Neural Network Basics

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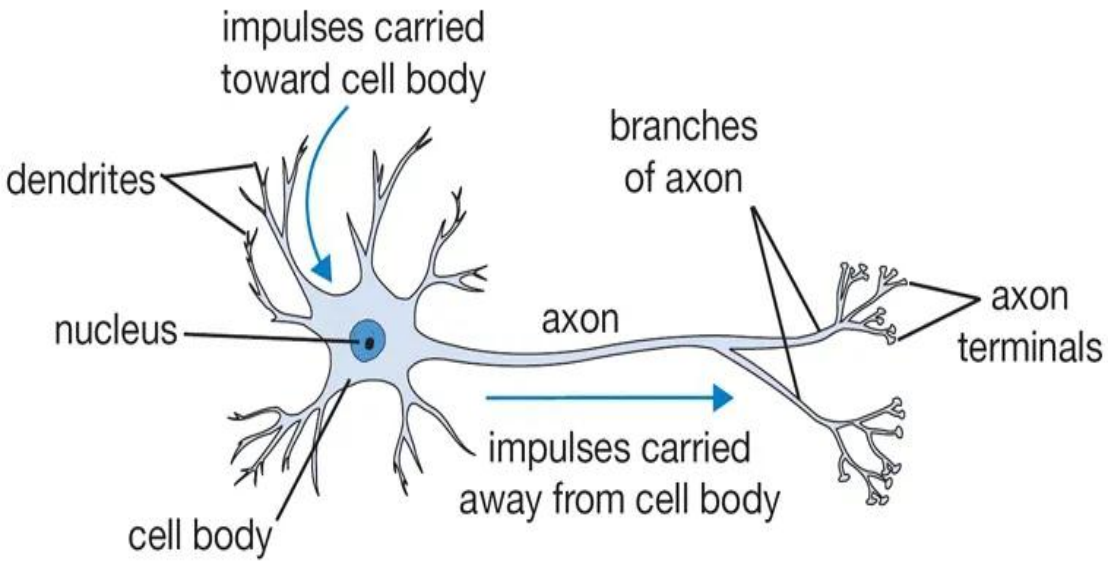
What is a Neural Network

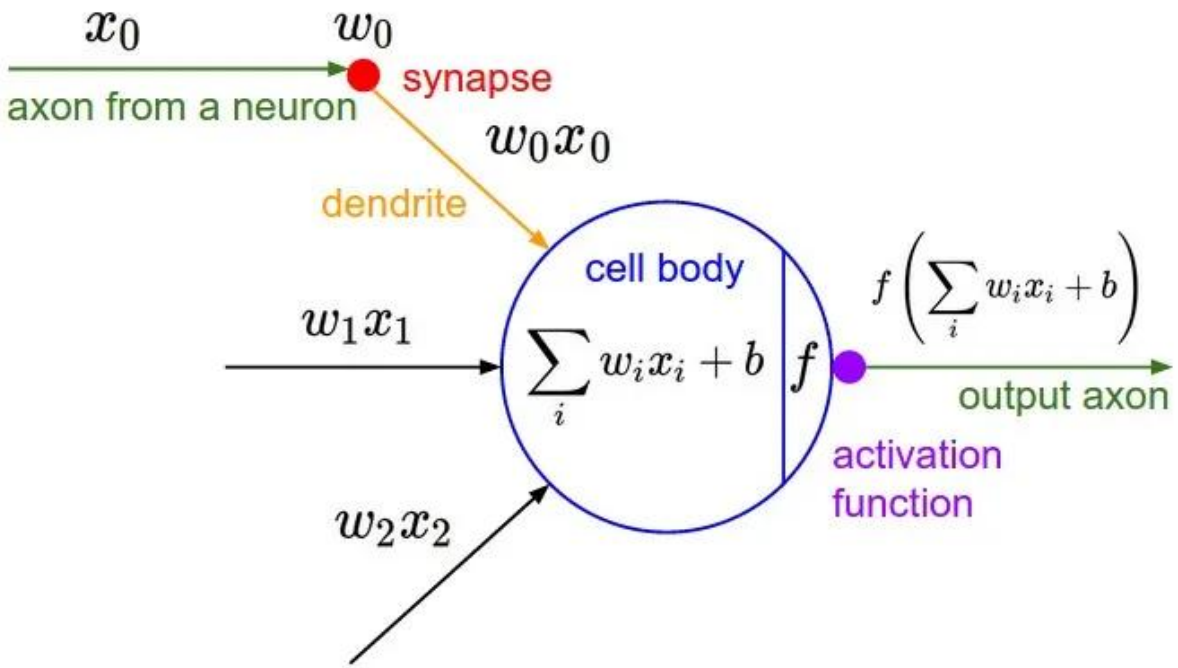
- A bunch of **neurons** grouped in a way to do complex tasks.

