Neural Network

19 June 2025   13:13

Motive — Replicate human brain
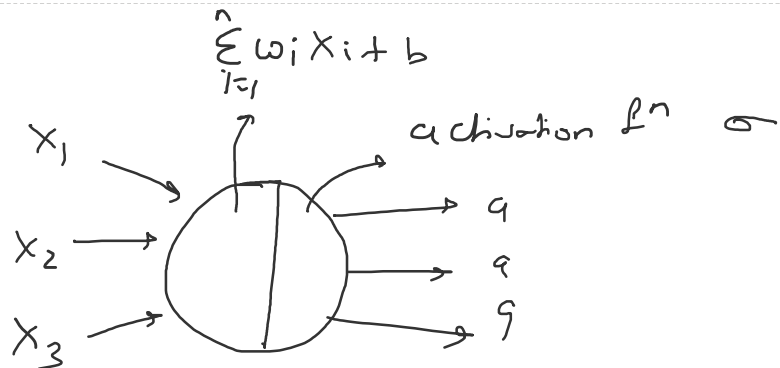
[DL] →

⬆

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human brain → neuron
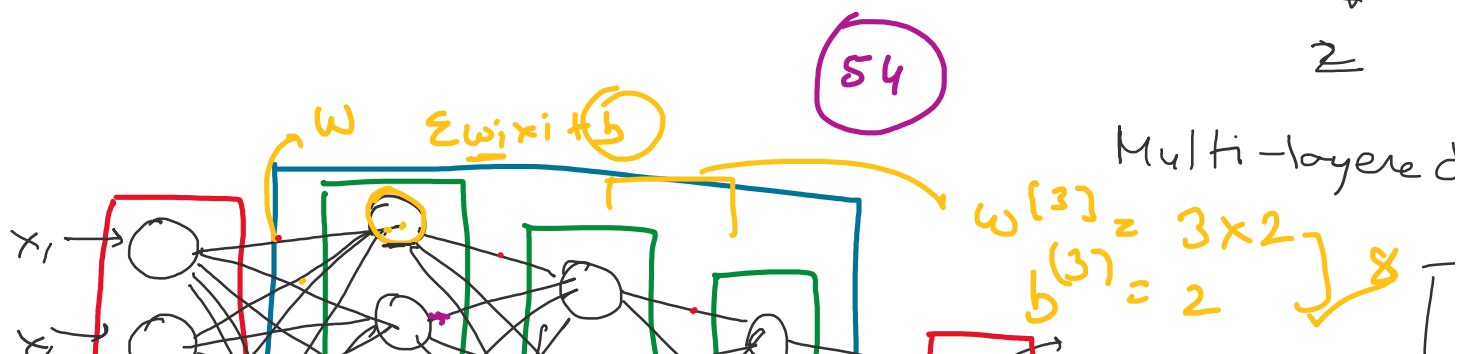

