Machine Learning In Python

Subject: Artificial Neural Network

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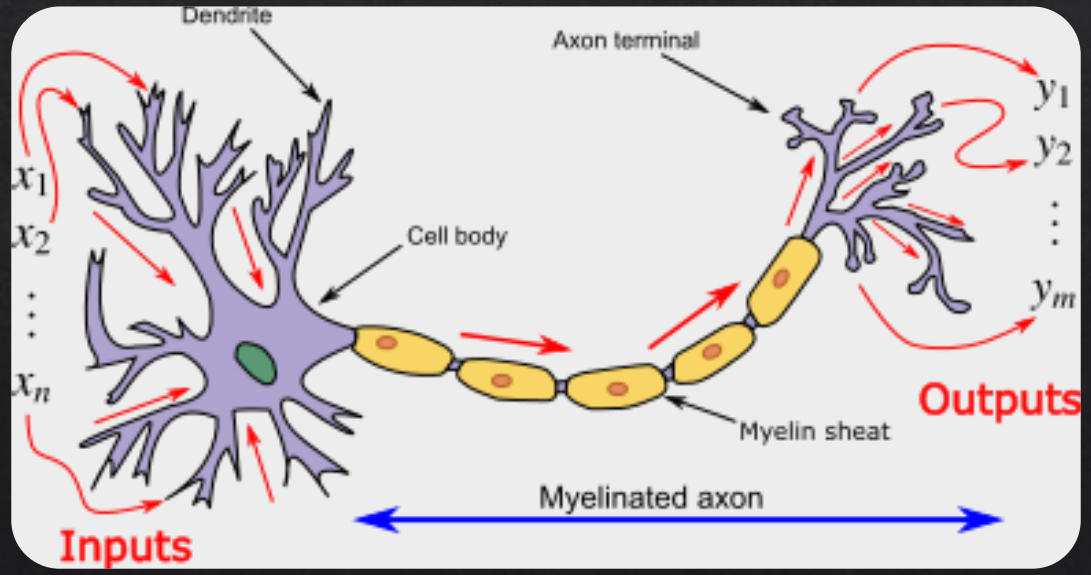
Artificial Neural Network

- Artificial Neural Network (ANN) is a type of supervised machine learning techniques which is used for classification and regression problems.
- The main idea of ANN is inspired of human neural biological processes.



Artificial Neural Network

Perceptron Neural Network

- The simplest Neural Network: Perceptron

$[X]_{1\times n}$: ***Input Data with n Features***

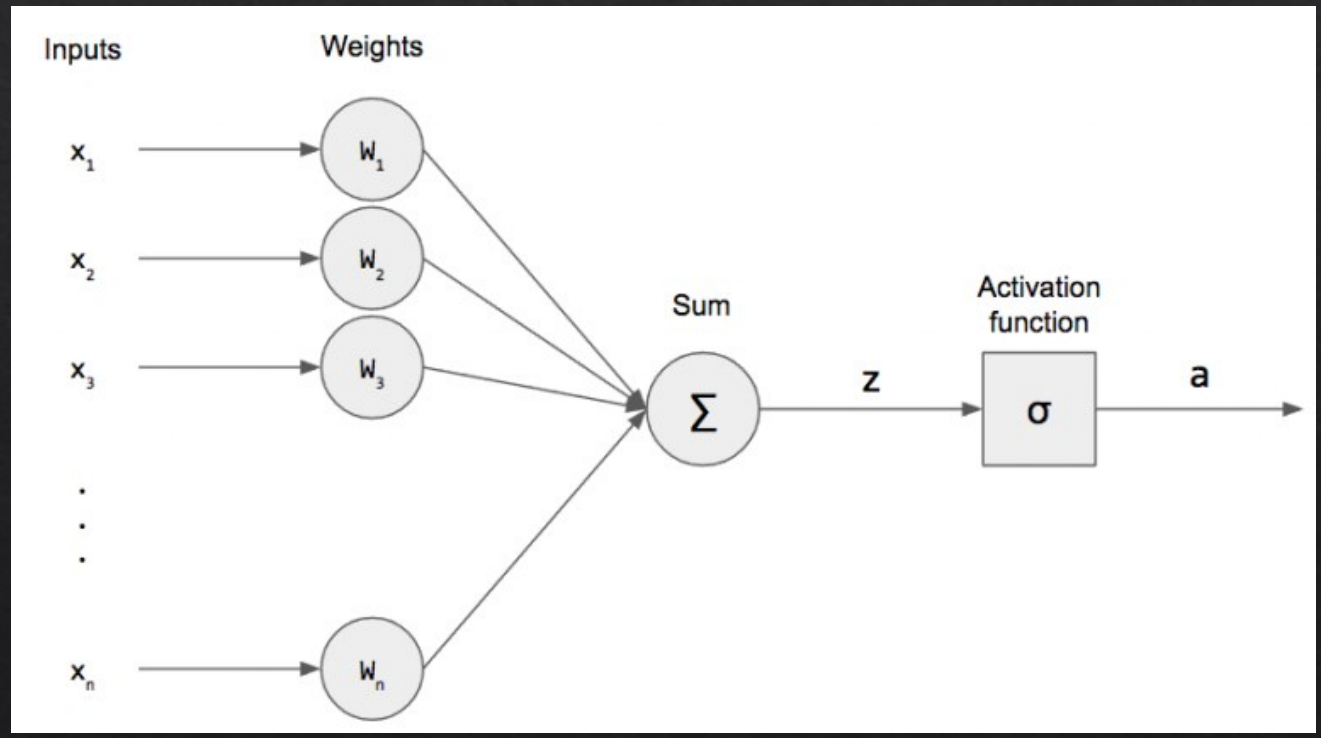
$[X]_{1\times n}$: $[x_1, x_2, \dots, x_n]^T$

