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CI Activity - 4

(Q1) Implement AND function using McCulloch-Pitts neuron.

x_1	x_2	y
1	1	1
1	0	0
0	1	0
0	0	0

Ans) Assume 2 weights $w_1 = w_2 = 1$ for i/p layer
Threshold value $= \theta$

$\Rightarrow \theta \geq nw - p$

$\theta \geq 2(1) - 0$

$\Rightarrow \theta \geq 2$

$\therefore$ Output of neuron will be :-

$$y = f(y_{in}) = \begin{cases} 1 & ; \text{if } y_{in} \geq 2 \\ 0 & ; \text{if } y_{in} < 2 \end{cases}$$

(Q2) Implement XOR function using McCulloch-Pitts neuron.

x_1	x_2	Y
0	0	0
0	1	1
1	0	1
1	1	0

Ans) Assume 2 weights $w_1 = w_2 = 1$ for the i/p layer

$$\therefore y_{in} = \bar{x}_1 x_2 w_1 + x_1 \bar{x}_2 w_2$$

Now, making net input for all neurons :-

x_1	w_1	x_2	w_2	y_{in}	y
0	1	0	1	0	0
0	1	1	1	1	1
1	1	0	1	1	1
1	1	1	1	0	0

In this case, $\theta \geq wn - p$

$\Rightarrow \theta \geq 1$

The output of neuron will be :-

$$y = f(y_{in}) = \begin{cases} 1 ; & \text{if } y_{in} \geq 1 \\ 0 ; & \text{if } y_{in} < 1 \end{cases}$$

(Q3) Design a hebb-net to implement logical AND function.

x_1	x_2	b	y
1	1	1	1
1	-1	1	-1
-1	1	1	-1
-1	-1	1	-1

Ans) Initially, set weights & bias to 0.

$w_1 = w_2 = b = 0$

First input $[x_1, x_2, b] = [1, 1, 1]$ & target $= 1$ i.e. $y = 1$

$w_i' = w_i + \Delta w_i$

$\Delta w_i = x_i y$

$\Rightarrow \Delta w_1 = x_1 y = 1 \cdot 1 = 1$

$\Delta w_2 = x_2 y = 1 \cdot 1 = 1$

$\Rightarrow \Delta b = y = 1$

$w_1' = w_1 + \Delta w_1 = 0 + 1 = 1$

$w_2' = w_2 + \Delta w_2 = 0 + 1 = 1$

$b' = b + \Delta b = 0 + 1 = 1$

Second i/p $[x_1, x_2, b] = [1, -1, 1]$ and $y = -1$

The weight change here is :—

$\Delta w_1 = x_1 y = 1 \cdot (-1) = -1$

$\Delta w_2 = x_2 y = (-1) \cdot (-1) = 1$

$\Delta b = y = 1$

New weights are :—

$w_1' = w_1 + \Delta w_1 = 1 + -1 = 0$

$w_2' = w_2 + \Delta w_2 = 1 + 1 = 2$

$b' = b + \Delta b = 1 - 1 = 0$

Similarly :—

I/P			Weight change				weights		
x_1	x_2	b	y	Δw_1	Δw_2	Δb	w_1	w_2	b
1	1	1	1	1	1	1	1	1	1
1	-1	1	-1	-1	1	-1	0	2	0
-1	1	1	-1	1	-1	-1	1	1	-1
-1	1	1	-1	1	1	-1	2	2	-2

(Q4) Design a Hebb-net to implement OR function.

x_1	x_2	b	y
1	1	1	1
1	-1	1	1
-1	1	1	1
-1	-1	1	-1

Ans) Set the weights & bias to zero.

