The Brain

0.0 Background

0.1 Abstract

When thinking of a human in contrast to a computer, one thing generally comes to mind, *adaptability*.

The reality of the situation is that computers are "dumb", while capable of doing hours of grueling work, they have to be told exactly what to do, or they won't do anything, humans, on the other hand, when given a task, can adapt to the goals and learn what to do, even from scratch, and that is what we wanted to create, a "brain", which when given a task and some inputs, can make intelligent decisions towards that goal.

0.2 Motivation

Most of the other work done in this field has a very specific outline, we wanted to create something that simulates the human brain in its generality, it also had to be reasonably simple, to keep the computational time low enough for it to be practical.

For simplicity's sake, we wanted to showcase the idea on something simple and with very clear-cut goals, one thing comes to mind :

Video Games.

1.0 The Brain

The brain works using a genetic algorithm, it creates multiple "players" to play a game, each player is a neural network of their own, to explain our idea, we decided to use the popular game "Flappy Bird".

1.1 The Game

Flappy Bird is a game that requires you, the player, to take play as a bird trying to jump through small gaps between two pipes.

Figure 1 : Example of the game

Even though the game is perfect for our study, it is a mobile game which was removed from all app stores a while back, so we had to create or find a replicate, Creating one would've been too time consuming, searching for a replicate on the other hand, was fruitful.

We found a replicate by the name of "FlapPy Bird"[1] by the github user "sourabhv" created using python utilizing a library called "Pygame", which eases the creation of the game.

We faced multiple issues with the game, such as the following :

- Understanding the game itself well enough to manipulate it.
- Learning to create multiple players simultaneously.
- Having to remove multiple parts of the game that were not necessary.
- Somehow implementing the brain into the game in a practical manner.

Thankfully after some amount of work, we were able to do what was needed for it to work.

1.2 The Player

Each player the brain creates is a neural network, one decision we had to make was what input to use for our neural network, and we eventually came to the following inputs :
- The height of the bird.
- The height of the next gap.
- A "normalized" distance to the next pipe.

These all seemed like reasonable inputs as any human playing the game would take these three factors into account.

Considering you could only take one action in the game, jump, the only output possible was a decision on whether to jump or not at any given moment.

As mentioned above, the brain controls the players and uses a genetic algorithm to make them play better, naturally, it has all the parts of a genetic algorithm.

The fitness function used was the following :

Fitness = (Distance+1)/Abs(Height-HeightOfNextGap)+1

There were some unexpected suicidal tendencies for some of the players, where they would instantly fly up to their deaths, to curb these tendencies, we simply set the fitness of any bird that does that to -1000 to make sure they had very little chance to cross over.

For the Cross Over function, we went simple :

Take all the weights of a neural network and put them in an array, then swap half of them with the same array for the second crossover participant and re-apply these new weights.

The mutation :

