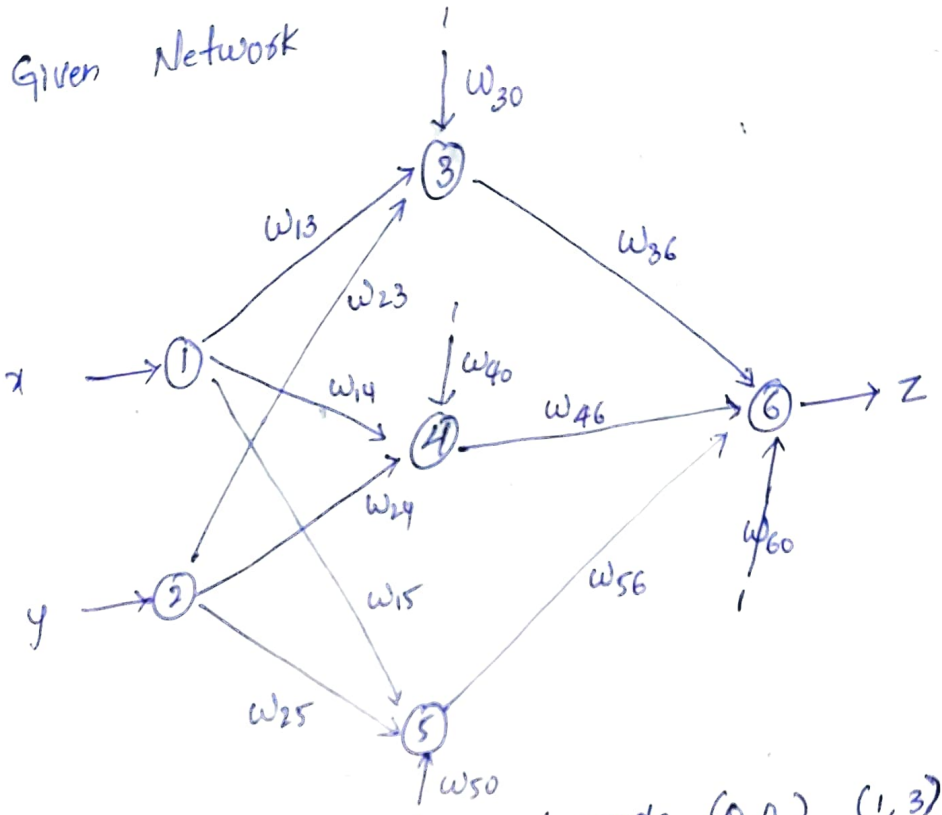
# Group 55 - Assignment 1 - Problem 2

Given Network



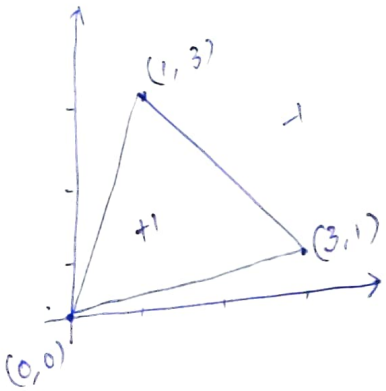

Given Vertices of the triangle (0,0), (1,3), (3,1)

Equations of lines passing through these points

(0,0) & (3,1) $\Rightarrow$ $x - 3y = 0$ $\rightarrow$ ①

(0,0) & (1,3) $\Rightarrow$ $3x - y = 0$ $\rightarrow$ ②

(3,1) & (1,3) $\Rightarrow$ $x + y - 4 = 0$ $\rightarrow$ ③




Points inside triangle are considered of class 1 and Points on and outside triangle are class -1.

Input for node 3 is

$$w_{13}x + w_{23}y + w_{30}(1) \rightarrow (4)$$

for node 4 $\Rightarrow$ $w_{14}x + w_{24}y + w_{40}(1) \rightarrow (5)$

for node 5 $\Rightarrow$ $w_{15}x + w_{25}y + w_{50}(1) \rightarrow (6)$

Comparing equations (1) (2) & (3) with (4), (5) and (6) respectively

$w_{13} = 3$, $w_{23} = -1$, $w_{30} = 0$

$w_{14} = 1$, $w_{24} = -3$, $w_{40} = 0$

$w_{15} = 1$, $w_{25} = 1$, $w_{50} = -4$

If a point lies inside the triangle then the point should lie above the line $x - 3y = 0$ and below the lines $x + y - 4 = 0$, $3x - y = 0$.

We have, a point $A(x_1, y_1)$ is above a line $ax + by + c = 0$ if,

(i) $ax_1 + by_1 + c > 0$ and $b > 0$

(ii) $ax_1 + by_1 + c < 0$ and $b < 0$

a point $A(x_1, y_1)$ is below a line $ax + by + c = 0$ if,

(i) $ax_1 + by_1 + c < 0$ and $b > 0$

(ii) $ax_1 + by_1 + c > 0$ and $b < 0$

Hence, for a

Point inside a triangle, it should be ① below

$3x - y = 0$ ⇒ output of node 3 should be $> 0$

since $b < 0$

② above $x - 3y = 0$ ⇒ output of node 4 should be $< 0$

since $b < 0$

③ below $x + y - 4 = 0$ ⇒ output of nodes should be $< 0$

since $b > 0$

we considered Signum functions as activation functions at nodes 3, 4, 5 & 6.

Hence we get

$$w_{36} = 1, \quad w_{46} = -1, \quad w_{56} = -1$$

to make outputs of nodes 3, 4, 5 +ve, -ve and -ve respectively.

Input to node 6 is $f_3 w_{36} + f_4 w_{46} + f_5 w_{56} + w_{60}$

This equation is greater than 0 for point inside triangle.

$$f_3 w_{36} + f_4 w_{46} + f_5 w_{56} + w_{60} > 0$$

$$1 \times 1 + (-1)(-1) + (-1)(-1) + w_{60} > 0$$

$$w_{60} > -3$$

Considering $W_{60}$ to be $-2$.

Here are the final weights.

$W_{13} = 3$ $W_{14} = 1$ $W_{15} = 1$ $W_{36} = 1$

$W_{23} = -1$ $W_{24} = -3$ $W_{25} = 1$ $W_{46} = -1$

$W_{30} = 0$ $W_{40} = 0$ $W_{50} = -4$ $W_{56} = -1$

$W_{60} = -2$