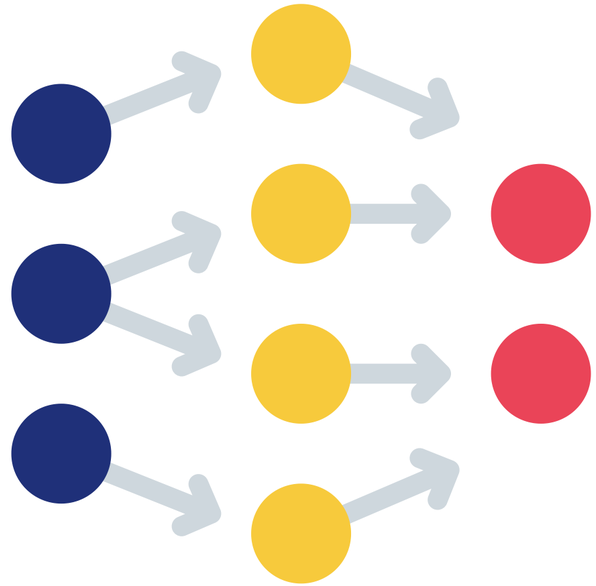
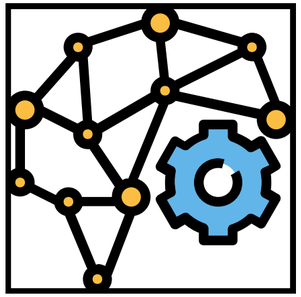
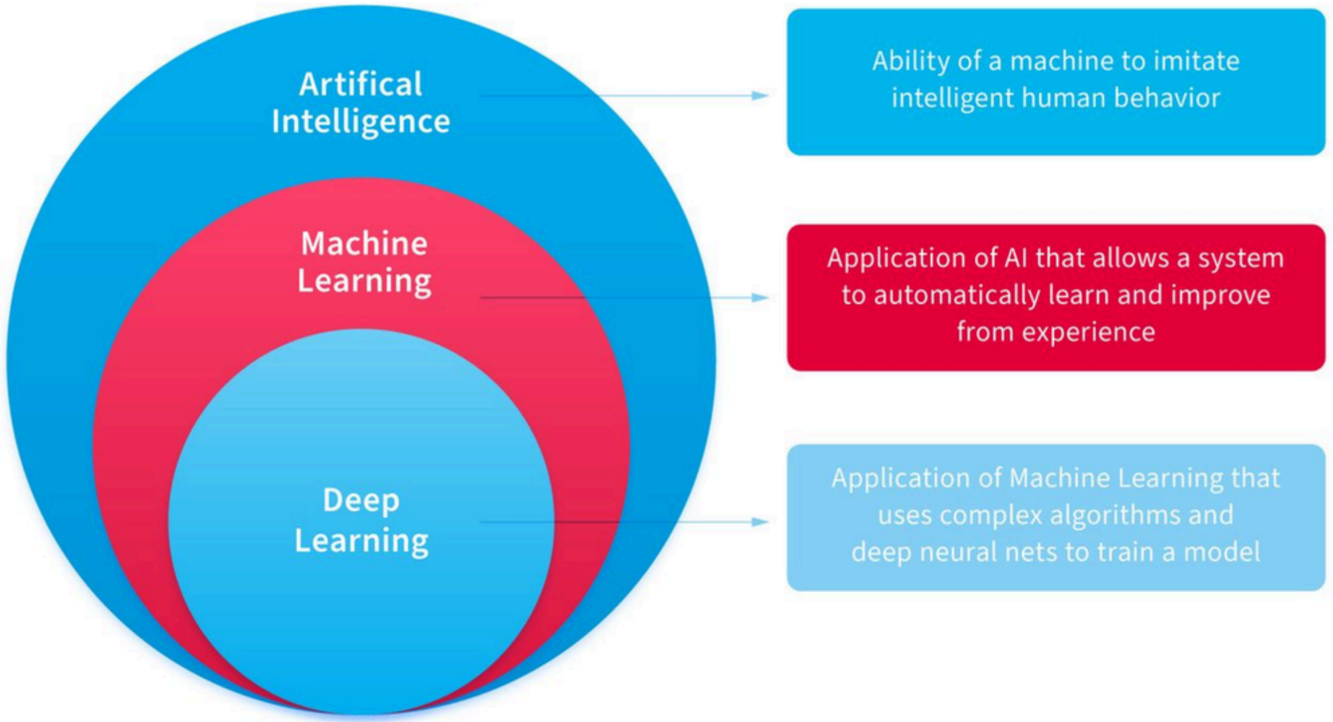
What is Deep Learning?



Meet Deep Learning



- **Deep Learning** is a branch of machine learning that uses complex algorithm and deep neural networks to train a model.



WHAT IS NEURON

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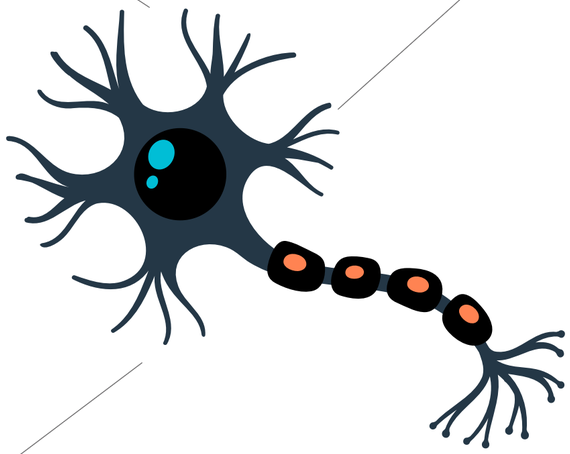
The brain has over **100 billion** neurons communicating through electrical and chemical signals.

Neurons communicate with each other and help us see, think, and generate ideas.



Human brain learns by creating connections among these neurons.

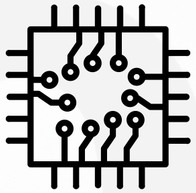
ANNs are information processing models inspired by the human brain.