$w_1 = w_2 = b = 0$

First input $[x_1, x_2, b] = [1, 1, 1]$ & target $y = 1$

Setting the initial weights as old weights & applying Hebb rule, we get :—

$$w_i' = w_i + \Delta w_i$$

$$\Delta w_i = x_i y$$

$$\Rightarrow \Delta w_1 = x_1 y = 1 \times 1 = 1$$

$$\Delta w_2 = x_2 y = 1 \times 1 = 1$$

$$\Delta b = y = 1$$

$$\Rightarrow w_1' = w_1 + \Delta w_1 = 0 + 1 = 1$$

$$\Rightarrow w_2' = w_2 + \Delta w_2' = 0 + 1 = 1$$

$$\Rightarrow b' = b + \Delta b = 0 + 1 = 1$$

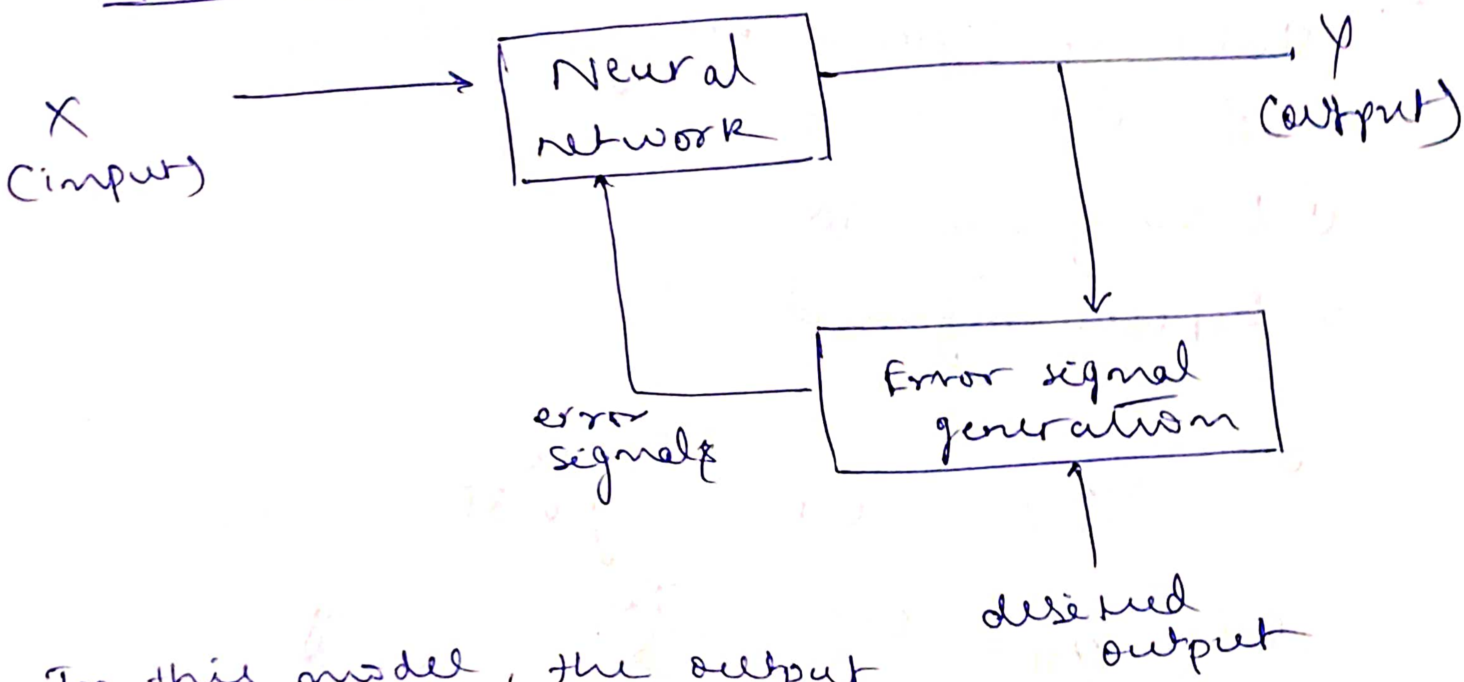
For second input :—

I/P				Weighted changes			Weights		
x_1	x_2	b	y	Δw_1	Δw_2	Δb	w_1	w_2	b
1	1	1	1	1	1	1	1	1	1
1	-1	1	1	1	-1	1	2	0	2
-1	1	1	1	-1	1	1	1	1	3
-1	-1	1	-1	1	1	-1	0	2	4

(Q5) What is the objective of learning? Explain the difference between supervised & unsupervised learning.

