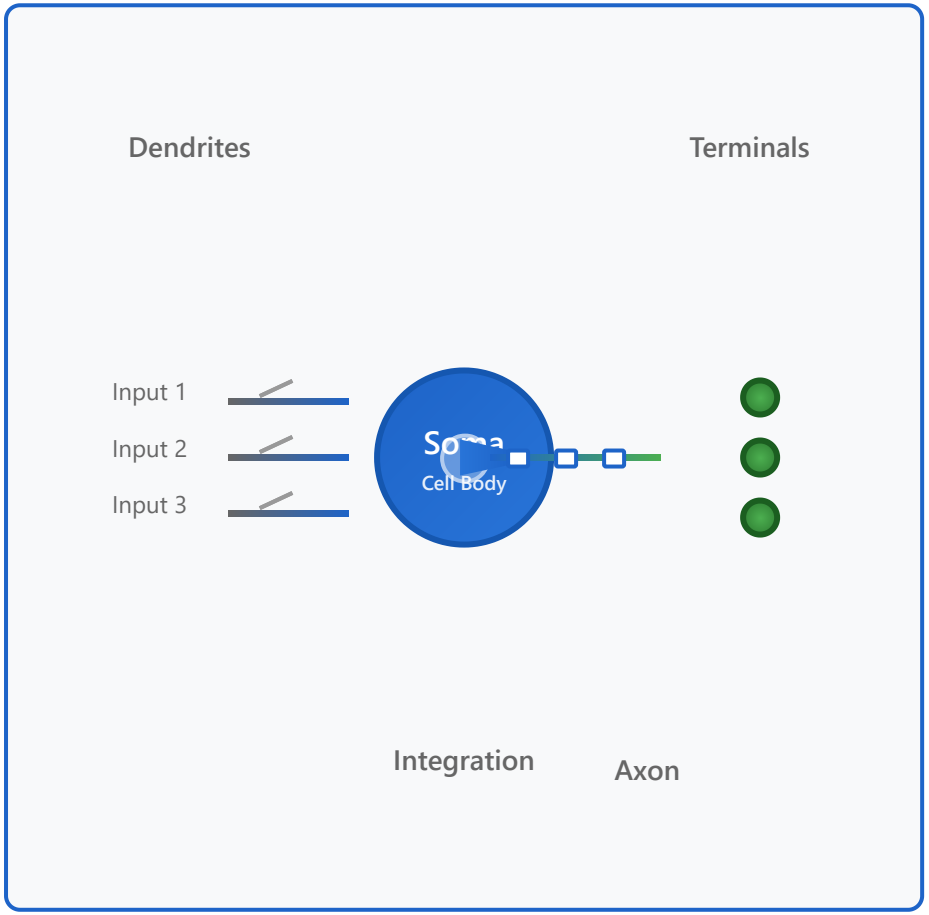
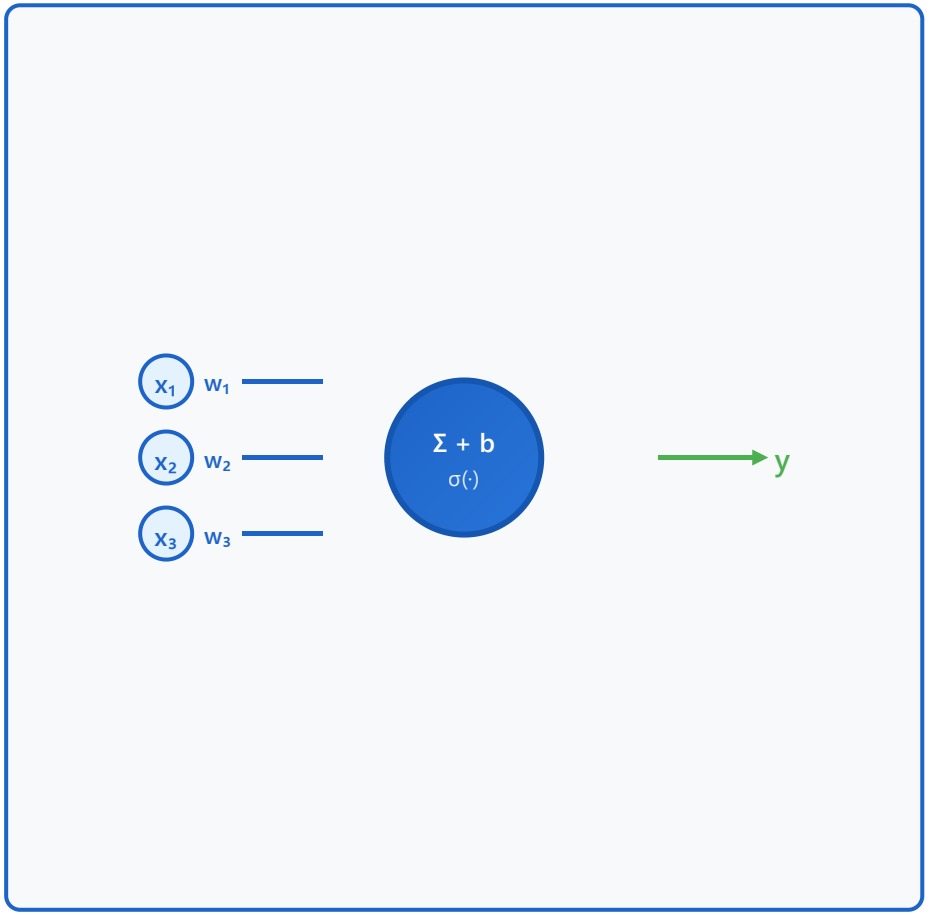
Biological Neuron vs Artificial Neuron