$[W]_{1\times n}$: ***Weights of a Layer***

$[W]_{1\times n}$= $[w_1, w_2, \dots, w_n]^T$

$a = \sigma(XW^T)$

a: ***The output of Perceptron***



Artificial Neural Network

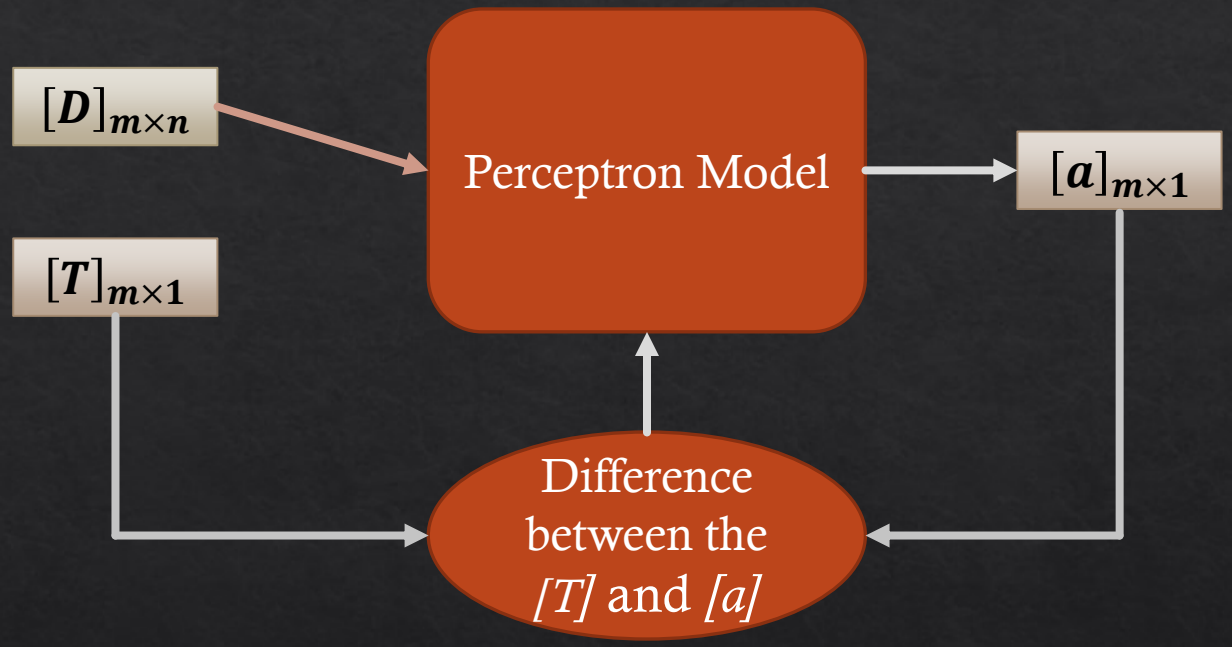
How to train Perceptron Neural Network

