REDES NEURAIS ARTIFICIAIS

INTRODUÇÃO

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Rede Neural Artificial (sem metáfora cognitiva)

(**Antes**) Função de predição:

$$f = Wx$$

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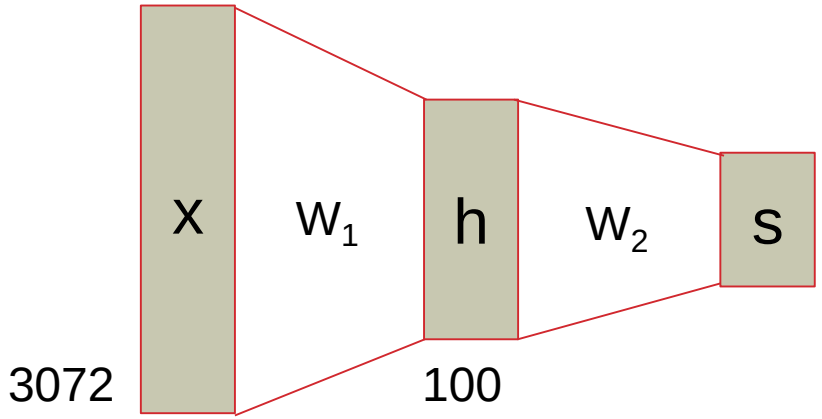


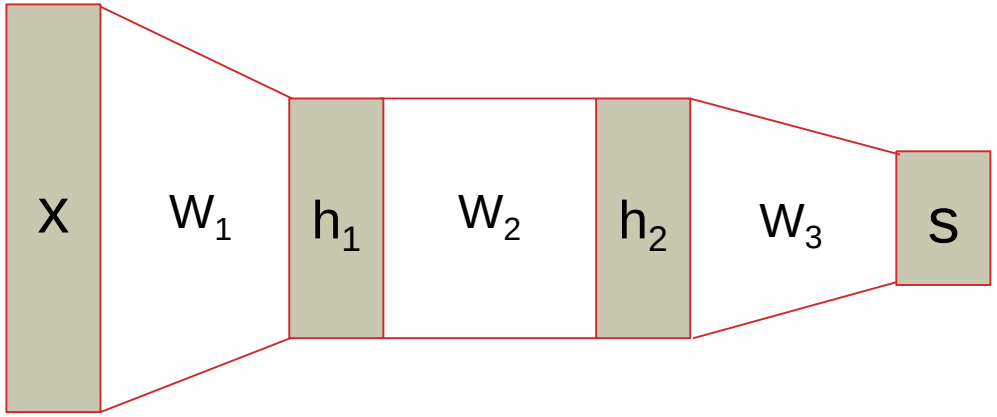
Rede Neural Artificial (sem metáfora cognitiva)

(**Antes**) Função de predição: $f = Wx$

(**Agora**) Rede neural de 2 camadas: $f = W_2 \max(0, W_1 x)$

ou Rede neural de 3 camadas:

$$f = W_3 \max(0, W_2 \max(0, W_1 x))$$



Código para Treino de Rede Neural de 2 Camadas

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2  from numpy.random import randn
3
4  N, D_in, H, D_out = 64, 1000, 100, 10
5  x, y = randn(N, D_in), randn(N, D_out)
6  w1, w2 = randn(D_in, H), randn(H, D_out)
7
8  for t in range(2000):
9    h = 1 / (1 + np.exp(-x.dot(w1)))
10   y_pred = h.dot(w2)
11   loss = np.square(y_pred - y).sum()
12   print(t, loss)
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14   grad_y_pred = 2.0 * (y_pred - y)
15   grad_w2 = h.T.dot(grad_y_pred)
16   grad_h = grad_y_pred.dot(w2.T)
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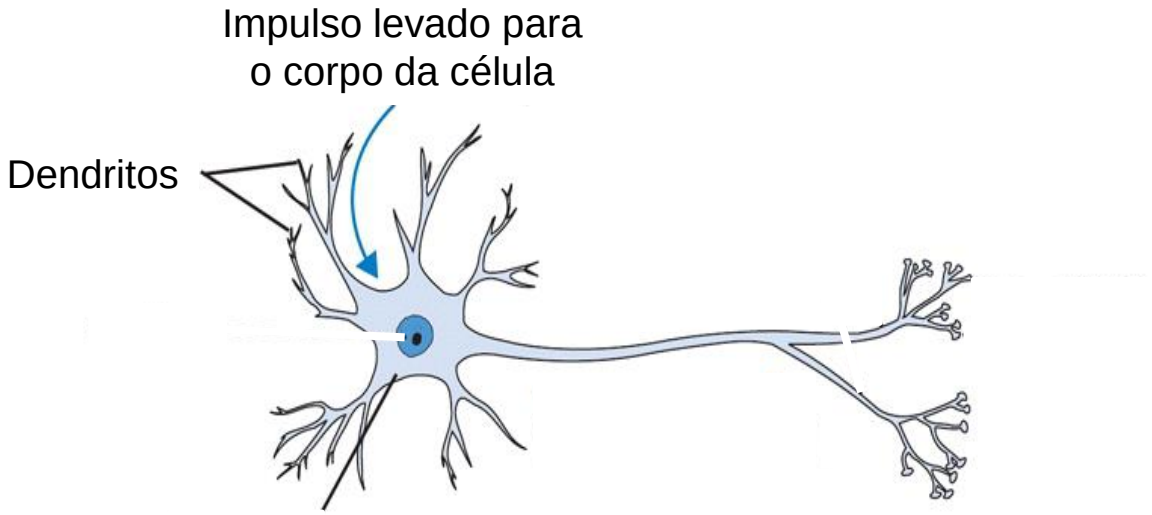
Apenas ~20 linhas!

Inspiração Biológica



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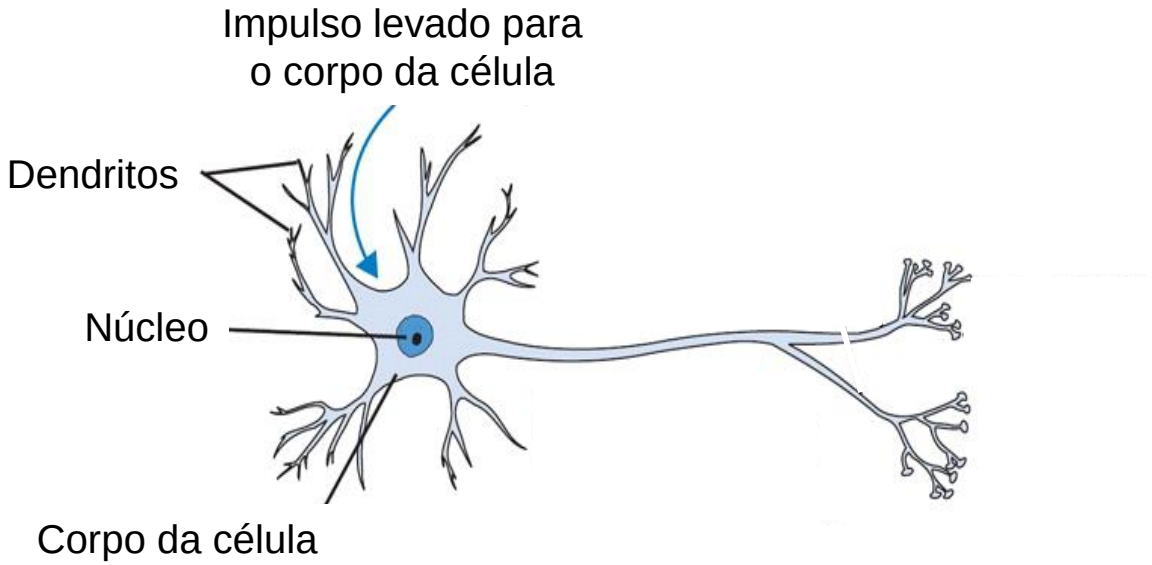