Neuron Anatomy

dendrite

nucleus

soma

Scwann cell

node of Ranvier

myelin

axon

axon terminal
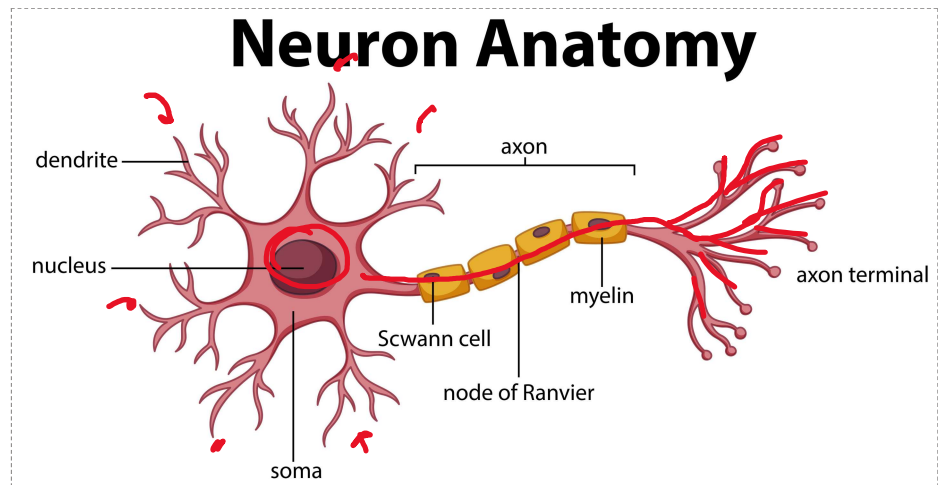
Artificial Neuron

Perceptron
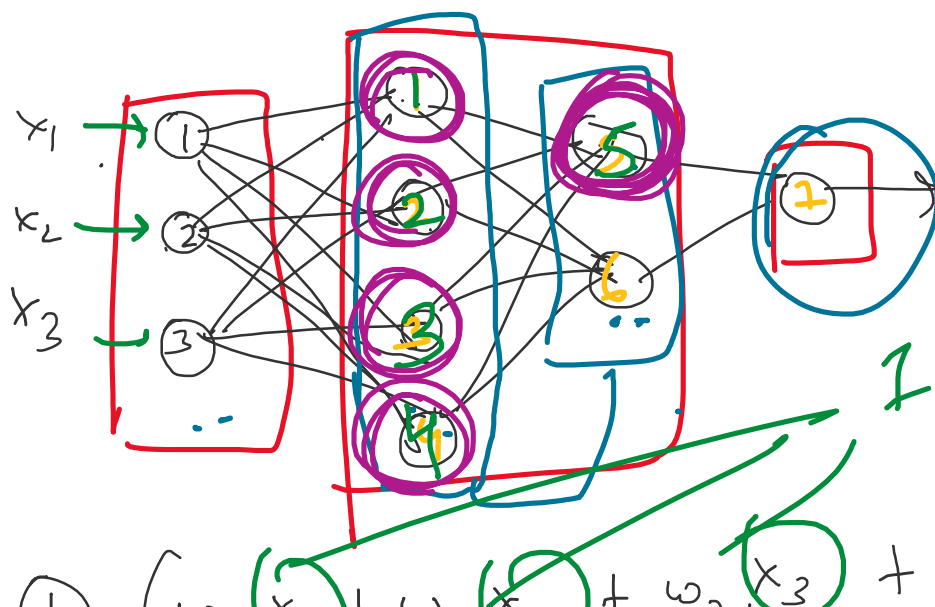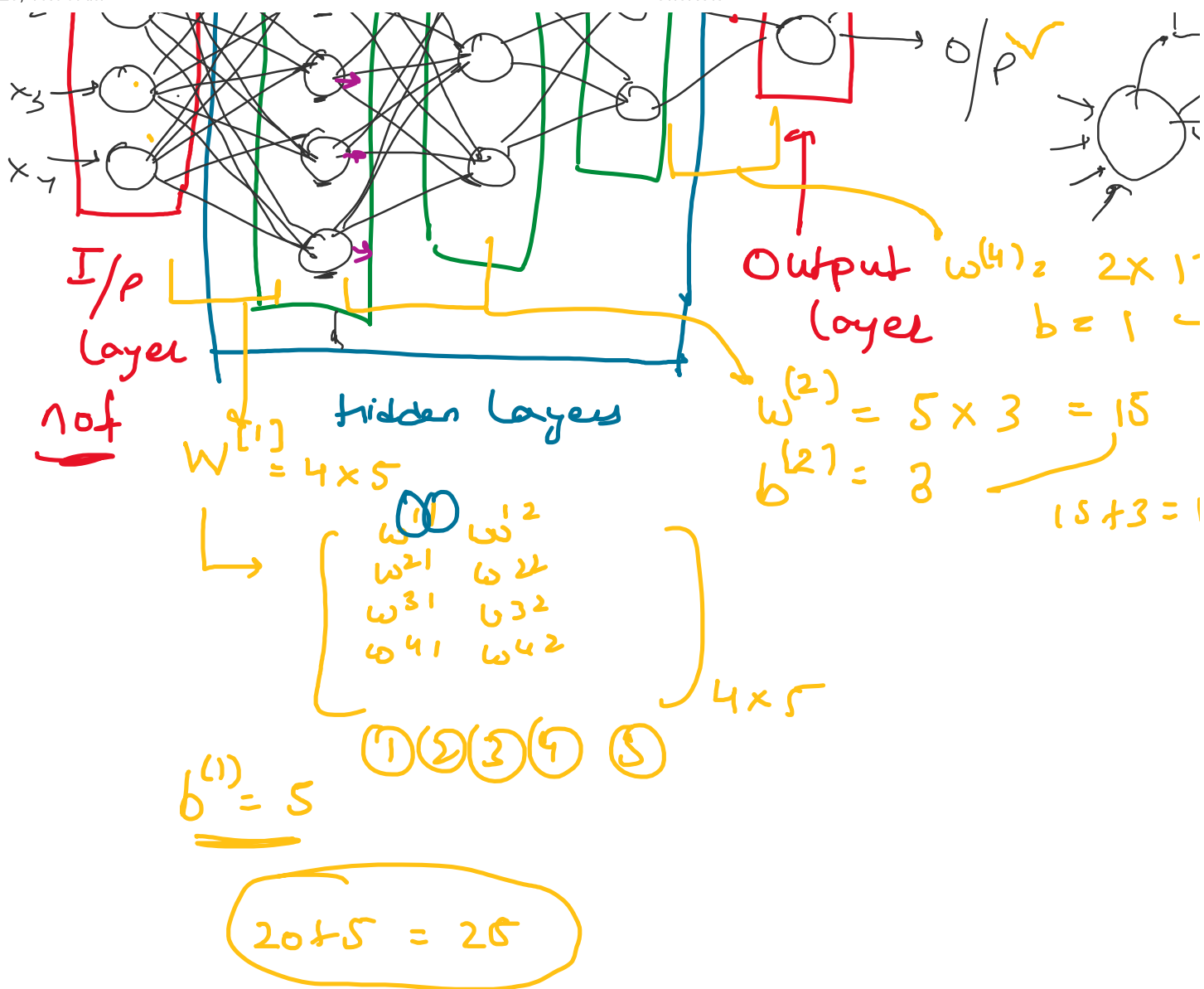
$\sum_{i=1}^{n} \omega_i x_i + b$

