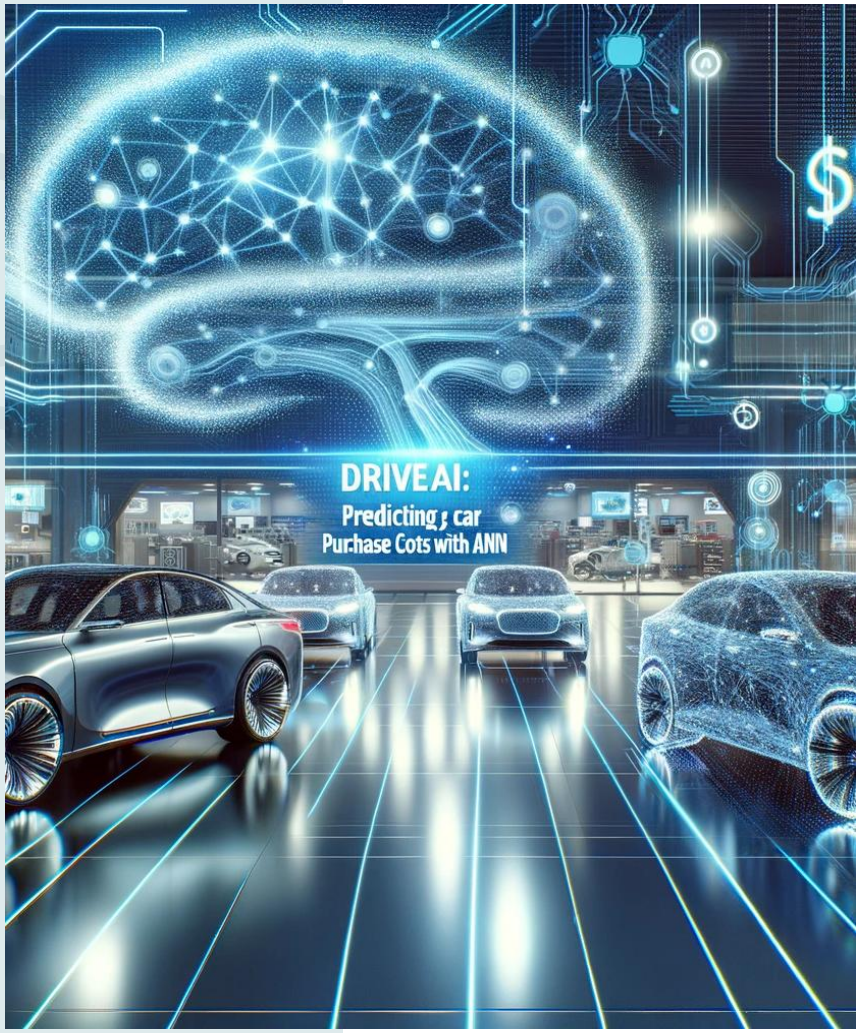
PREDICTING CAR PURCHASE COSTS WITH ANN

A Regression-Based Approach Using Artificial Neural Networks to Estimate Car Purchase Amounts



PROBLEM STATEMENT :-

Develop an Artificial Neural Network (ANN) model to predict car purchasing amounts based on customer attributes.

INTRODUCTION :-

•Predicting how much a customer is likely to spend on a car is important for businesses to offer better services and make informed decisions.
•Traditional methods often fail to handle the complexities of customer data, which include factors like age, income, and preferences.
•Artificial Neural Networks (ANNs) provide an effective way to model these relationships, as they can capture patterns and make accurate predictions.
•This project aims to create a regression-based ANN model to predict car purchasing amounts with improved precision.
•The results of this project can help businesses personalize their strategies, improve customer engagement, and optimize marketing efforts.

Project Overview

This project aims to develop an Artificial Neural Network (ANN) model to predict the car purchase amount based on customer attributes like age, salary, credit card debt, and net worth. The model will be trained using customer data to accurately forecast the amount a customer is willing to pay.

-Attributes:-

- Customer e-mail
- Customer Name
- Country
- Gender
- Age
- Annual Salary
- Credit Card Debt
- Net Worth

Goal: The goal is to build and train an Artificial Neural Network (ANN) model that can accurately predict the Car Purchase Amount based on customer data. This model will help in understanding the factors influencing car purchase decisions and can be used for targeted marketing, sales strategies, and customer relationship management.