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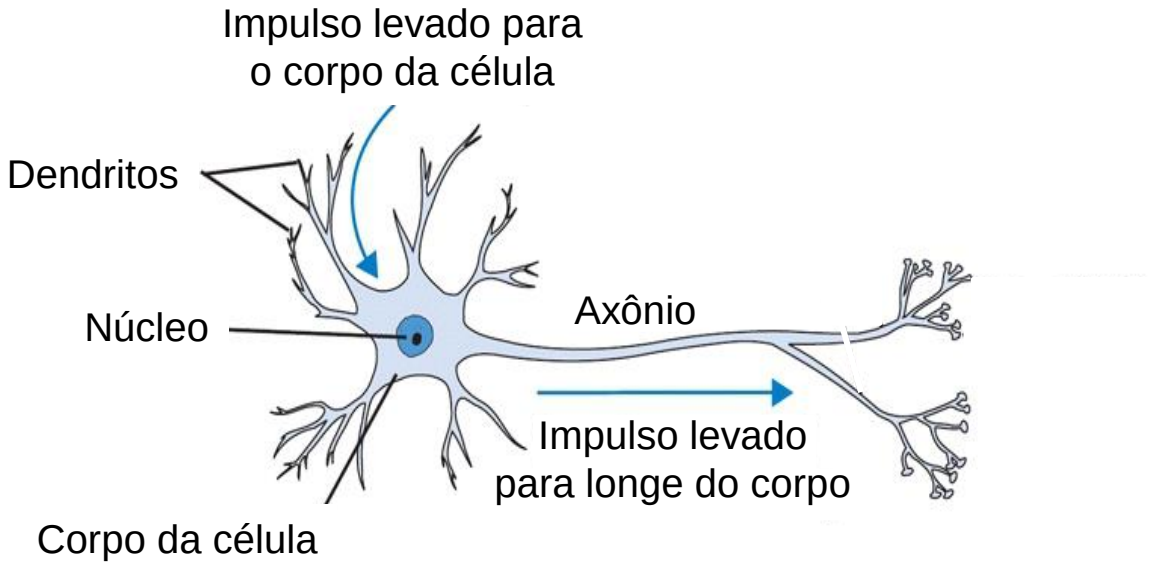

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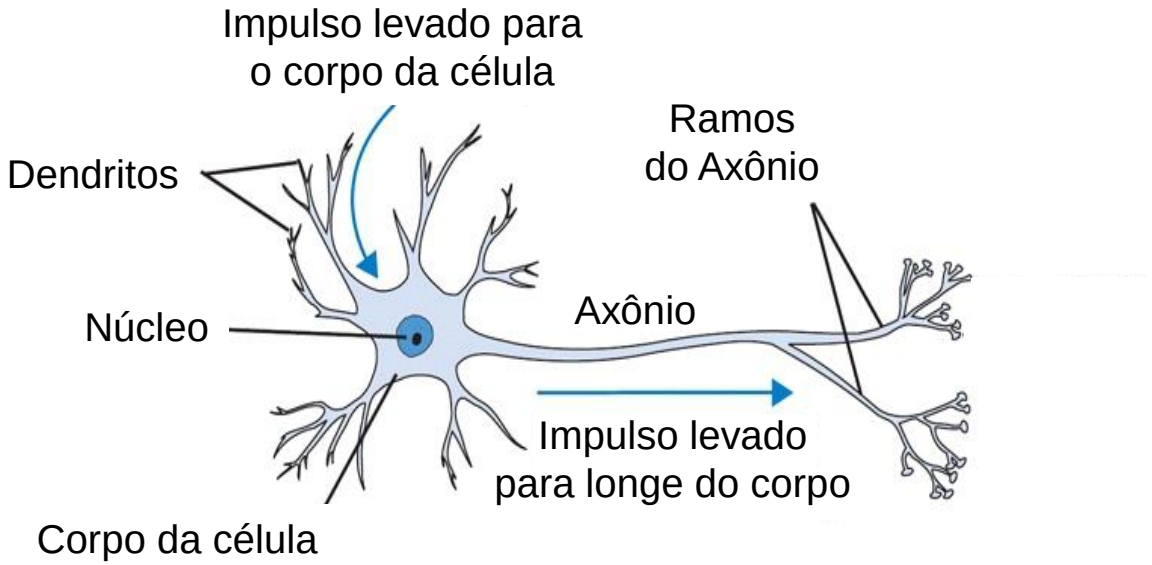

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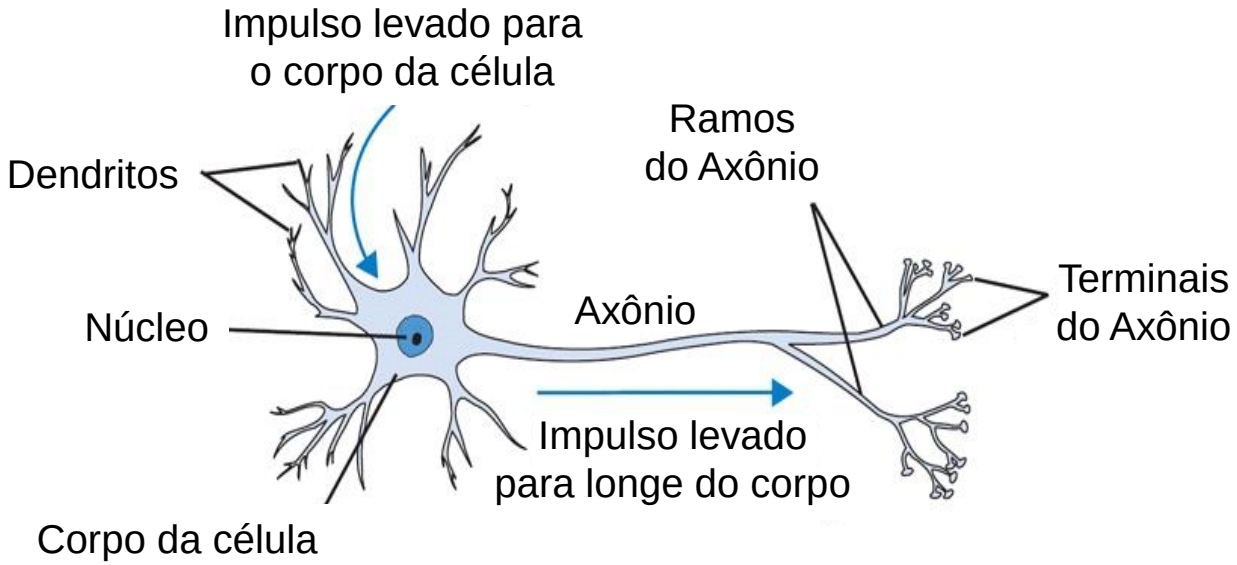

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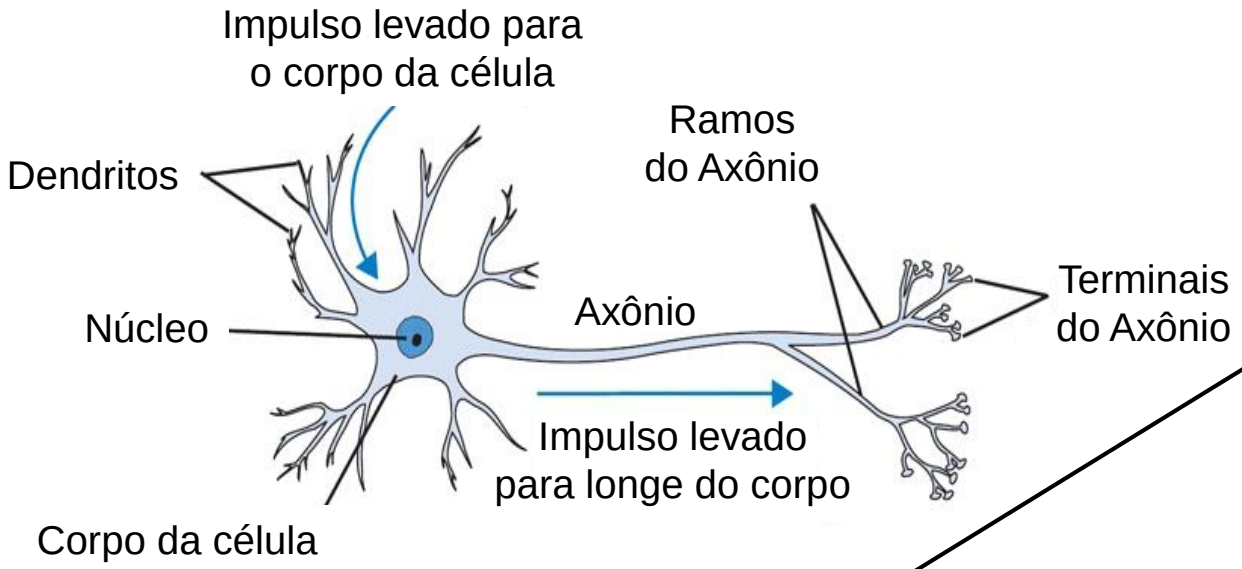

