**Methods:**

This bird agents in the project were trained by the NEAT algorithm, which was imported as the python-neat library. NEAT (Neuroevolutionary of Augmenting Topologies) is an algorithm for “evolving arbitrary neural networks” (neat documentation, 2021), it works just like how natural selection works. The NEAT algorithm can generate neural networks which are responsible for reactions, based on feedback given back to the algorithm.

The neural network itself is just a series of mathematical steps to compute outputs using inputs. Among a population size of 50 birds, each bird agent has a neural network that’s different from other agents, so they all react differently. In this case, the input of the network is the current height of the bird, as well as the height of the pair of closest pipes that it needs to pass. The output of the network is a single number that decides if the bird should flap or not.

The process of training starts by the first generation. Having a population of 50 birds, each bird has a randomly generated network that reacts differently to the input parameters, and therefore having different reactions to the pipes. A fitness score is maintained as a source of feedback to the NEAT algorithm. When a bird hits a pipe, the neural network associated with this bird will be deprecated, therefore the neural network that gets the highest fitness score gets maintained for the next generation.

Starting from the second generation, the population gets generated by mutating the last survivor of the previous generation. Therefore, the overall behaviour of agents in this generation will be relatively similar to the last survivor of the previous generation. The process of deprecation maintains the same.

This process repeats until the fitness score of an agent exceeds a predefined target.

Since this solution is utilizing “natural selection” to generates and evolves agents with behaviours that fits the environment, this can be considered as methods from artificial intelligence. As a result, the bird agents adapt to the game and passes can over 50 pipes without crashing, we conclude that it meets our objective.

The advantage of such approach of using the NEAT algorithm, is that it allows achieving our objective easily, while allowing further modifications and improvements, mostly because of the adjustable parameters.

A disadvantage of the way of this implementation, is the limitations in edge cases. As our neural network only observes the closest pair of pipes, in case where the opening of the second closest pair of pipes is too low, the bird have a high chance of crashing because of the lack of space to fall. Another disadvantage of this approach is the approach that mutates only the last survivor from last generation. In case when the survivor is too bad, the evolution process will stuck in a dead loop, that none of the birds can pass the first pair of pipes.

Reference:

Neat documentation. Web Archive: Dec-06, 2021 <https://neat-python.readthedocs.io/en/latest/>