$[D]_{m\times n}$: ***Dataset Matrice***

$[T]_{m\times 1}$: ***Target Matrice***

$[D]_{m\times n} = [X_1, X_2, \dots, X_m]$

$[a]_{m\times 1}$: ***The output of Perceptron***

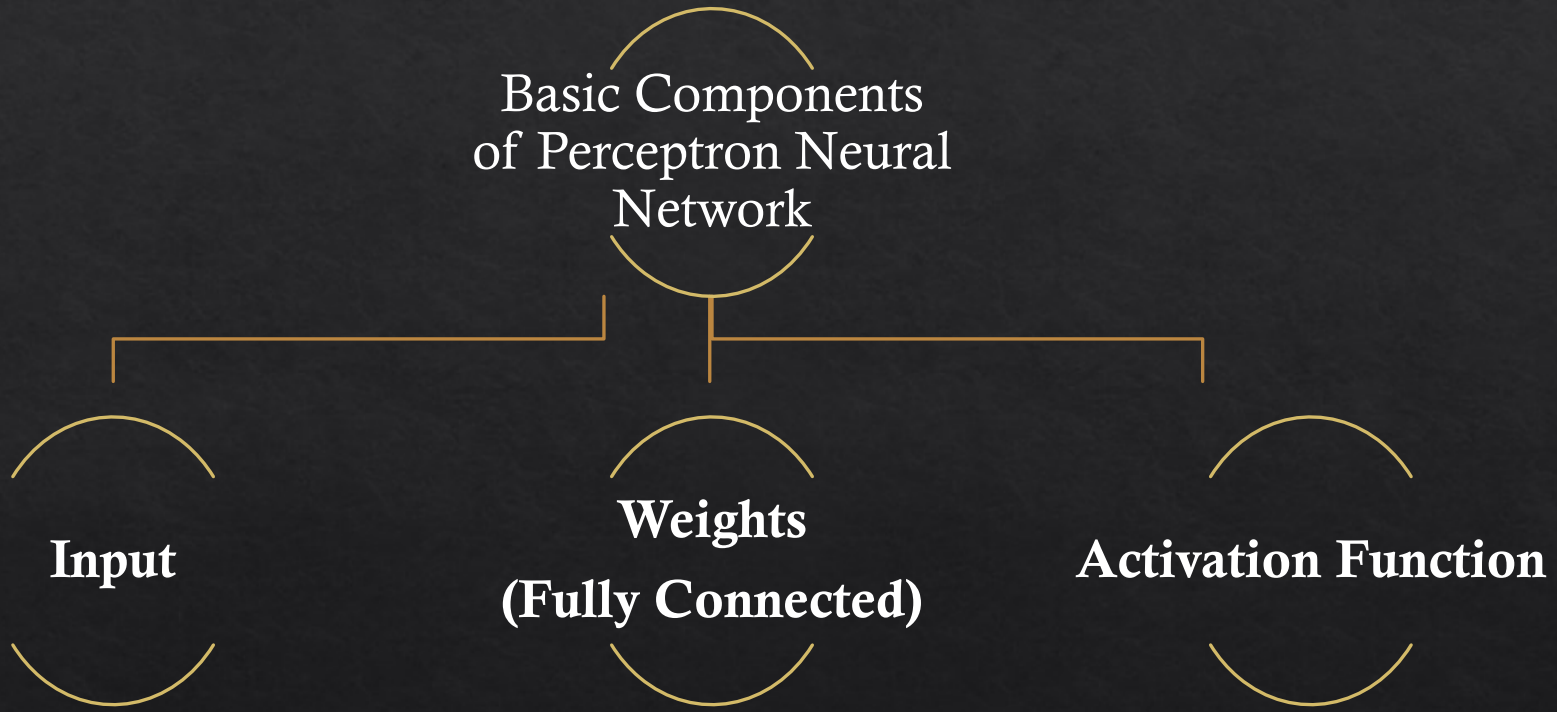


- The training of Neural Networks is based on optimizing weights.

