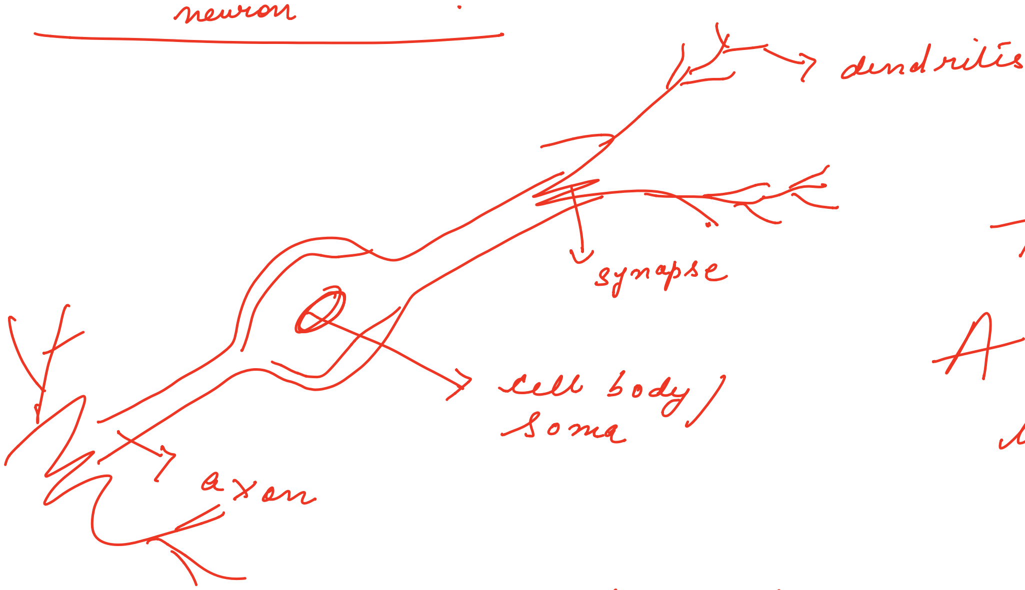
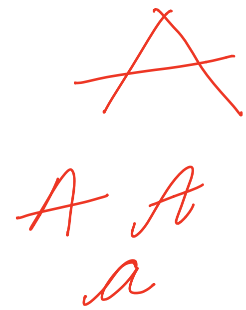
dec-24 05/03/21

Introduction to Neural Networks

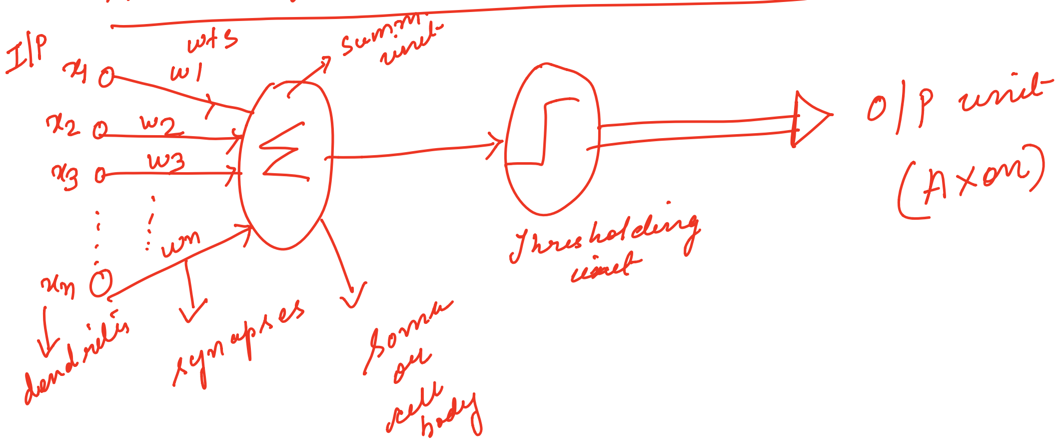
- → Introdn. to NN
- → standard activation functions
- → NN architectures
- → Learning paradigms.