The model should predict:

- Car Purchase Amount

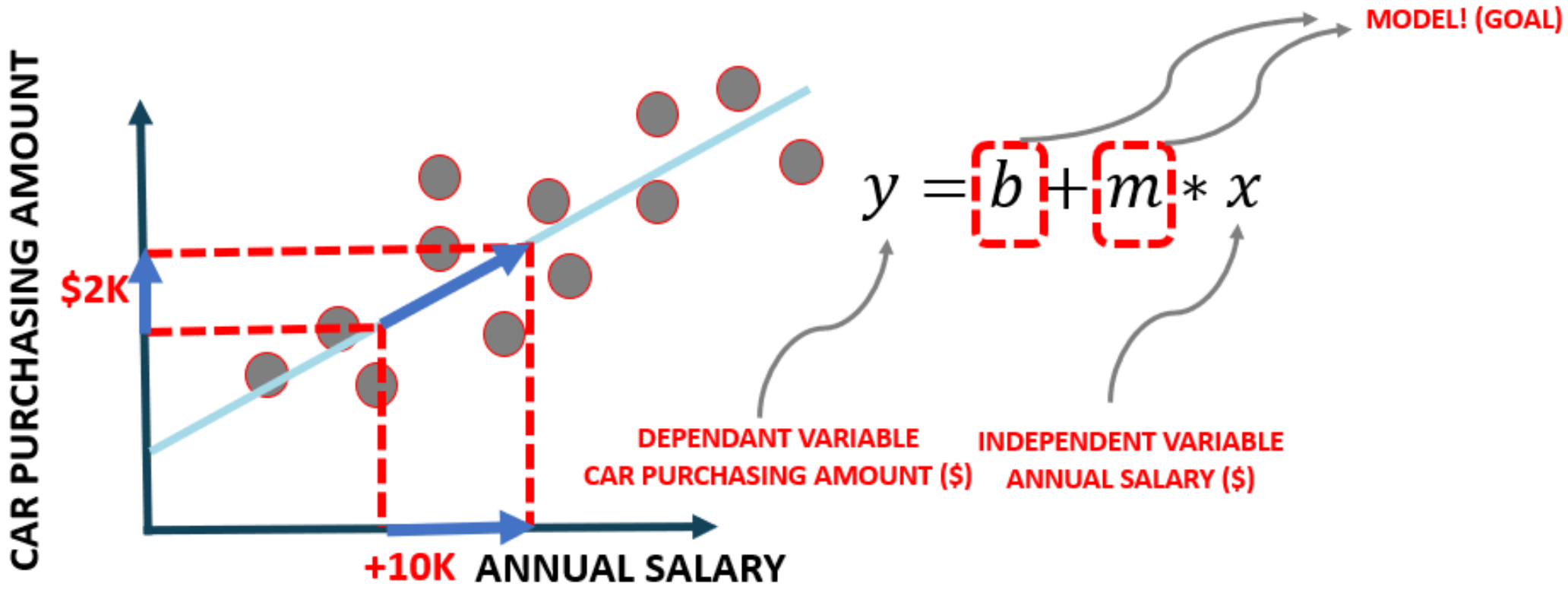
WHAT IS REGRESSION? INTUITION

- Regression works by predicting value of one variable Y based on another variable X.
- X is called the independent variable and Y is called the dependant variable.

Annual Salary	Car Purchase Amount
62812.09301	35321.45877
66646.89292	45115.52566
53798.55112	42925.70921
79370.03798	67422.36313
59729.1513	55915.46248
68499.85162	56611.99784
39814.522	28925.70549
51752.23445	47434.98265
58139.2591	48013.6141
53457.10132	38189.50601
73348.70745	59045.51309
55421.65733	42288.81046
37336.3383	28700.0334
68304.47298	49258.87571
72776.00382	49510.03356
64662.30061	53017.26723
63259.87837	41814.72067
52682.06401	43901.71244
54503.14423	44633.99241
55368.23716	54827.52403
63435.86304	51130.95379
64347.34531	43402.31525

