

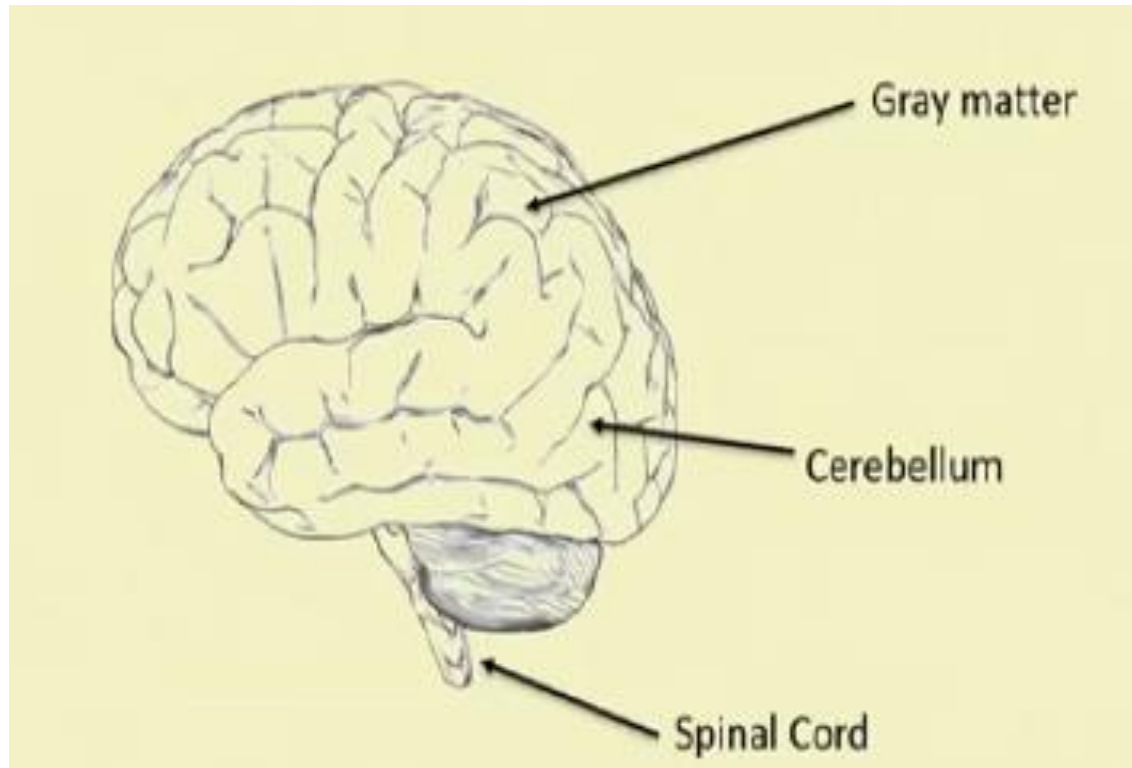
# Introduction to Neural Network.

