Name = Praddyumn Wadekar
Class = BE comp SS
PRN = S1711038

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# SCOA Assignment - 03

Q1) Explain Hebb learning using example

→ Donald O. Hebb learning using an example to update the weights between neurons in neural network this method of weight updation enables neurons to learn which is named as Hebbian learning. According to the Hebb rule the weight vector is found to increase proportionally to the product of the input & output learning signal

$$w_i(new) = w_i(old) + x_i y$$

Example :-

Hebb network to implement Logic + function (bipolar inputs)

| $x_1$ | $x_2$ | b | y |
|---|---|---|---|
| 1 | 1 | 1 | 1 |
| 1 | -1 | 1 | -1 |
| -1 | 1 | 1 | 1 |
| -1 | -1 | 1 | -1 |

initially $w_1 = w_2 = b = 0$

first input = $[x_1 \ x_2 \ b] = [1 + 1]$

Target $f(-1) = 1$

$w_i(new) = w_i(old) + x_i y$

$b_i(new) = b_i(old) + y$

$w_i(new) = 0 + 1(1) = 1$

$w_2(new) = 0 + (1) = 1$

$b(new) = 0 + 1 = 1$

These weights will now be used as initial weights for the next input

Second input = $[x_1 \ x_2 \ b] = [1 \ -1 \ 1]$

Target = $-1$

$w_1(new) = (1) + 1(-1) = 0$

$w_2(new) = 1 - (-1) = 2$

$b(new) = 1 + (-1) = 0$

similar, processing all inputs

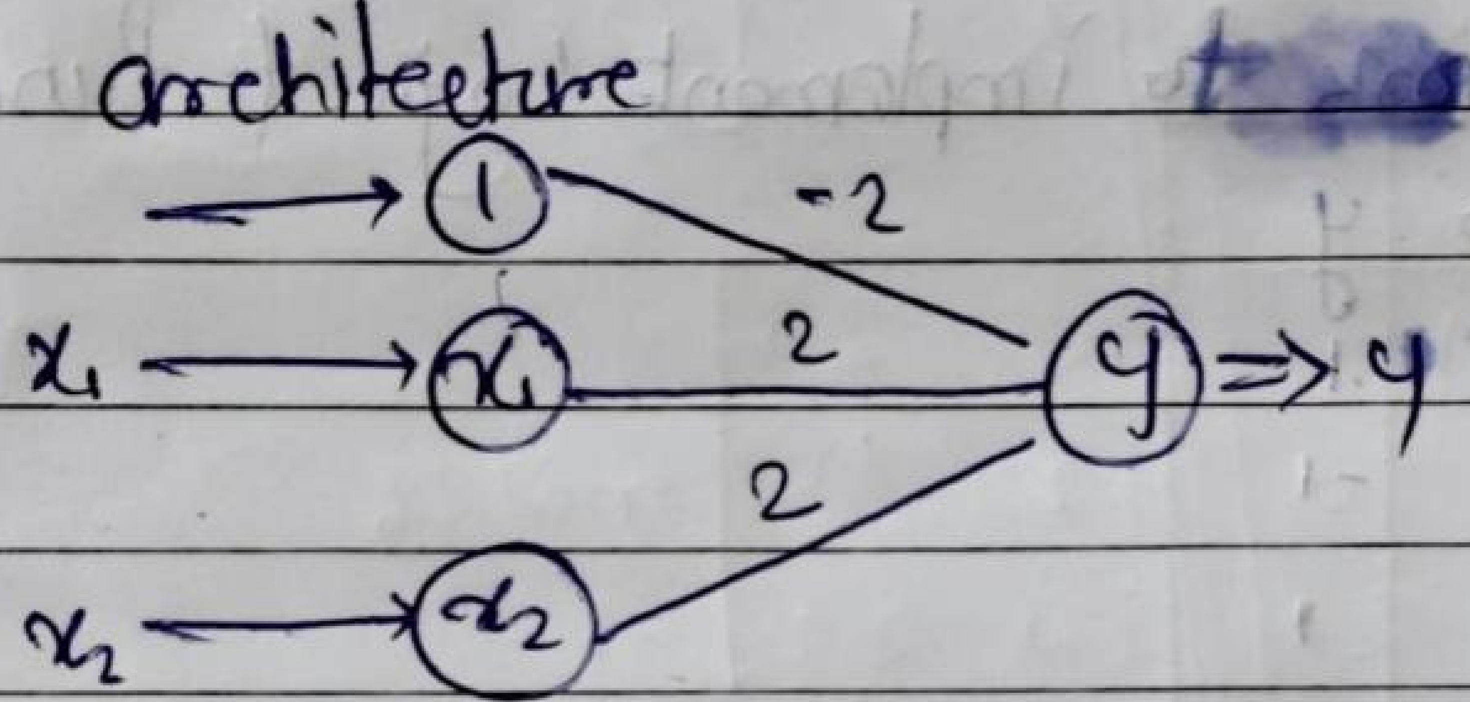
inputs

| $y$ | $x_1$ | $x_2$ | $b$ |
|---|---|---|---|
| 1 | 1 | 1 | 1 |
| -1 | 1 | -1 | 1 |
| -1 | -1 | 1 | 1 |
| -1 | -1 | -1 | 1 |

