# Kohonen Self Organizing Map

## Algorithm.

1) Initialize the weights $w_{ij}$ to random values. & assume the learning rate $\alpha$.

2) Calculate the square of the Euclidian distance for each $j = 1$ to $m$

$$D(j) = \sum_{i=1}^{n} \sum_{j=1}^{m} (x_i - w_{ij})^2$$

3) Find the winning vector / unit $j$, sothat $D(j)$ is the minimum for that i/p vector.

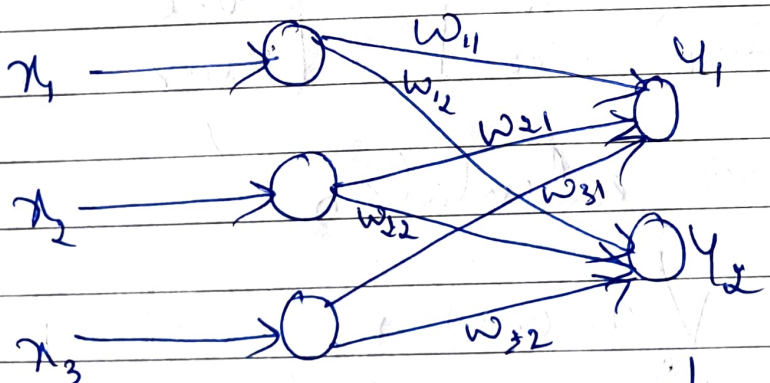
4) Adjust the weights for all $i$ units within a specific neighbahood of $j$ & for all $i$.

$$w_{ij}(n) = w_{ij}(o) + \alpha (x_i - w_{ij}(o))$$

5) Update the learning rate $\alpha$ using the formula

$$\alpha(t+1) = 0.5\, \alpha(t)$$

$t \rightarrow$ : iteration



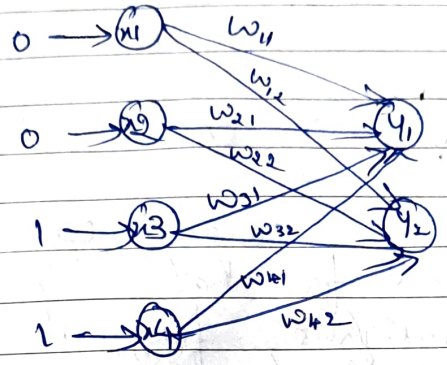

i/p layer

o/p layer / cluster layer

Construct KSOFM to cluster given 2 vectors [0 0 1 1], [1 0 0 0]. No of clusters to be formed is 2. Assume an initial learning rate of 0.5

[0 1 1 0] [0 0 0 1]

$n = 4$ & $m = 2$.




$X = [0\ 0\ 1\ 1]$

Initialize weights ~~rang~~ randomly b/w 0 & 1

$$w_{ij} = \begin{matrix} y_1 & y_2 \end{matrix} \begin{bmatrix} w_{11} & w_{12} \\ w_{21} & w_{22} \\ w_{31} & w_{32} \\ w_{41} & w_{42} \end{bmatrix} = \begin{bmatrix} 0.2 & 0.9 \\ 0.4 & 0.7 \\ 0.6 & 0.5 \\ 0.8 & 0.3 \end{bmatrix}$$

$X = [0\ 0\ 1\ 1]$

Distance calculation

for $j = 1$, i.e $y_1$

$$D(1) = \sqrt{(0-0.2)^2 + (0-0.4)^2 + (1-0.6)^2 + (1-0.8)^2}$$

$$D(1) = \sqrt{0.4} = 0.6324$$

for $j = 2$ i.e $y_2$

$$D(2) = \sqrt{(0-0.9)^2 + (0-0.7)^2 + (1-0.5)^2 + (1-0.3)^2}$$

$$D(2) = \sqrt{2.04} = 1.428$$

Since $D(1) < D(2)$ $\therefore$ $D(1)$ is the winning unit

# Weight Adjustment

$w_{11(n)} \rightarrow 0.2 + 0.5(0 - 0.2) = 0.1$

$w_{21(n)} = 0.2$

$w_{31(n)} = 0.8$

$w_{41(n)} = 0.9$

no. of iterations

$\alpha(t+1) = 0.5 * \alpha(t)$

$\alpha(1) = 0.5 * \alpha(0)$

$= 0.5 * 0.5$

$= 0.25$

$X = [1\ 0\ 0\ 0]$ → $D_1 = 2.2$, $D_2 = 0.84$, $D_2$ is winning

$w_{12} = 0.95$, $w_{22} = 0.35$, $w_{32} = 0.25$, $w_{42} = 0.15$