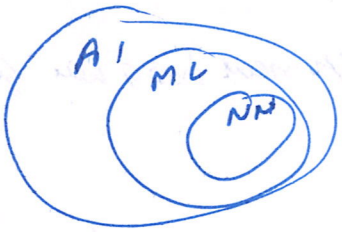


* NN are simplified models of the biological nervous system. is a massively parallel distributed processing system made up of high interconnected neural computing elements

ANS ANS OR NN

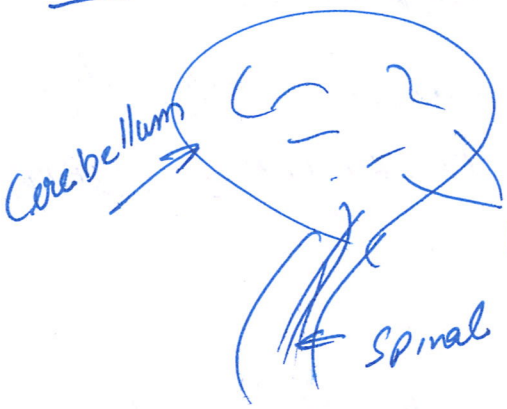
human Brain develops with time with experience

Stability & plasticity

↓ ↓

Preserve old experience adapt/learn new

Ramon Y Cajal (1911) made study of brain compared ears



→ Contains 10^{10} basic units called Neurons.

→ each neuron is connected to 10^4 other neurons.

→ Neuron is a small cell that receives electro-chemical signal from its various source & in turn response by transmit electric impulses to other neurons.

Brain avg wts $\simeq$ 1.5 kg & aver neur has a wt of 1.5×10^{-9} gm

Some neurons perfm input & output oper refer to as
(afferent) (efferent) cells

remains for a part of an interconnn networks of neurons.
→ signal Transformath.
→ storage. of info

Despite all this they share common characteristics.

Neuron

compose of a nucleus - a cell body known as SOMA
attached to the soma are long irregularly shaped filaments
called dendr DENDRITES (behave as inputs channels

→ all inf from other neuron comes through dendrites
→ form a tree struct like branch of trees.

AXON is electrically active & act as output channel
→ this is a non-linear threshold device which produce
voltage pulse called ACTION POTENTIAL or (SPIKE)
for less than millisec

If cummulat inputs received by soma raise the intern electr
potent (known as Membrane Potential) then neuron 'fires'
by propogat the actn potential down to axon. axon to
excite or inhibit other neurons.

Axon termina in a specialise contact called SYNAPSE (Synaptic junction) (where Axon connect with dendrites)

Synaptic gap is a very minut gap at the end of dendrit link contains neuro-transmitter fluid

↓

this fluid is responsible for accelerate or retarding the electric charges to the soma

Each DENDRITE can have many SYNAPTIC ~~JUNCTION~~ INPUTS. acting on it this brings massive inter connectivity.

IN GENERAN

A neuran can have many synaptic inputs & outputs

& the size of synapse are beliened to be related to learning

large Synaps → excits
small Synaps → inhibits
} beliened.

increased neuron activities though to be responsible for learning & memory.

Donald Hebb (1949) says that.

