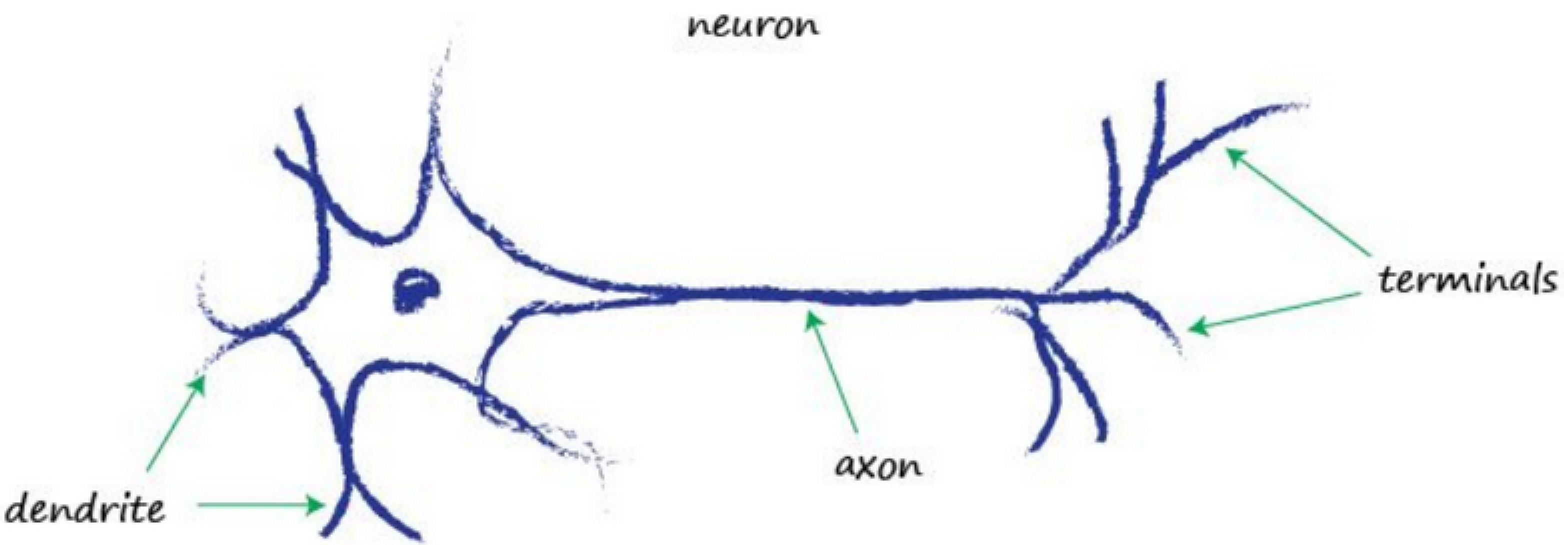
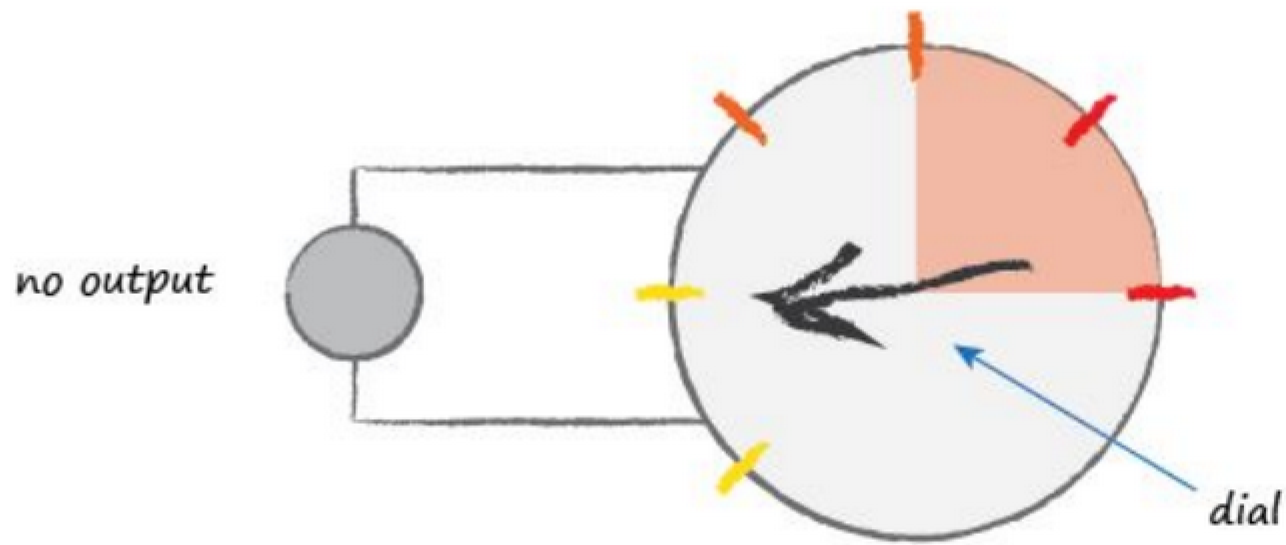
Neurons and Activation Function