Model of a biological neuron :





Model of an artificial neuron :



$x_1, x_2 \ldots x_n$ are n inputs to artificial neuron

$w_1, w_2 \ldots w_n$ are weights attached to input links

$$I = w_1 x_1 + w_2 x_2 + \dots + w_n x_n$$

$$= \sum_{i=1}^{n} w_i x_i$$

$$\boxed{Y = \phi(I)}$$

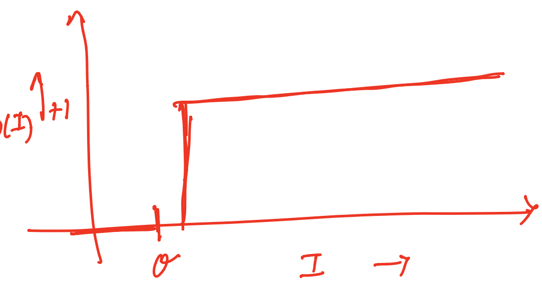
To generate the final o/p Y, the sum is passed to a non-linear filter ϕ which releases the o/p.

Standard activation functions :

1. Thresholding function :

If $I > \theta$ then $Y = 1$

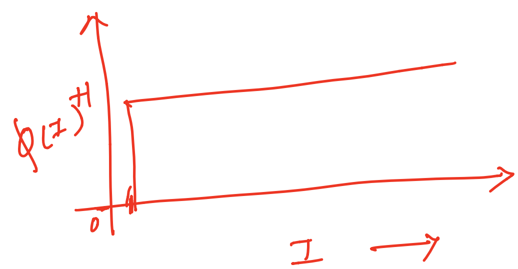
else $Y = 0$



2. Heaviside function :

If $I > 0$, then $\phi(I) = 1$

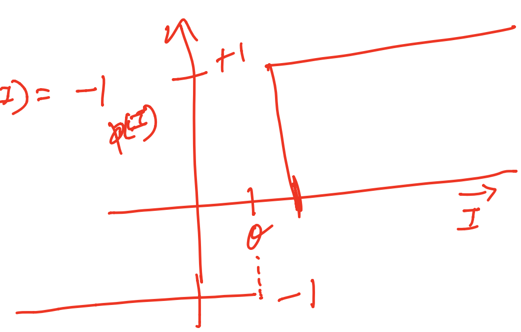
else $\phi(I) = 0$



3. signum function :

If $I > \theta$ then $\phi(I) = +1$

else (if $I \leq \theta$) then $\phi(I) = -1$



v.imp

4) Sigmoidal function :

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

$\lambda \to$ sigmoidal gain

* sigmoidal functions are differentiable.

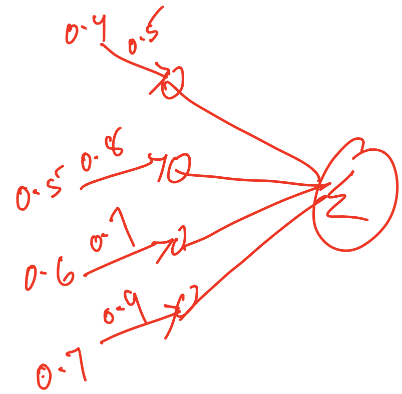
5] Hyperbolic tangent function :

$$\boxed{\phi(I) = \tanh(I)}$$

which can produce negative o/p values.