WHY DEEP LEARNING NOW?

In general, three technical forces are driving advances in machine learning:

I. Big Data

- **Larger Datasets**
- **Easier Collection**
- **Storage**



II. Hardware

- **Graphics Processing Units (GPUs)**
- **Massively Parallelizable**

III. Software

- **Improved Techniques**
- **New Models**
- **Toolboxes**

Types of Deep Learning

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SUPERVISED

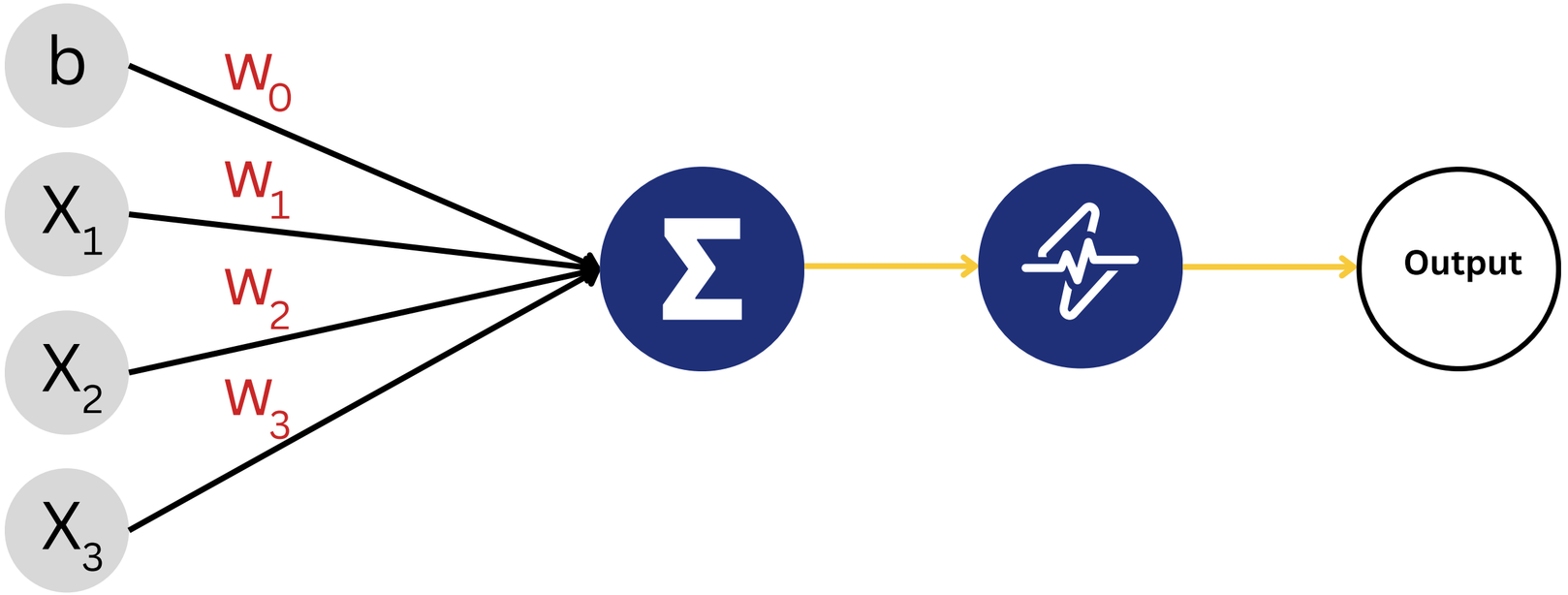
- Artificial Neural Networks
- Convolutional Neural Networks
- Recurrent Neural works

UNSUPERVISED

- Self-Organing Maps
- Deep Boltzmann Machines
- AutoEncoders

The Perceptron

$$\hat{y} = g\left(\sum_{i=1}^{m} x_i y_i\right)$$



The PERCEPTRON

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In this section, we'll learn about the **perceptron**, which is the first step in our journey to understand **deep learning**. A basic understanding of **neurons** is a necessary feature in deep learning.

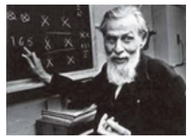
TOPICS WE'LL COVER:

- **INPUT LAYER**
- **HIDDEN LAYER**
- **WIEGHT**
- **ACTIVATION FUNCTION**

GOALS FOR THIS SECTION:

- Understand the Perceptron
- Understand the input layer
- Gain knowledge about the hidden layer
- Explore the concept of weights
- Learn about activation functions

THE PERCEPTRON



Warren Sturgis McCulloch

SUNRISE INSTITUTE

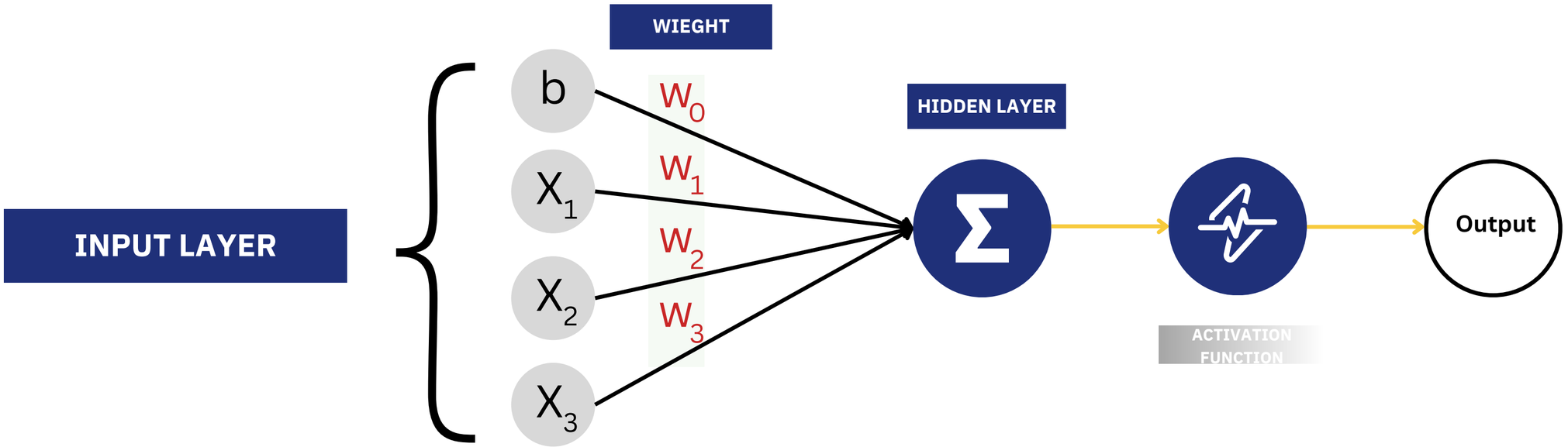
In **machine learning**, the **perceptron** (or **McCulloch–Pitts neuron**) Perceptron is one of the simplest Artificial neural network architectures.