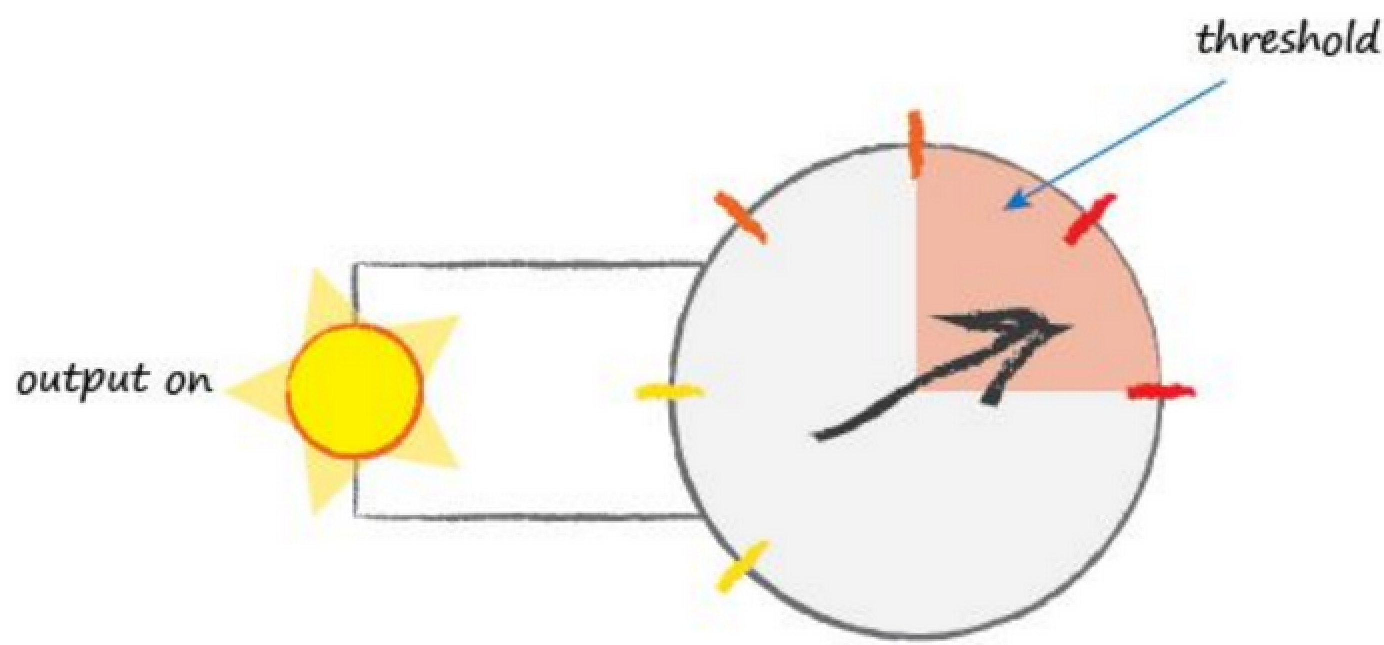
Since we are dealing with neural networks here, lets take a look back at the history of it. Its modeled after the artificial brain which had neurons which do the same task they take a signal as an input and generate an output signal. The only difference they have with computers is that they process data very sequentially and in exact terms concrete way while brains process the data in parallel and ambiquity is a feature in it.