X_1

X_2

X_3

activation f^n σ

q

q

q

$a = \sigma \left(\sum_{i=1}^{n} \omega_i x_i + b \right.$

lear

z

$\Large\boxed{54}$

ω $\sum \omega_i x_i + b$

X_1

X_2

Multi-layered

$\omega^{[3]} = 3 \times 2$

$b^{[3]} = 2$

8

x_3

x_4

I/p Layer

nof

$W^{[1]} = 4 \times 5$

Hidden Layers

Output Layer

$W^{(4)} = 2 \times 1$

$b = 1$

$W^{(2)} = 5 \times 3 = 15$

$b^{(2)} = 8$

$15 + 3 = 1$

O/p

$$\begin{bmatrix} w^{12} & w^{12} \\ w^{21} & w^{22} \\ w^{31} & w^{32} \\ w^{41} & w^{42} \end{bmatrix} \quad 4 \times 5$$

①②③④ ⑤

$b^{(1)} = 5$

$20 + 5 = 25$

x_1

x_2

x_3

I/P

$(w_2 \cdot x_3) + b_1)$

$$① = \sigma(\omega_{11}x_1 + \omega_{21}x_2 , \quad \sigma(\ )$$

$$② = \sigma(\omega_{12}x_1 + \omega_{22}x_2 + \omega_{32}x_3 + b_2)$$

$$③ = \sigma(\omega_{13}x_1 + \omega_{23}x_2 + \omega_{33}x_3 + b_3)$$

$$④ = \sigma(\omega_{14}x_1 + \omega_{24}x_2 + \omega_{34}x_3 + b_4)$$

$$⑤ = \sigma(\omega_{15}① + \omega_{25}② + \omega_{35}③ + \omega_{45}④)$$

$$⑥ = \sigma(\omega_{16}① + \omega_{26}② + \omega_{36}③ + \omega_{46}④ +$$

$$⑦ = \sigma(\omega_{57}⑤ + \omega_{67}⑥ + b^7) \Rightarrow$$

O/P

Activation functions

$$① \quad \text{Sigmoid} = \frac{1}{1+e^{-z}} \qquad \in \quad \sigma(z) \in \{$$

$$② \quad \text{Tanh} = \frac{e^z - e^{-z}}{} \qquad \tanh(z)$$

$$e^z + e^{-z}$$

③ Relu = max $(0, z)$ Relu$(z) \in$

④ Leaky Relu = max $(0.01z, z)$ $\in -\infty,$

⑤ Softmax : $\dfrac{e^{z_i}}{\sum\limits_{j=1}^{c} e^{z_j}}$ $\forall i$ $\Big]\longrightarrow$

Output (multiclass
Layer   Classification)

Forward Propogation]