So What is a Neuron Then?

Biological Neuron

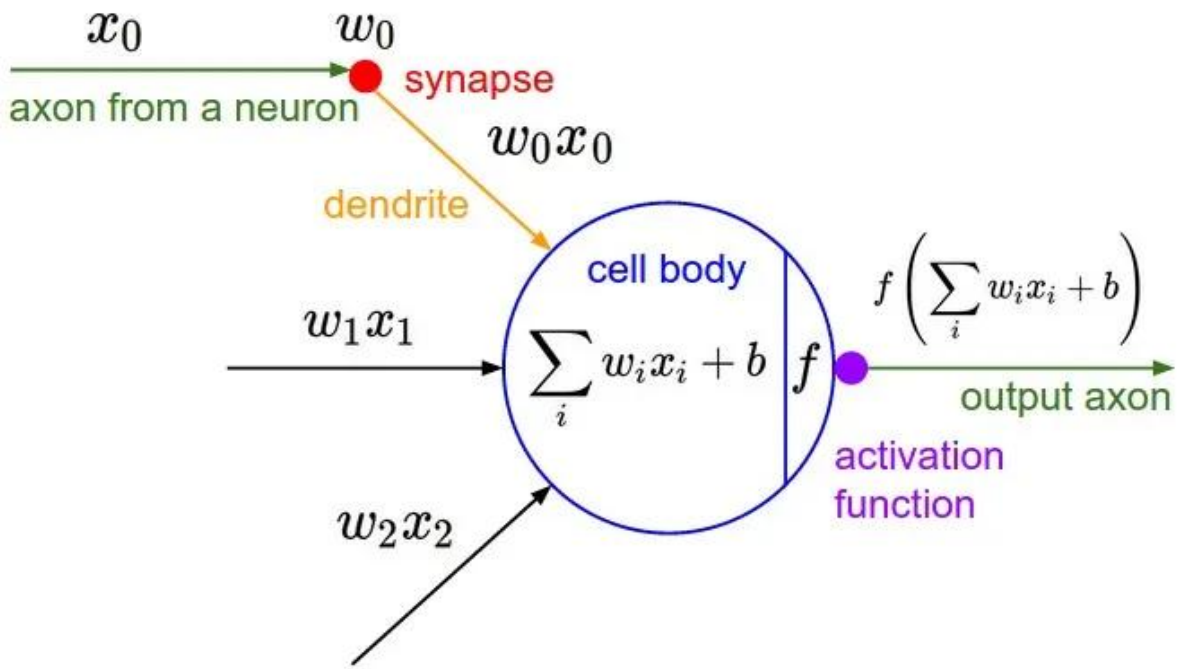


Machine Learning Neuron



How does a Neuron work?