Q: How can we model an artificial neuron?



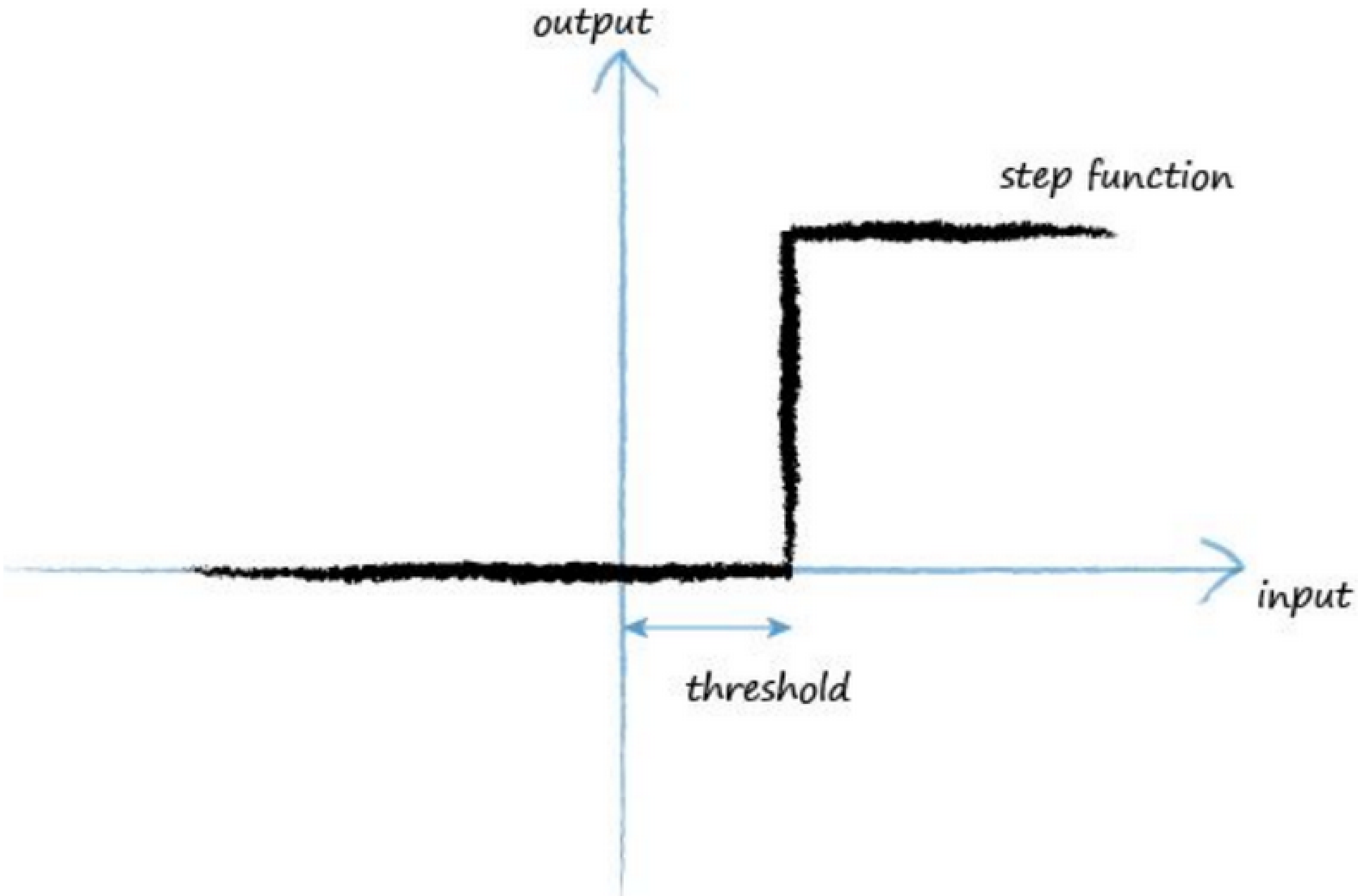
So could we represent the neuron as a linear function, just like we did before? No, because a biological neuron doesnot produce an output that is linear.It works in a way like filling a glass with water. Once the water reaches a certain threshold it then generates an output signal.



