AI Flappy Bird Using NEAT Algorithm

Explore the fascinating world where artificial intelligence takes on the iconic game of Flappy Bird. Discover how the NEAT algorithm enables AI agents to master this challenging avian adventure.

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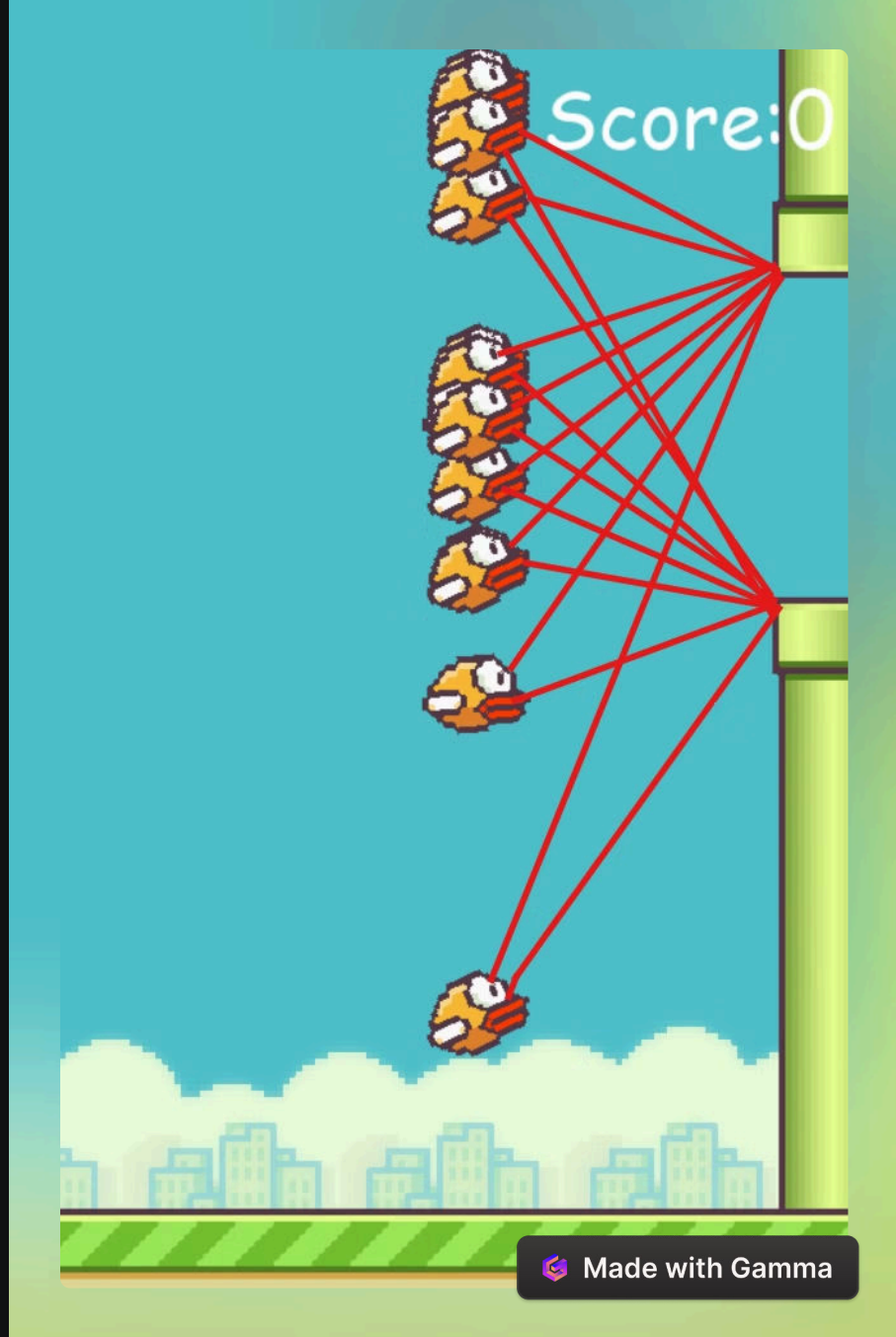
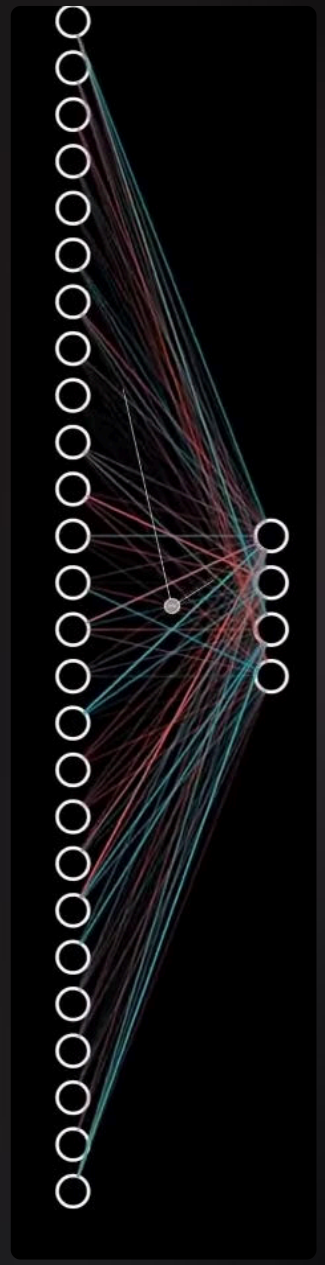