INPUT LAYER

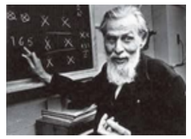
HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION



THE PERCEPTRON



Warren Sturgis McCulloch

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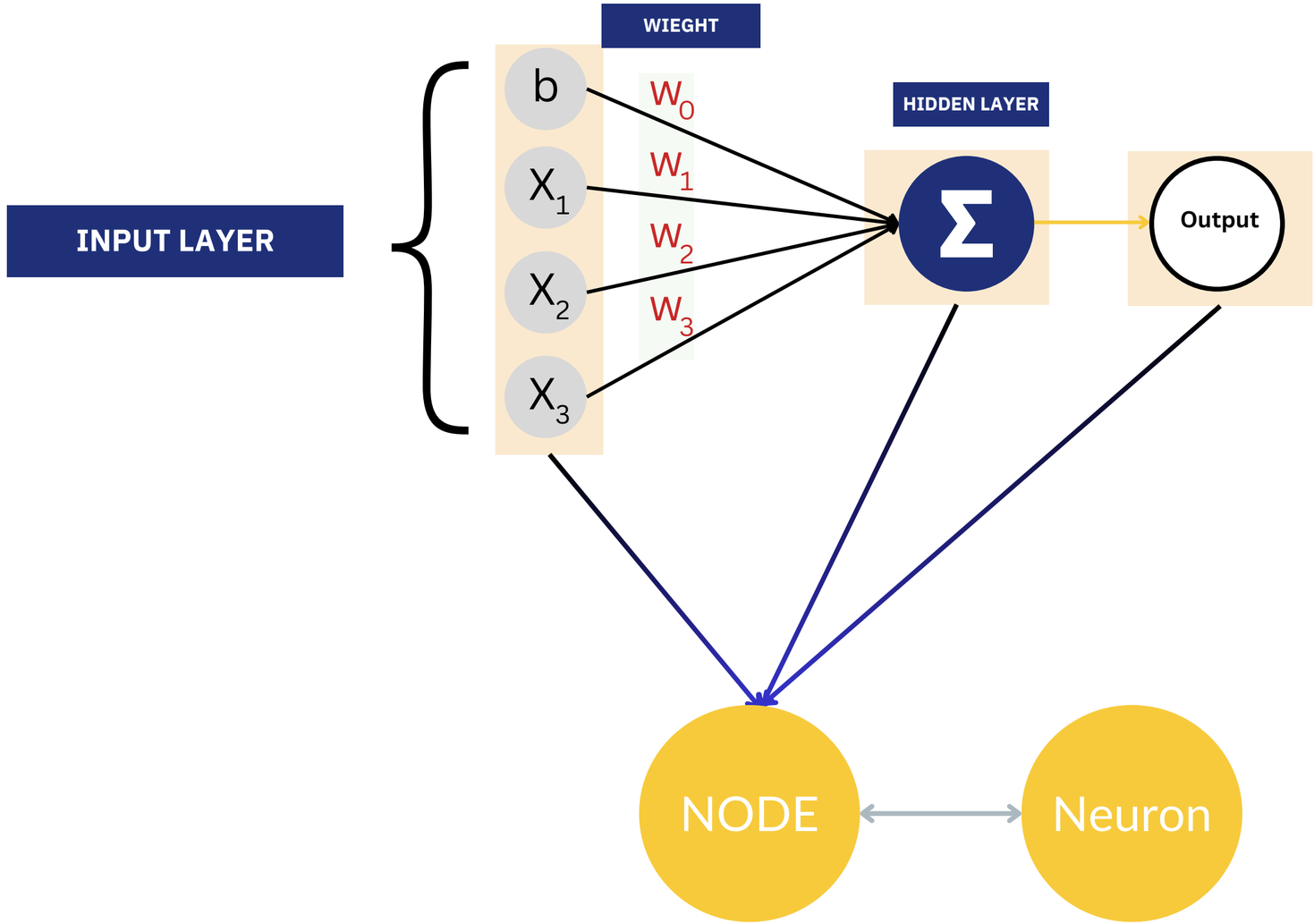
INPUT LAYER

HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION



THE INPUT LAYER

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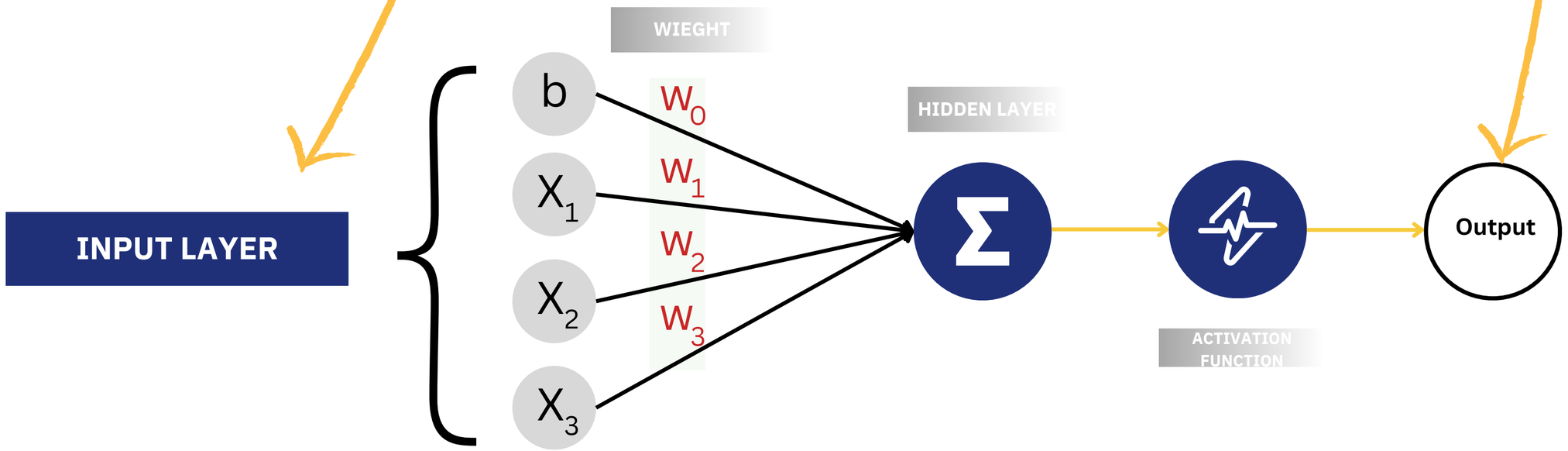
INPUT LAYER

HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION

ıup	DeviceProtection	TechSupport	StreamingTV	StreamingMovies	Contract	PaperlessBilling	PaymentMethod	MonthlyCharges	TotalCharges	Churn
	No	No	No	No	Month-to-month	Yes	Electronic check	29.85	29.85	No
	Yes	No	No	No	One year	No	Mailed check	56.95	1889.5	No
	No	No	No	No	Month-to-month	Yes	Mailed check	53.85	108.15	Yes
	Yes	Yes	No	No	One year	No	Bank transfer (automatic)	42.3	1840.75	No
	No	No	No	No	Month-to-month	Yes	Electronic check	70.7	151.65	Yes
	Yes	No	Yes	Yes	Month-to-month	Yes	Electronic check	99.65	820.5	Yes
	No	No	Yes	No	Month-to-month	Yes	Credit card (automatic)	89.1	1949.4	No
	No	No	No	No	Month-to-month	No	Mailed check	29.75	301.9	No



Example Input Layer

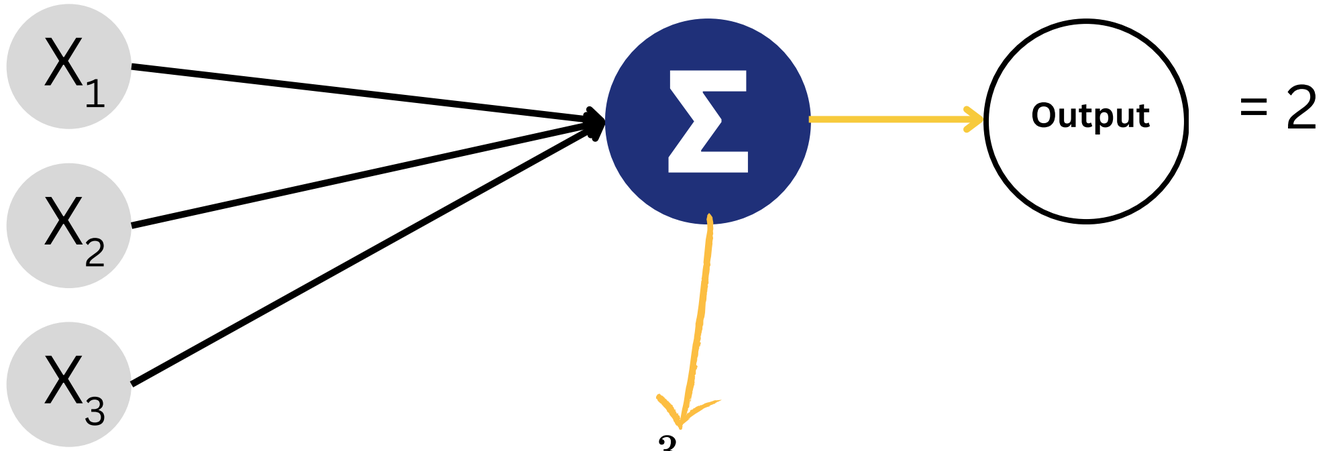
INPUT LAYER

HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION

If we have: $X_1 = 1$ $X_2 = 2$ $X_3 = 3$



$$\frac{\sum_{i=1}^{3} x_i}{3} \quad \text{where} \quad x_1 = 1,\ x_2 = 2,\ x_3 = 3$$