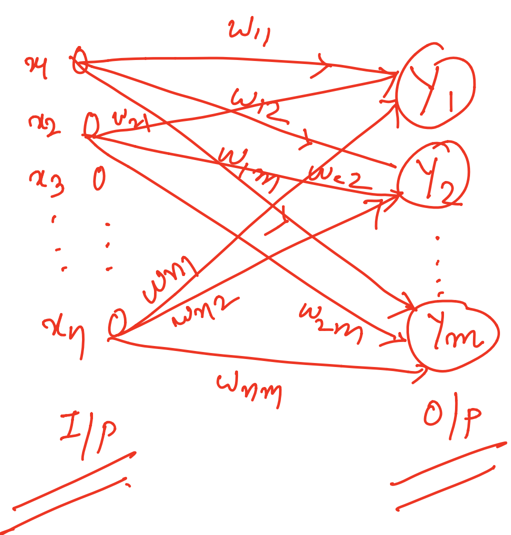
$f_1 \quad f_2 \quad f_3 \quad f_4$

$\langle 0.4 \quad 0.5 \quad 0.6 \quad 0.7 \rangle$

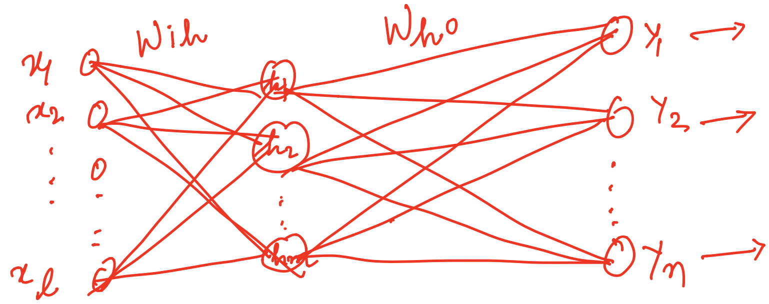


NN architectures :

- single layered feed forward NN
- multilayered feed forward NN
- recurrent NN.



2) multilayered FFNN :



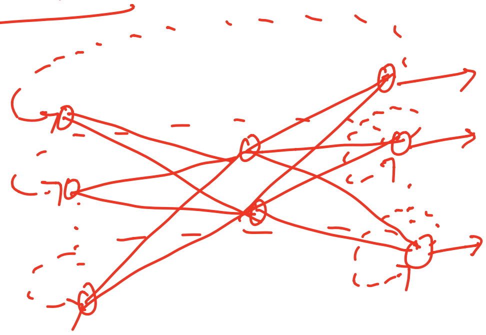
$$l \times m \times n$$

$C1 \rightarrow [1 \quad 0 \quad 0]$

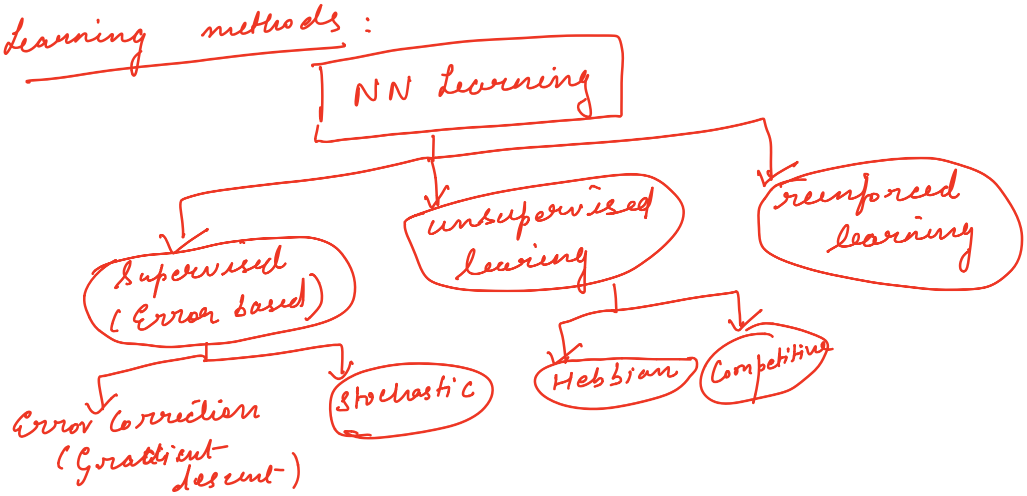
$C2 \rightarrow [0 \quad 1 \quad 0]$

$C3 \rightarrow [0 \quad 0 \quad 1]$

3) Recurrent NN :



Learning methods :



Least mean square

Back propagation

$\langle I/P \rangle \ldots\ldots \langle Target \rangle$

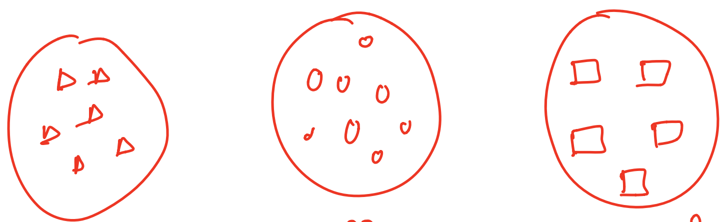
O/P label

O

T

$(T-O)^2 = Err$

$$\frac{\partial E}{\partial W}$$



C1 C2 C3