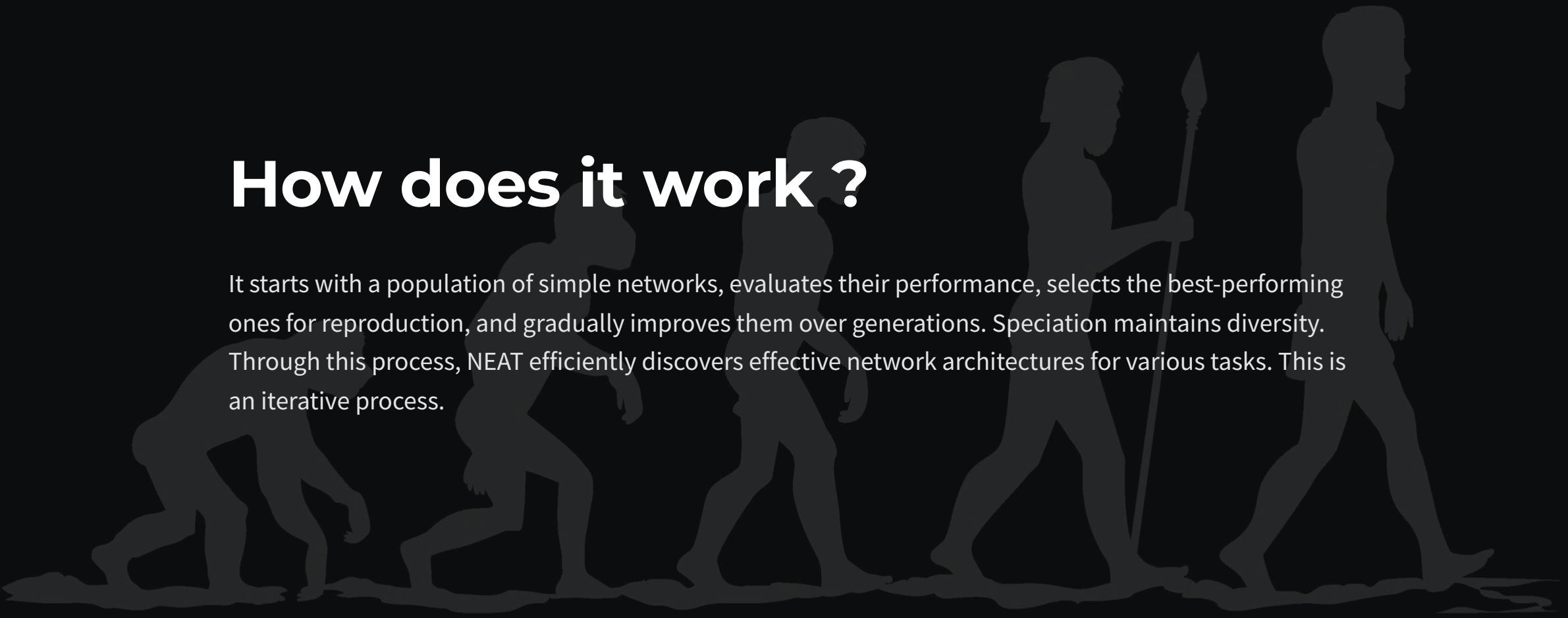


What is NEAT Algorithm ?