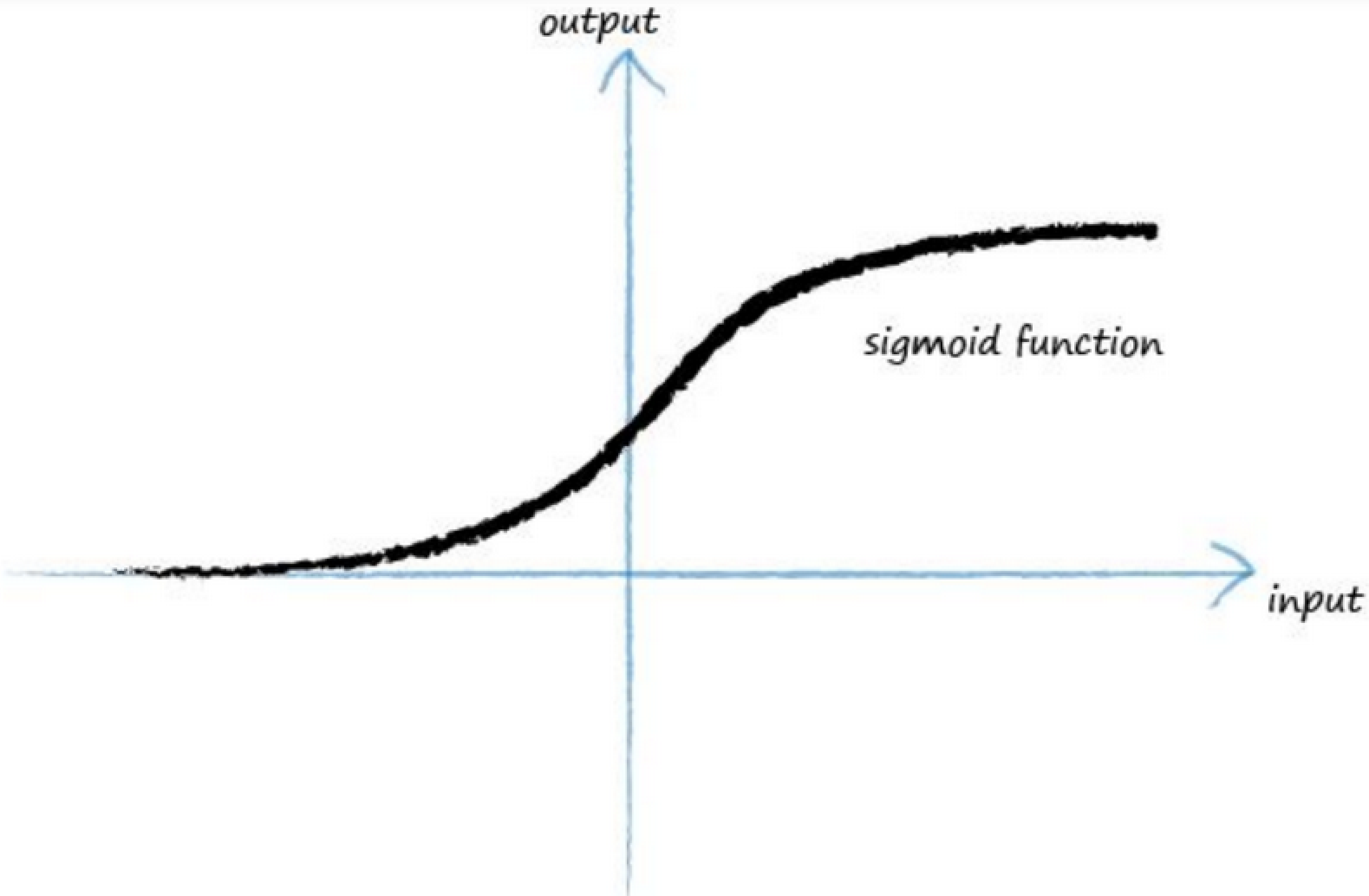


This function of thresholding is called the activation function.