Presented By

Prof Subash Ranjan Kabat

HoD,EE

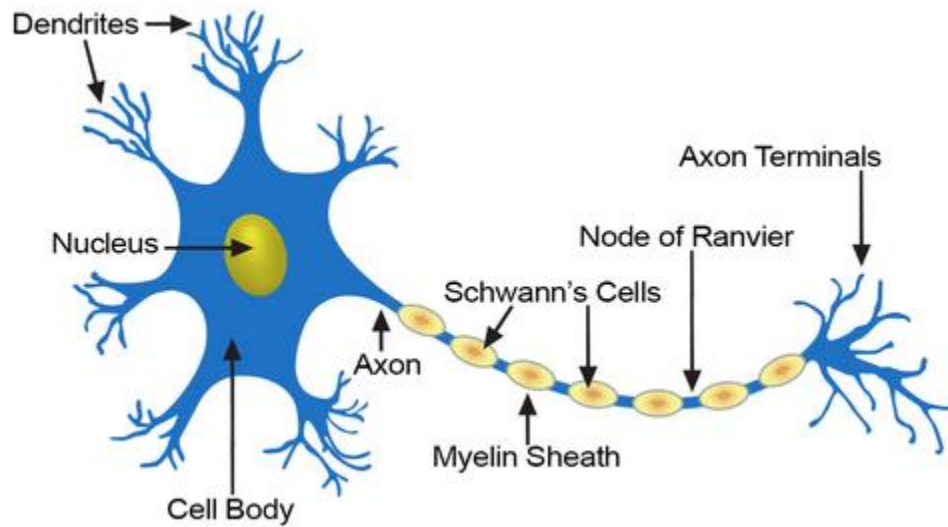
# Brain: Center of the Nervous System



# Biological Nervous System

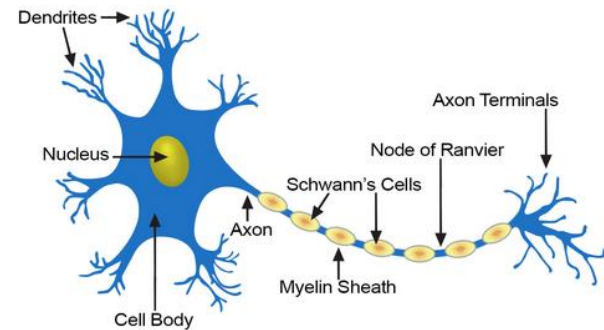
- Biological nervous system is the most important part of many living things particular human beings.
- There is a part called brain at the center of human nervous system.
- In fact ,any biological nervous system consists of a large no of interconnected processing units called neurons.
- Each neuron is approximately 10micro long and they can operate in parallel.
- Typically ,a human brain consists of of approximately  $10^{11}$  neurons communicating with each other with the help of electrical impulses.

# Neuron: Basic unit of nervous System



# Neuron and its working

- **Dendrite** : A bush of very thin fibre.
- **Axon** : A long cylindrical fibre.
- **Soma** : It is also called a cell body, and just like as a nucleus of cell.
- **Synapse** : It is a junction where axon makes contact with the dendrites of neighbouring dendrites.