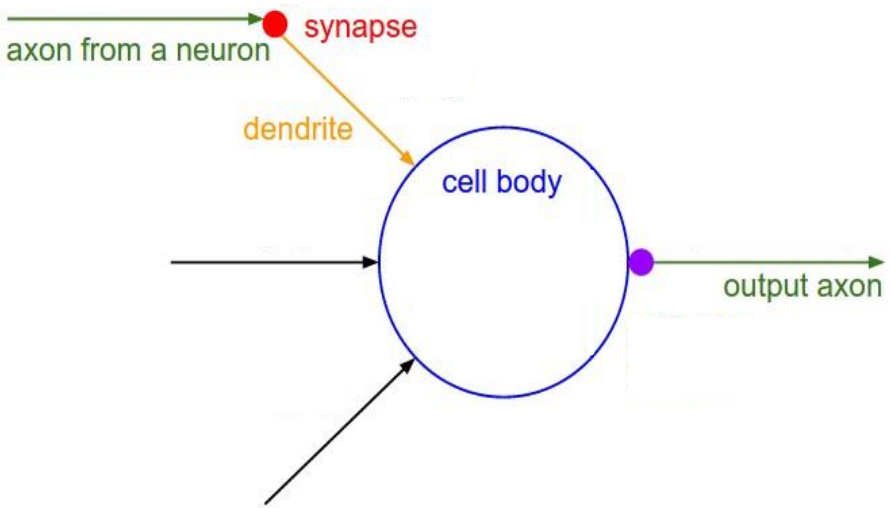

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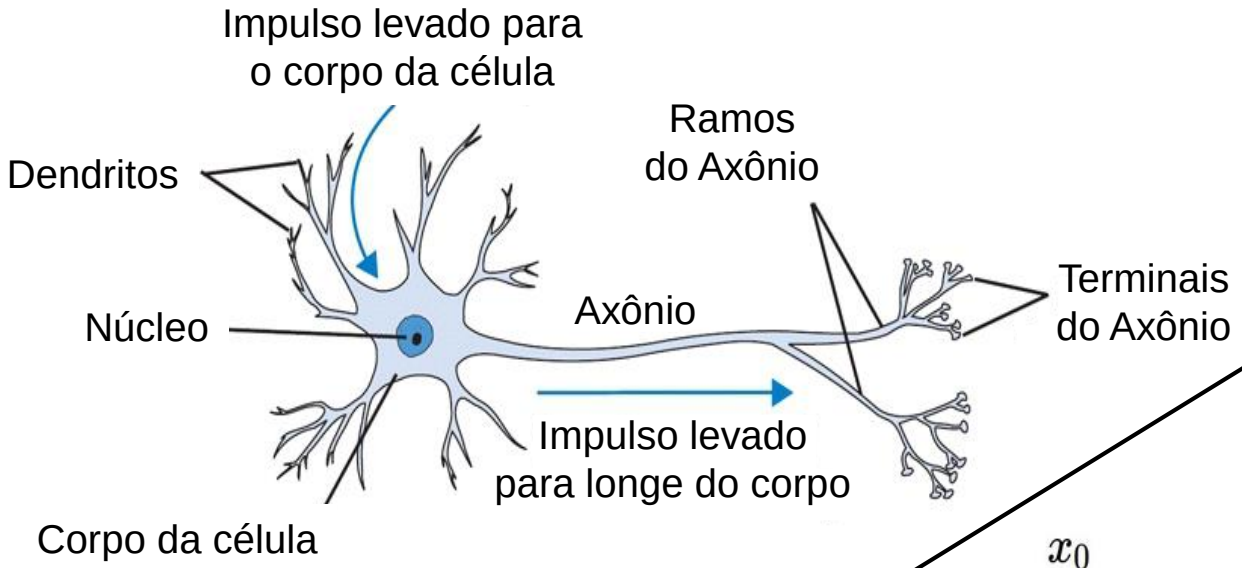

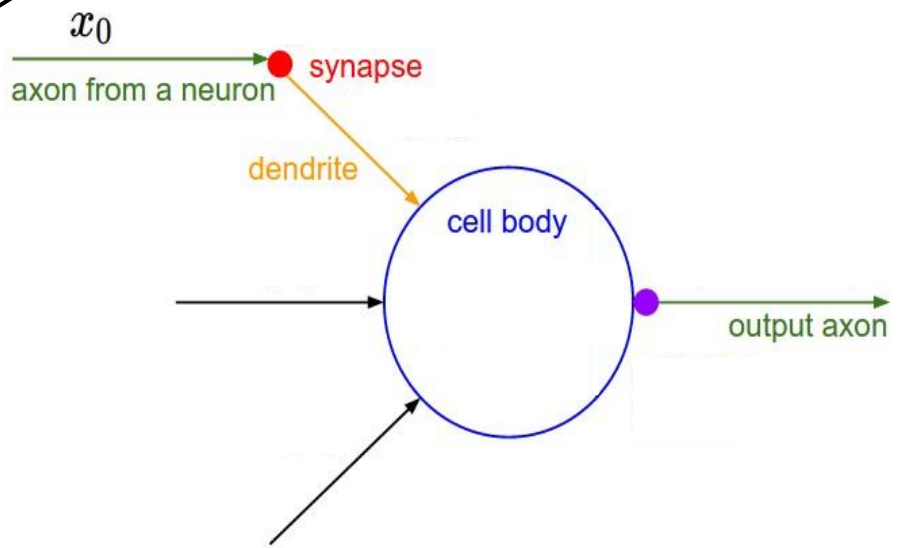

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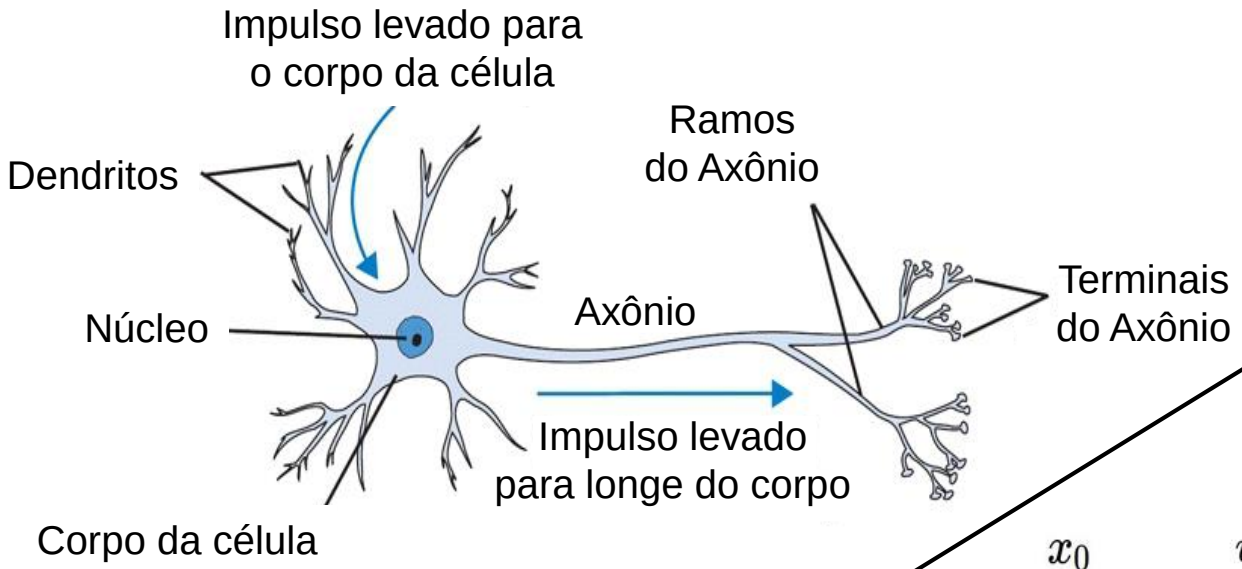