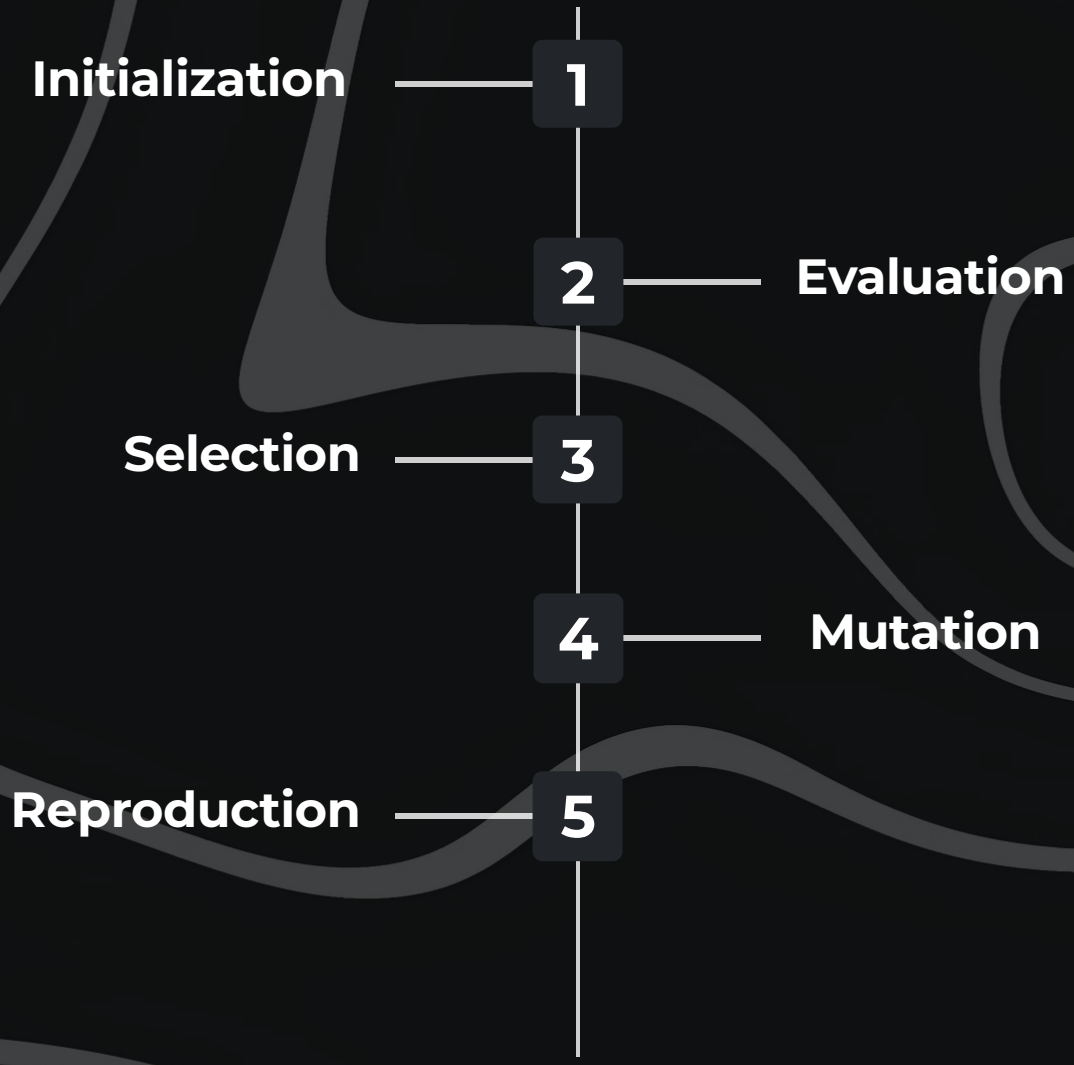
NEAT, Neuro-Evolution of Augmenting Topologies is a population-based evolutionary algorithm. It is also called as genetic algorithm. NEAT's genetic encoding and fitness-based selection process make it highly effective for complex tasks like Flappy Bird.

How does it work ?

It starts with a population of simple networks, evaluates their performance, selects the best-performing ones for reproduction, and gradually improves them over generations. Speciation maintains diversity. Through this process, NEAT efficiently discovers effective network architectures for various tasks. This is an iterative process.