Example Input Layer

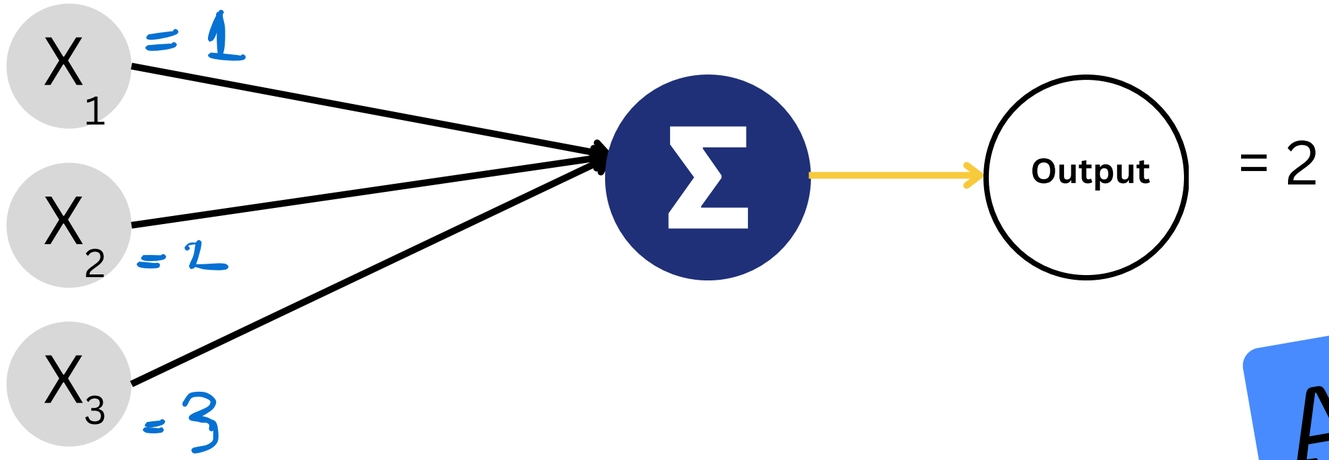
INPUT LAYER

HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION

If we have: $X_1 = 1$ $X_2 = 2$ $X_3 = 3$



An average machine

$$\frac{\sum_{i=1}^{3} x_i}{3} \quad \text{where} \quad x_1 = 1,\ x_2 = 2,\ x_3 = 3$$

THE HIDDEN LAYER

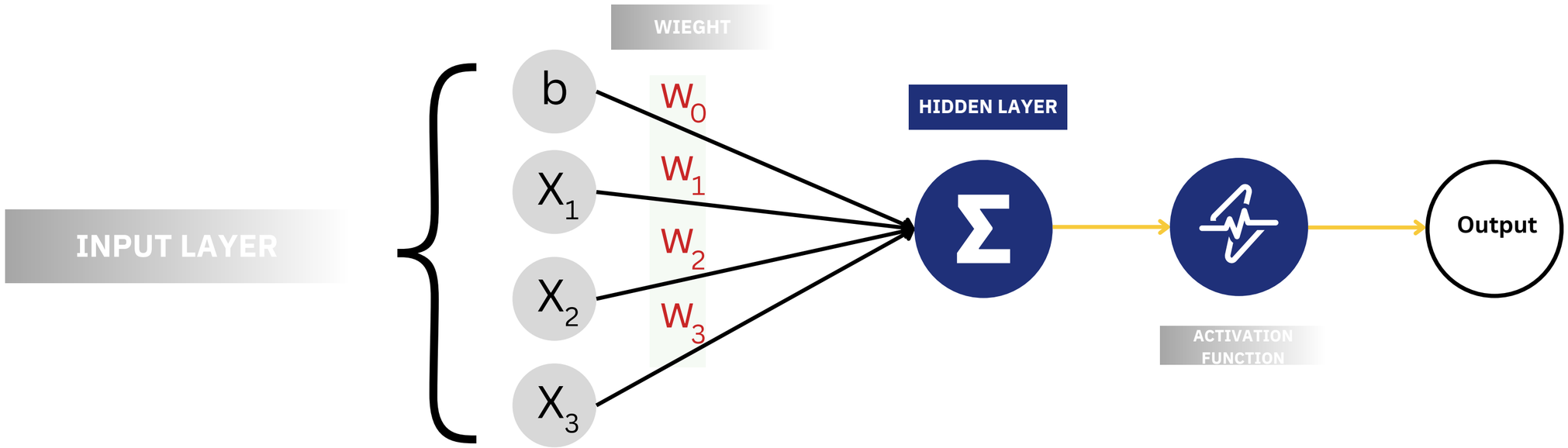
Hidden layer is an intermediate layer of neurons between the **input layer** (where the data is received) and the **output layer** (where the result is produced).

INPUT LAYER

HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION



Example Hidden Layer

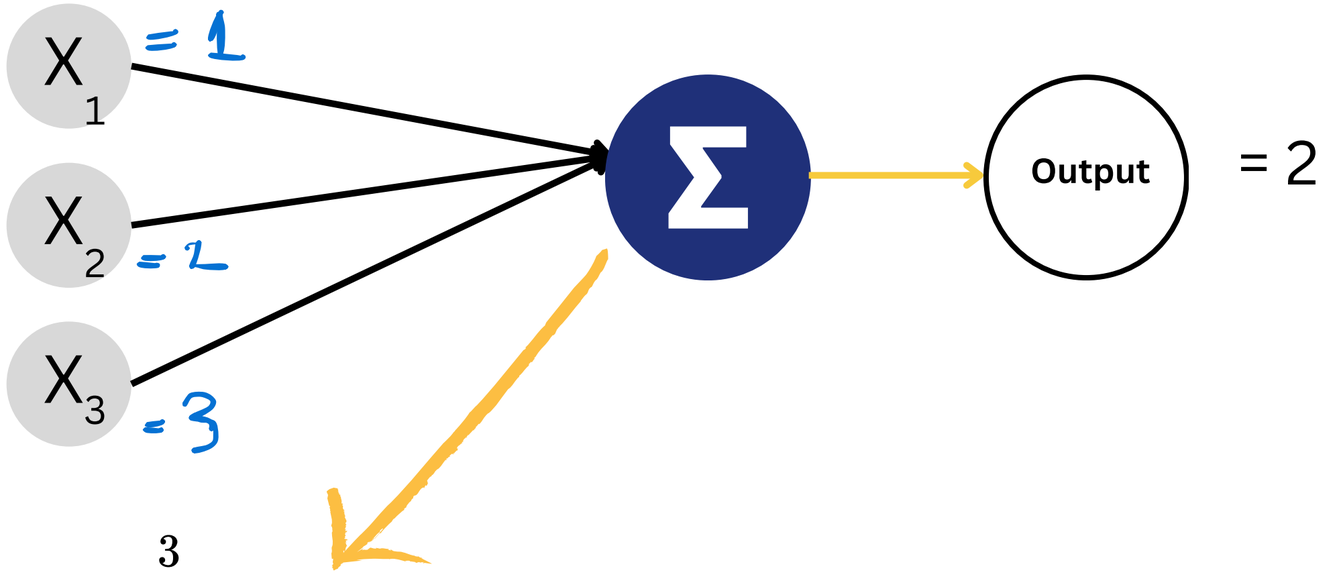
INPUT LAYER

HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION

If we have: $X_1 = 1$ $X_2 = 2$ $X_3 = 3$



$$\frac{\sum_{i=1}^{3} x_i}{3} \quad \text{where} \quad x_1 = 1,\ x_2 = 2,\ x_3 = 3$$