- During training phase, the optimizing weights is conducted according to the Difference between the *[T]* and *[a]*

Artificial Neural Network

Basic Components of Perceptron Neural Network

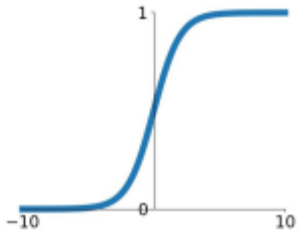


Artificial Neural Network

Activation Functions

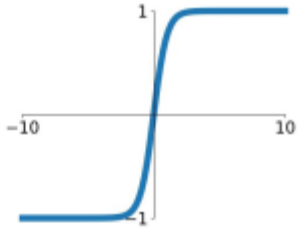
Sigmoid

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



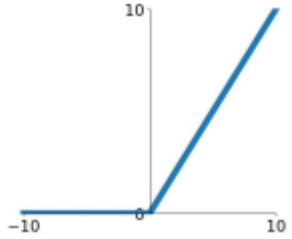
tanh

$$\tanh(x)$$



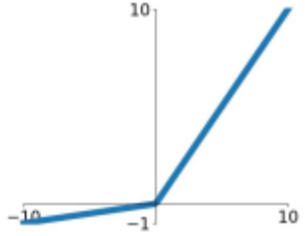
ReLU

$$\max(0, x)$$



Leaky ReLU

$$\max(0.1x, x)$$

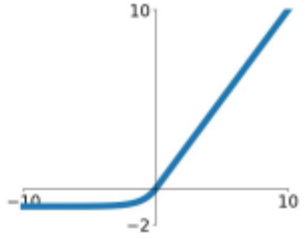