Examples would be the step function.



This function switches on the output when we reach the certain threshold. but we normally use sigmoid function becaude of its smooth curve. Nature rarely hard cold hard edges.



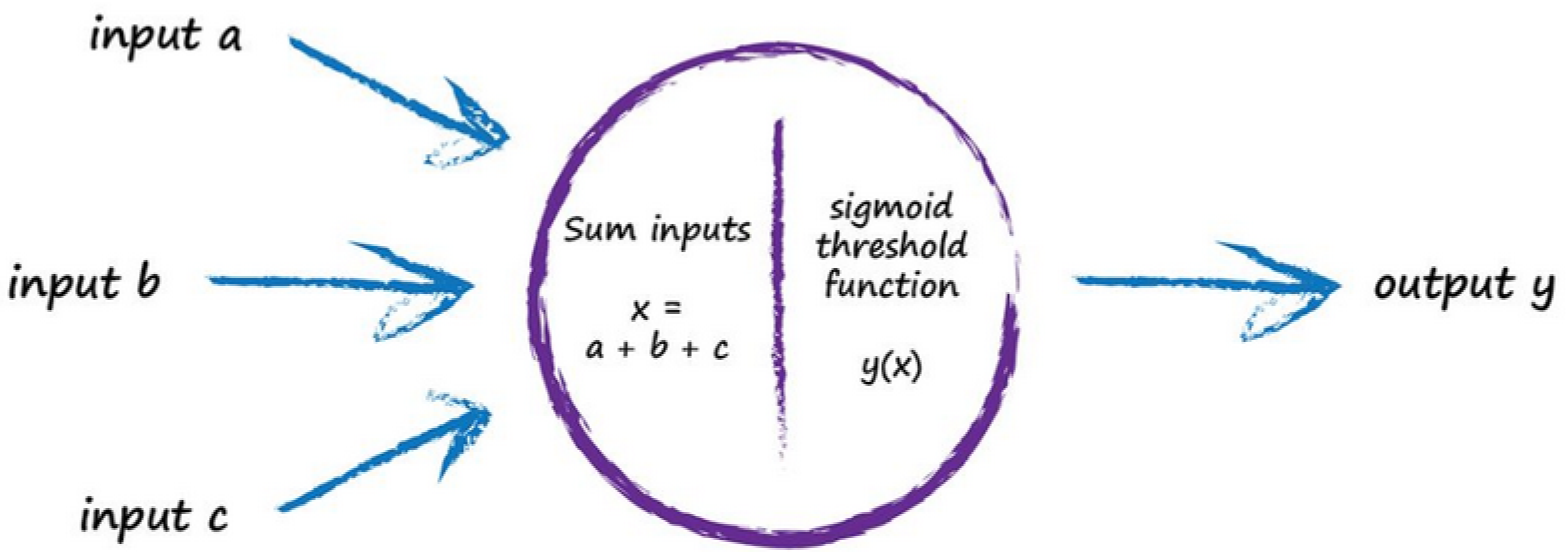
The reason Sigmoid functions is used instead of other s-shaped functions is because it is easier to do calculations with.

$$y = \frac{1}{1 + e^{-x}}$$

Don't be afraid, its just a function that takes x a an input and gives us an output. Lets get back to neurons and consider model how would we model an artificial neuron.