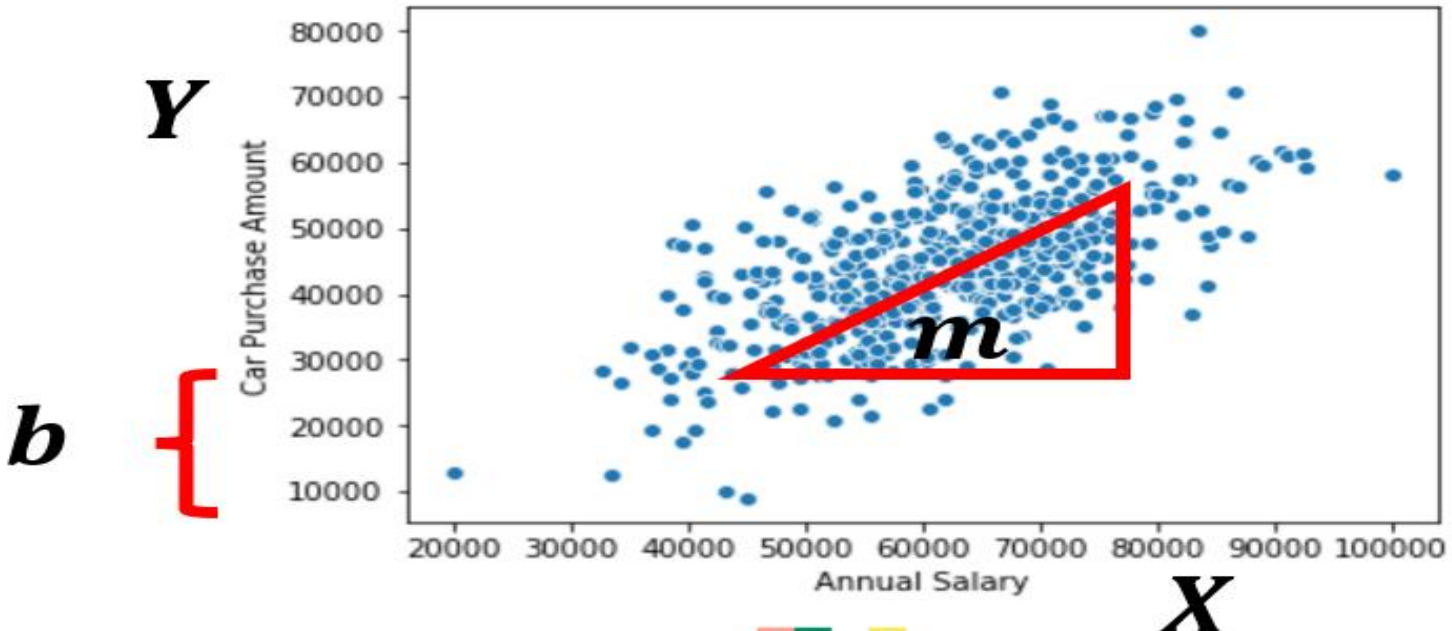
REGRESSION MATH!

Goal is to obtain a relationship (model) between the Annual salary and car purchasing amount.



HOW ARE WE GOING TO USE THE MODEL?

- Once the coefficients ‘m’ and ‘b’ are obtained, you have obtained a regression model!
- This “trained” model can be later used to predict car purchase amount (dollars) based on the annual salary.