Biological Neuron



Artificial Neuron (Perceptron)



Dendrites → Soma → Axon ≈ Weighted Inputs → Summation & Activation → Output

🔢 Perceptron Calculation Example

📊 Given Data

Variable	Value	Description
x_1	2.0	Input 1
x_2	3.0	Input 2
x_3	-1.0	Input 3
w_1	0.5	Weight 1
w_2	-0.3	Weight 2
w_3	0.8	Weight 3
b	1.0	Bias

📐 Perceptron Formula:

$$z = w_1x_1 + w_2x_2 + w_3x_3 + b$$

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

📝 Step-by-Step Calculation

Step 1: Calculate Weighted Sum

Multiply each input by its weight and sum all products

$$z = w_1x_1 + w_2x_2 + w_3x_3 + b$$
$$= (0.5 \times 2.0) + (-0.3 \times 3.0) + (0.8 \times -1.0) + 1.0$$
$$= 1.0 + (-0.9) + (-0.8) + 1.0$$

Step 2: Sum All Terms

Add all terms together

$$y = \sigma(\Sigma\, w_i x_i + b)$$
$$= \sigma(w_1 x_1 + w_2 x_2 + w_3 x_3 + b)$$

🔄 Activation Function (Step Function):

$$\sigma(z) = 1 \text{ if } z \geq 0$$
$$\sigma(z) = 0 \text{ if } z < 0$$

$$z = 1.0 - 0.9 - 0.8 + 1.0$$
$$z = 0.3$$

Step 3: Apply Activation Function

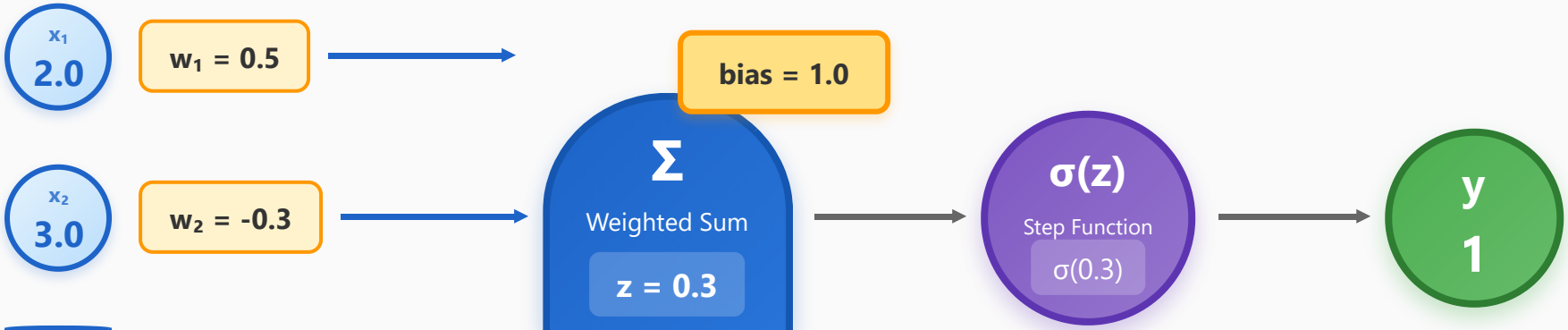
Apply Step function: Since z ≥ 0

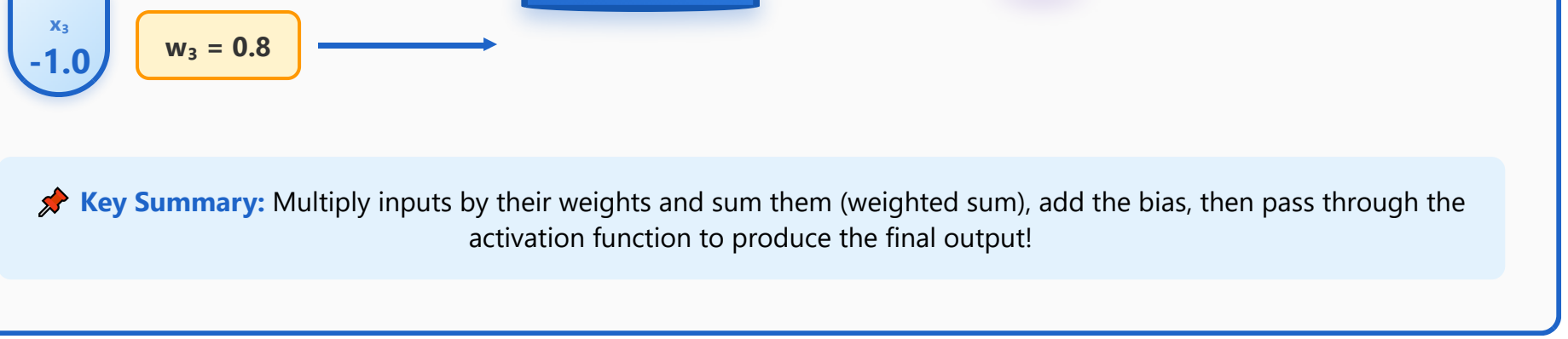
$$y = \sigma(0.3) = 1$$
(Activated because 0.3 ≥ 0!)

🎯 **Final Output**

y = 1

🎨 Visualization: Perceptron Operation Process





📌 **Key Summary:** Multiply inputs by their weights and sum them (weighted sum), add the bias, then pass through the activation function to produce the final output!