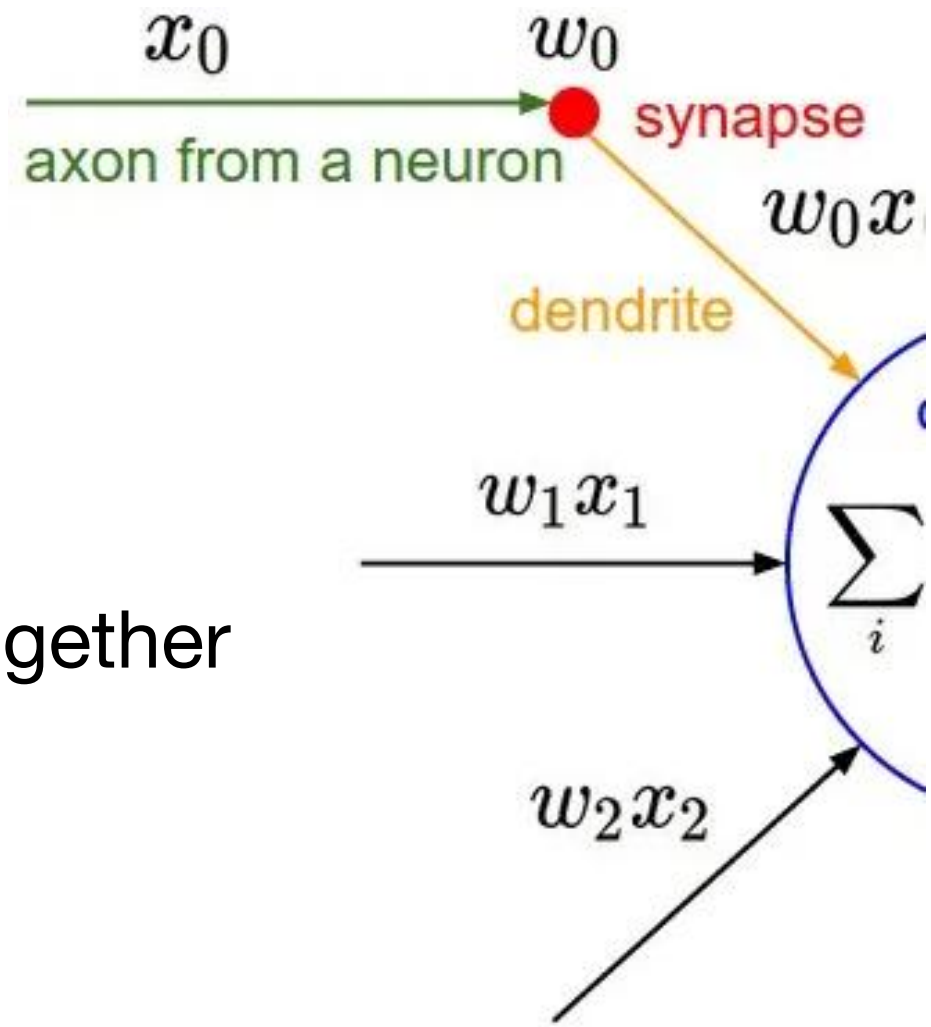
$$f\left(b + \sum_{i=1}^{n} x_i w_i\right)$$



How does a Neuron work?

$$f\left(b + \sum_{i=1}^{n} x_i w_i\right)$$

Weights (w):