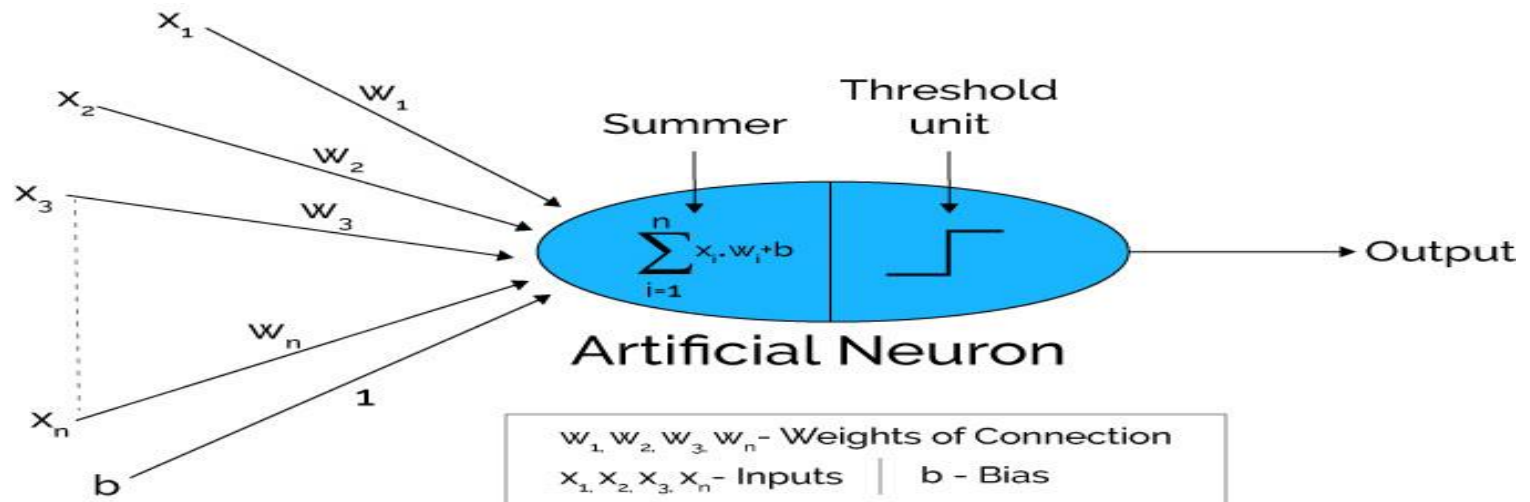
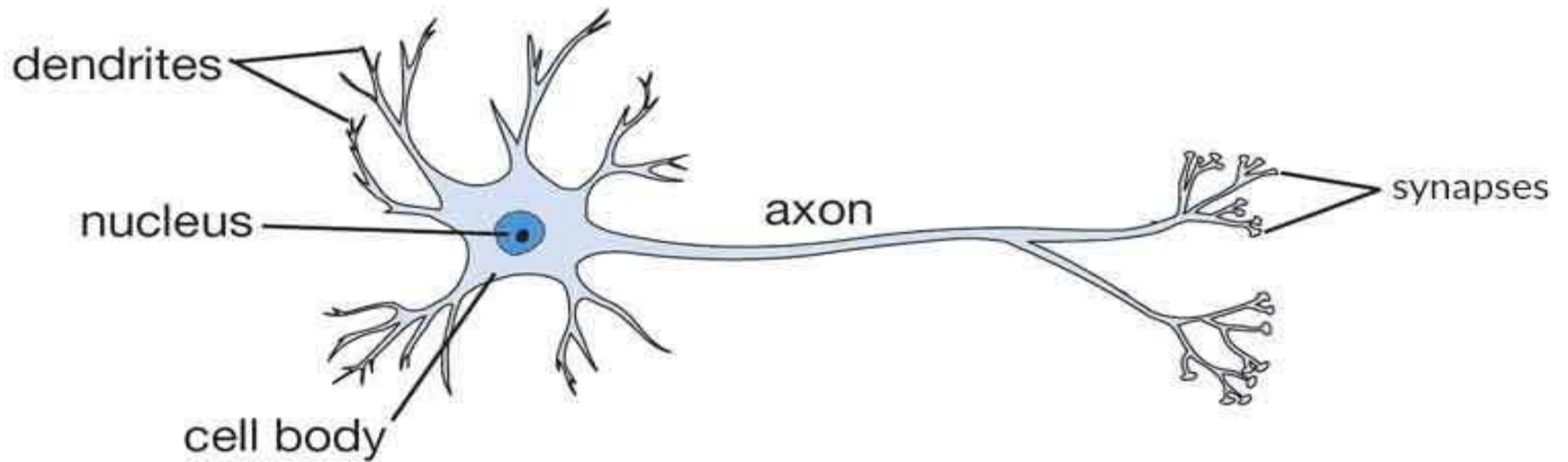
# Neuron and its working

- There is a chemical in each neuron called **neurotransmitter**.
  - A signal (also called sense) is transmitted across neurons by this chemical.
  - That is, all inputs from other neuron arrive to a neurons through dendrites.
  - These signals are accumulated at the synapse of the neuron and then serve as the output to be transmitted through the neuron.
  - An action may produce an electrical impulse, which usually lasts for about a millisecond.
  - Note that this pulse generated due to an incoming signal and all signal may not produce pulses in axon unless it crosses a **threshold value**.
  - Also, note that an action signal in axon of a neuron is **commutative signals** arrive at dendrites which summed up at soma.
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# Artificial Neural Network

- ❖ In fact the human brain is a highly complex structure viewed as a massive ,highly interconnected network of simple processing elements called neurons.
- ❖ ANN or NN which are simplified models of the biological nervous system and have been motivated by the kind of computing performed by the human brain.
- ❖ The behaviour of a biological neural network can be captured by a simple model called artificial neuron or perceptron.

