Neural Networks

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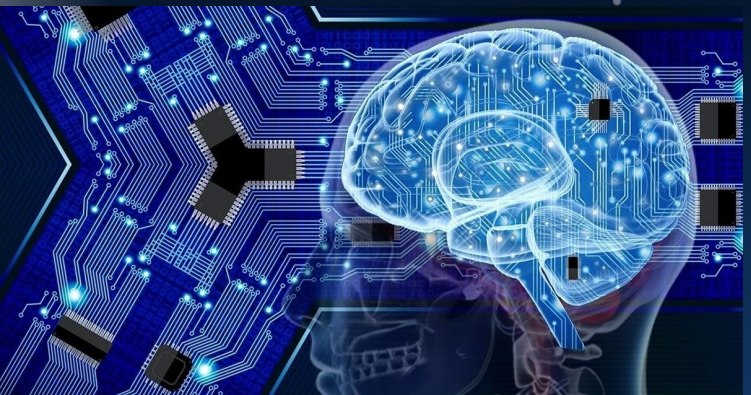
What is a Neural Network?

According to IBM, “a neural network is a machine learning program, or model, that makes decisions in a manner similar to the human brain, by using processes that mimic the way biological neurons work together to identify phenomena, weigh options and arrive at conclusions.” In other words, a neural network simulates decisions from a human perspective. It comprised of a collection of nodes with an input, output, and hidden layers.



Example

Let's break down what one single node might look like using binary values. We can apply this concept to a more tangible example, like whether you should go to McDonald's (Yes: 1, No: 0). The decision to go or not to go is our predicted outcome, $\hat{y}$ (pronounced y-hat). Y-hat is a common variable used in statistics and computer analytics. Let's assume that there are three factors influencing your decision-making:

1. Are you hungry? (Yes: 1, No: 0)
2. Do you like McDonald's? (Yes: 1, No: 0)
3. Is there a McDonald's close to you? (Yes: 1, No: 0)

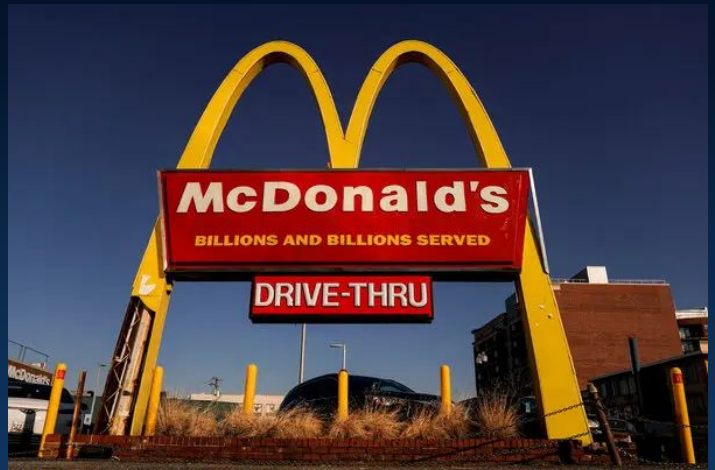
Take for example a Stuyvesant student. Let's name him Cam. Then, let's assume the following for Cam, giving us the following inputs:

4. X1 = 1, since Cam is hungry
5. X2 = 0, since Cam isn't a fan of junk food
6. X3 = 1, since there is a McDonald's one block away from Stuyvesant

Weighting

Now, we need to assign some weights to determine importance. Larger weights signify that particular variables are of greater importance to the decision or outcome.

1. W1 = 5, since Cam doesn't want to go to eat unless he is hungry
2. W2 = 2, since Cam doesn't mind junk food once in a while
3. W3 = 4, since Cam does not like to travel far



Activation Function

We can assume a threshold value of 3. This means that if our data results in a number greater than or equal to 3, we will receive an output of 1, which means Cam will go to McDonalds. If our data results in a number less than 3, there will be an output of 0, which means that Cam will not go to McDonald's. To achieve this result, we must input our data into an activation function, shown below.

$$\sum w_i x_i + \text{bias} = w_1 x_1 + w_2 x_2 + w_3 x_3 + \text{bias}$$

From the previous slides, we know that

$x_1 = 1$ $\quad W_1 = 5$
$x_2 = 0$ $\quad W_2 = 2$
$x_3 = 1$ $\quad W_3 = 4$

The bias is equal to the opposite of our threshold value, so bias = b = -3.

$$(1 * 5) + (0 * 2) + (1 * 4) - 3 = 6$$

6 is greater than 0, so our data results in a value greater than our threshold. This means that our activation function will output a 1, so Cam will go to McDonald's!

Note: This outcome will change based on the threshold and weights we use. For our project, we start with randomized values which will be updated and improved as the program runs.