Backward Propogation J
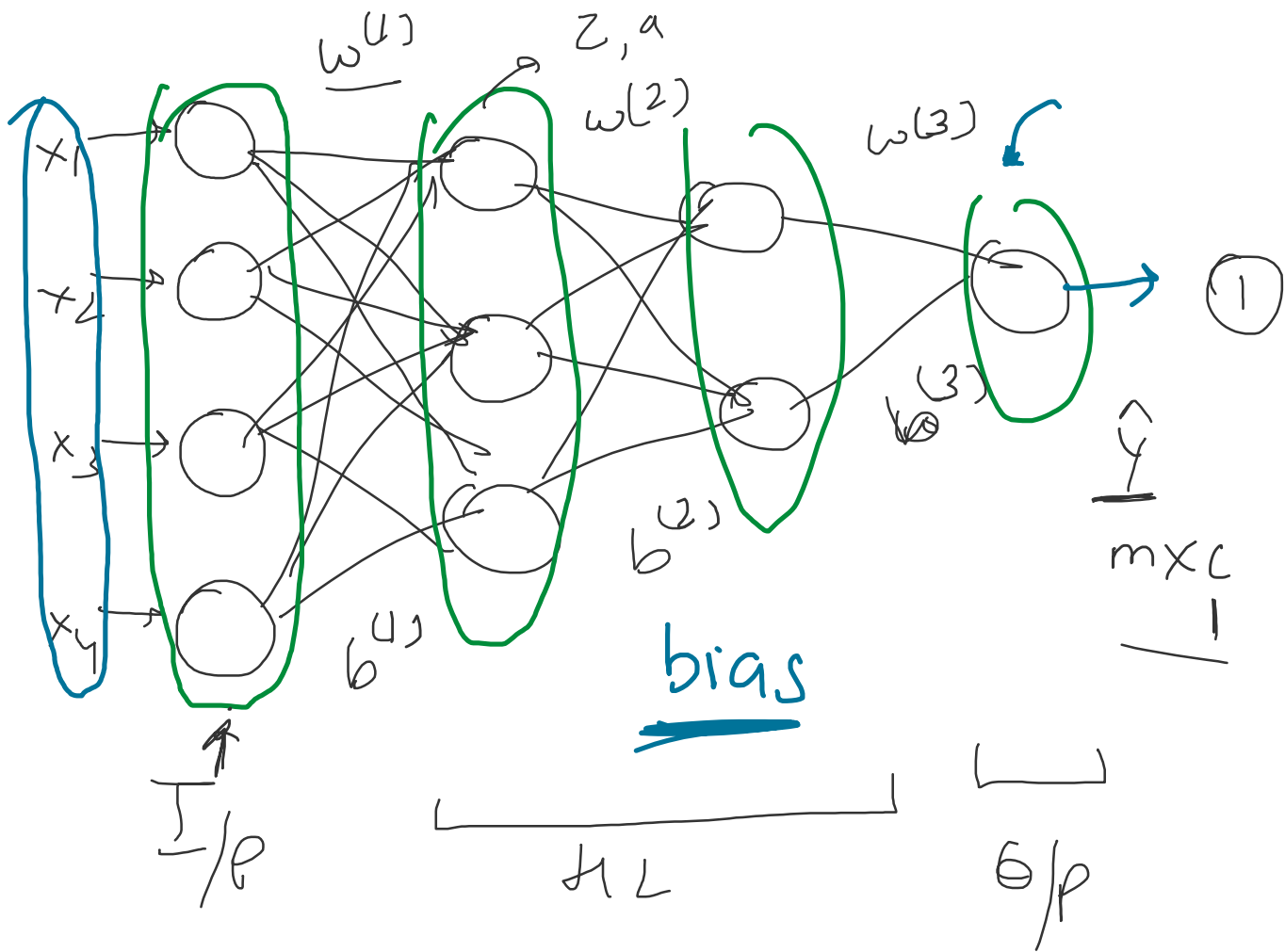
$$J = \sum_{i=1}^{m} \left[y_i \log(a^{(3)}) + (1-y_i) \log(1-a \cdots \right.$$

Gradient Descent

$$\omega^{(1)}, \ \omega^{(2)}, \ \omega^{(3)} \qquad b^{(4)}, \ '$$

$$\frac{\partial J}{\partial \omega^{(4)}}, \ \frac{\partial J}{\partial \omega^{(2)}}, \ \frac{\partial J}{\partial \omega^{(3)}} \ \rightarrow \ \frac{\partial J}{\partial b^{(4)}},$$

$$\frac{\partial J}{\partial \omega^{(3)}} = \frac{\partial J}{\partial a^{(3)}} \ \ast \ \frac{\partial a^{(3)}}{\partial z^{(1)}} \ \times \ \frac{\partial z}{\partial \omega}$$

$$\frac{\partial J}{\partial \omega^{(2)}} = \frac{\partial J}{\partial a^{(3)}} \ \ast \ \frac{\partial a^{(3)}}{\partial z^{(3)}} \ \ast$$

$$\frac{\partial J}{\partial \omega^{(1)}} = \frac{\partial J}{\partial a^{(3)}} \ \times \ \frac{\partial a^{(3)}}{\partial z^{(3)}} \ \ast \ \frac{\partial z^{(}}{\partial a^{2}}$$