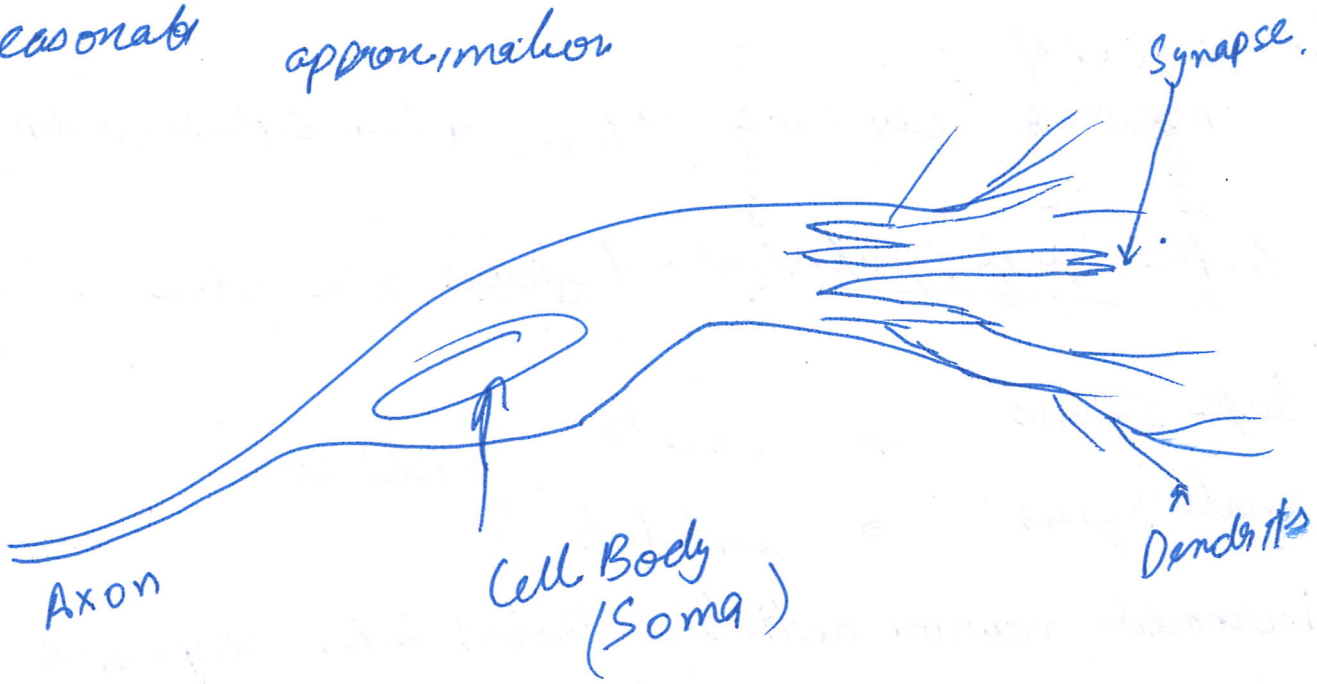
Neuron A ⟶ Neuron B
excites
repeatedly

then there are some metabolic changes in A & B that increase efficiency of A firing B.

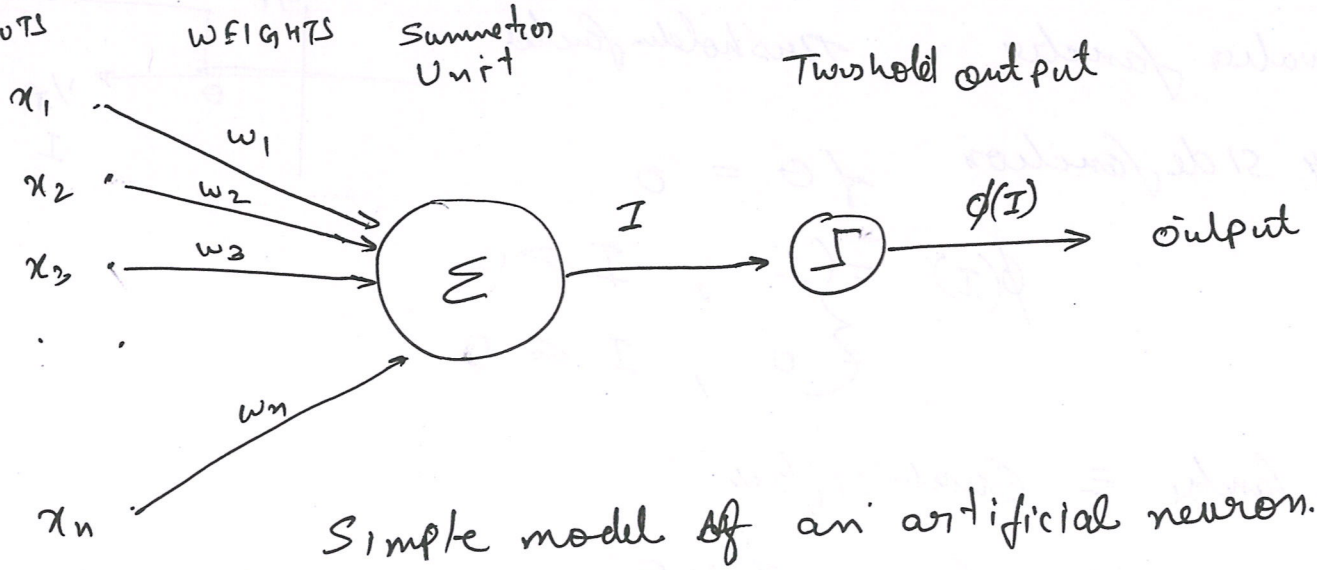
this observation branded as Hebbian learning has influenced many learning models.