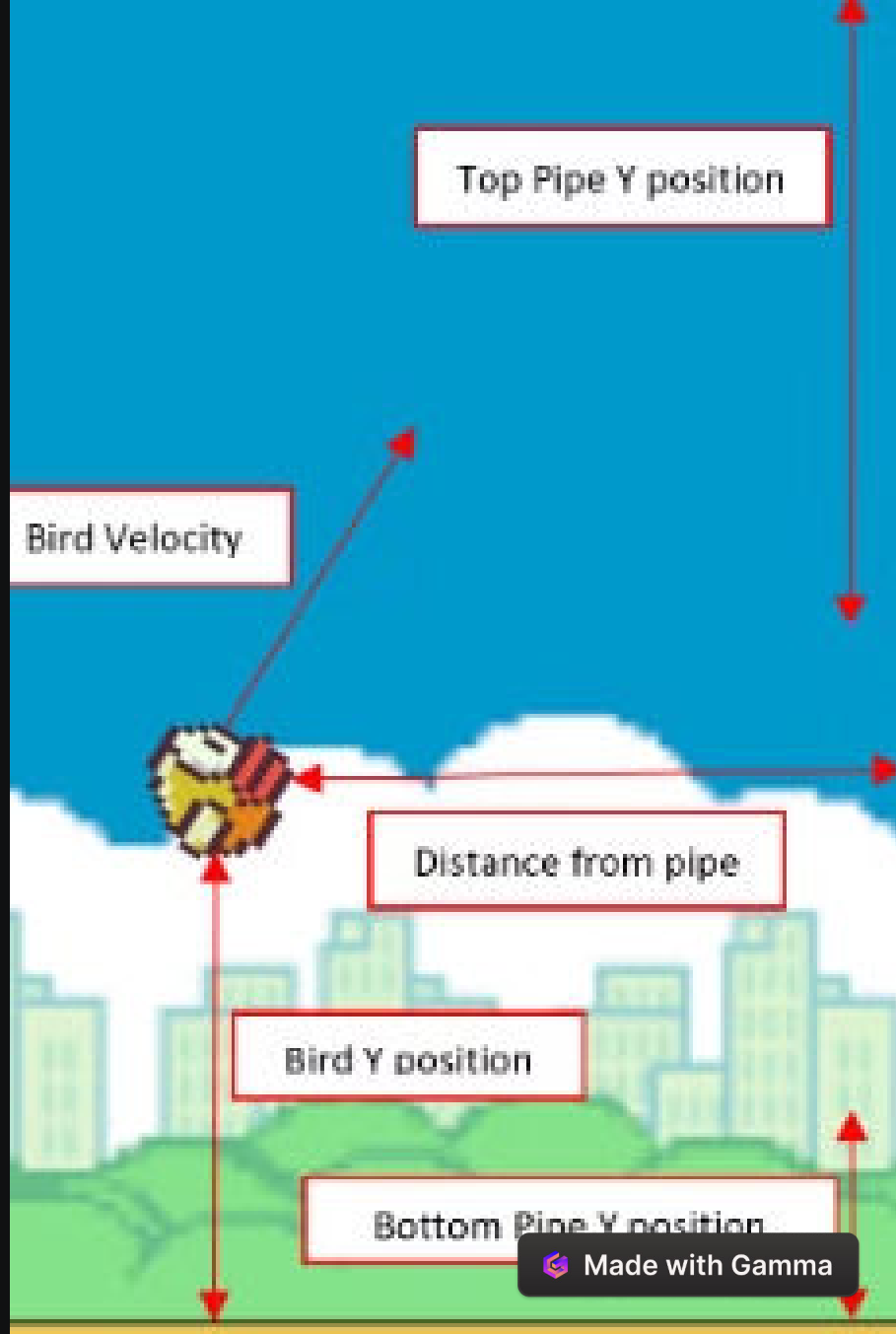
Steps Involved :



Initialization:

NEAT starts with a population of simple neural networks, each bird is a neural network called genomes. In NEAT it is called as population size. Initially, these networks might consist of just a few neurons representing inputs (e.g., bird's position, distance to the next pipe, bird's velocity) and outputs (e.g., jump or don't jump).

```
pop_size = 200
```



Evaluation and Fitness Function

At the heart of the NEAT algorithm lies the fitness function, which evaluates the performance of each AI agent in the Flappy Bird game. This function assesses factors like the bird's distance traveled, obstacles navigated, and points scored to determine the agent's aptitude. The fitness function assigns a fitness score to each of the genome.