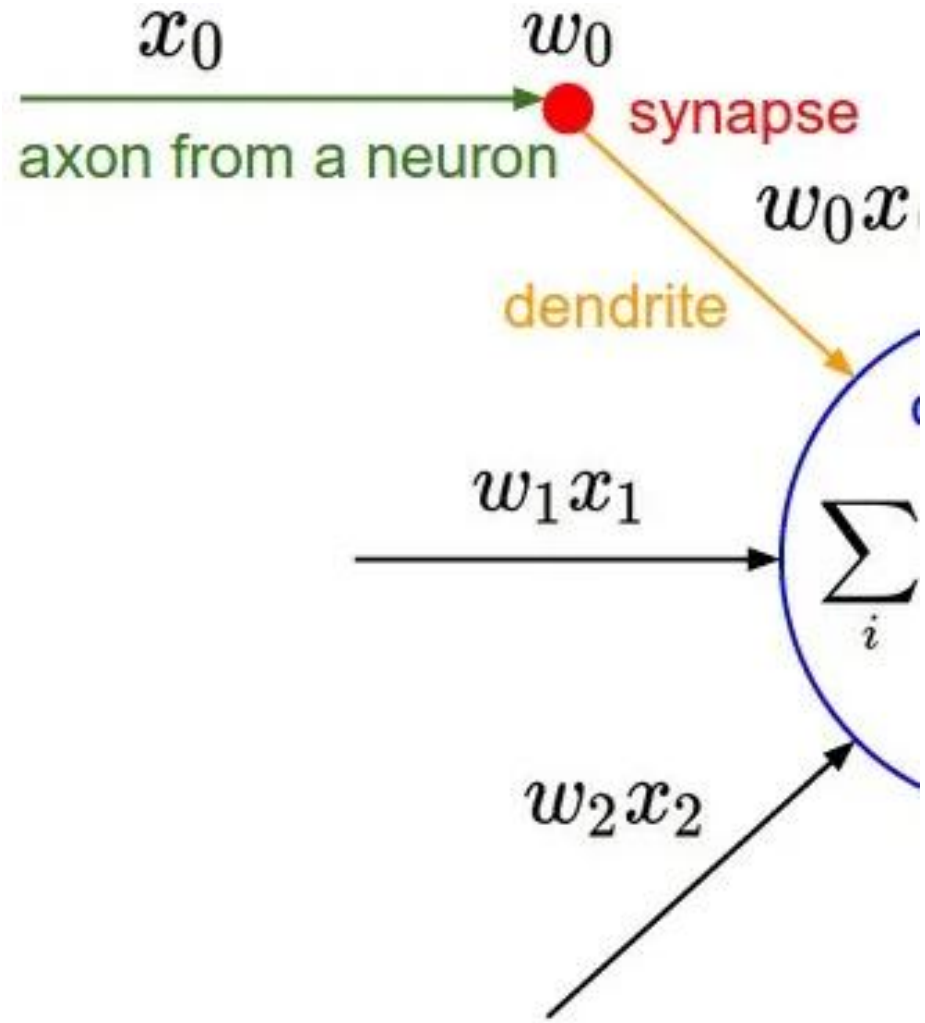
Inputs from other neurons first
get multiplied by their weights w_i,
and then all the $w_i x_i$ gets added together

How does a Neuron work?

$$f\left(b + \sum_{i=1}^{n} x_i w_i\right)$$

Bias (b):

We then add a value b to the sum.
This value is called the bias.