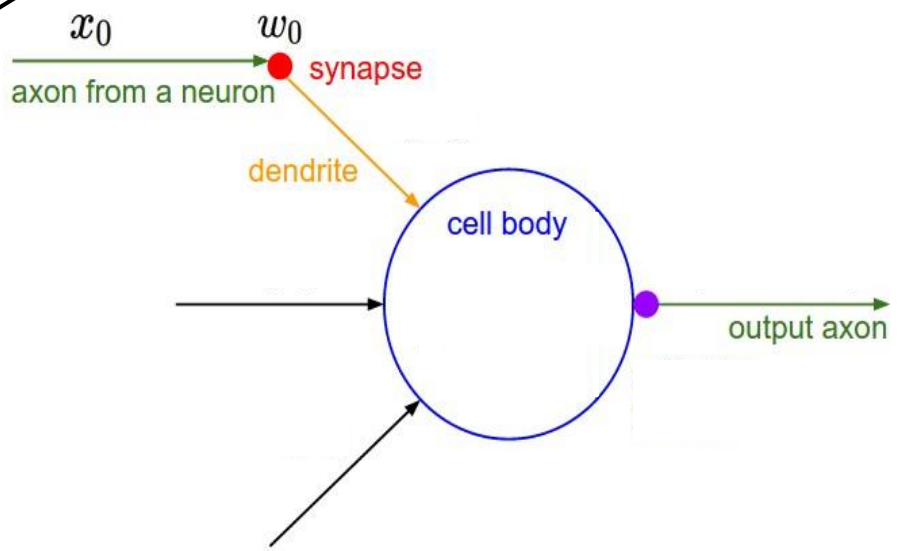

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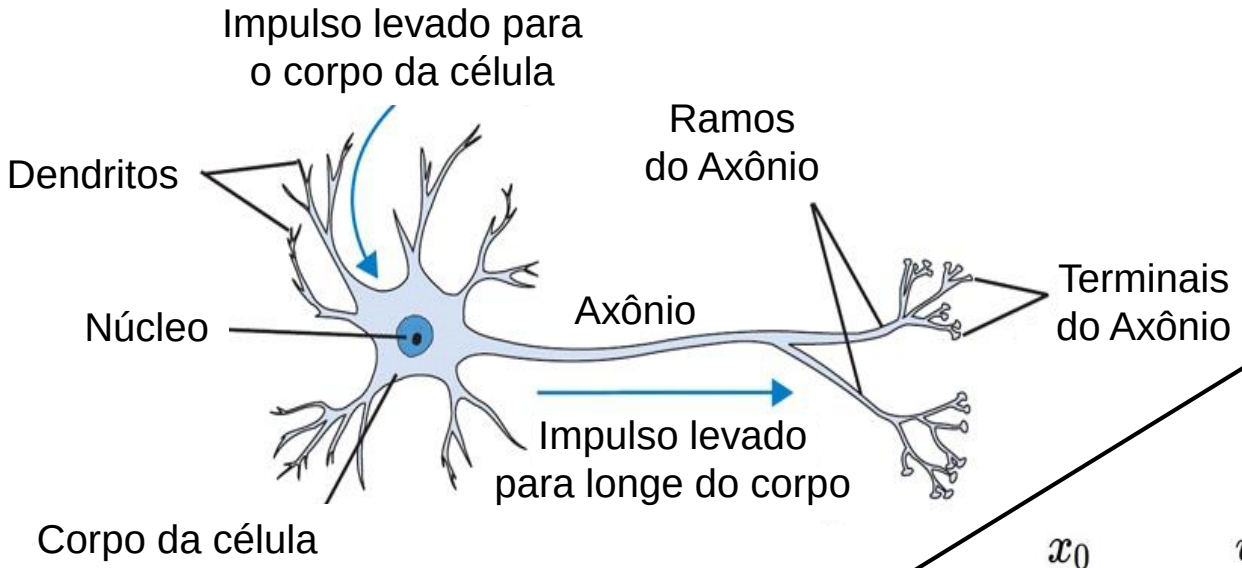

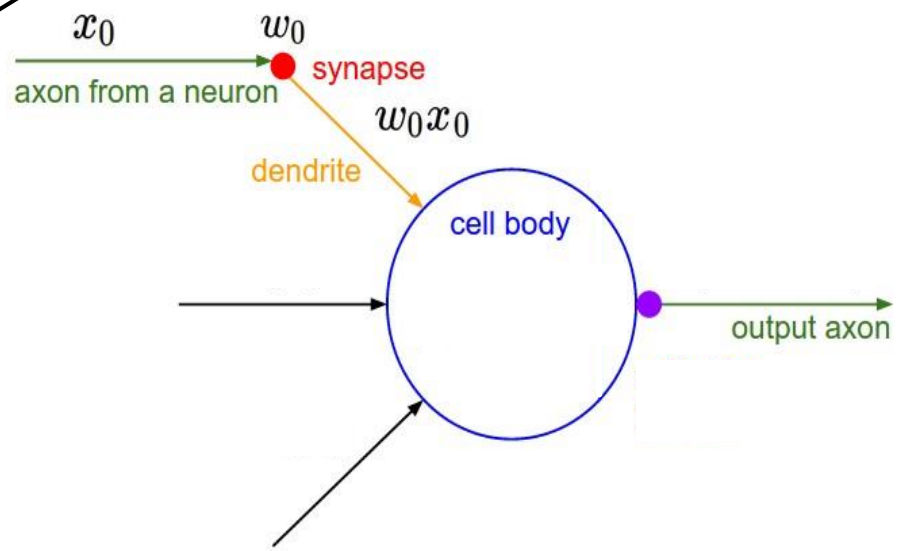

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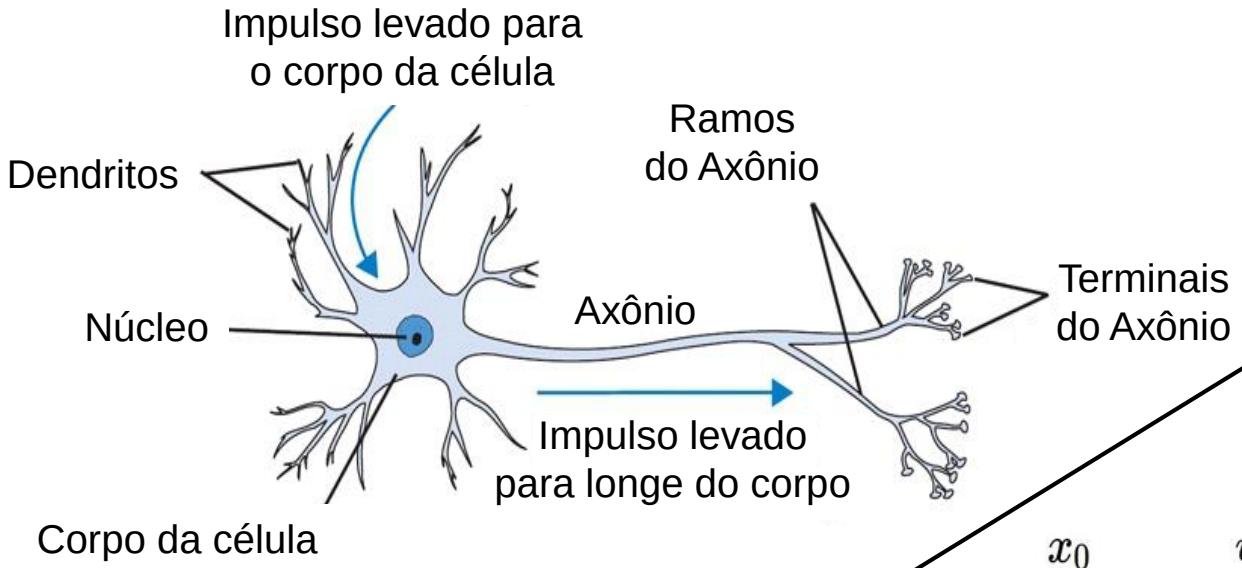