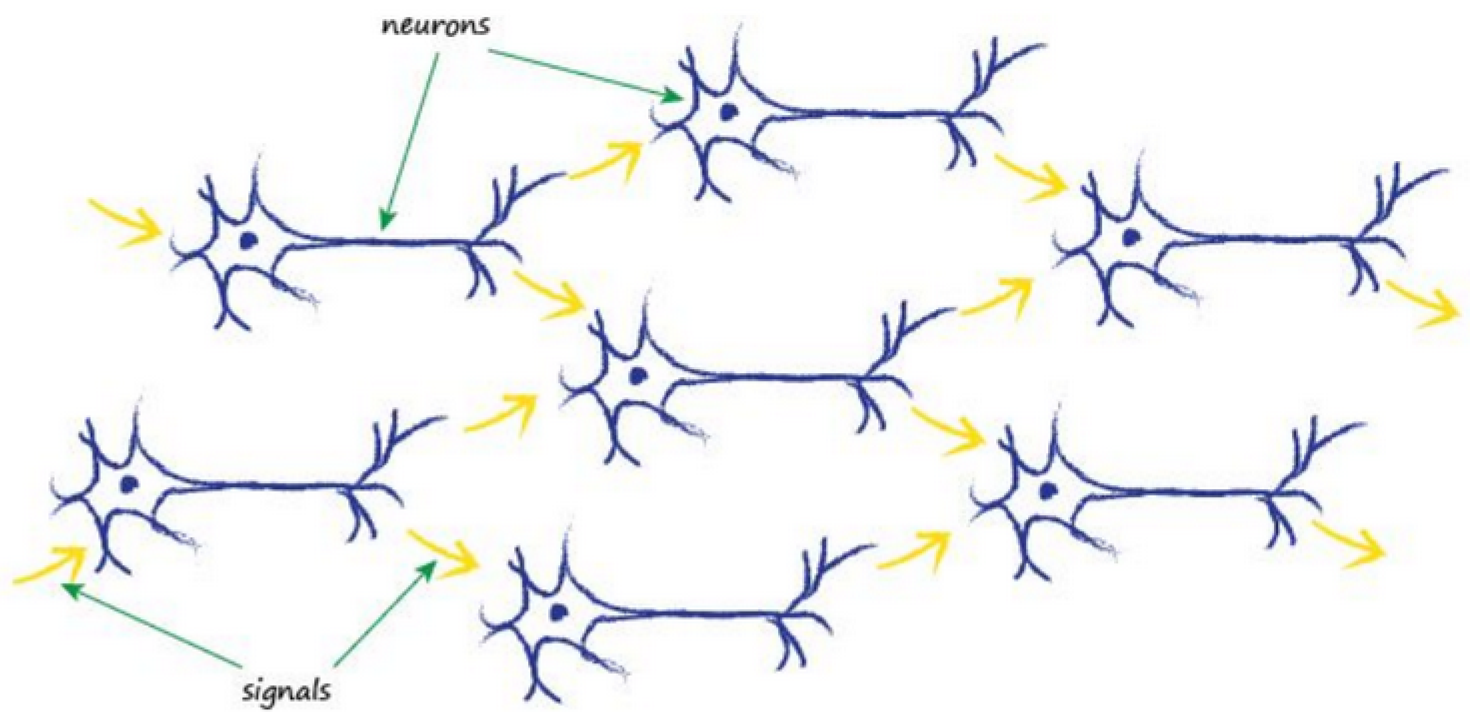
Modeling Artifical Neuron

First of all neuron take multiple inputs signals and threshold them.so the structure would look something like this.