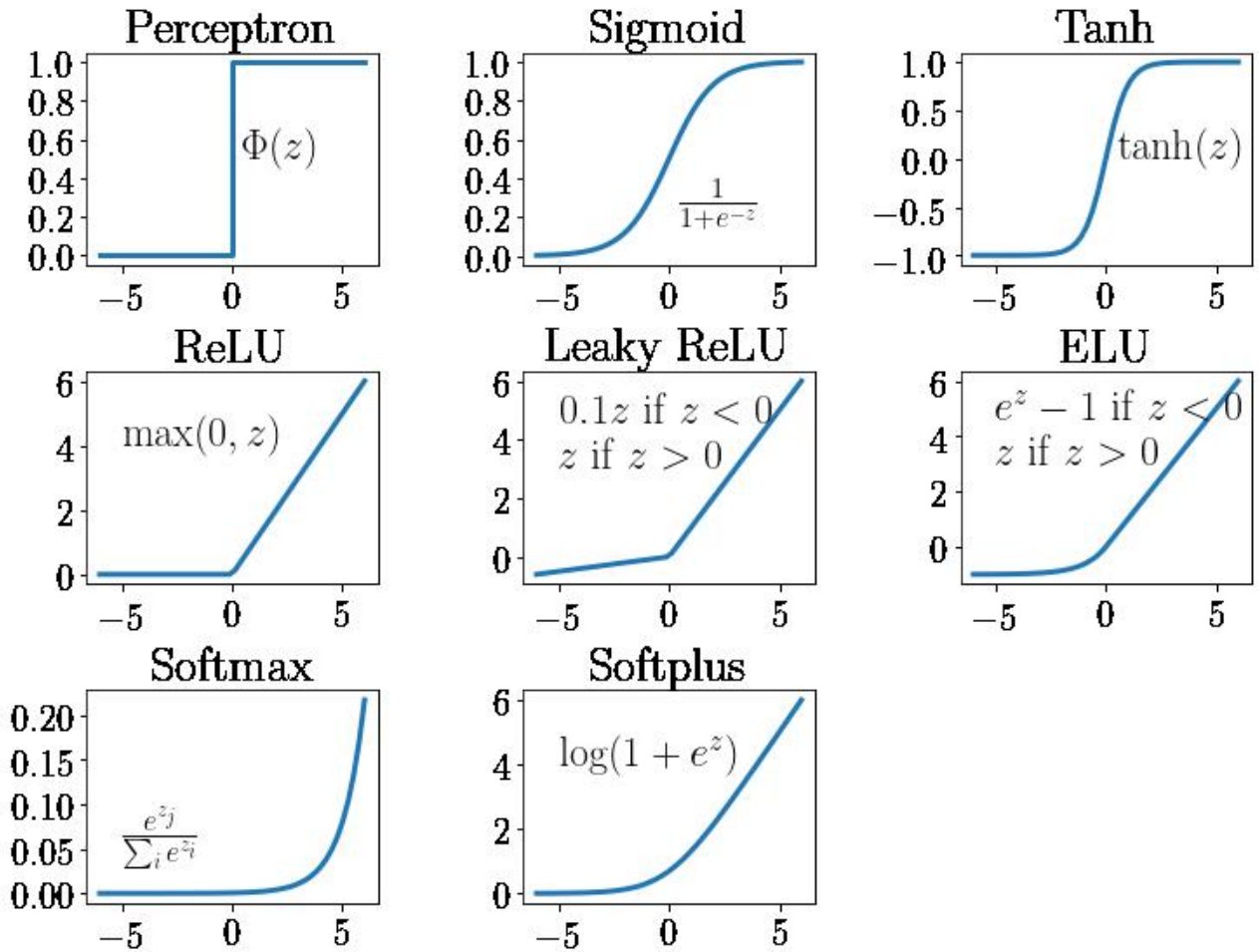


How does a Neuron work?

$$f\left(b + \sum_{i=1}^{n} x_i w_i\right)$$

Activation function(f):

Then this value is passed into an activation function



How does a Neuron work? An example

Lets understand how a neuron work with an example.
Suppose this neuron's job is to tell us whether we should wear a sweater.

How does a Neuron work? An example

Weights: In this example, the neuron assigns different weights to different features to capture the important stuff.
(Biases can also be negative)

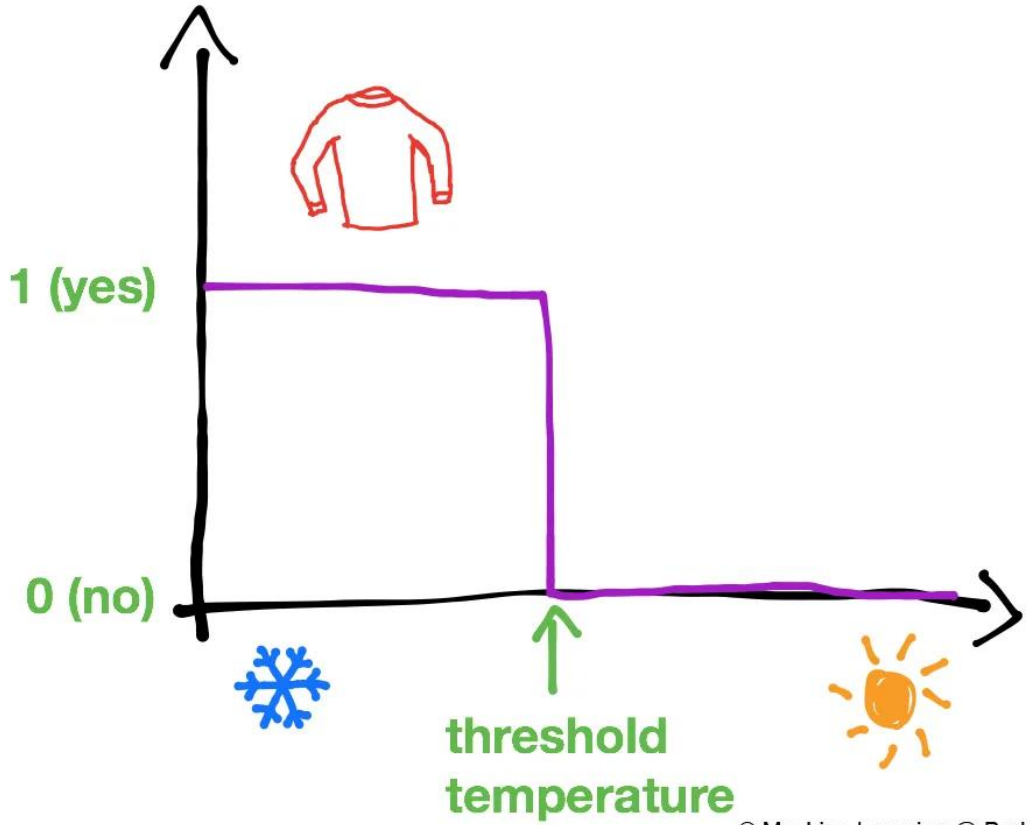
Wind speed is kinda important
so a moderate weight is assigned