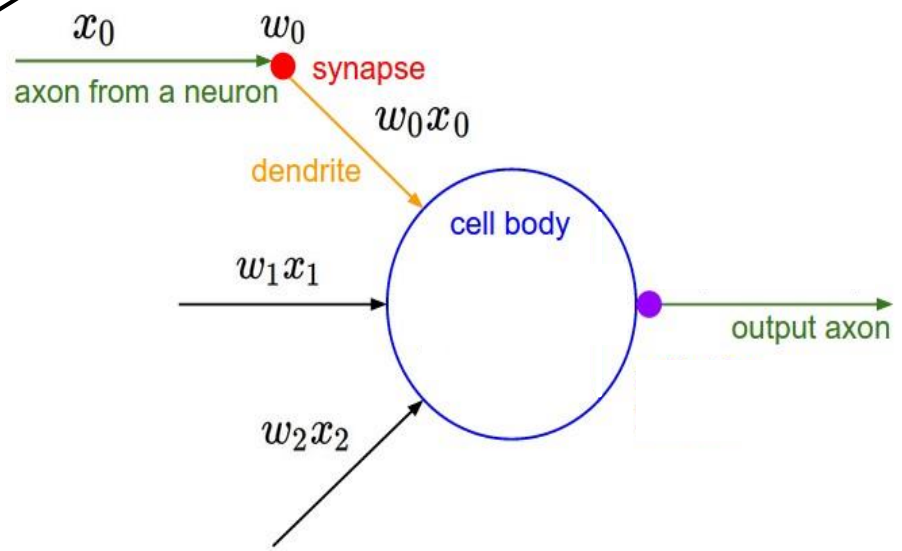

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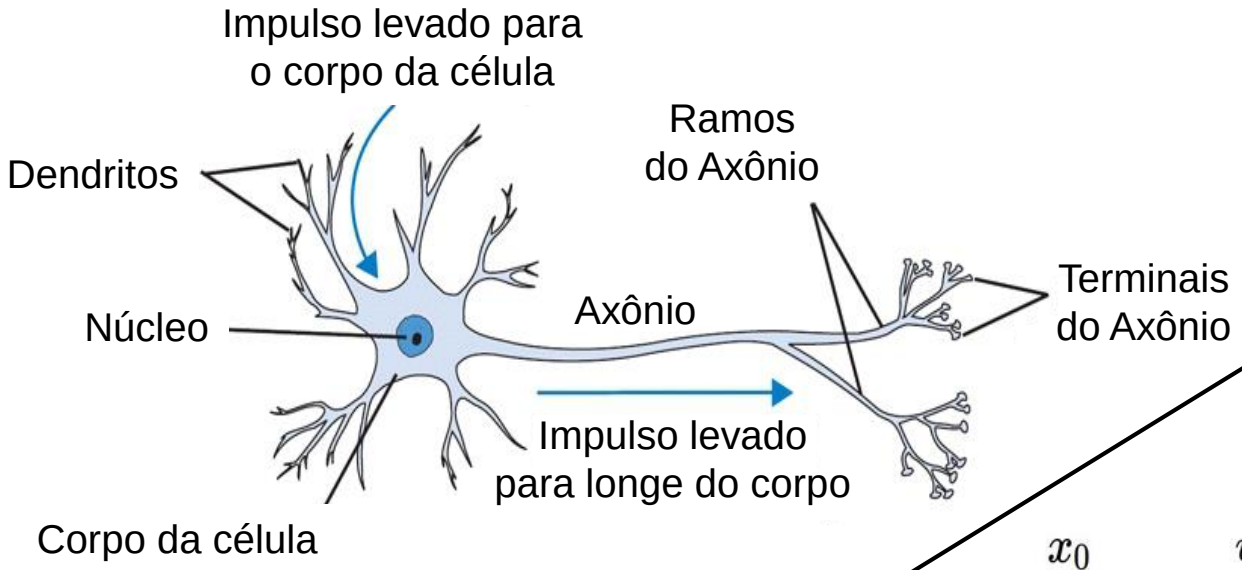

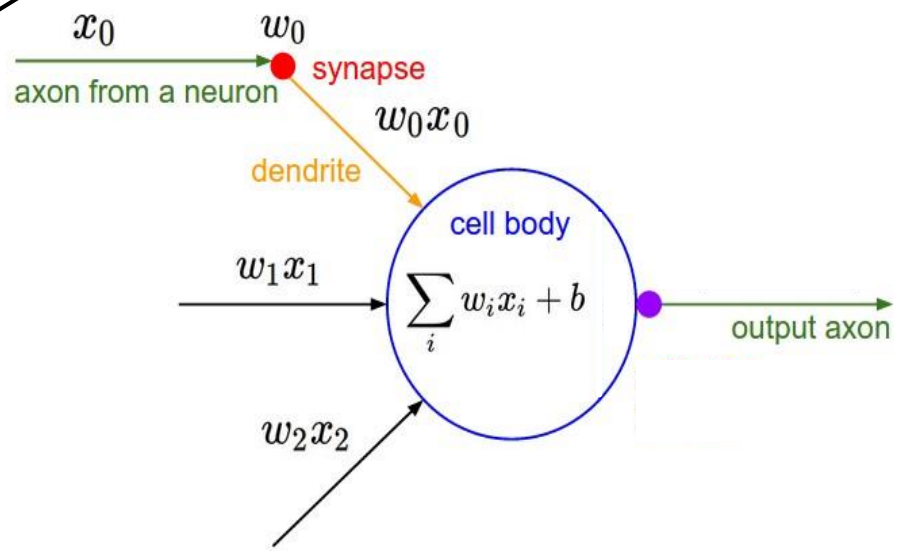

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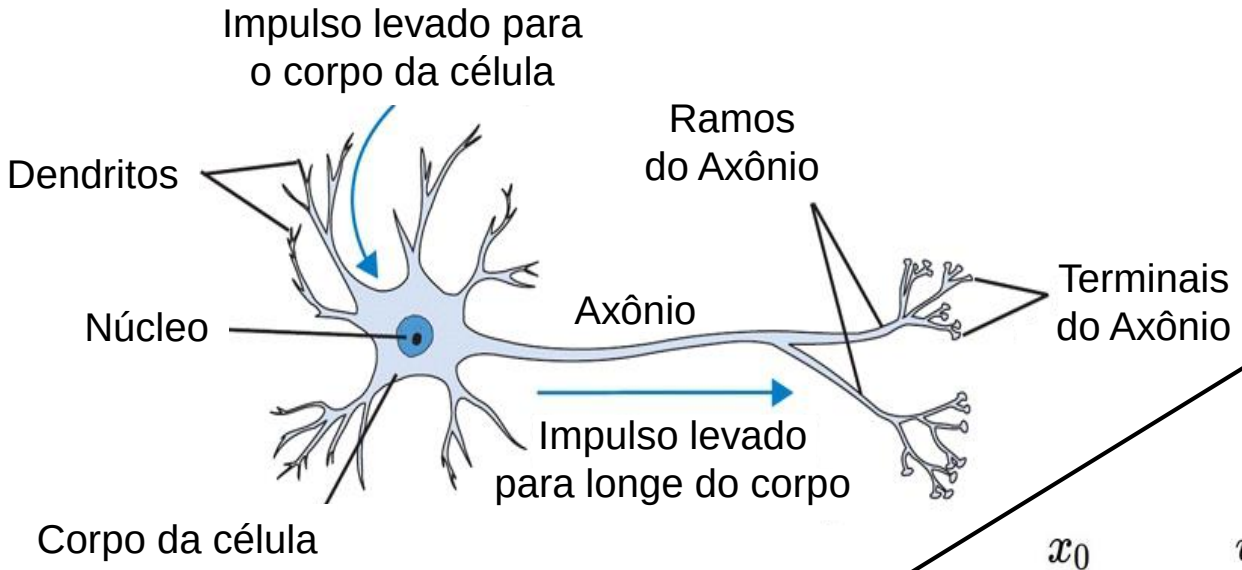