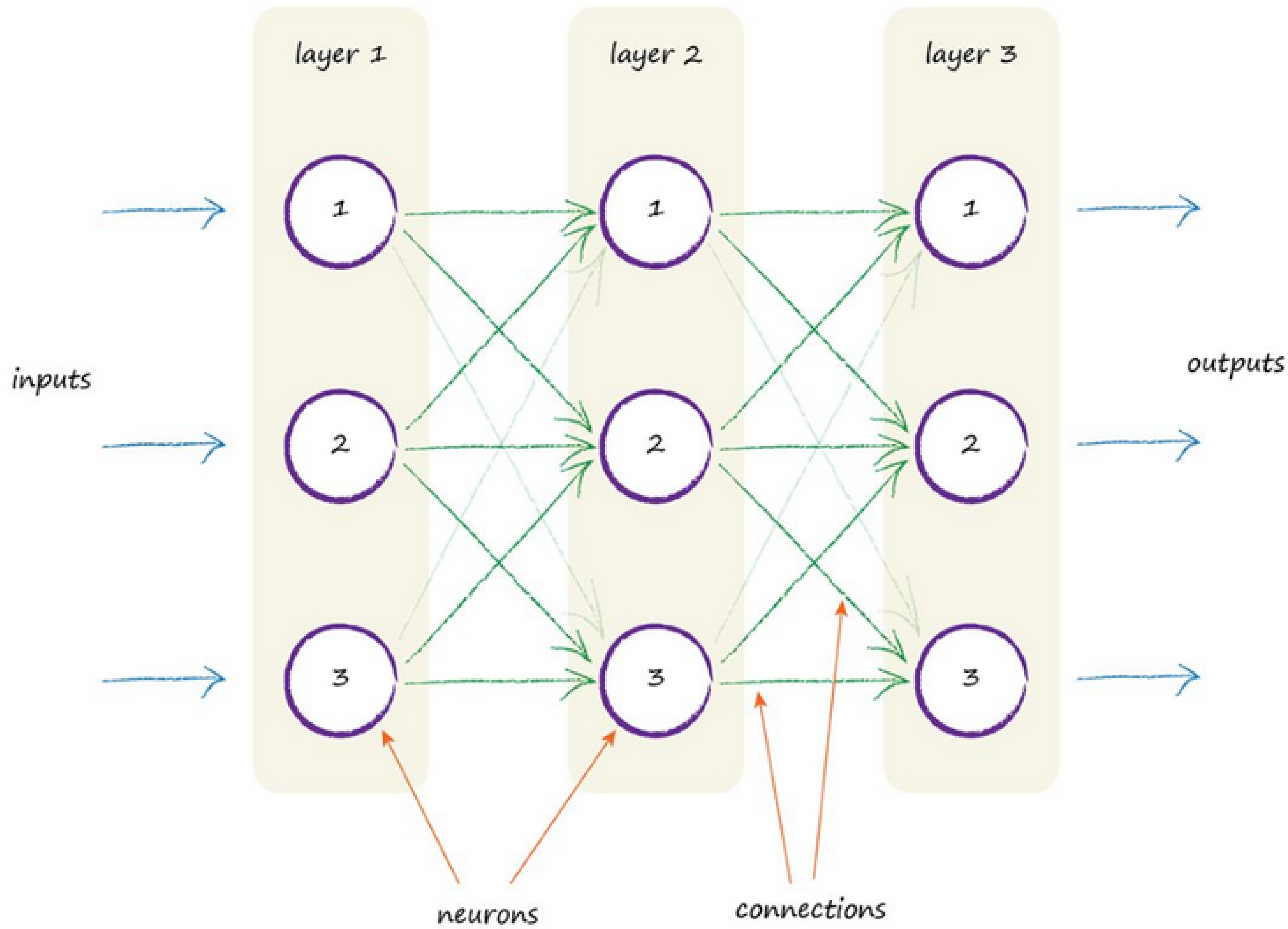


If the combines signal is not large enough, the sigmoid suppresses the signal and if it is large enough it fires the neuron.If only one input is large and other are small, they neuron will still fire. Moreover, the neuron will still fire when some of the inputs are almost, but not quite, large enough because the combined signal sum overcomes the threshold.In an intuitve sense, this gives off the sense of sophisticated and fuzziness in its nature.

Neurons then fire a signal down the axon towards the terminal to pass it to the next neuron dentrites.