$y = mX + b$

DEPENDANT VARIABLE

INDEPENDANT VARIABLE

Regression Quiz :-

Match the equations to the figures: $y = 3 * x$ $y = 15 - 10 * x$

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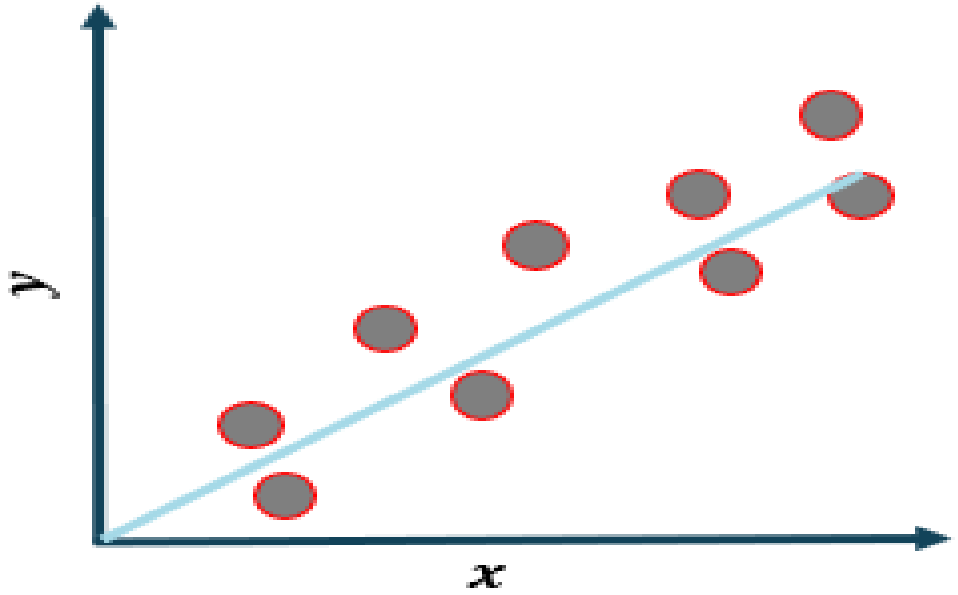
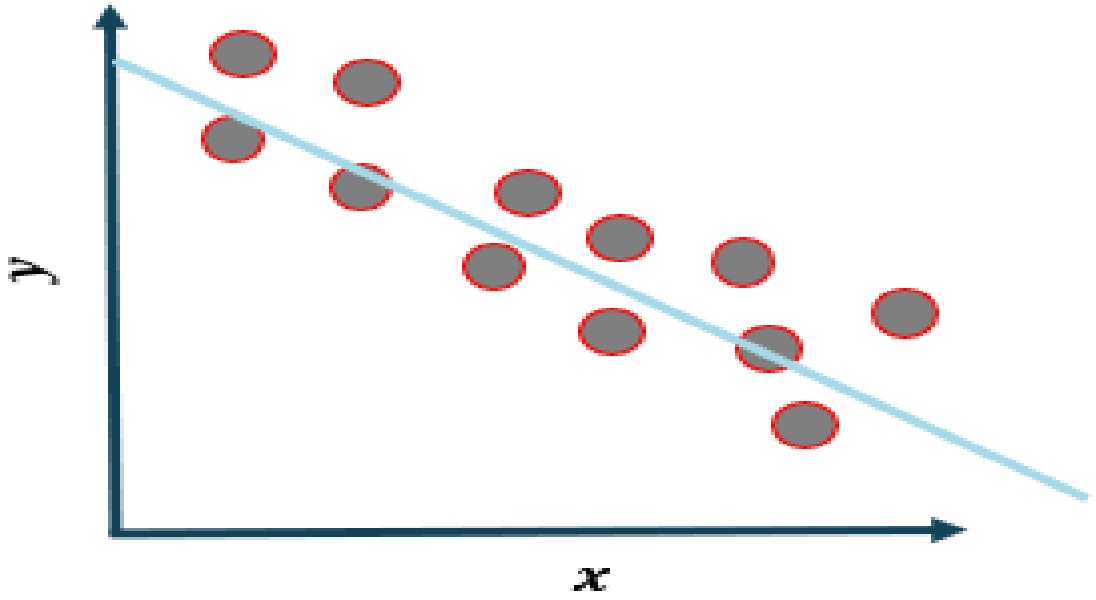
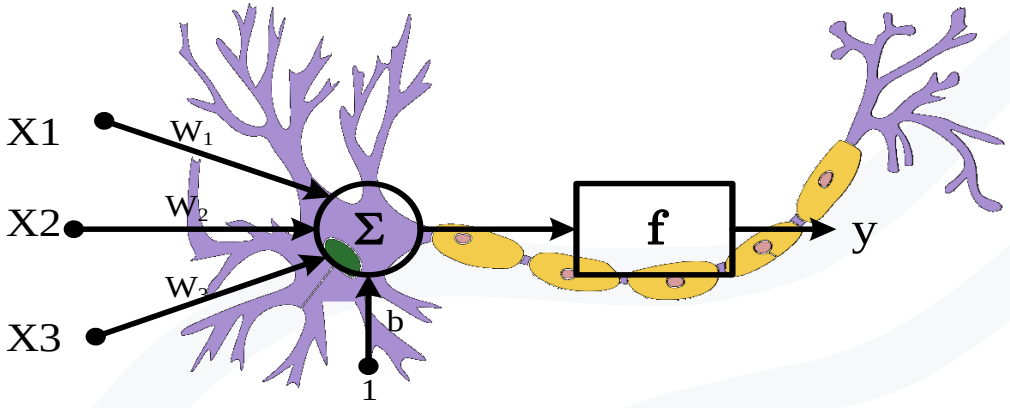
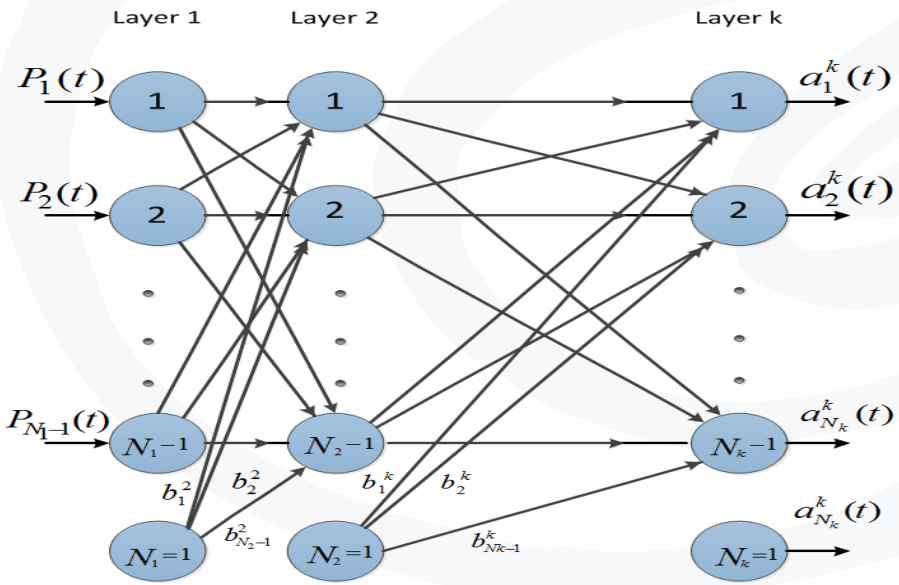