Maxout

$$\max(w_1^T x + b_1, w_2^T x + b_2)$$

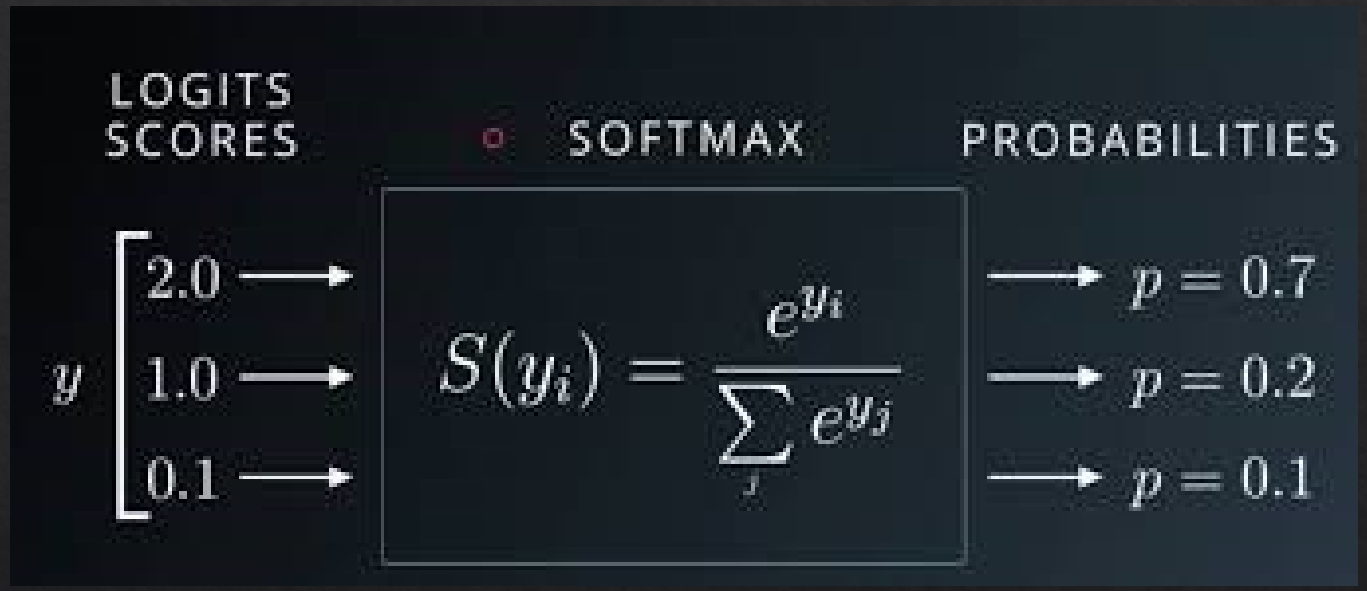
ELU

$$\begin{cases} x & x \geq 0 \\ \alpha(e^x - 1) & x < 0 \end{cases}$$



Artificial Neural Network

Activation Functions



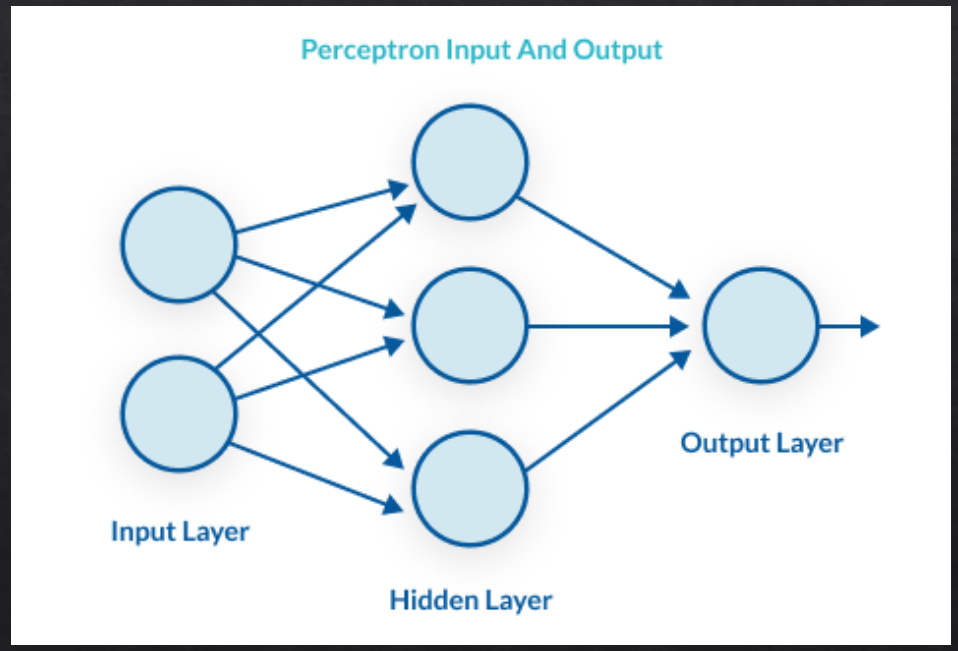
Artificial Neural Network

What is a layers in perceptron ?

- Input Layer: First Layer of the Network which receives an input sample.

- Output Layer: Last Layer of the Network which provides the output of the network.

- Hidden Layer: A layer consists of a Fully connected and activation function.