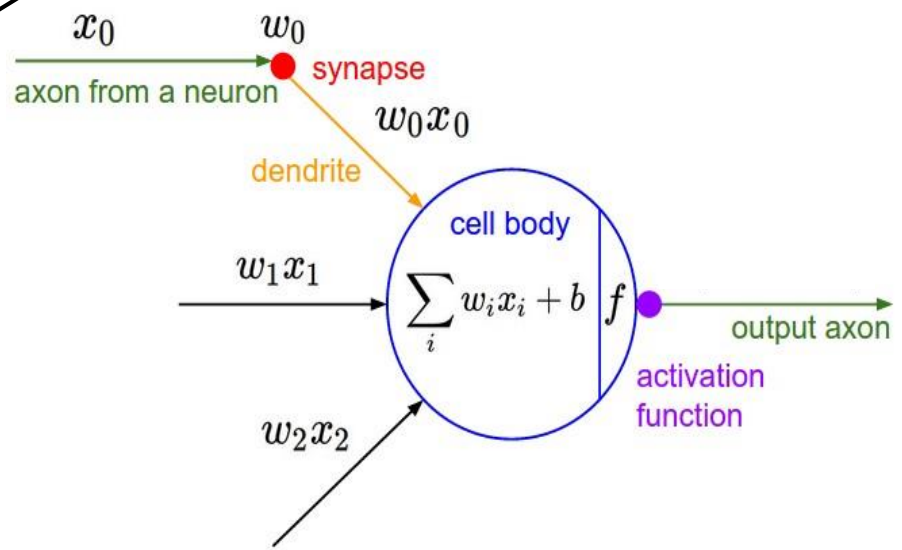

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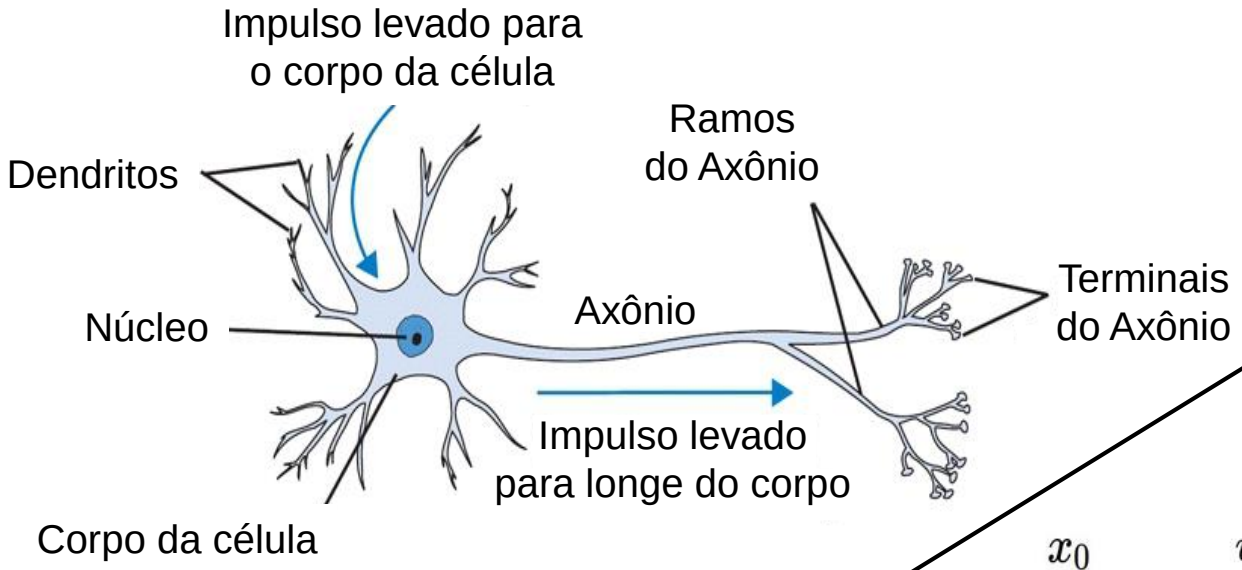

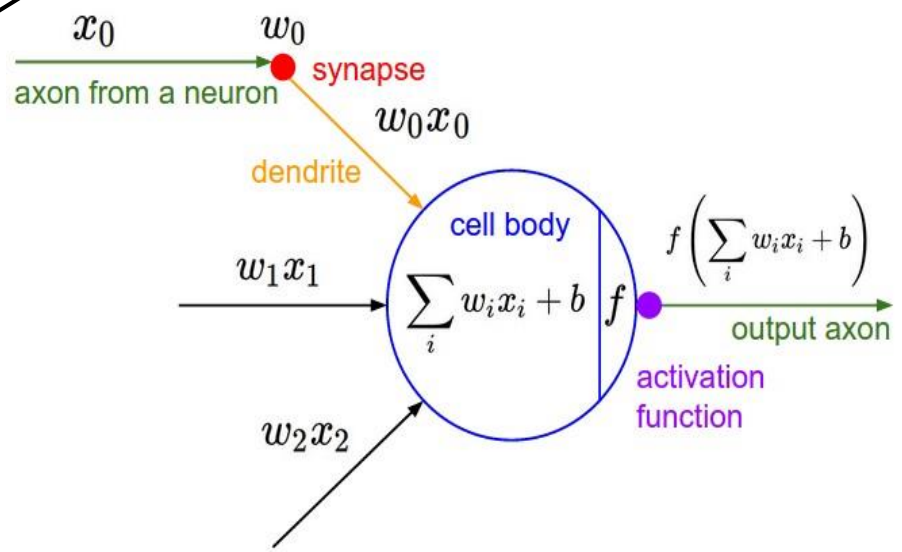

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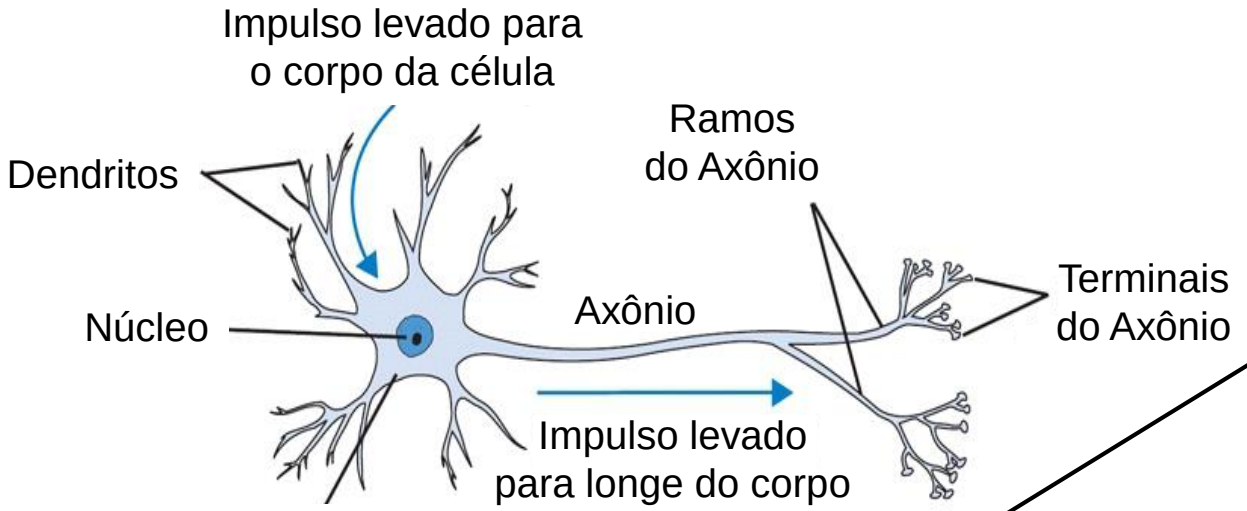
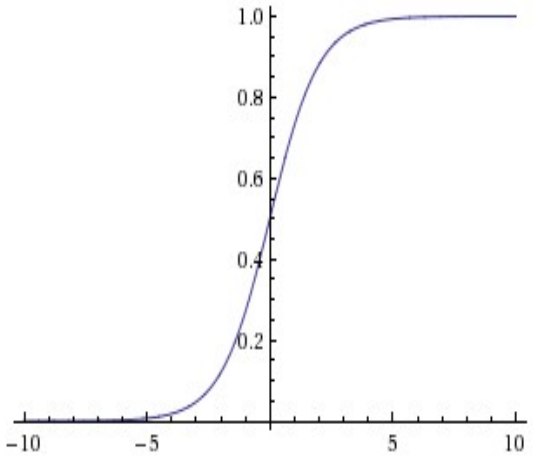
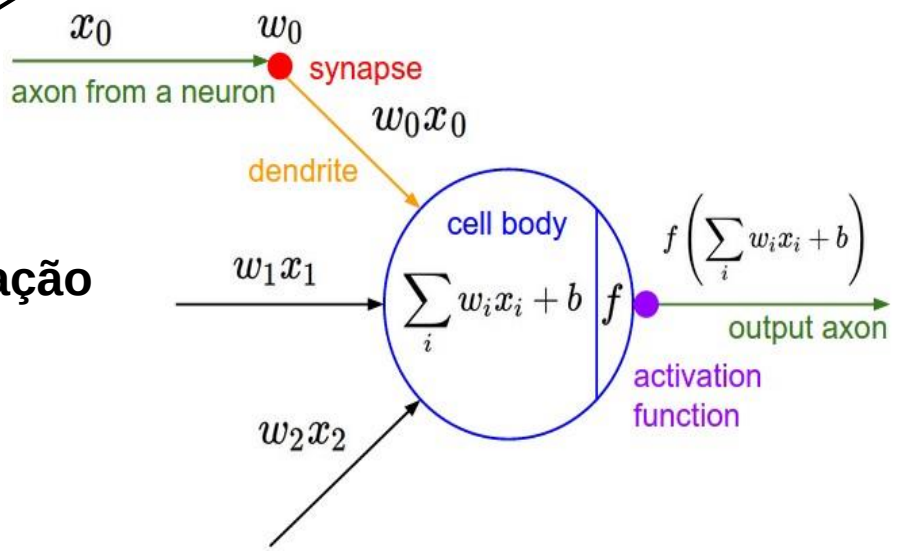