ARTIFICIAL NEURAL NETWORK: INTRODUCTION:-

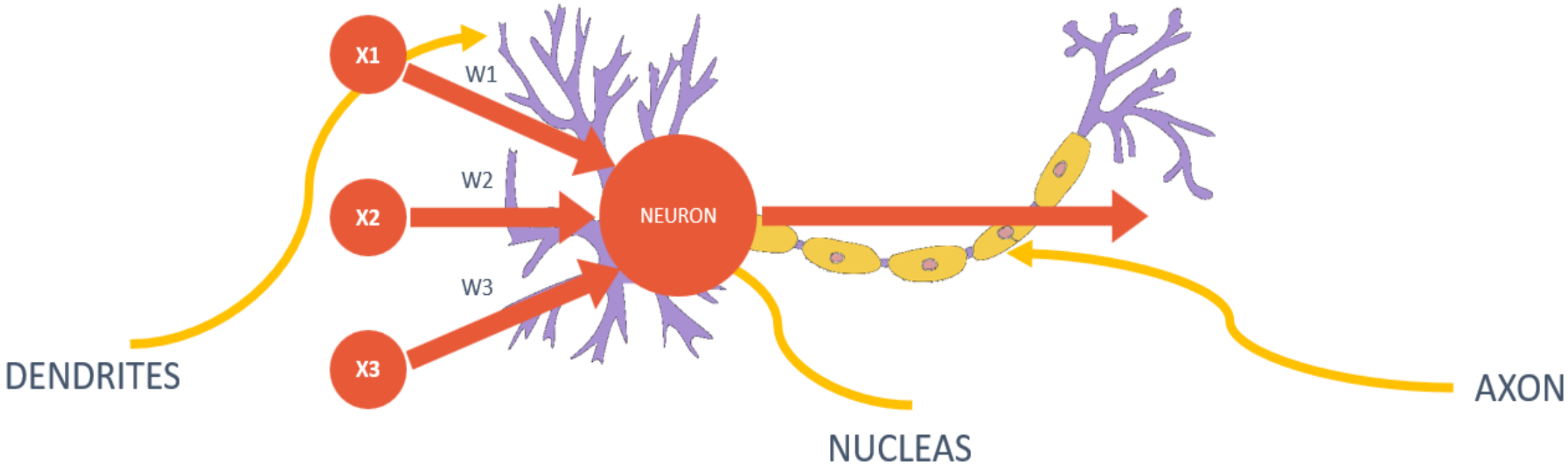
- The brain has over 100 billion neurons communicating through electrical and chemical signals.
- Neurons communicate with each other and help us see, think, and generate ideas.
- Human brain learns by creating connections among these neurons.
- ANNs are information processing models inspired by the human brain.





