



NEAT Based AI For Flappy Bird

M. Osama Asif
I174295@lhr.nu.edu.pk

M. Ibraheem Waheed
I174315@lhr.nu.edu.pk

Waleed Iqbal
I174032@lhr.nu.edu.pk

M. Husnain Maqsood
I174032@lhr.nu.edu.pk

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Instructor: Mubashir Baig

Introduction

OVERVIEW:

Neuro-Evolution of Augmenting Topologies is a genetic algorithm based NN.

Flappy Bird is a 2013 2D side scrolling mobile game, famous for a single control, that is difficult for a human to be consistent at for long time.

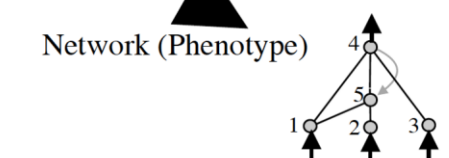
NEAT is a very fast and efficient approach to making an AI for games such as Flappy Bird.

AIM:

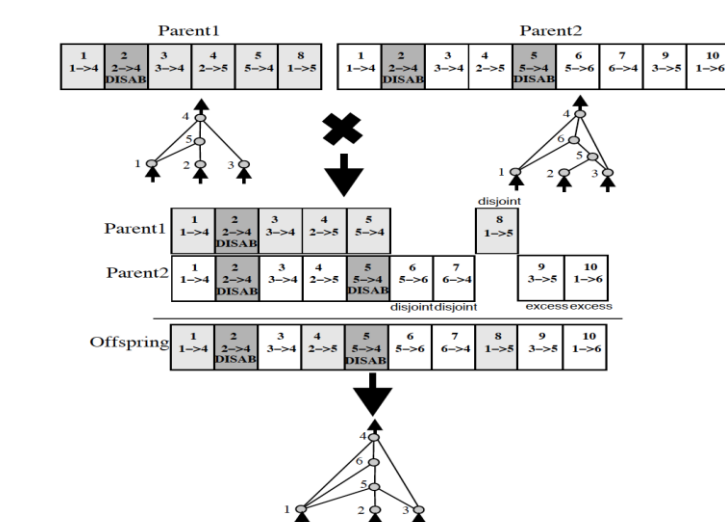
Make a very basic AI using NEAT-Python library, that is capable of mastering the game in the as early a generation possible, e.g. within 1 or 2 generations.

NEAT

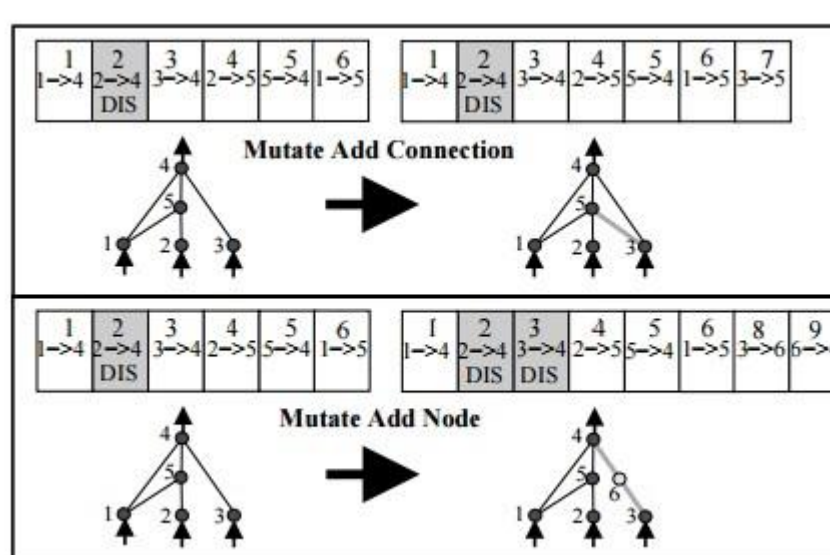
Genome (Genotype)									
Node Genes		Node 1		Node 2		Node 3		Node 4	
		Inname	Outname	Inname	Outname	Inname	Outname	Inname	Outname
Connection Genes		In 1	Out 1	In 2	Out 2	In 3	Out 3	In 4	Out 4
		Weight	0.7	Weight	0.5	Weight	0.2	Weight	0.4
		Enabled	DISABLED	Enabled	DISABLED	Enabled	DISABLED	Enabled	DISABLED
		Inneur 1	Inneur 2	Inneur 3	Inneur 4	Inneur 5	Inneur 6	Inneur 7	Inneur 8



Mutation is done by changing or replacing connections, weights assigned either randomly or a combo of 1 and old weight.



Direct Encoding used, means nodes etc are well defined.



Speciation and Historical markings make It possible to produce a “healthy” offspring, by limiting competition within species (done with markings).

Flappy Bird

A 2013 mobile based **2D side scroller** made by a Vietnamese developer and artist.