weights

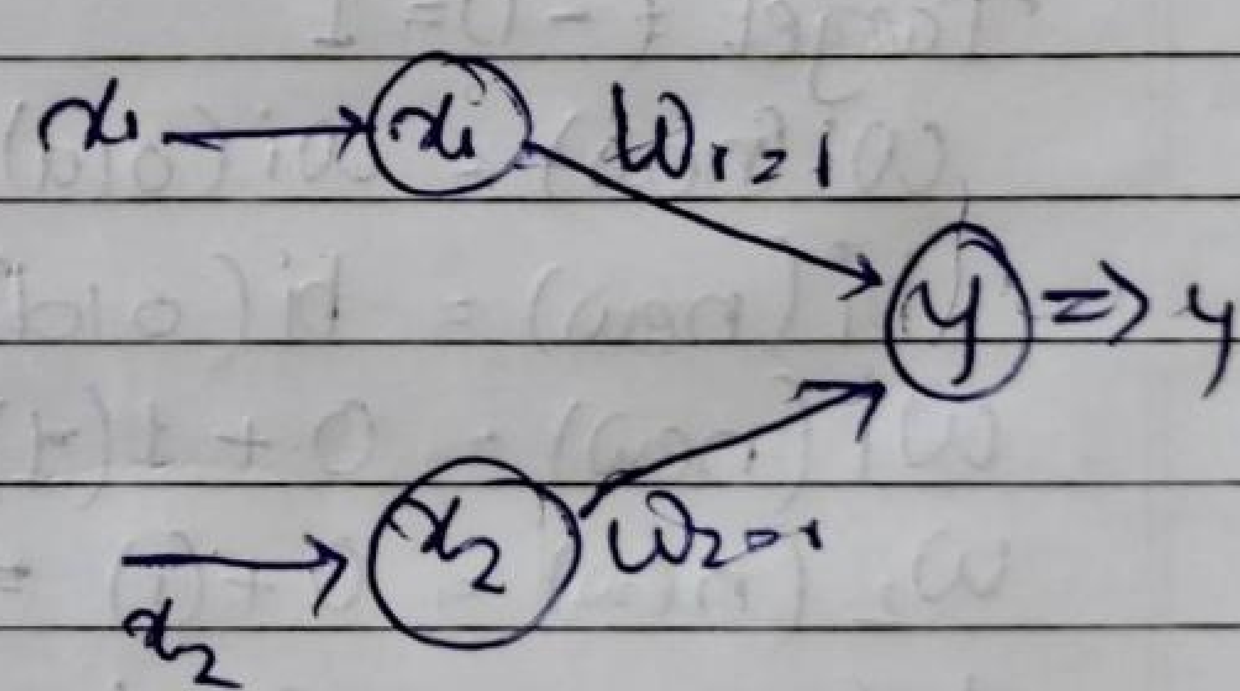
| $w_1$ | $w_2$ | $b$ |
|---|---|---|
| 1 | 1 | 1 |
| 0 | 2 | 0 |
| 1 | 1 | -1 |
| 2 | 2 | -2 |

final architecture




Q2) Explain McCulloch-pitts Neuron in breif by considering AND gate example

| $x_1$ | $x_2$ | $y$ |
|---|---|---|
| 1 | 1 | 1 |
| 1 | 0 | 0 |
| 0 | 1 | 0 |
| 0 | 0 | 0 |




In MP neuron, only analysis is being done

Assume $w_1 = 1$ & $w_2 = 1$

with these assumed weights, net input is calculated for 4 inputs

$(1,1)$ $y_{in} = x_1 w_1 + x_2 w_2 = 1(1) + 1(1) = 2$

$(1,0)$ $y_{in} = x_1 w_1 + x_2 w_2 = 1(1) + 0(1) = 1$

$(0,1)$ $y_{in} = 0(1) + 1(1) = 1$ ; $(0,0)$ in $y_{in} = 0(1) + 0(1) = 0$

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for AND function O/P is high if both inputs are high

$\therefore$ Net i/p calculate is 2

$\therefore$ Threshold = 2

$$\therefore \quad y = f(y_{in}) = \begin{cases} 1, & y_{in} \geq 2 \\ 0, & y_{in} < 2 \end{cases}$$

Q8] Implement AND function using McCulloch-Pits neuron?

$\rightarrow$ As we know the ~~the~~ truth table of AND function There fore in AND function, the output will be High or 1, if both inputs are high.

- Truth Table of AND function

| $x_1$ | $x_2$ | $y$ |
|---|---|---|
| 1 | 0 | 0 |
| 1 | 1 | 1 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |

- lets assume two weights $\omega_1 = \omega_2 = 1$ for the inputs

- Calculating Net Input :-

$$y_{in} = x_1 * W_1 + x_2 * \omega_2$$

So based on above formula we are going to calculate Net Input

| $x_1$ | $\omega_1$ | $x_2$ | $\omega_2$ | $y_{in}$ | $y$ |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 2 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 | 0 |

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- Calculate threshold value :-

$$\theta \geq nw - p$$

n = number of inputs
w = positive weights
p = negative weights

So threshold value will be $\theta \geq 2 \times 1 - 1$, $\theta \geq 2$

- Defining activation function

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

$[\theta \geq 2]$

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