⇒ **Competitive learning** → learning rules that could be used to train the weights in a competitive network. It uses the ~~Kohen~~ Kohonen Rule.

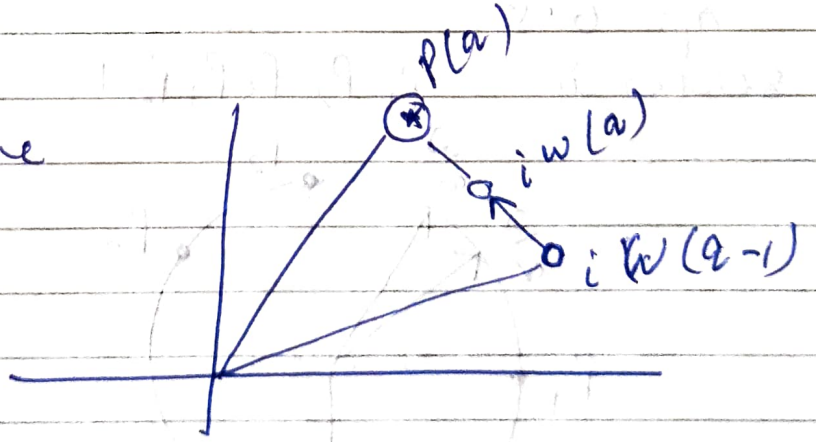
$$_iw(q) = {}_iw(q-1) + \eta\,(p(q) - {}_iw(q-1)), \quad \text{for } i \in X(q)$$

$$= (1-\eta)\,{}_iw(q-1) + \eta\,p(q)$$

And

$${}_iw(q) = {}_iw(q-1) \qquad i \neq i^*$$

weight matrix closest to the input vector or move towards the input vector.



i^* is winning neuron.

Competitive Layer

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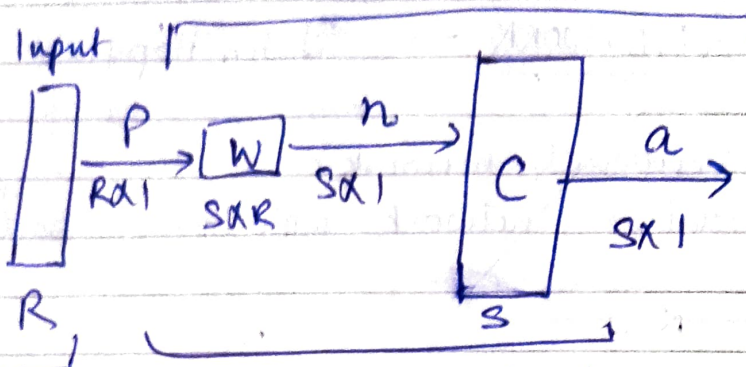
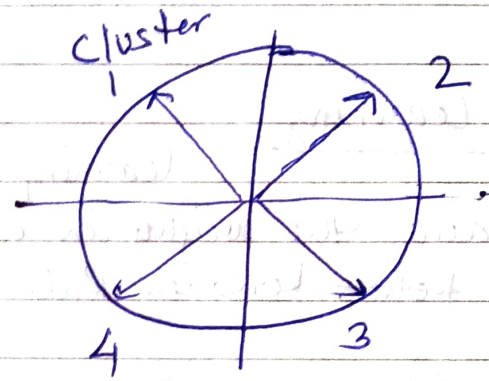


$$a = \text{compet}(Wp) = \begin{cases} 1, & i = i^* \\ 0 & i \neq i^* \end{cases}$$

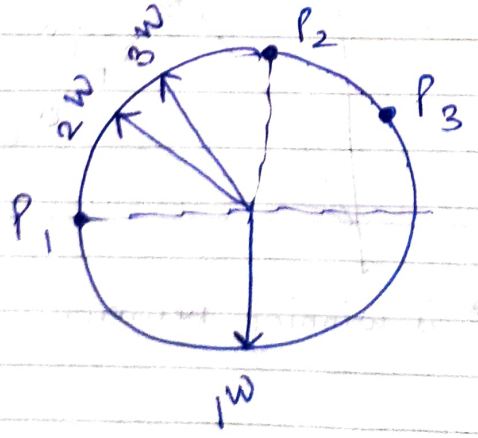


Ex → $p_1 = \begin{bmatrix} -1 \\ 0 \end{bmatrix}$, $p_2 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $p_3 = \begin{bmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \end{bmatrix}$

${}_1w = \begin{bmatrix} 0 \\ -1 \end{bmatrix}$, ${}_2w = \begin{bmatrix} -2/\sqrt{5} \\ 1/\sqrt{5} \end{bmatrix}$, ${}_3w = \begin{bmatrix} -1/\sqrt{5} \\ 2/\sqrt{5} \end{bmatrix}$

$\eta = 0.5$

series is $p_1\ p_2\ p_3\ p_1\ p_2\ p_3$



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$$W = \begin{bmatrix} {}_1w^T \\ {}_2w^T \\ {}_3w^T \end{bmatrix} = \begin{bmatrix} 0 & -1 \\ -2/\sqrt{5} & 1/\sqrt{5} \\ -1/\sqrt{5} & 2/\sqrt{5} \end{bmatrix}$$

Start point (first vector) p_1

$$a = \text{compet}(Wp_1) = \text{compet}\begin{bmatrix} 0 \\ .894 \\ .447 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

the second neuron won, so ${}_2w$ was closest to p_1

Therefore update ${}_2w$ with Kohonen rule.

Each neuron excites itself & inhibits all other neurons.

$$a = \text{compet}(n)$$

finding the index i^* of neuron with largest net input, setting its to 1 & other outputs are set to 0

$${}_2w^{new} = {}_2w^{old} + \eta(p_1 - {}_2w^{old}) = \begin{bmatrix} -.947 \\ .224 \end{bmatrix}$$