The temp is really important,
so a high weight is assigned

This is not important at all
so a weight of 0 is assigned

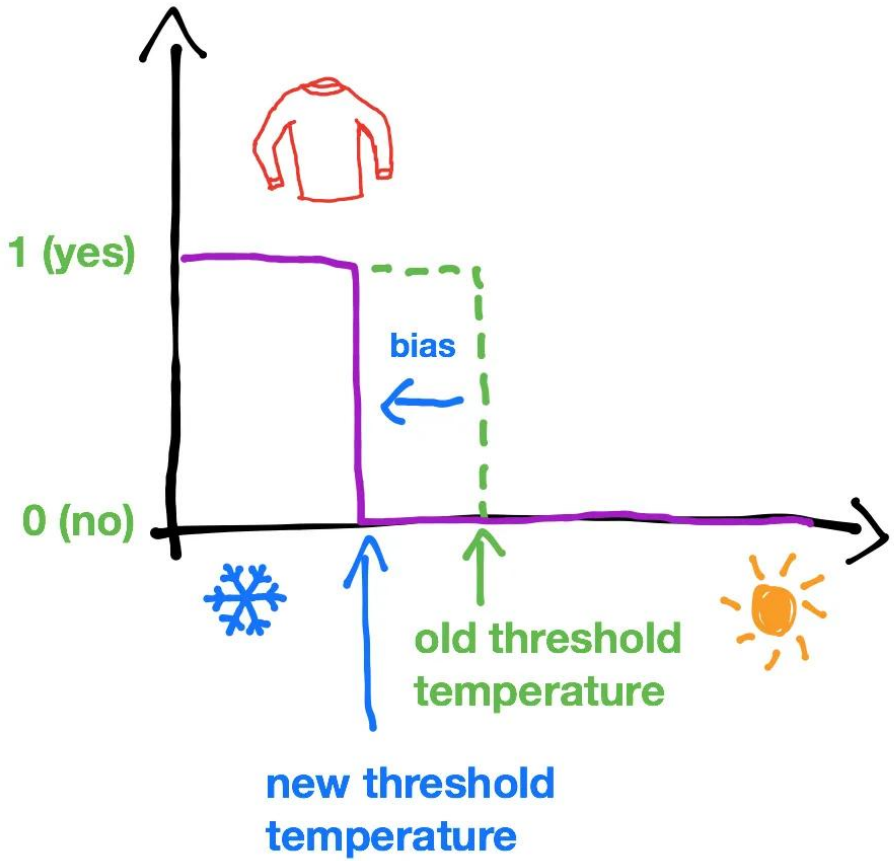
How does a Neuron work? An example

Activation function: In this case, the activation function is the thing that processes a value into a yes/no answer. A simple example may look something like this:



How does a Neuron work? An example

Bias: But sometimes the threshold temperature isnt just one value. for instance, it might be different for Canada, which has a colder climate. The bias's job is to shift the activation function to fit specific needs.