There is a 10% mutation chance, where we apply a random change to the weights in the range of (-0.5,0.5), there is also a more rare, extreme mutation, at 5% chance, that applies the same change with the range of (-2,2).
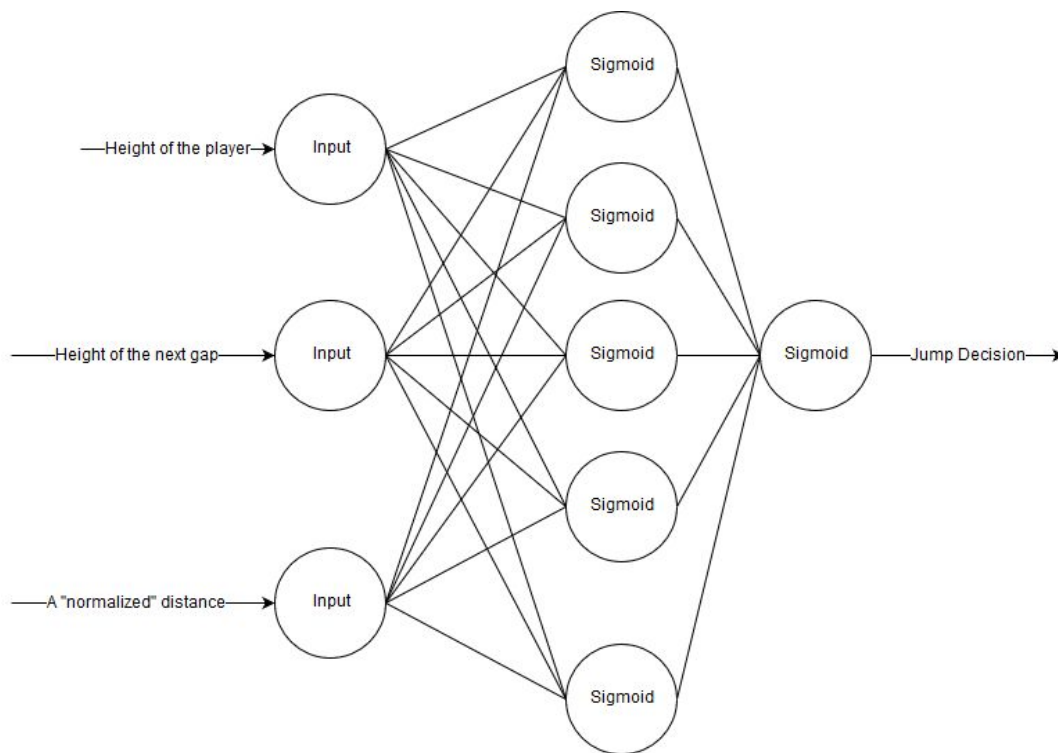

Figure 2 : Sample player

3.0 The Results

The first few generations didn't do very well, dying after getting at most, 5 points. Thankfully, after around 190 generations, we reached a successful player.
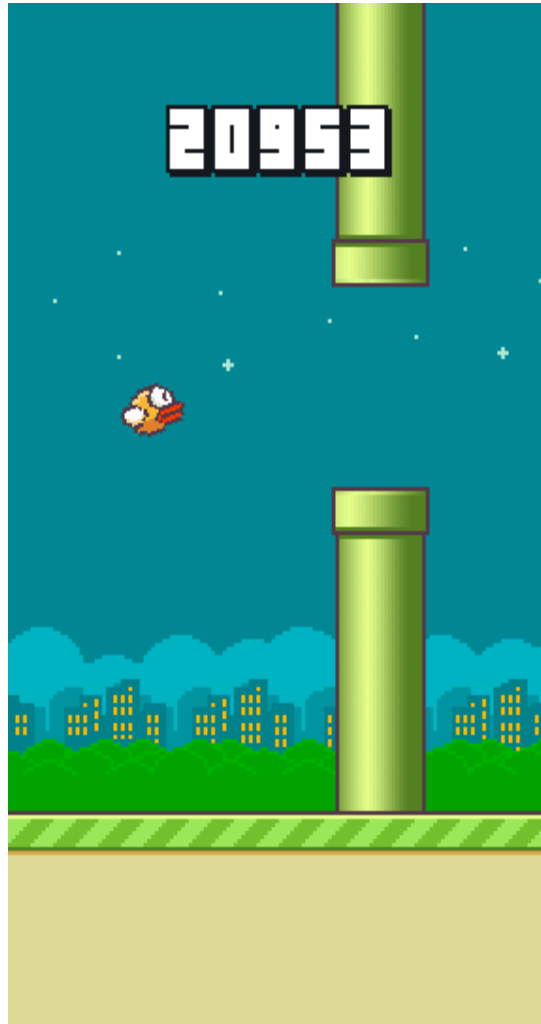

Figure 3 : Success!

We are proud to say that we've tested the brain on one more game and it worked out well, while these are very simple games, we believe this is a good step towards a more general AI application.

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[1] : https://github.com/sourabhv/FlapPyBird