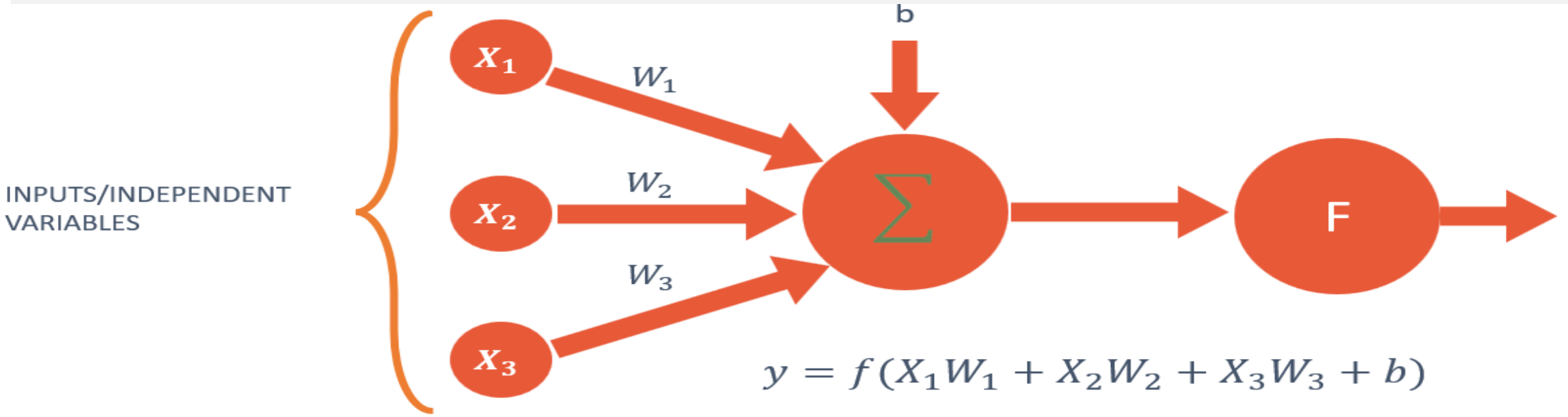
NEURON MATHEMATICAL MODEL

- The neuron collects signals from input channels named dendrites, processes information in its nucleus, and then generates an output in a long thin branch called axon.



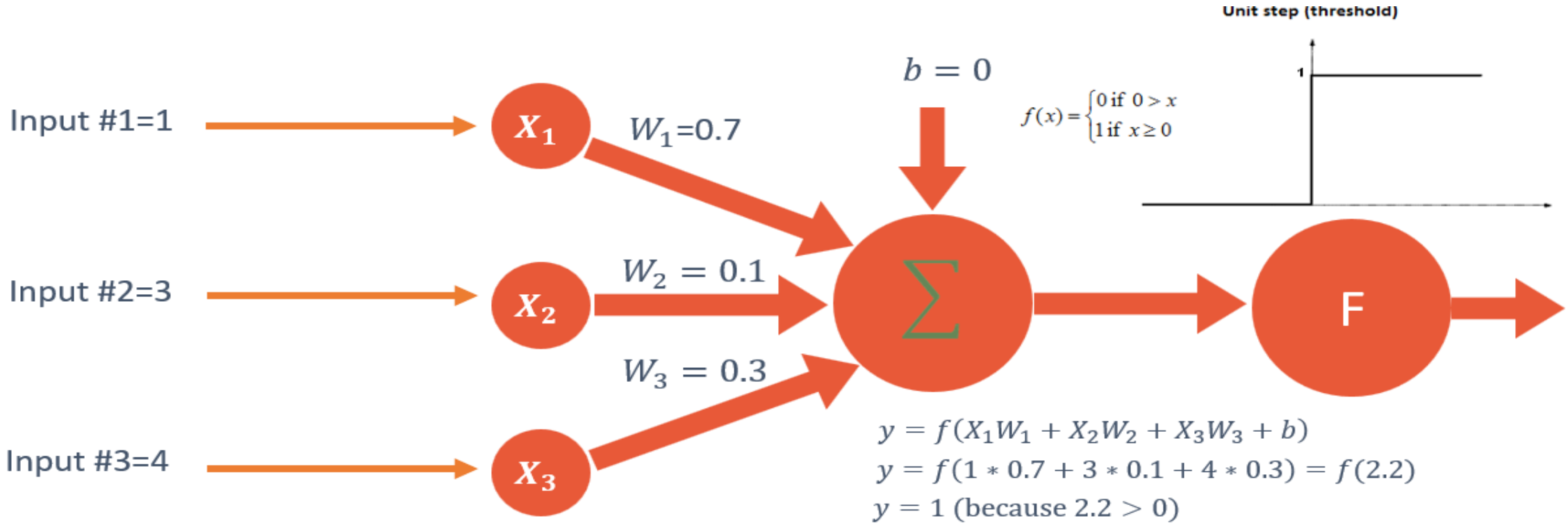
NEURON MATHEMATICAL MODEL

- Bias allows to shift the activation function curve up or down.
- Number of adjustable parameters = 4 (3 weights and 1 bias).
- Activation function “F”.