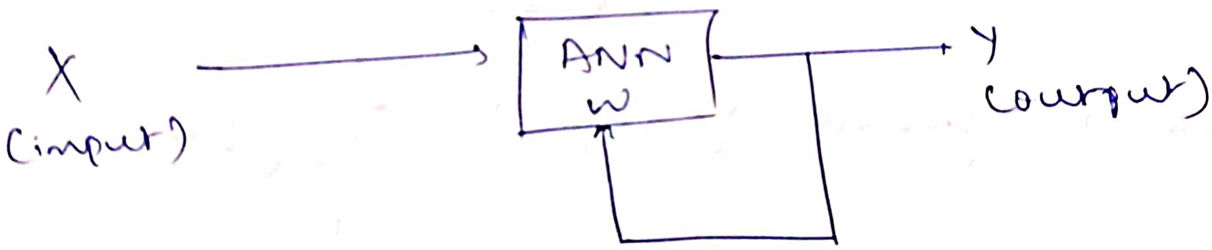
Ans) Learning is a process of training a neural network such that it adapts itself to a stimulus by making proper parameter adjustments resulting in the production of desired response.

Supervised learning :-



In this model, the output & input layers are precisely labelled & error is calculated as well as backpropagated to hidden layers on the basis of actual output.

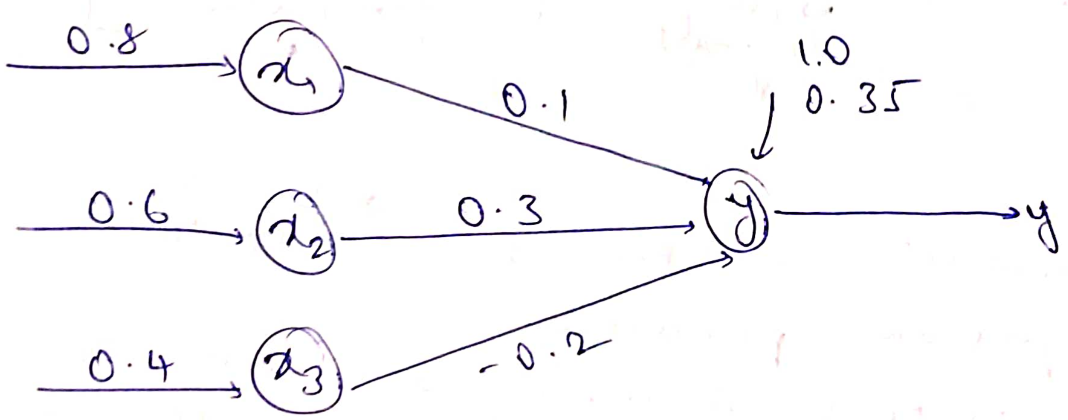
Unsupervised learning :-



In this model, input vectors of similar types are grouped without use of training data to specify how a member of each group looks or to which a member belongs.

(Q6) Obtain O/P of neuron Y for network shown in figure using activation function as :-