Neural activity is quite complex but

~~Very~~ simple sum of inputs they receive is a reasonable approximation



Structure of a neuron.



Simple model of an artificial neuron.

Inputs through dendrites — Sum the & produce output at axon. if sum is greater than threshold val

accelerate / retard to of input signal is modelled by weights.

∴ Total input recen by the soma of AN is

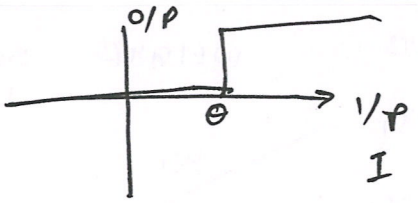
$$I = w_1 x_1 + w_2 x_2 \dots w_n x_n = \sum_{i=1}^{n} w_i x_i$$

Final output is sum passed to a non linear filter ϕ called activation function or Transfer function. or Squash function

Output of AN :

$$Y = \phi(I) = \phi\left(\sum_{i=1}^{n} w_i x_i\right)$$

Activation function Threshold function

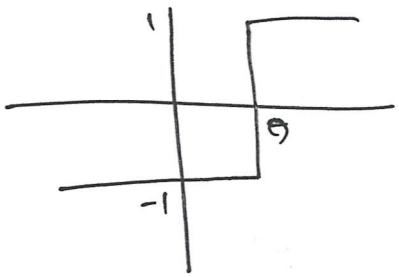


Heavy side function if $\theta = 0$

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

Signum function ≡ Quadratic fun

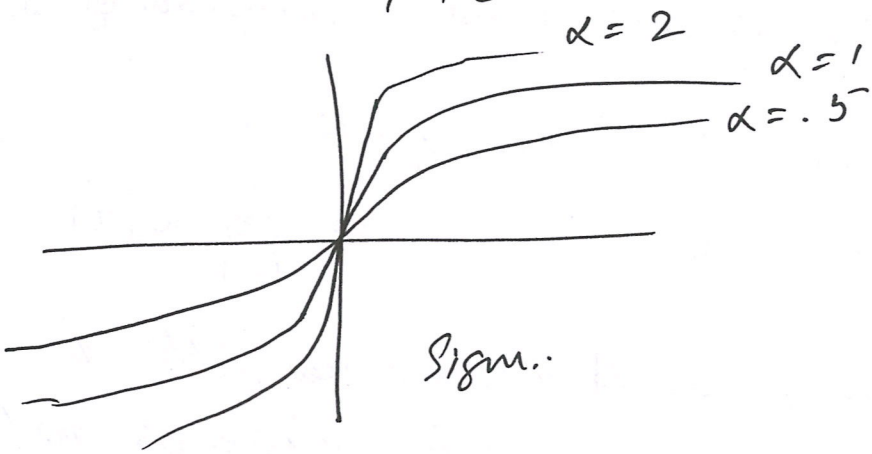
$$\phi(I) = \begin{cases} +1 , & I > \theta \\ -1 , & I \leq \theta \end{cases}$$



Sigmoid fun bet 0 & 1 or -1 & +1

$$\phi(I) = \frac{1}{1+e^{-\alpha I}}$$

α = slope.



Hyper Bolic fn $\phi I = \tanh(I)$

Relu Rectified Linear

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

Leaky Relu

$$\phi I = \begin{cases} I , & I > 0 \\ \alpha I , & I \leq 0 \end{cases}$$

α is very small.

