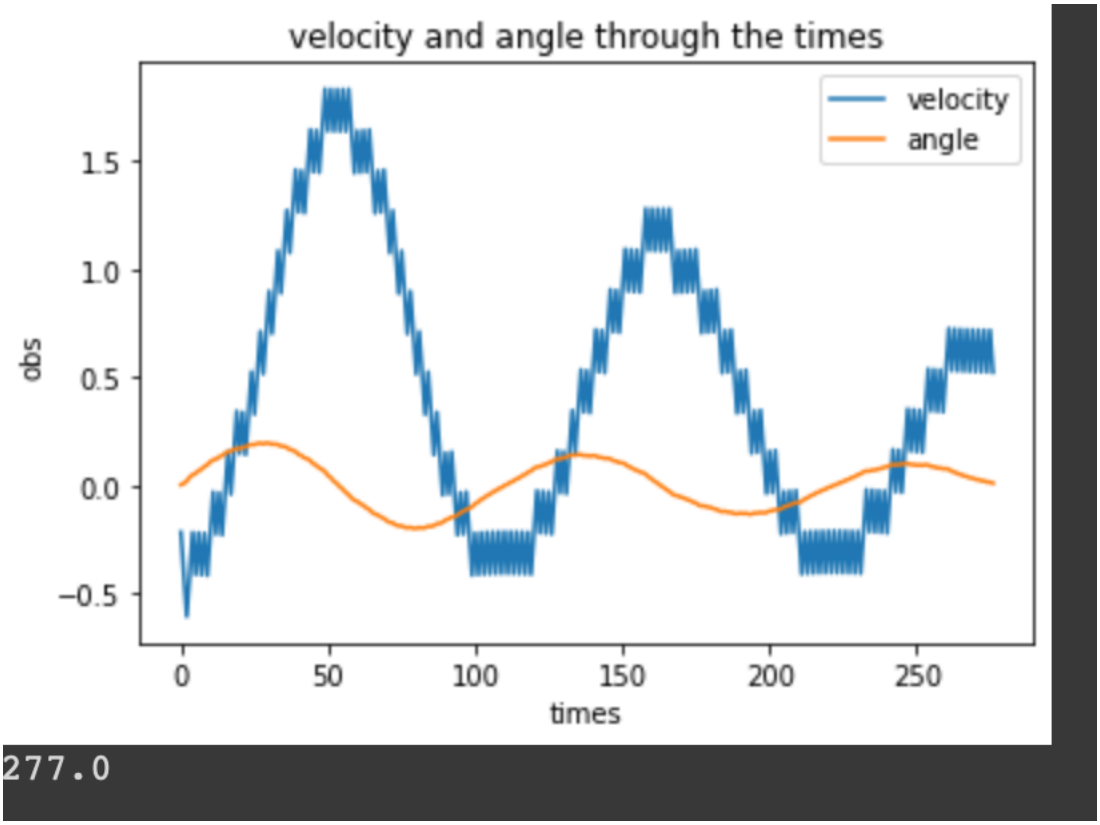
I chose to use 1500 epochs for training but after 1150 it starts to overfit, so the average fitness stays around 70 precents. The GA Agent performed faster than the population of hillclimbers algorithm as it found faster the maximum fitness with the same parameters for cross-over probability.



CONCLUSION



In these two plots I compare the velocity and angle of pole in a period of 30 and 300 times. as we can see in the first plot as the angel gets bigger the speed decreases as module gets less reward, in a bigger timeframe (plot below) we see how our agent manages to maintain the pole in balance using a genetic algorithm.



This paper presents the structured and explained view of solution to the cart pole task by implementing genetic agents.

To conclude, genetic algorithms can choose the optimal subset of the model's variables, but they often demand a significant amount of computation. The role of genetic operators such as crossover, mutation, and selection are important as from them depends on the accuracy of the algorithm and how it evolves throw time.

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