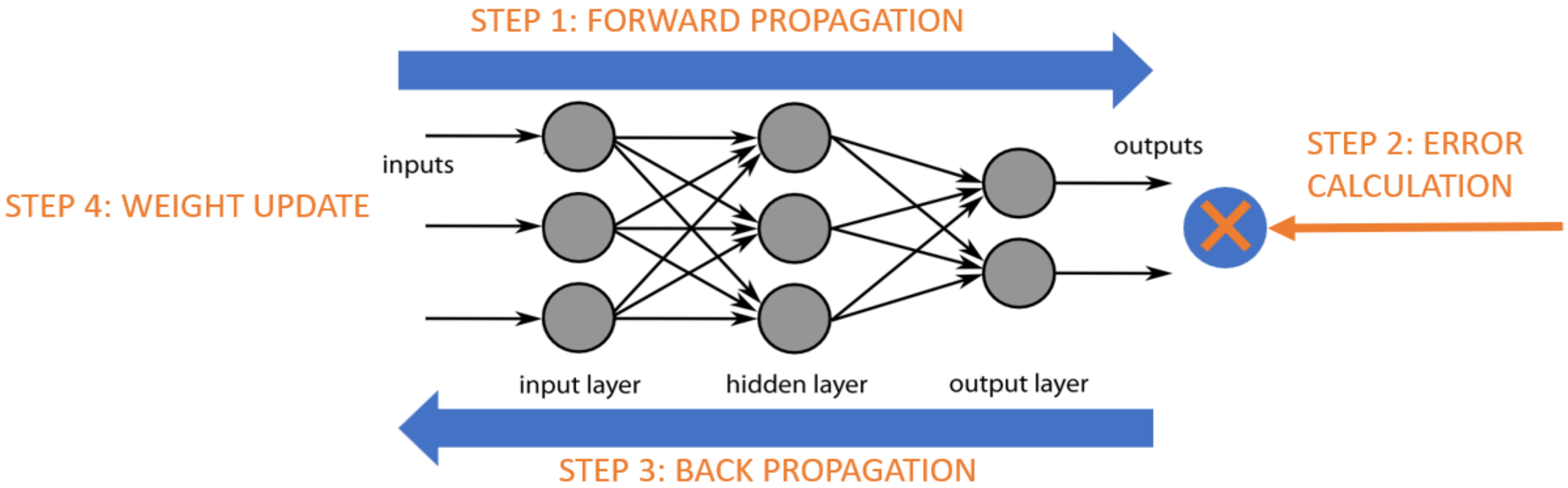
Single Neuron Model In Action

- Let's assume that the activation function is a Unit Step Activation Function.
- The activation functions is used to map the input between (0, 1).



NETWORK TRAINING: BACK PROPAGATION

- Backpropagation is a method used to train ANNs by calculating gradient needed to update network weights.
- It is commonly used by the gradient descent optimization algorithm to adjust the weight of neurons by calculating the gradient of the loss function.



2 NEURON MODEL: MATRIX REPRESENTATION

- The network is represented by a matrix of weights, inputs and outputs.
- Total Number of adjustable parameters = 8:
  - Weights = 6
  - Biases = 2