Neural Network Architecture

data processing system consisting of large number of simple highly interconnected processing elements in an architecture inspired by studies of the cerebral cortex of the brain

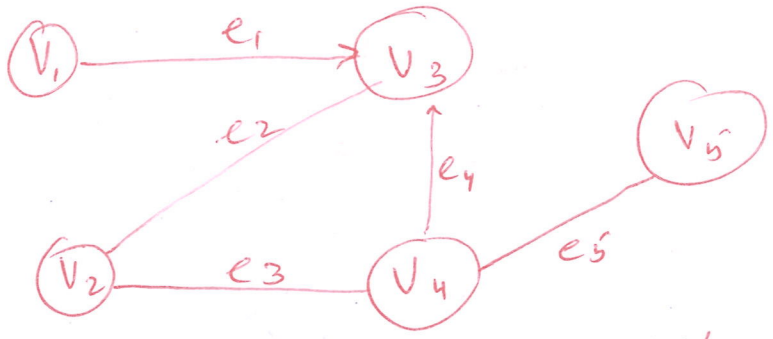
≡ ANN structure can be represented as a directed graph

A graph G is an ordered 2-tuple (V, E) consisting of
set V of vertices & set E of edges

each edge is assigned ~~direction~~ an orientation

Vertices of graph represent neuron (input/output) & the edges the synaptic links

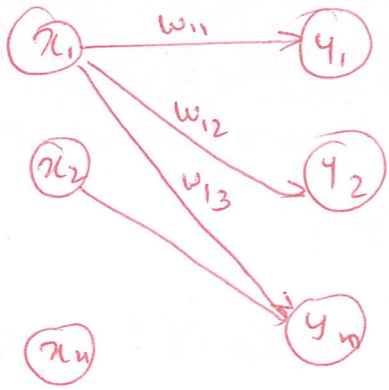
Edges are labelled by weight attached to synaptic links



We focus of 3 classes of NN

1. Single layer feed forward Nets
2. Multilayer feed forward Nets
3. Recurrent Neural Nets

Single layer feed forward network



I/P layer

O/P layer.

x_i : Input

y_j : Output neuron

w_{ij} : Weight

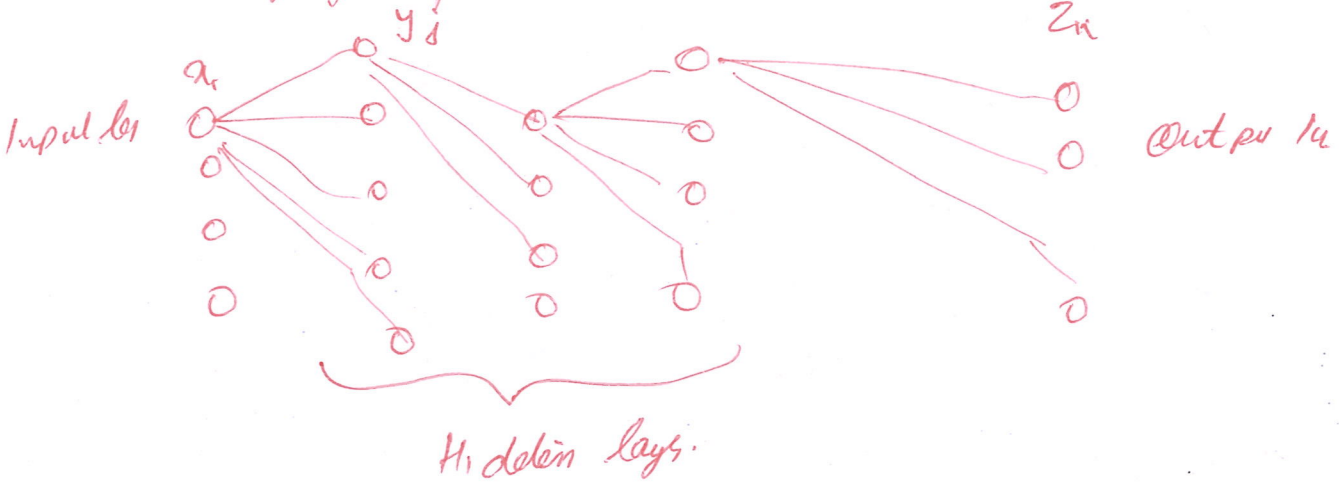
Input neuron

Output neuron.

⇒ only output layer is performing computation hence called Single layer

Fully connected ?

Multi layer feed forward Network



Recurrent Network (These have atleast one feedback loop

useful for:
time series data
audio / language