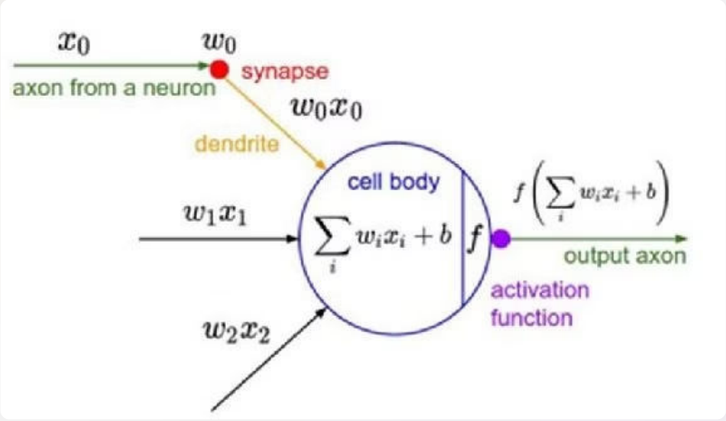
```
fitness_criterion  = max
fitness_threshold  = 100
```

Selection Process

The NEAT algorithm employs powerful selection process to drive the evolution of the AI agents. These operators ensure the most successful neural networks are propagated, while introducing beneficial mutations and crossovers to explore new solutions.

1. Tournament Selection: It is based on how well they are performing in the task they are given such as how long they travel and a fitness score is assigned accordingly.
2. Score Basis : After assigning the fitness score to each genome the algorithm will categorize each genome based on their fitness score and they are ranked based on their fitness score
3. Next Step: The individual with the highest fitness score are eligible for the reproduction process.

```
elitism = 2
survival_threshold = 0.2
```



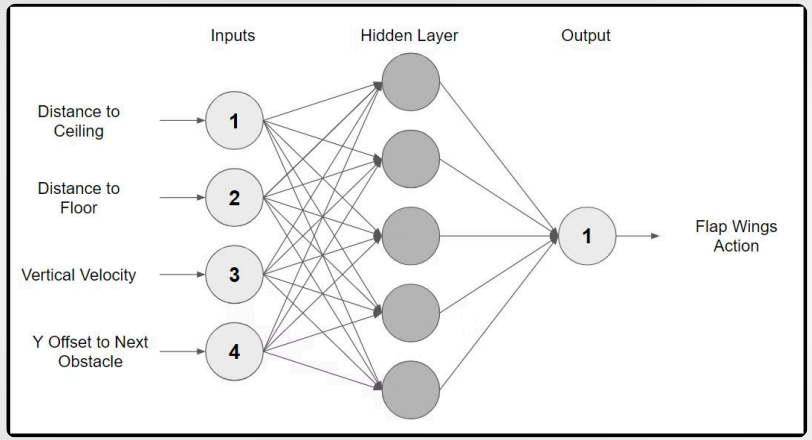
Mutation

1. Activation Function Mutation : Activation function serves to determine how the inputs to the neural network are transformed into outputs.
2. Node Mutation : Adding nodes can create new pathways for information processing, potentially leading to more sophisticated decision-making. Removing nodes can simplify the bird's brain, reducing computational complexity.
3. Connection Weight Mutation : This change in connection can strongly affect how the birds respond to different inputs such as obstacle and velocity of the bird.

```
activation_default      = tanh
bias_init_mean          = 0.0
bias_init_stdev         = 1.0
bias_max_value          = 30.0
bias_min_value          = -30.0
bias_mutate_power       = 0.5
bias_mutate_rate        = 0.7
bias_replace_rate       = 0.1
```

Reproduction

After the mutation and crossover the best performing birds or genome are allowed to bred to produce a desirable offspring. Less fit individuals are replaced by these off-springs and then these off springs go through the same process for number of times.



Applications of NEAT

Gaming Industry

NEAT is often used to create intelligent agents in video games, allowing characters to adapt and learn optimal strategies to navigate complex game environments.

Robotics

The algorithm can be applied to train autonomous robots to perform tasks, enabling them to learn and evolve their behaviors through trial and error.

Artificial Life Simulation

Artificial life simulation involves creating populations of virtual organisms represented by neural networks that evolve and adapt to their environment over successive generations

Anomaly Detection

NEAT is used for anomaly detection in cybersecurity, finance, industrial systems, and network monitoring.

THANK YOU