# Biological Neuron





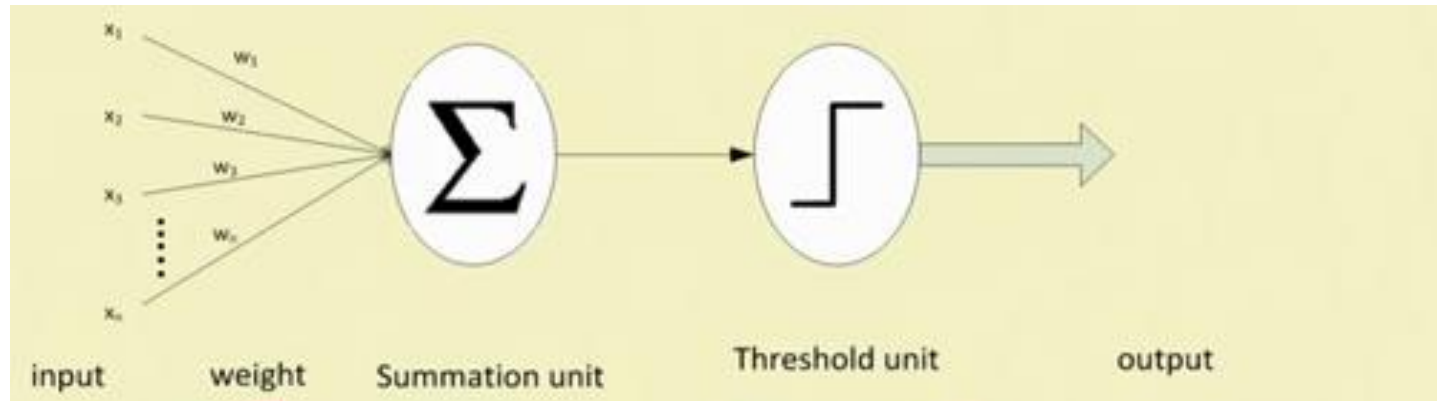
# Artificial neural network

We may note that a neuron is a part of an interconnected network of nervous system and serves the following.

- Compute input signals
- Transportation of signals (at a very high speed)
- Storage of information
- Perception, automatic training and learning

We also can see the analogy between the biological neuron and artificial neuron. Truly, every component of the model (i.e. artificial neuron) bears a direct analogy to that of a biological neuron. It is this model which forms the basis of neural network (i.e. artificial neural network).

# Artificial neural network



Here  $x_1, x_2, x_3, \dots, x_n$  are the  $n$  inputs to the artificial neuron.  
 $w_1, w_2, \dots, w_n$  are the weights attached to the inputs.

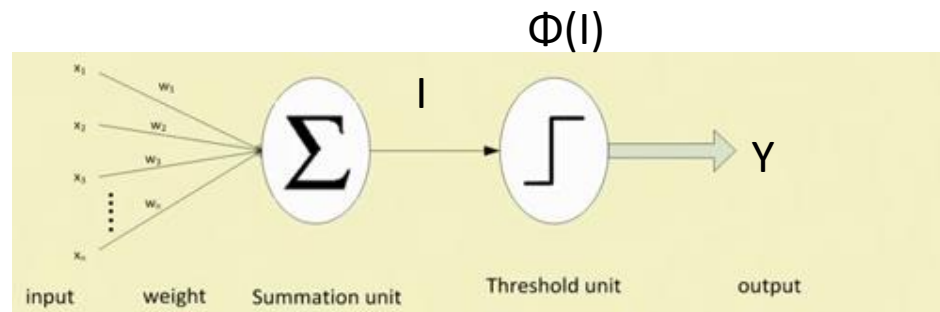
# Artificial neural network

Hence the total input  $I$  received by the soma of the artificial neuron is

$$I = W_1X_1 + W_2X_2 + \dots + W_nX_n$$

To generate the final output  $y$ , the sum is passed to a filter  $\phi$  called **transfer function**, which releases the output.

That is  $y = \phi(I)$



# Transformation functions

- **Hard-limit transfer function** : The transformation we have just discussed is called hard-limit transfer function. It is generally used in perception neuron.  
In other words,

$$\phi(I) = \begin{cases} 1 & ,if I > \theta \\ 0 & ,if I \leq \theta \end{cases}$$

- **Linear transfer function** : The output of the transfer function is made equal to its input (normalized) and its lies in the range of  $-1.0$  to  $+1.0$ . It is also known as **Signum or Quantizer function** and it defined as

$$\phi(I) = \begin{cases} +1 & ,if I > \theta \\ -1 & ,if I \leq \theta \end{cases}$$

# Examples



