Perceptron vs Multi-layer perceptron

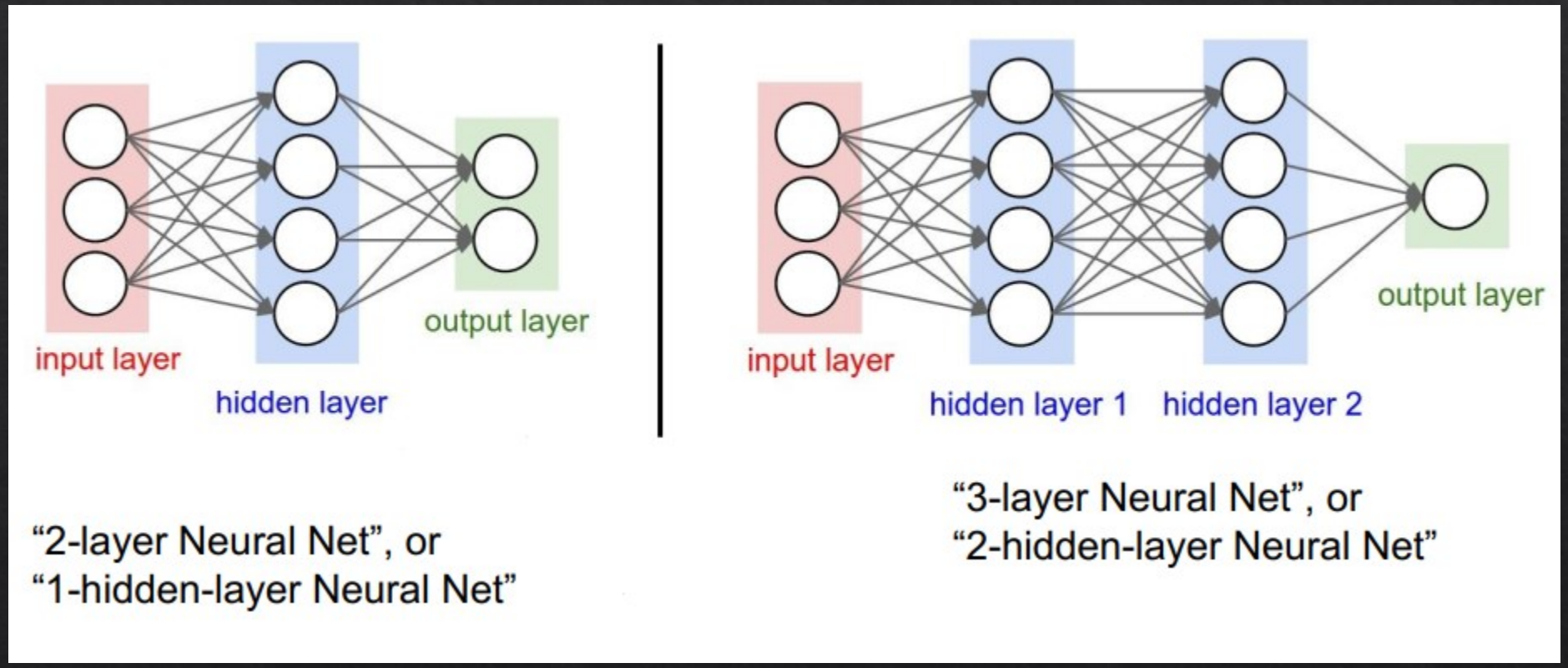
Perceptron

- **Just has a single hidden layer.**

Multi-layer Perceptron

- **It has multiple hidden layers.**

Perceptron vs Multi-layer perceptron



Multi-layer perceptron

How to train Multi-layer perceptron Neural Network

$[D]_{m\times n}$: ***Dataset Matrice***

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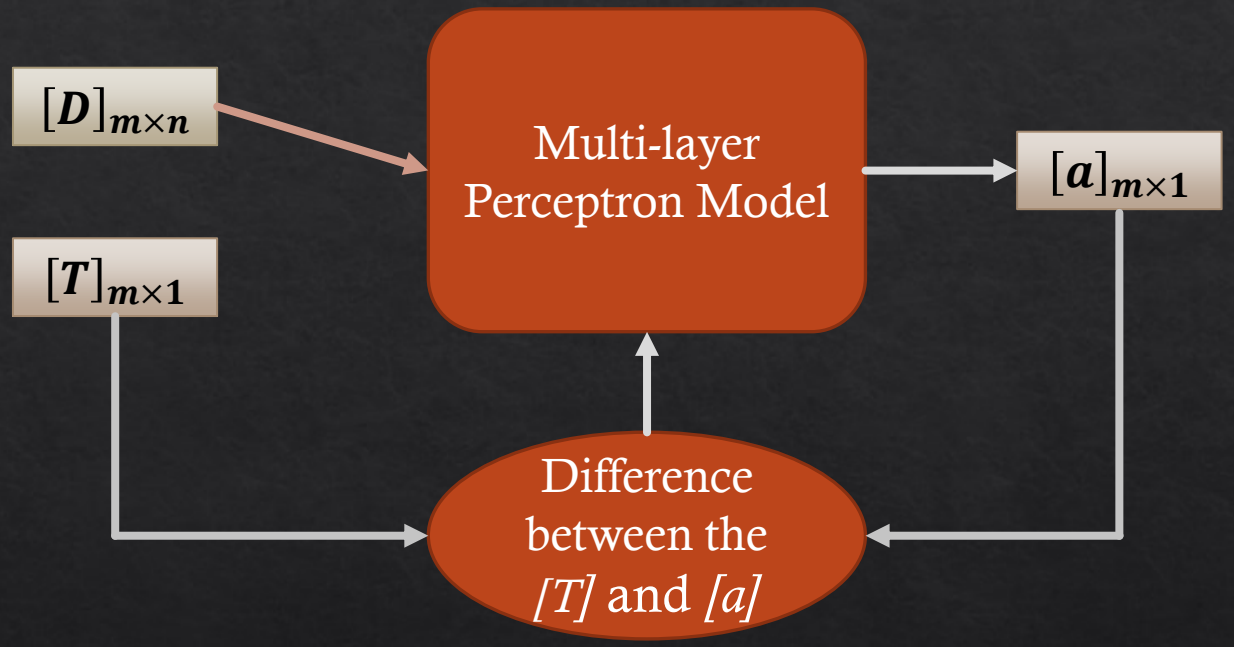

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Artificial Neural Network

Different Types of ANN

- Perceptron Neural Network
- Multi-layer Perceptron (MLP)
- Convolutional Neural Network (CNN)
- Recurrent Neural Network (RNN)
- Hopfield Neural Network
- Boltzman Machine