# Introduction:

The standard AI model:

Input layer

Hidden layer 1

Hidden layer 2

Output  
layer

In this model, there are 2 input neurons in the input layer, 4 neurons in the hidden layers, and 2 output neurons in the output layer.

Data will be passed from the input layer, to the hidden layer 1, then to the hidden later 2, then to the output layer.

Simple example:

Height

Weight

40lbs

2ft 2in

Species 1

Species 2

One example of this could be trying to predict whether an animal is species 1 or species 2 by using only height and weight inputs.

# Forward pass

Normalizing the height and weight, we can see that the values are as follows: 0.8, 0.5

Height

Weight

0.5

0.8

Species 1

Species 2

The next important step is to randomize the weights and bias’ of the neurons of the artificial network. The below diagram depicts the top half of the graph, showing the weights and biases:

0.8

W1

W2

W3

W4

W5

W6

W7

W8

B1

B2

B3

B4

B5

Do not mistake the biases as the neuron’s data, these are different. Randomizing these values gives you:

0.8

0.2

0.4

0.5

0.3

0.1

0.2

0.4

0.7

0.8

0.2

0.2

0.1

0.1

0.4

0.1

0.5

0.4

0.1

0.1

0.9

0.1

0.6

0.3

0.4

0.6

0.3

0.4

…

Now we are ready to do our first forward pass. During a forward pass, the neuron data is passed from the input neuron(s) to the output neuron(s), passing through many different mathematical manipulations.

The first stage of this forward pass is to calculate the value of the 2nd layer, given the value of the normalized values from the input layer (height of 0.8, as seen above, and weight of 0.5, as seen previously)

The 2nd layer neuron values are equal to the sum of the previous nodes, multiplied by the weight factor, adding a bias. This value is then passed through an activation function. For simplicy, we will be using ReLU for the activation function, which is shown below:

Where represents the number of neurons in net layer , and represents the weights of net layer

Visually, an example of neuron is shown below in the second layer:

0.8

0.2

0.1

0.1

0.5

…

0.31

i

j

The mathematical calculation for this is shown below:

After computing the first neuron of layer 2, we then go on to calculate all others. Then, similar to what is being shown, the neurons in layer 3 and layer 4 are calculated.

The final calculation for the forward pass is using the neuron values in the layer 4 to determine the output. There are 2 options as the theoretical answer: Species 1 and Species 2. The species that the AI determines as the right answer will be the highest value. So at the end, if the neuron values are 0.3 and 0.9, then the species will be determined to be species 2.

# Backward pass

The backwards pass is a bit more complicated. Essentially, we are going to take the actual resulting value, and then calculate how much the weights at each stage have an effect on the output, and then try to correct that value.