THE WIEGHT

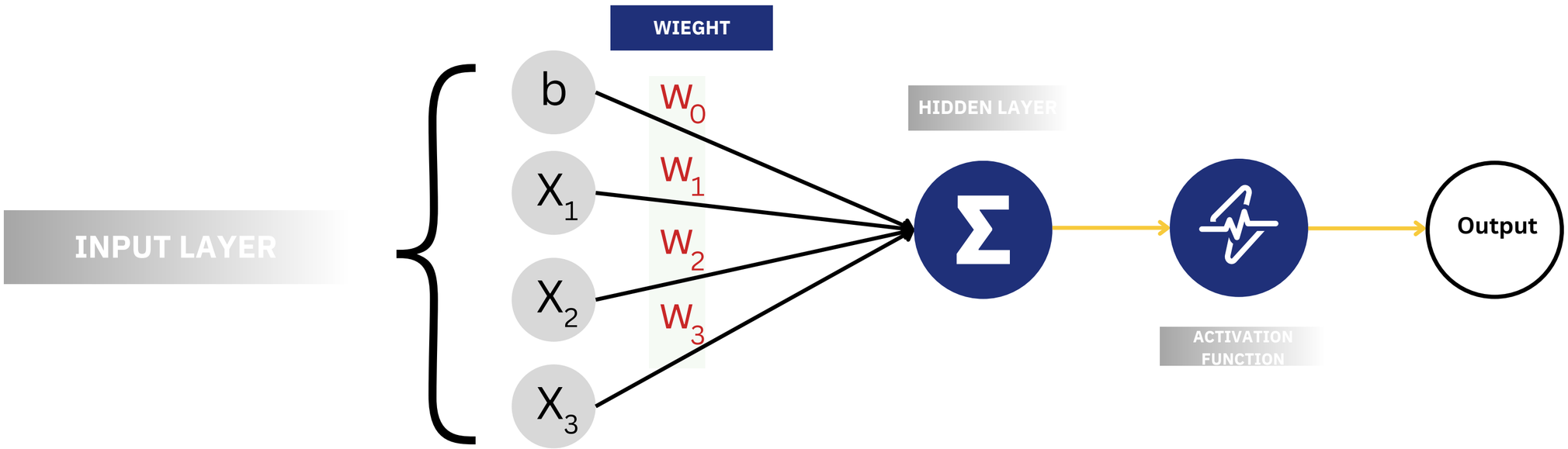
In **machine learning**, the **perceptron** (or **McCulloch–Pitts neuron**) is an algorithm for **supervised learning** of **binary classifiers**.

INPUT LAYER

HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION



Example WIEGHT

INPUT LAYER

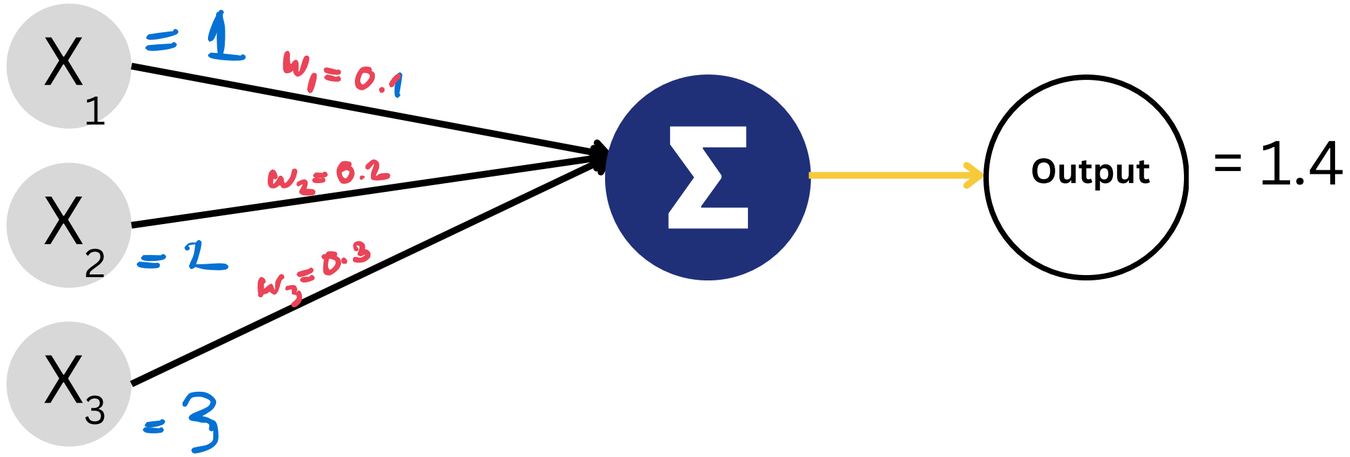
HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION

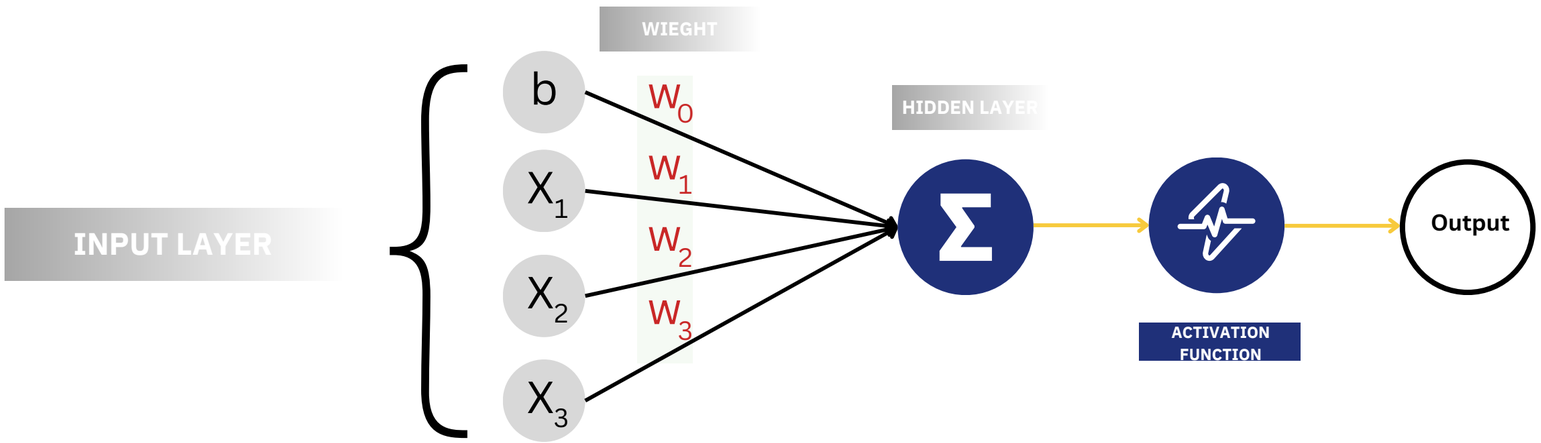
If we have: $x_1 = 1, \quad x_2 = 2, \quad x_3 = 3$

$w_1 = 0.1, \quad w_2 = 0.2, \quad w_3 = 0.3$



$$z = \sum_{i=1}^{3} w_i x_i = (0.1 \cdot 1) + (0.2 \cdot 2) + (0.3 \cdot 3)$$

The Activation Function



THE ACTIVATION FUNCTION

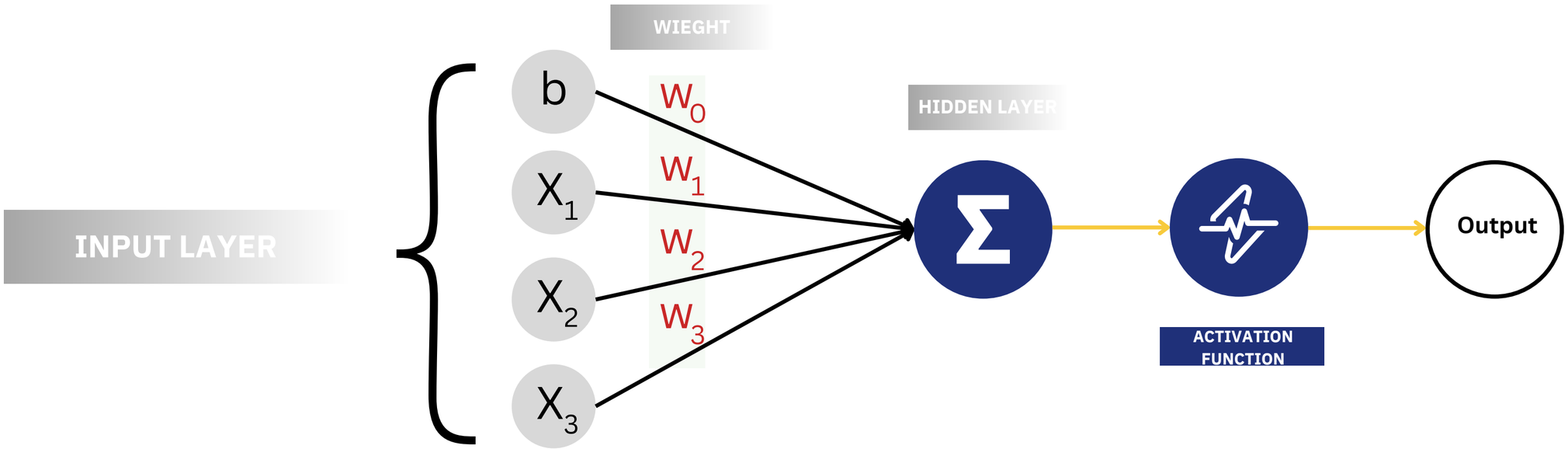
The **activation function** of a node in an **artificial neural network** is a function that calculates the output of the node based on its individual inputs and their weights.

INPUT LAYER

HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION



Example WIEGHT

INPUT LAYER

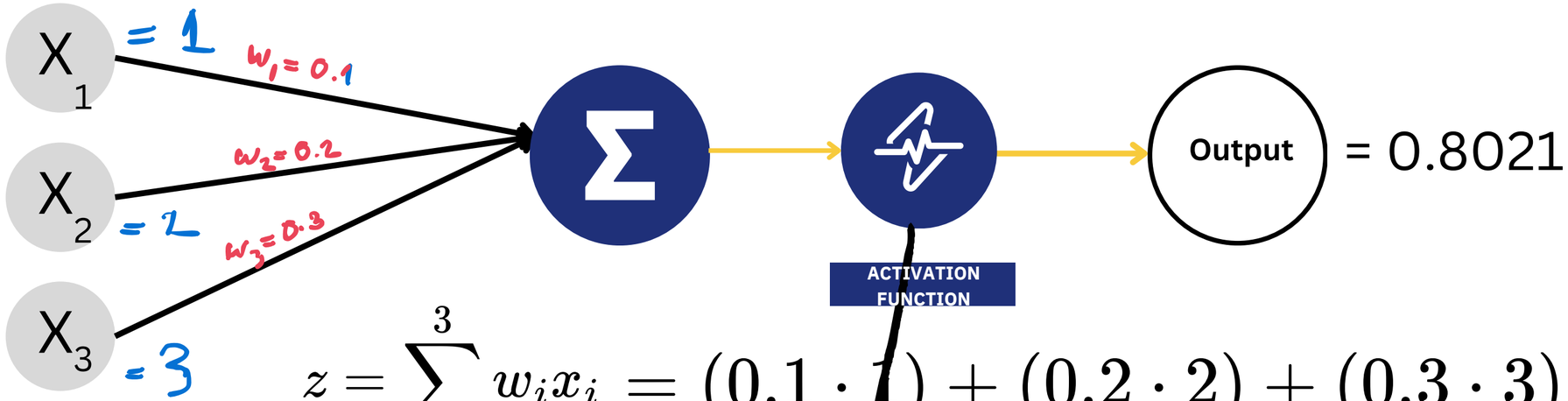
HIDDEN LAYER

WIEGHT

ACTIVATION FUNCTION

If we have: $x_1 = 1, \quad x_2 = 2, \quad x_3 = 3$

$w_1 = 0.1, \quad w_2 = 0.2, \quad w_3 = 0.3$



$$z = \sum_{i=1}^{3} w_i x_i = (0.1 \cdot 1) + (0.2 \cdot 2) + (0.3 \cdot 3) = 1.4$$

