Assignment #7

MODEL SOLUTION

ECE449, Intelligent Systems Engineering

Fall 2019

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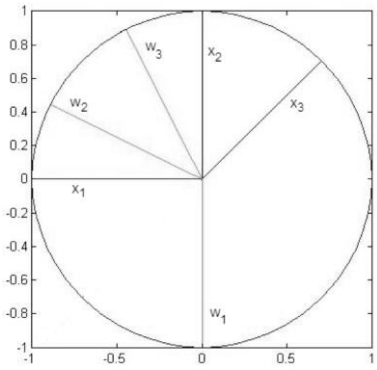
1. Consider a neural network with two inputs and three neurons in the competitive layer. The input vectors in the training set have the values

$$x_1 = \begin{bmatrix} -1 \\ 0 \end{bmatrix}, x_2 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, x_3 = \begin{bmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \end{bmatrix},$$

and the initial weight vectors are

$$w_1 = \begin{bmatrix} 0 \\ -1 \end{bmatrix}, w_2 = \begin{bmatrix} -2/\sqrt{5} \\ 1/\sqrt{5} \end{bmatrix}, w_3 = \begin{bmatrix} -1/\sqrt{5} \\ 2/\sqrt{5} \end{bmatrix}.$$

a) Plot the input vectors and initial weights on a unit circle.

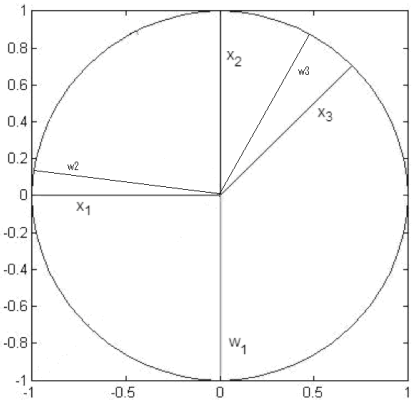


b) Calculate the resulting weights found after training the neurons with competitive learning rule using learning rate α=0.5, on the following sequence of inputs: $\mathbf{x}_1$, $\mathbf{x}_2$, $\mathbf{x}_3$, $\mathbf{x}_1$, $\mathbf{x}_2$, $\mathbf{x}_3$.

Pattern	Winning Weight Vector	New weight (re-normalized)
$\mathbf{x}_1$	$\mathbf{w}_2$	$\mathbf{w}_2$=[-0.973,0.230]
$\mathbf{x}_2$	$\mathbf{w}_3$	$\mathbf{w}_3$=[-0.230,0.973]
$\mathbf{x}_3$	$\mathbf{w}_3$	$\mathbf{w}_3$=[0.273,0.962]
$\mathbf{x}_1$	$\mathbf{w}_2$	$\mathbf{w}_2$=[-0.993,0.116]
$\mathbf{x}_2$	$\mathbf{w}_3$	$\mathbf{w}_3$=[0.138,0.990]
$\mathbf{x}_3$	$\mathbf{w}_3$	$\mathbf{w}_3$=[0.446,0.895]

Final weights are $\mathbf{w}_1$=[0,-1], $\mathbf{w}_2$=[-0.993,0.116], and $\mathbf{w}_3$=[0.446,0.895].

c) Analyze the resulting weights and elaborate on the final weight distribution with respect to the input vectors.



Note:

- Weight $\mathbf{w}_1$ does not change – too far away from the other patterns (dead neuron)
- Weight $\mathbf{w}_2$ approaches $\mathbf{x}_1$
- Weight $\mathbf{w}_3$ oscillates between $\mathbf{x}_2$ and $\mathbf{x}_3$