Pipes parallel to each other with **random length**, with a gap in between move from right to left and the **bird (player) has to pass through the gaps.**

The pipes move after a defined time. The **collision with pipes or ground leads to death.**



The control are simply to press space to jump, and not doing so leads to bird falling.

Setup and Evaluation

SETUP:

NEAT-Python we use requires a **configuration file** that has some basic requirements for genetic algorithm and NN in it.

```
[NEAT]
fitness_criterion = max
fitness_threshold = 100
pop_size = 50
reset_on_extinction = False

[DefaultGenome]
# node activation options
activation_default = tanh
activation_mutate_rate = 0.0
activation_options = tanh

# node aggregation options
aggregation_default = sum
aggregation_mutate_rate = 0.0
aggregation_options = sum

# node bias options
bias_init_mean = 0.0
bias_init_stddev = 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

# genome compatibility options
compatibility_disjoint_coefficient = 1.0
compatibility_weight_coefficient = 0.5
```

Fitness_criterion was set to **max** which is used to select the best genome in each generation.
Pop_size was set to 50, and activation function to **tanh**.

EVALUATION FUNCTION:

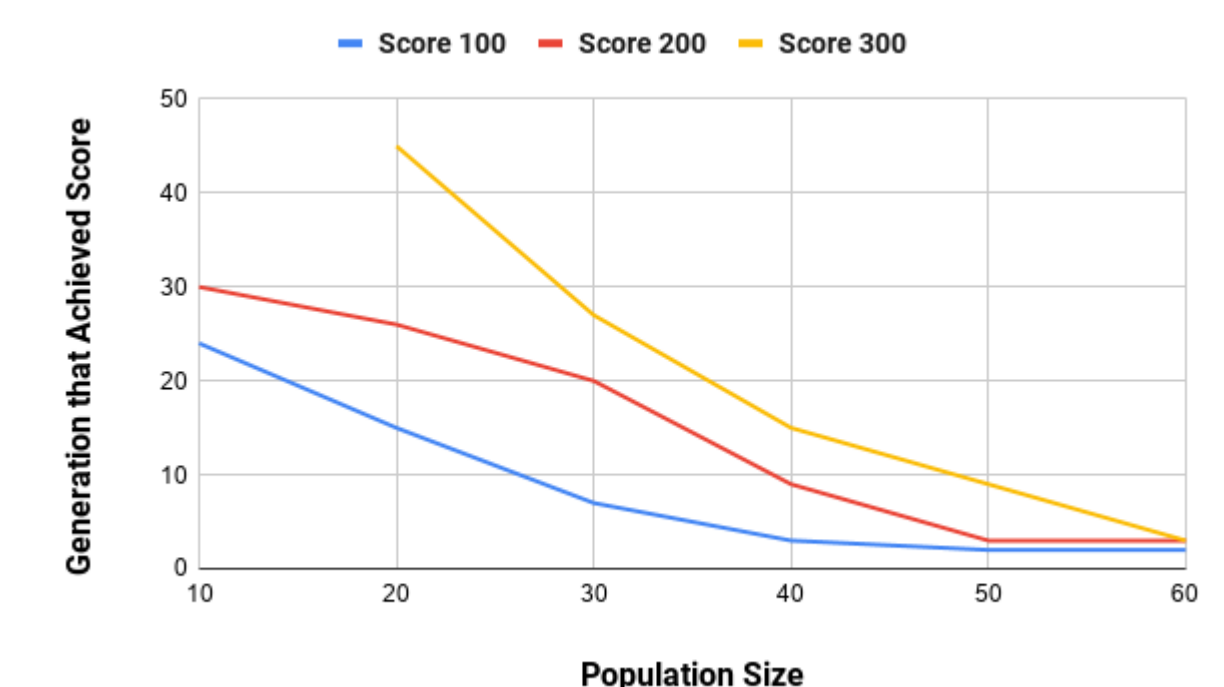
Add a score of 0.1 each frame as an incentive for just moving, **add 5 for crossing a gap.**

If a collision with either of the closest pipe is detected a score of **1 is deducted.**

Results

The results are of three different experiments, with different population sizes, while rest was kept constant.

The max generation count was kept at 50. The population sizes used were; **10, 20, 30, 40, 50 and 60**, and score goals used are; **100, 200 and 300.**



Conclusion

Given the tests, and the values chosen after experimentation, we can see that NEAT AI is perfect to be used as a player for Flappy Bird, being able to learn the overall game within 2-3 generations, and the best genome can easily outperform a human player.

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- [1] H. Heidenreich, "NEAT:AnAwesomeApproachtoNeuroEvolution", towardsdatascience.com, Jan.4,2019. [Online]. Available:<https://towardsdatascience.com/neat-an-awesome-approach-to-neuroevolution-3eca5cc7930f>. [Accessed June 12, 2020]
- [2] K. O. Stanley, R. Miikkulainen, "Evolving Neural Networks throughAugmenting Topologies", Department of Computer Science, University of Texas, 2002. Available: <http://nn.cs.utexas.edu/downloads/papers/stanley.ec02.pdf>. [Accessed June 12, 2020]