Multilayer Perceptron:-

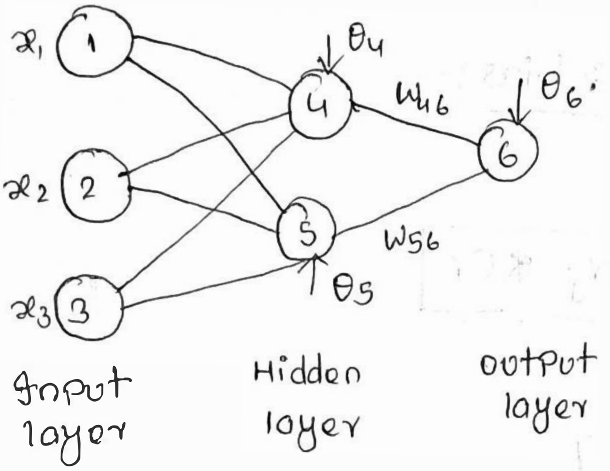
→ Multilayer Perceptron have been applied to solve difficult

→ It Consists three layers.

⇒ Input layer

⇒ one or more hidden layer

⇒ Output layer



Algorithm:-

Step-1:- Initialize weights & thresholds set all weights and thresholds to small random value.

Step-2:- Present the input & the desired output

Input $X_p = X_0, X_1, X_2, \ldots X_{n-1}$ 'n' is the no. of input nodes.

Target output $= t_0, t_1, t_2, \ldots t_{m-1}$ 'm' is the no. of o/p nodes.

Set w_0 is $-\theta$ called bias and x_0 is always +1 active neuron.

Step-3:-

Calculate the actual output

$$O_j = \frac{1}{1+e^{-ij}}$$

and Passes that as input to the next layer the final layer o/p values O_{pj}

Error Calculation: Hidden layer

$$\boxed{Err = O_j (1 - O_j) \sum_K err_K \cdot w_{jK}}$$

Input $I_j = \sum_i w_{ij} x_i + \theta_i$

Error of Output layer

$$Err_j = O_j (1 - O_j)(T_j - O_j)$$

Updation of weight & bias :-

weight updation

$$\boxed{w_{ij} = W_{ij} + l * err_j * O_i}$$

Bias updation

$$\boxed{\theta_j = \theta_j + l * err_j}$$

Multilayer Perception

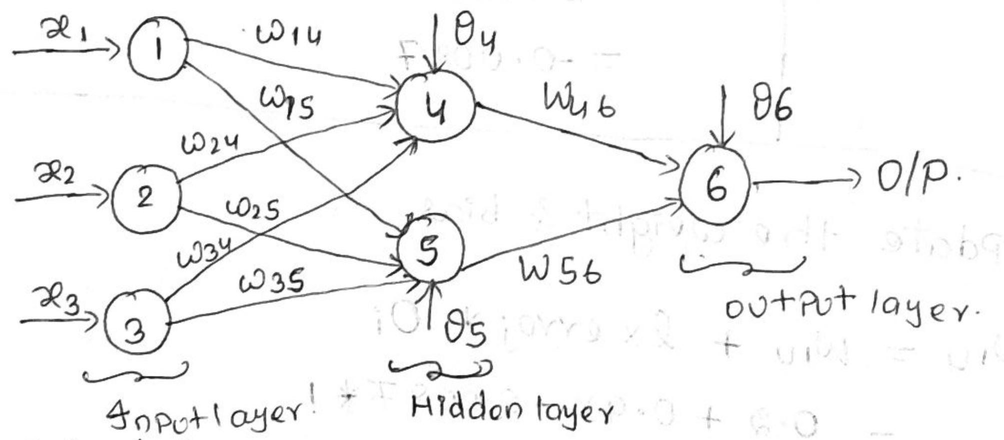
→ Consider the following multilayer feed forward neural network. Let the Learning rate is 0.9.
Initial input, weights, bias value are given in the table.

x_1	x_2	x_3	w_{14}	w_{15}	w_{24}	w_{25}	w_{34}	w_{35}	w_{46}	w_{56}	θ_4
1	0	1	0.2	-0.3	0.4	0.1	-0.5	0.2	-0.3	-0.2	-0.4

θ_5	θ_6
0.2	0.1

Training tuple is (1,0,1) - Target value is '1'

Sol



Sol Calculate the input & output.

Unit	Input	Output
4	$w_{14} \times x_1 + w_{24} \times x_2 + w_{34} \times x_3 + \theta_4 \times \text{Target}$ $\Rightarrow 1 \times 0.2 + 0 \times 0.4 + 1 \times -0.5 - 0.4 \times 1 = -0.7$	$\Rightarrow \frac{1}{1+e^{-ij}}$ $\Rightarrow \frac{1}{1+e^{0.7}} = 0.332$
5	$\Rightarrow w_{15} \times x_1 + w_{25} \times x_2 + w_{35} \times x_3 + \theta_5 \times \text{Target}$ $\Rightarrow 1 \times -0.3 + 0 \times 0.1 + 1 \times 0.2 + 0.2$ ~~$+\theta_6 \times \text{Target}$~~ $\Rightarrow 0.1$	$\Rightarrow \frac{1}{1+e^{-0.1}} = 0.525$
6	$\Rightarrow w_{46} \times Out_4 + w_{56} \times Out_5 + Tar \times \theta_6$ $\Rightarrow 0.332 \times -0.3 + 0.525 \times -0.2 + 0.1$ $\Rightarrow -0.105$	$\Rightarrow \frac{1}{1+e^{0.105}} = 0.474$

* Calculate the error rate

unit	Error rate calculation
6	$Err_j = O_j(1-O_j)(Tar_j - O_j)$ $= 0.474(1-0.474)(1-0.474)$ $= 0.1311$
5	$Err = O_j(1-O_j)\sum err_k \cdot w_{ik}$ $= 0.525(1-0.525) * 0.1311 \times -0.2$ $= -0.0065$
4	$Err = O_j(1-O_j)\sum err_k \cdot w_{ik}$ $= 0.332(1-0.332) * 0.1311 \times -0.3$ $= -0.0087$

* update the weight & bias

$W_{14} = W_{14} + l \times erro_j * O_i$

$= 0.2 + 0.9 \times -0.0087 * 1$

$= 0.192$

$W_{15} = W_{15} + l \times error_j * O_i$

$= -0.3 + 0.9 * -0.0065 * 1$

$= -0.306$

$W_{24} = W_{24} + l \times error_j * O_i$

$= 0.4 + 0.9 \times -0.0087 \times 0$

$= 0.4$

$W_{25} = 0.1 + 0.9 \times -0.0065 \times 0$

$= 0.1$

$W_{34} = -0.5 + 0.9 \times -0.0087 \times 1$

$= -0.508$

$w_{35} = 0.2 + 0.9 \times -0.0065 \times 1$

$= 0.194$

$w_{46} = -0.3 + 0.9 * 0.1311 \times 0.332$

$= -0.138$

$w_{56} = -0.2 + 0.9 \times 0.1311 \times 0.525$

$= 0.192$

<u>Bias</u>

$\theta_6^- = \theta_6 + l * err_j$

$= 0.1 + 0.9 * 0.1311$

$= 0.218$

$\theta_5 = \theta_5 + l \times err_j$

$= 0.2 + 0.9 \times -0.0065$

$= 0.194$

$\theta_4 = \theta_5 + l \times err_j$

$= -0.4 + 0.9 \times -0.0087$

$= -0.408$

Thus the weight & θ values are updated.