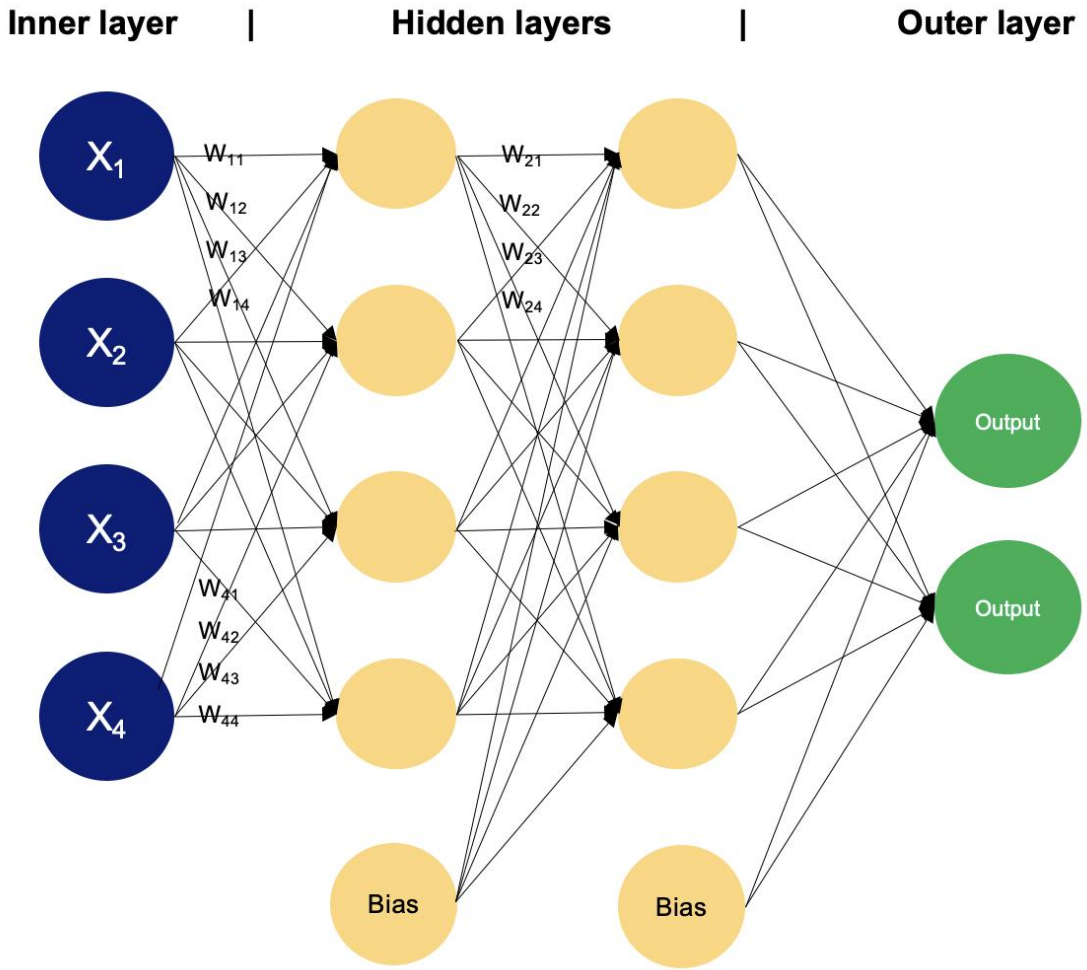


How does a Neuron work? Interactive demo

That was an oversimplified and unrigorous example. To get an intuition of how they exactly work, use our interactive demo notebooks!

Multiple Neurons Work together: MLPs

To model more complex things, we put more neurons together in hidden layers, and connect each neuron to all of the ones in the previous layers. This multilayer neural network is called the MultiLayer Perceptron (MLP)



So many weights and biases! How do we get them?

We can try to calculate how many parameters (total amount of weights and biases) there are in a MLP with 2 inputs and a hidden layer of 3, and a output of 2:

12 weights in total, and this number is going to only increase as we try more complex models. How do we set these parameters?

To be continued...

References

https://mlberkeley.substack.com/p/part-1