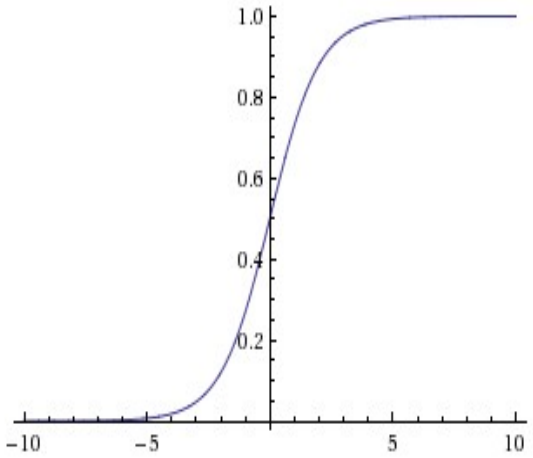
Função de ativação sigmoide

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



Inspiração Biológica

```python
class Neuron:
  # ...
  def neuron_tick(inputs):
    """ assume inputs and weights are 1-D numpy arrays and bias is a number """
    cell_body_sum = np.sum(inputs * self.weights) + self.bias
    firing_rate = 1.0 / (1.0 + math.exp(-cell_body_sum)) # sigmoid activation function
    return firing_rate
```



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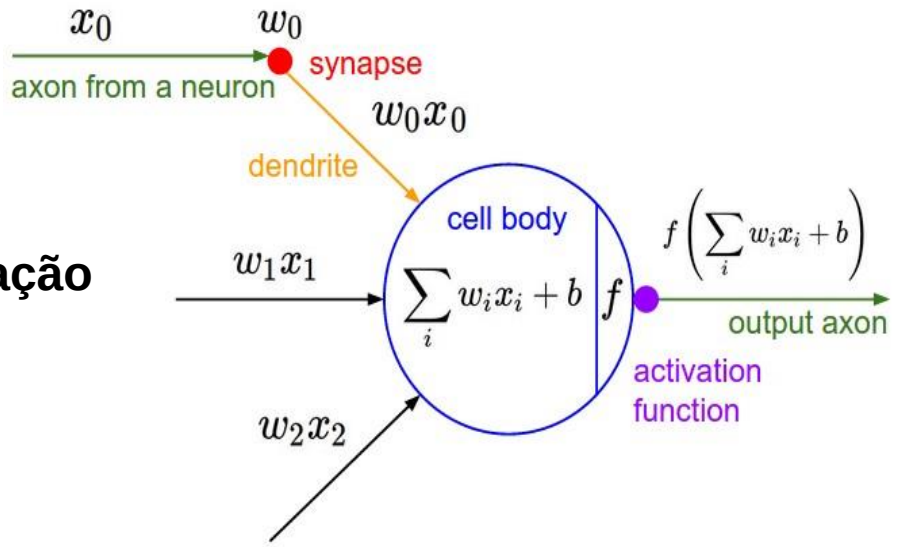
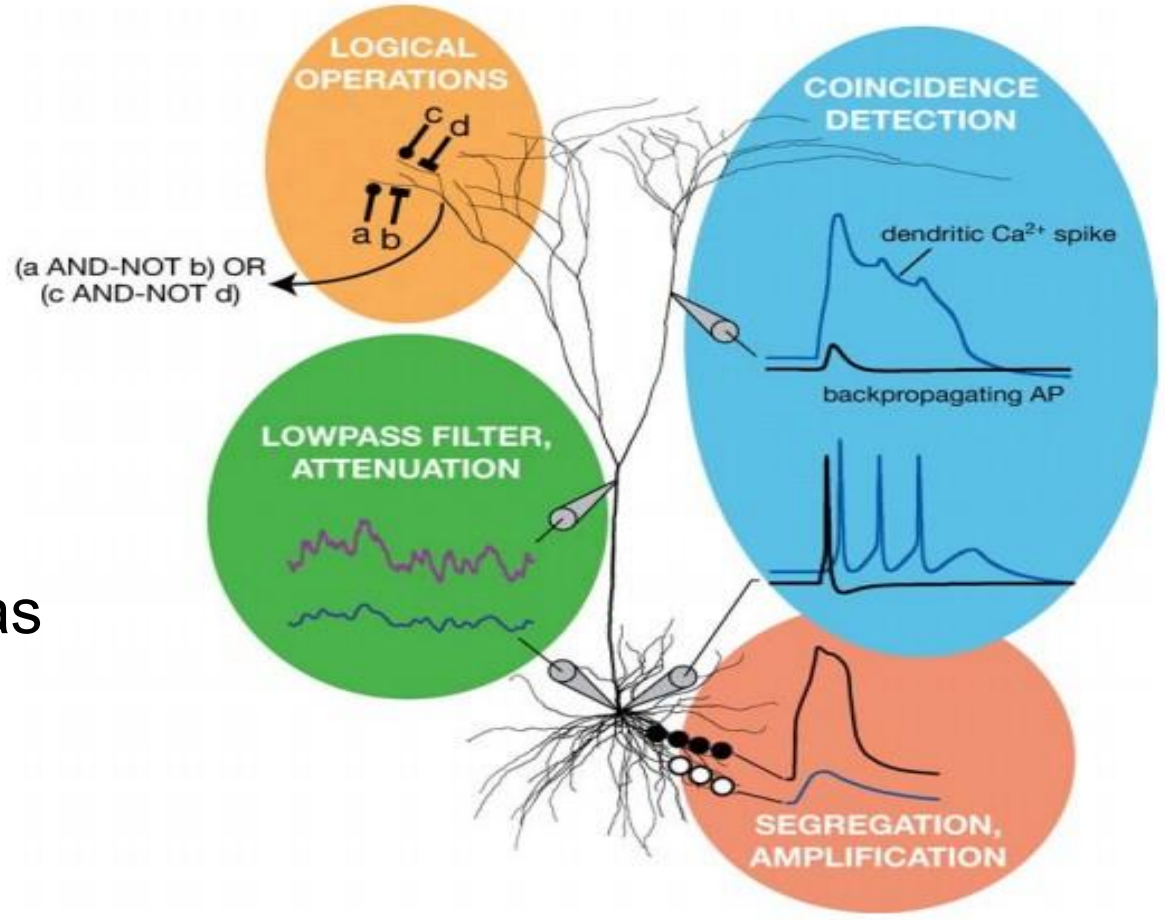


Cuidados com Analogias

Neurônio biológicos:

- Vários tipos diferentes
- Dendritos pode realizar computações não-lineares
- Sinapses não representam apenas um “simples peso” mas sim um complexo sistema dinâmico não-linear



London, M., & Häusser, M. Dendritic computation. *Annual Review of Neuroscience*, *28*: 503-532, (2005).