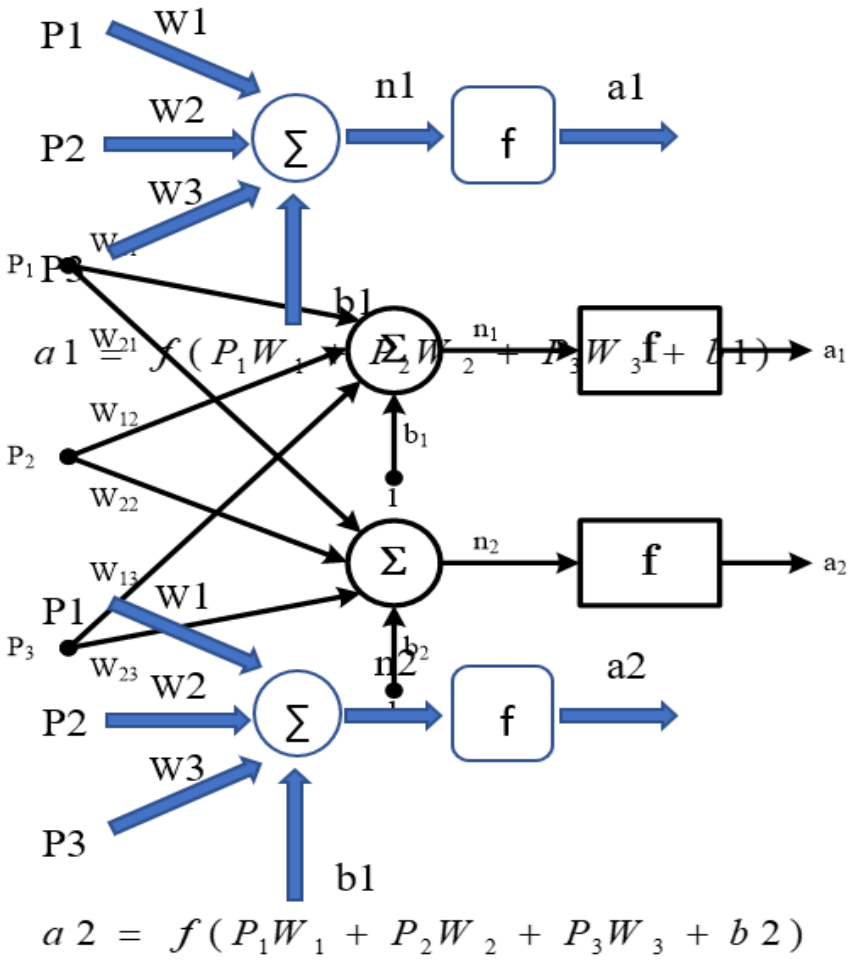
Matrix Representation

$$P = \begin{bmatrix} P_1 \\ P_2 \\ P_3 \end{bmatrix}$$

$$W = \begin{bmatrix} W_{11} & W_{12} & W_{13} \\ W_{21} & W_{22} & W_{23} \end{bmatrix}$$

$$b = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

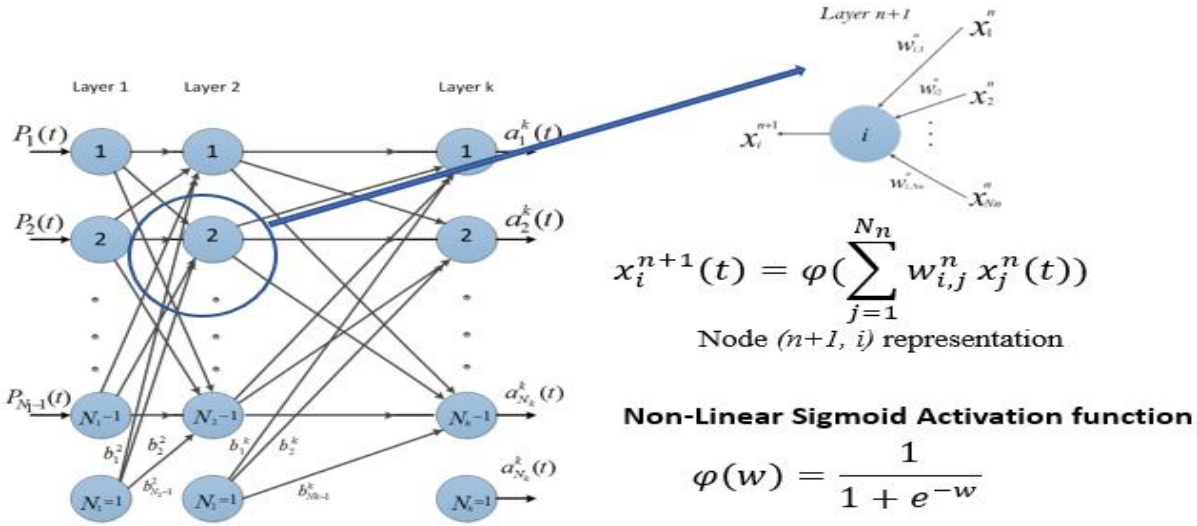
$$a = f(W \times P + b)$$



MULTI-LAYER PERCEPTRON MODEL: MATRIX REPRESENTATION

$$P = \begin{bmatrix} P_1 \\ P_2 \\ \vdots \\ P_{N_1} \end{bmatrix}$$

$$\begin{bmatrix} W_{11} & W_{12} & \cdots & W_{1,N_1} \\ W_{21} & W_{22} & & W_{2,N_1} \\ \vdots & & \ddots & \vdots \\ W_{m-1,1} & W_{m-1,2} & \cdots & W_{m-1,N_1} \\ W_{m,1} & W_{m,2} & & W_{m,N_1} \end{bmatrix}$$



$$x_i^{n+1}(t) = \varphi\left(\sum_{j=1}^{N_n} w_{i,j}^n \, x_j^n(t)\right)$$

Node *(n+1, i)* representation

Non-Linear Sigmoid Activation function

$$\varphi(w) = \frac{1}{1 + e^{-w}}$$

m: number of neurons in the hidden layer

N_1*: number of inputs*

Conclusion :-

This project successfully developed an Artificial Neural Network (ANN) model that accurately predicts the car purchase amount based on customer attributes such as age, salary, credit card debt, and net worth. By preprocessing the data, scaling features, and training the model, it was able to generate reliable predictions for the amount a customer is willing to pay for a car. The model's performance was evaluated using MAE and RMSE metrics, confirming its effectiveness in forecasting car purchase amounts for future customers.

THANK YOU !!