① Binary sigmoid
② Bipolar sigmoid



Ans) Net input, $y_{in} = b + x_1 w_1 + x_2 w_2 + x_3 w_3$

$= 0.35 + (0.8 \times 0.1) + (0.6 \times 0.3) + (0.4 \times (-0.2))$

$= 0.35 + 0.08 + 0.18 - 0.08$

$= 0.53$

① Binary sigmoid, $y = f(y_{in}) = \dfrac{1}{1+e^{-y_{in}}}$

$= \dfrac{1}{1+e^{-0.53}}$

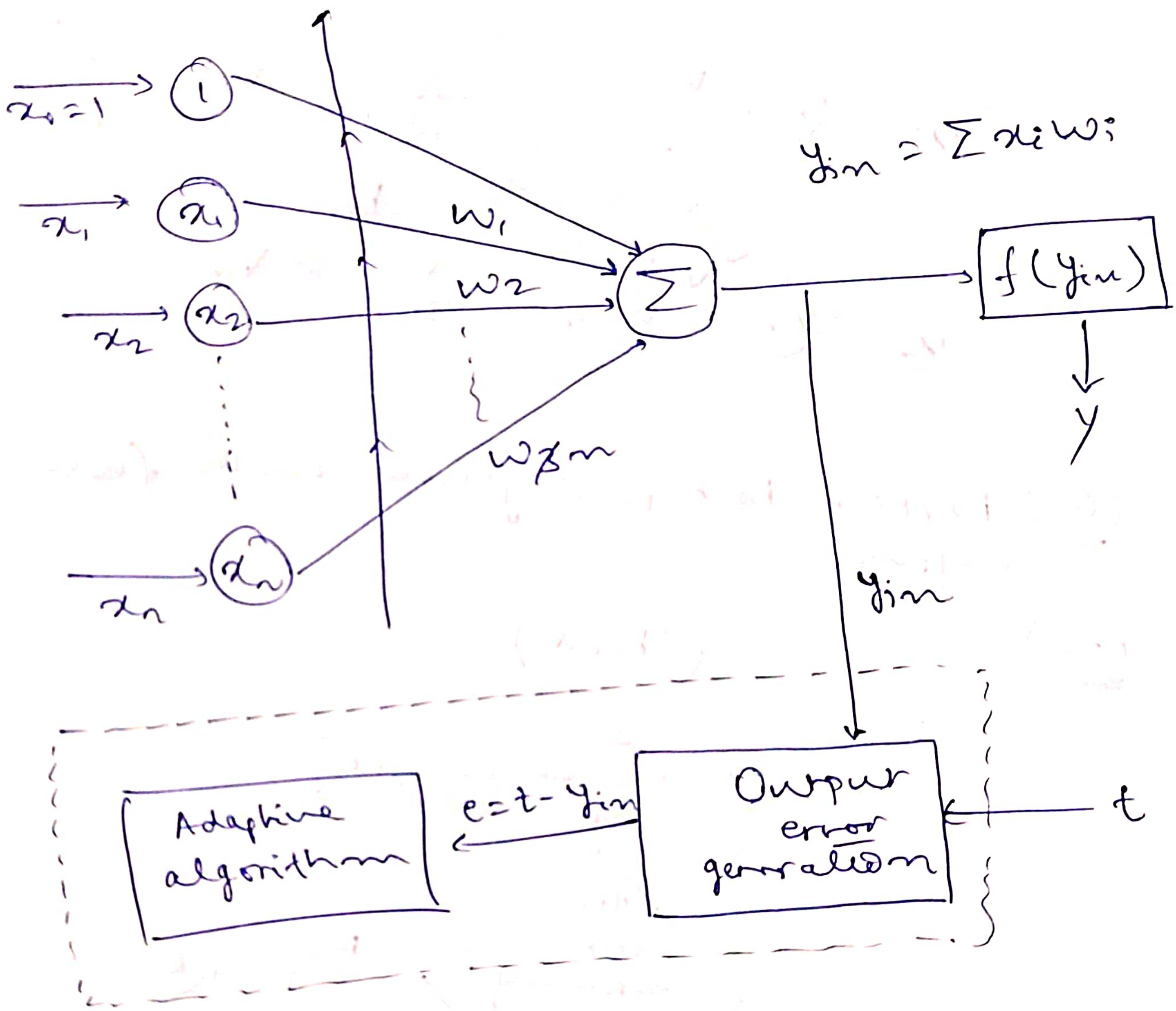
$\Rightarrow \quad y = 0.625$

② Bipolar sigmoid, $y = f(y_{in}) = \dfrac{2}{1+e^{-0.53}} - 1$

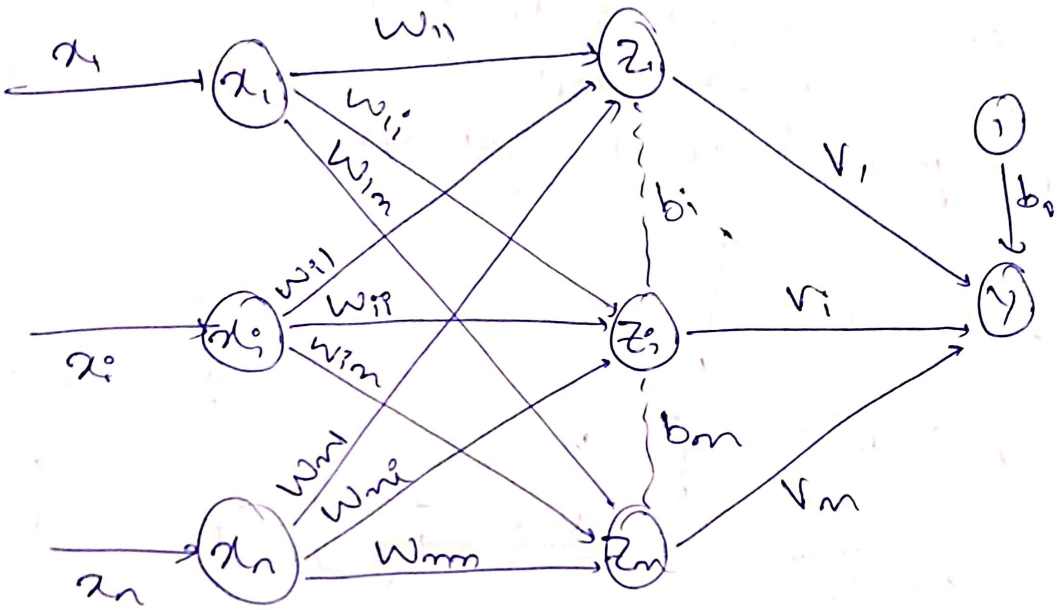
$= 0.259$

(Q7) Discuss adaline & madaline with their neural structure & flow diagram.

Ans) The units with linear activation function are called linear unity. A network with single linear unit is called adaline. Input output relationship is linear. It use bipolar activation for its i/p signals & its target o/p.

