Deep Learning

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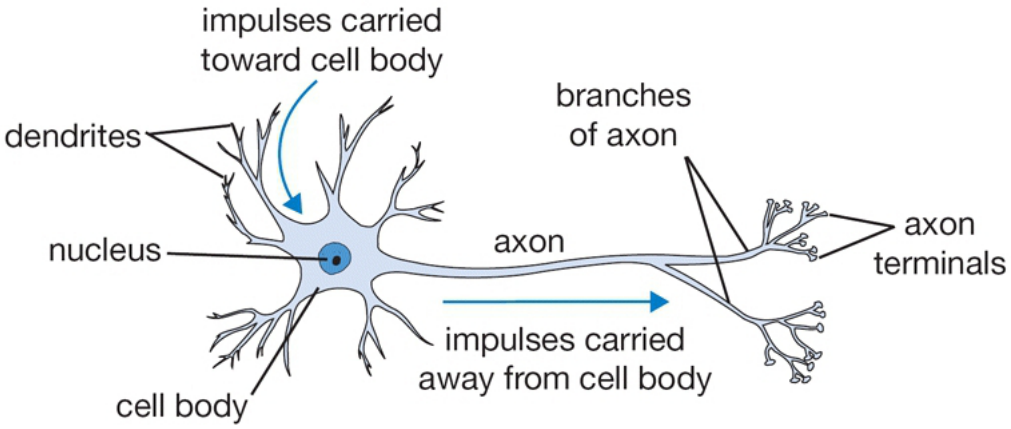
1 Types of neurons

1.1 Brain neurons



1.2 Linear neurons

A linear neuron is very simple and computationally limited in what it can do.

$$y = b + \sum_i x_i w_i$$

The output y is given by the bias b plus the sum of all the input connections x_i multiplied by their weight w_i.

1.3 Binary threshold neurons

Binary threshold neurons output a 1 or a 0 depending on its weighted value.

Given a threshold $\theta = -b$

$$z = b + \sum_i x_i w_i$$

$$y = \begin{cases} 1 \text{ if } z \geq 0 \\ 0 \text{ otherwise} \end{cases}$$

1.4 Rectified Linear Neurons or Linear threshold neurons

They compute a linear weighted sum of their inputs.
The output is a non-linear function of the total input.

Given a threshold $\theta = -b$

$$z = b + \sum_i x_i w_i$$

$$y = \begin{cases} z \text{ if } z > 0 \\ 0 \text{ otherwise} \end{cases}$$

1.5 Sigmoid neurons

They give a real-valued output that is a smooth and bounded function of their total input.

The logistic function is often used.

Given a threshold $\theta = -b$

$$z = b + \sum_i x_i w_i$$

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

This function has smooth derivatives that change continuously.
This characteristic makes the learning process easier.