$$\sigma(z) = \frac{1}{1 + e^{-z}}$$

$$\sigma(1.4) = \frac{1}{1 + e^{-1.4}} = 0.8021$$

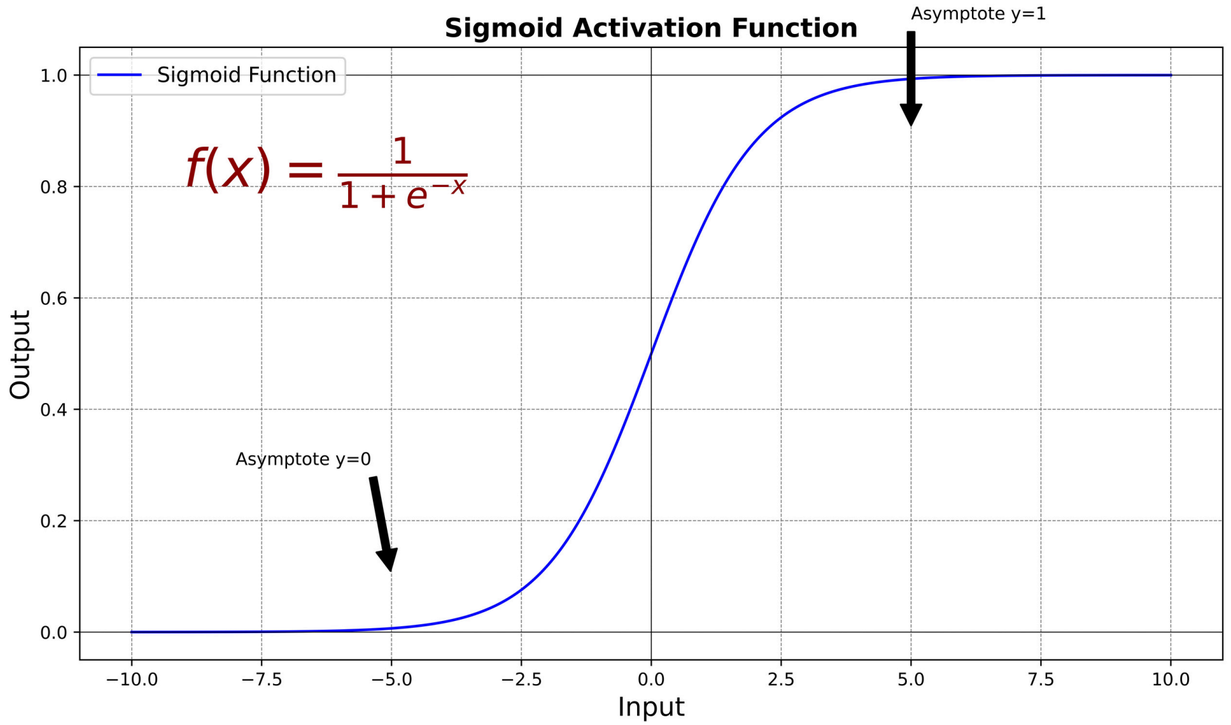
COMMON ACTIVATION FUNCTION

INPUT LAYER

HIDDEN LAYER

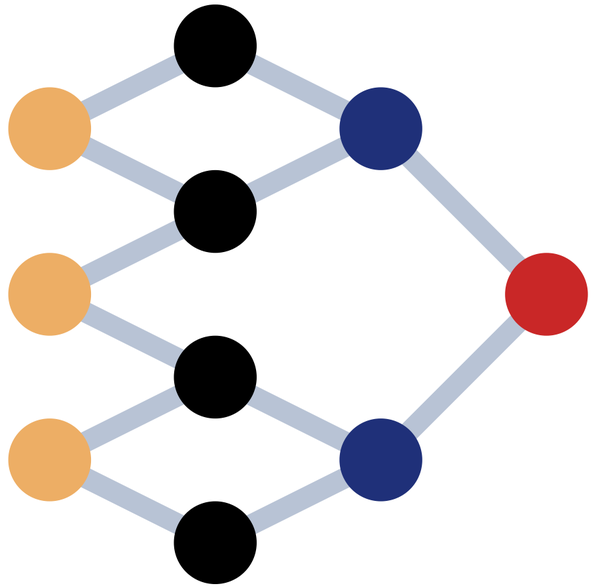
WIEGHT

ACTIVATION FUNCTION



The Artificial Neural Networks

$$z_{k,i} = w_{0,i}^{(k)} + \sum_{j=1}^{n_{k-1}} g(z_{k-1,j}) w_{j,i}^{(k)}$$



The Artificial Neural Networks

In this section, we'll learn about Analyze the key computations underlying deep learning, then use them to build and train deep neural networks

TOPICS WE'LL COVER:

- **L-Layer**
- **Forward Propogation**
- **WIEGHT**
- **ACTIVATION FUNCTION**

GOALS FOR THIS SECTION:

- Describe the successive block structure of a deep neural network
- Build a deep L-layer neural network
- Analyze matrix and vector dimensions to check neural network implementations
- Use a cache to pass information from forward to back propagation
- Explain the role of hyperparameters in deep learning
- Build a 2-layer neural network

L-Layer Neural Network

L-Layer Neural Network