Algumas Funções de Ativação

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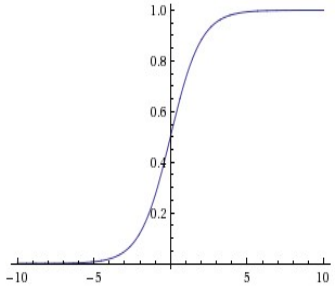
$$\sigma(x) = 1/(1 + e^{-x})$$



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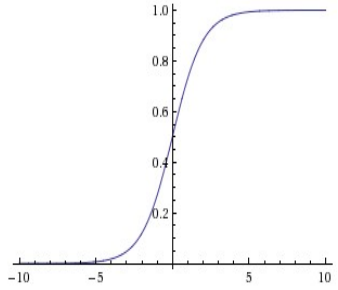
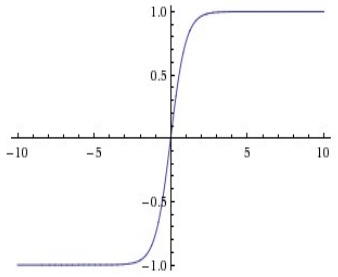


Tanh tanh(x)



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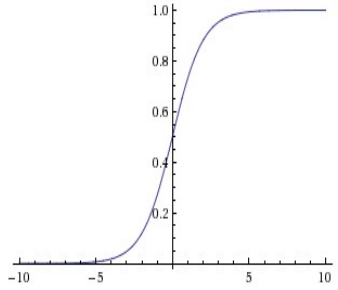

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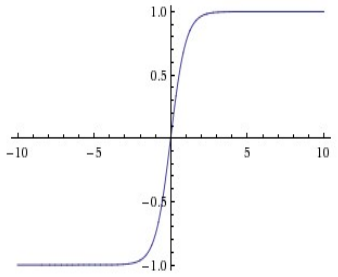
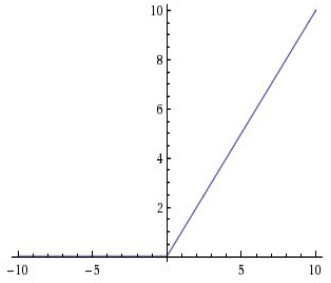


ReLU max(0,x)



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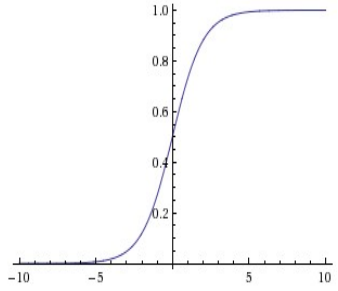

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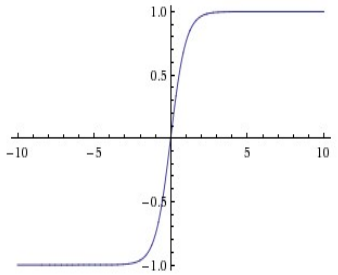
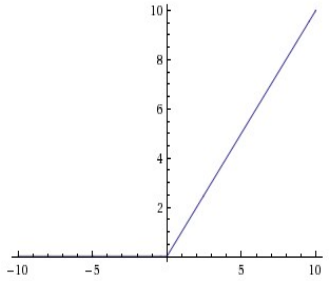
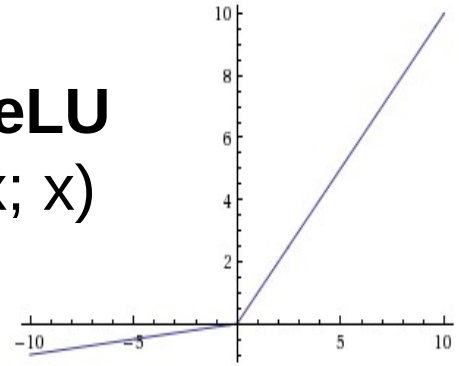


ReLU max(0,x)



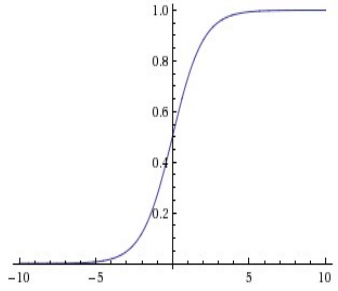
Leaky ReLU
max(0,1x; x)



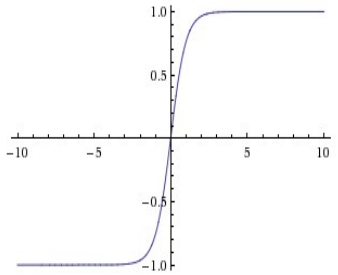
Algumas Funções de Ativação

Sigmoid

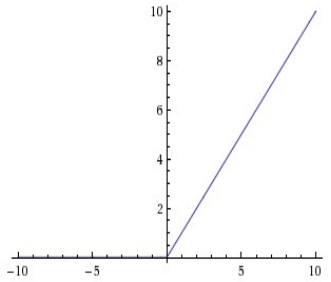
$$\sigma(x) = 1/(1 + e^{-x})$$



Tanh tanh(x)



ReLU max(0,x)



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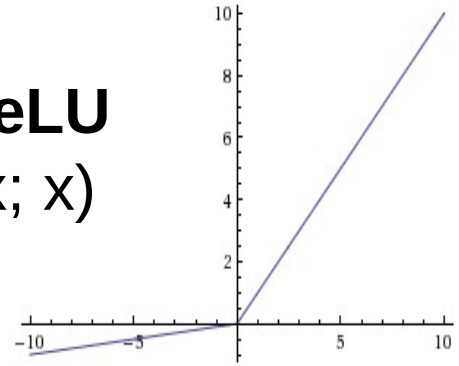
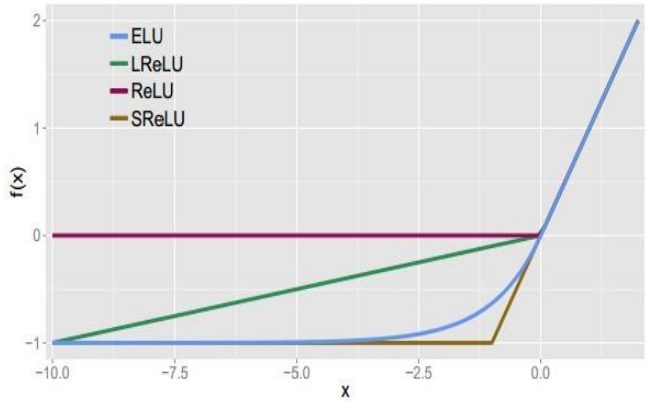
max(0,1x; x)



ELU

$$f(x) = \begin{cases} x & \text{if } x > 0 \\ \alpha\,(\exp(x) - 1) & \text{if } x \leq 0 \end{cases}$$



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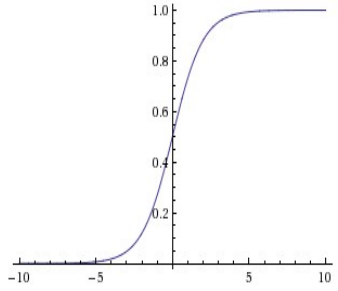
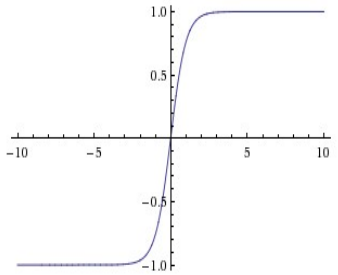
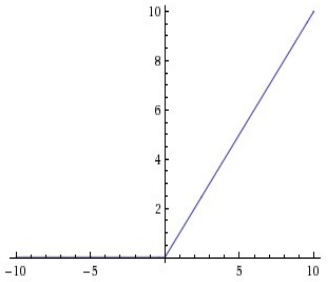


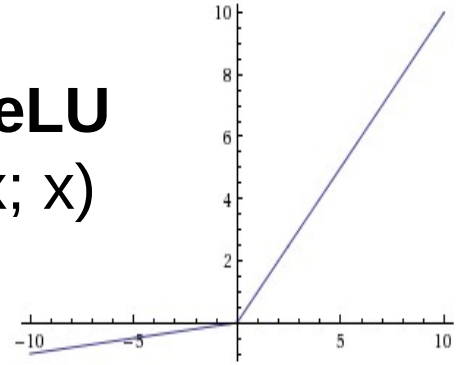
Tanh tanh(x)



ReLU max(0,x)



Leaky ReLU
max(0,1x; x)



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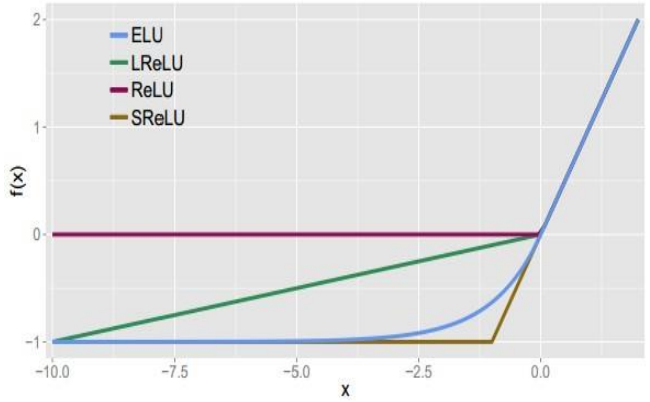

Maxout $\max(w_1^T x + b_1, w_2^T x + b_2)$