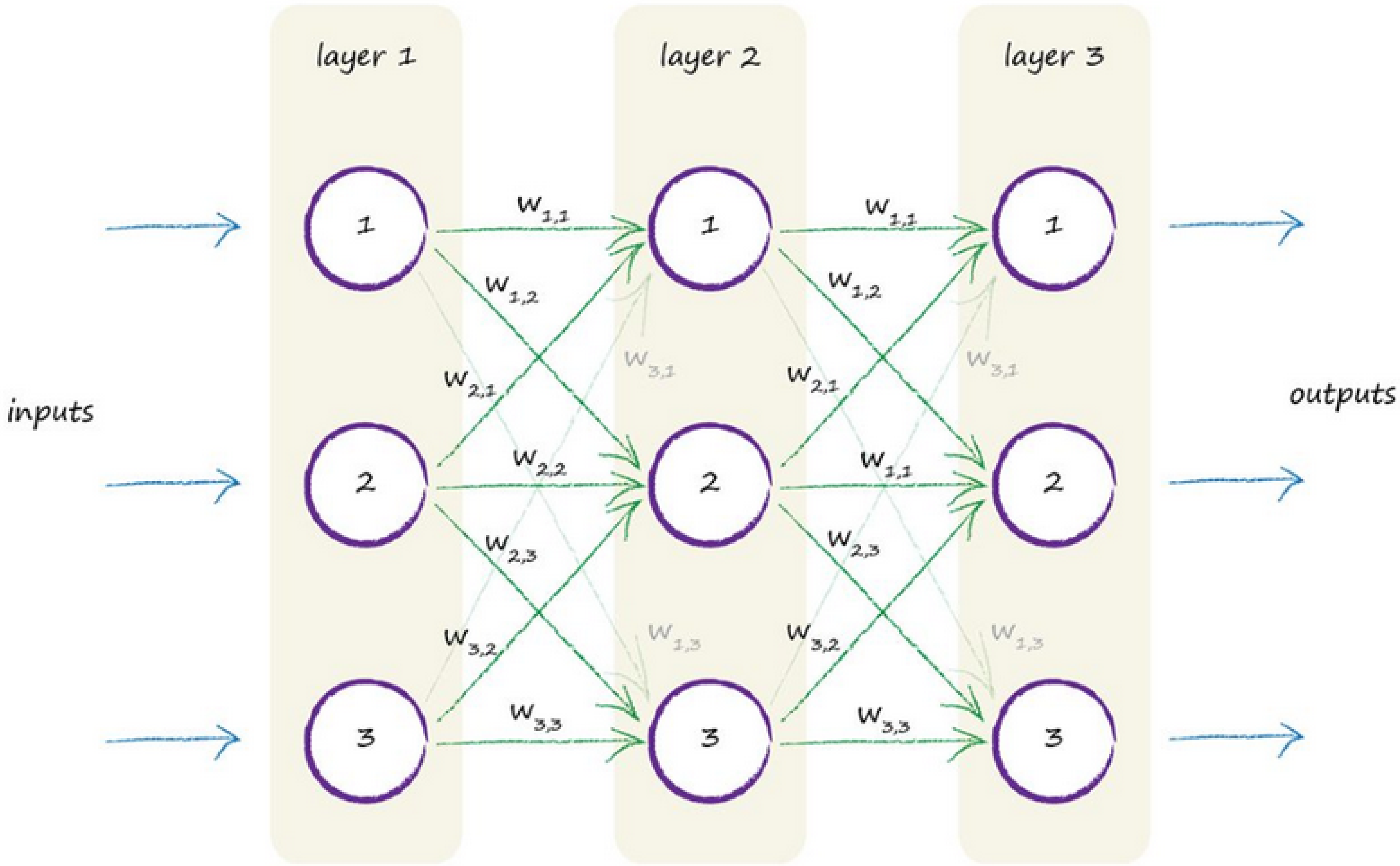
The thing to note here is that each neuron pass and get signals from multiple neurons before and after making each neurons in sort of layers giving us this layer like structure.



You can see the three layers, each with three artificial neurons, or nodes. You can also see each node connected to every other node in the preceding and next layers.

That's great! But what part of this cool looking architecture does the learning? What do we adjust in response to training examples? Is there a parameter that we can refine like the slope of the linear classifiers we looked at earlier?

The most obvious thing is to adjust the strength of the connections between nodes. Within a node, we could have adjusted the summation of the inputs, or we could have adjusted the shape of the sigmoid threshold function, but that's more complicated than simply adjusting the strength of the connections between the nodes.



So ladies and gents here we have modeled the neuron system. It seemed complicated but tuned out to be quite a bit simpler.

Conclusion:

- Brains, made of connected neuron, is an inspiration of artificial neural networks.