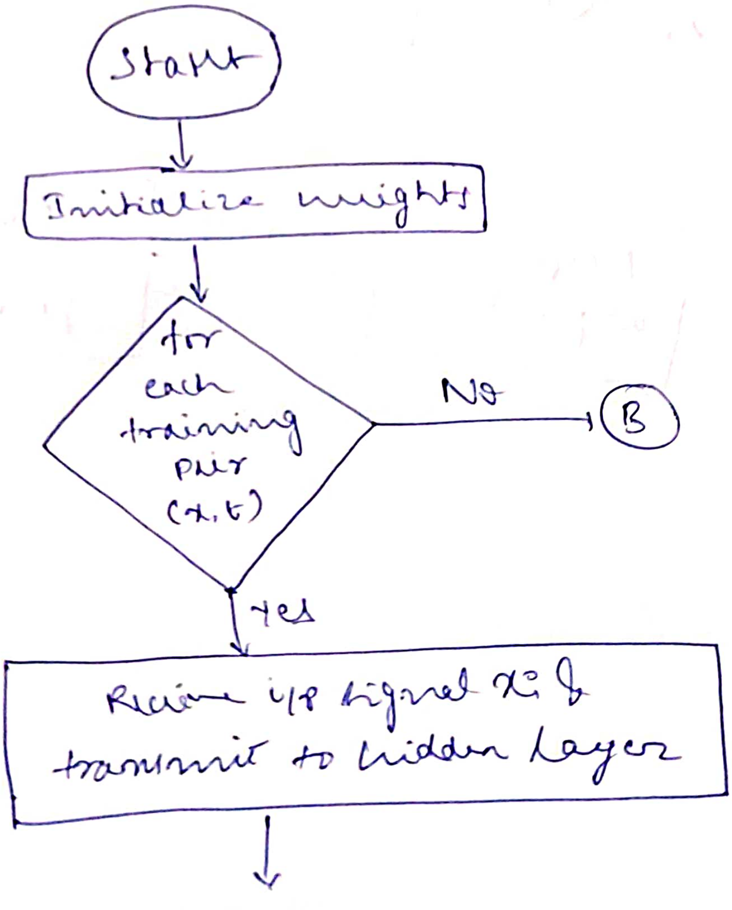


The madaline model consists of many adalines in parallel with a single output unit whose value is based on certain selection rules. It may use majority rule. On using this rule, the o/p would have either true or false.



(Q8) Explain back propagation with flow diagram.

Ans)



In hidden unit, calculate o/p $z_{in} = V_{0j} + \sum_{i=1}^{n} x_i V_{ij}$

$z_j = f(z_{inj})$ $j = 1$ to p, $i = 1$ to n

Send z_j to o/p layer unit

calc. o/p signal from o/p layer

$y_{ink} = W_{0k} + \sum_{i=1}^{n} z_j W_{jk}$

$y_k = f(y_{ink})$, $k = 1$ to m

Target pair t_k enters

A