Task 5: Machine Learning: LVQ

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CHART

x_2

1

0.8	C_3	C_4	C_1	C_2
0.6	C_1	C_2	C_3	C_4
0.4	C_3	C_4	C_1	C_2
0.2	C_1	C_2	C_3	C_4
0				
	0	0.2	0.4	0.6	0.8	1 → x_1

Initialise weights

$W_1 = \begin{bmatrix} 0.2 & 0.2 \\ 0.2 & 0.6 \\ 0.6 & 0.8 \\ 0.6 & 0.4 \end{bmatrix}$ Class = 1

$W_2 = \begin{bmatrix} 0.4 & 0.2 \\ 0.4 & 0.6 \\ 0.8 & 0.8 \\ 0.8 & 0.4 \end{bmatrix}$ Class 2

$W_3 = \begin{bmatrix} 0.2 & 0.4 \\ 0.2 & 0.8 \\ 0.6 & 0.6 \\ 0.6 & 0.2 \end{bmatrix}$ Class 3

$W_4 = \begin{bmatrix} 0.4 & 0.4 \\ 0.4 & 0.8 \\ 0.8 & 0.6 \\ 0.8 & 0.2 \end{bmatrix}$ Class 4

a) i/p = (0.25, 0.25)

$\alpha = 0.25$

$t = 1$

$D_{ij} = \sum_{i=1}^{2} (W_{ij} - x_i)^2$

$D_1 = (0.2 - 0.25)^2 + (0.2 - 0.25) = 0.005$

$D_2 = (0.25 - 0.2)^2 + (0.25 - 0.6)^2 = 0.125$

$D_3 = (0.6 - 0.25)^2 + (0.8 - 0.25)^2 = 0.425$

$D_4 = (0.6 - 0.25)^2 + (0.4 - 0.25)^2 = 0.145$

Subject

$\therefore D(1)$ is minimum and $j(1)$ is the winning unit

$T = G$ $\therefore$ Bring the cluster closer.

$W_{(new)} = W_{old} + \alpha(x - W_j(old))$

$W_{11} = 0.2 + 0.25(0.25 - 0.2) = 0.2125$

$W_{21} = 0.2 + 0.25(0.25 - 0.2) = 0.2125$

Updated weight $= \begin{bmatrix} 0.2125 & 0.2 & 0.6 & 0.6 \\ 0.2125 & 0.6 & 0.8 & 0.4 \end{bmatrix}$

(b) ip $-(0.4, 0.35)$ $T = 1$ $\alpha = 0.25$

$D(1) = (0.2 - 0.4)^2 + (0.2 - 0.35)^2 = 0.0625$

$D(2) = (0.2 - 0.4)^2 + (0.6 - 0.35)^2 = 0.1025$

$D(3) = (0.6 - 0.4)^2 + (0.8 - 0.35)^2 = 0.2425$

$D(4) = (0.6 - 0.4)^2 + (0.4 - 0.35)^2 = 0.0425$

$D(4)$ is minimum ie: $j(4)$ is winning.

$T \neq G$ $\therefore$ Push away from the cluster

$W_{(new)} = W_{(old)} - \alpha(x - W_j(old))$

$W_{14}(new) = 0.6 - 0.25(0.4 - 0.6) = 0.65$

$W_{24}(new) = 0.4 - 0.25(0.35 - 0.4) = 0.4125$

Updated weight $= \begin{bmatrix} 0.2 & 0.2 & 0.6 & 0.65 \\ 0.2 & 0.6 & 0.8 & 0.4125 \end{bmatrix}$

(c) i/p (0.4, 0.45) $\alpha = 0.25$

$D(1) = (0.2-0.4)^2 + (0.2-0.45)^2 = 0.1025$

$D(2) = (0.2-0.4)^2 + (0.6-0.45)^2 = 0.1025$ ~~0.1025~~ 0.625

$D(3) = (0.6-0.4)^2 + (0.8-0.45)^2 = 0.2425$ ~~0.2425~~ = 0.1625

$D(4) = (0.6-0.4)^2 + (0.4-0.45)^2 = 0.0425$

D(4) is minimum ∴ j(4) is winning

T ≠ G ∴ Push the vector away

$W_{(new)} = W_{(old)} - \alpha(x - W_{(old)})$

$W_{14(new)} = (0.6) - 0.25(0.4-0.6) = 0.65$

$W_{24(new)} = (0.4) - 0.25(0.45-0.4) = 0.3875$

∴ Updated weight vector

$$W = \begin{bmatrix} 0.2 & 0.2 & 0.6 & 0.65 \\ 0.2 & 0.6 & 0.8 & 0.3875 \end{bmatrix}$$