**Activation Function**

Definition :

* An activation function is a mathematical function applied to the output of a neuron. It introduces non-linearity into the model, allowing the network to learn and represent complex patterns in the data. Without this non-linearity feature, a neural network would behave like a linear regression model, no matter how many layers it has.
* The activation function decides whether a neuron should be activated by calculating the weighted sum of inputs and adding a bias term. This helps the model make complex decisions and predictions by introducing non-linearities to the output of each neuron.

Types Of Activation Function in ANN :

A) Identity Function :

* Identity function is used as an activation function for the input layer. It is a linear function having the form.
* **Formula :**
* yout = f(x) = x, ∀x

B) Thereshold/step Function :

* It is a commonly used activation function. As depicted in the diagram, it gives **1 as output** of the input is either 0 or positive. If the input is negative, it gives **0 as output**. Expressing it mathematically.
* **Formula :**
* yout = f(ysum) = {1,x >= 0 (or) 0,x < 0

C) ReLU(Rectified Linear Unit) Function :

* It is the most popularly used activation function in the areas of convolutional neural networks and deep learning. It is of the form.
* **Formula :**
  + - f(x) = {x,x >= 0 (or) 0,x < 0

D) Sigmoid Function :

* It is by far the most commonly used activation function in neural networks. The need for sigmoid function stems from the fact that many learning algorithms require the activation function to be differentiable and hence continuous.
* There are two types of sigmoid function:
  + **Binary Sigmoid Function**
  + **Bipolar Sigmoid Function**
* **Binary Sigmoid Function** **:**
* Formula :
  + - yout = f(x) = 1/1+e-kx
* Where **k = steepness or slope parameter,**By varying the value of k, sigmoid function with different slopes can be obtained. It has a range of (0,1).  The slope of origin is **k/4.**As the value of k becomes very large, the sigmoid function becomes a threshold function.
* **Bipolar Sigmoid Function :**
  + Formula :

* + - * Yout  = f(x) = 1-e-kz/1+e-kz
* The range of values of sigmoid functions can be varied depending on the application. However, the range of (-1,+1) is most commonly adopted.

E) Hyperbolic Tangent Function :

* It is bipolar in nature. It is a widely adopted activation function for a special type of neural network known as **Backpropagation Network.**The hyperbolic tangent function is of the form.
* Formula :
  + - yout = f(x) ex-e-x/ ex+e-x
* This function is similar to the bipolar sigmoid function.