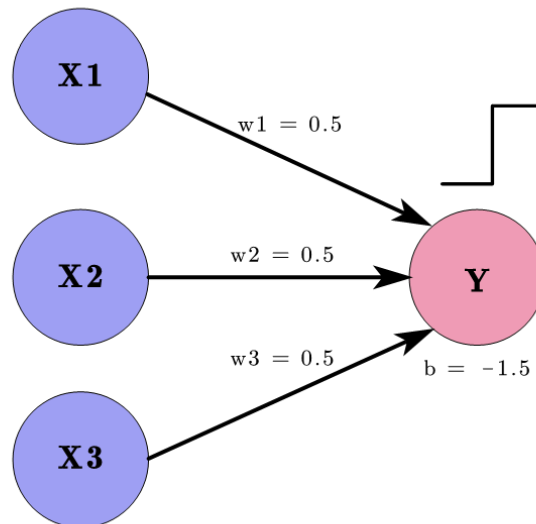


AAI Assignment 3

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1. Solution:

Network structure:



Relationship between input and output:

$$Y = \sigma(w_1 * X_1 + w_2 * X_2 + w_3 * X_3 + b) = \sigma(0.5 * X_1 + 0.5 * X_2 + 0.5 * X_3 - 1.5)$$

Where $w_1 = w_2 = w_3 = 0.5$, $b = -1.5$ and $\sigma(z)$ is a **Hard-threshold function** in Lecture7 PPT:

$$\sigma(z) = \begin{cases} 1, & z \geq 0 \\ 0, & z < 0 \end{cases}$$

How the ANN predict the True labels:

X ₁	X ₂	X ₃	X ₁ w ₁ +X ₂ w ₂ +X ₃ w ₃ +b	Y(label)
0	0	0	-1.5	0
0	0	1	-1	0
0	1	0	-1	0
0	1	1	-0.5	0
1	0	0	-1	0
1	0	1	-0.5	0
1	1	0	-0.5	0
1	1	1	0	1

The loss function we choose for the training process:

Mean-Square Error equation:

$$\mathcal{L}(w_1, w_2, w_3) = \frac{1}{2N} \sum_{n=1}^N [y^{(n)} - h_w(x^{(n)})]^2$$

Where N is the whole number of the training samples, $h_w(x^{(n)}) = \sigma(\mathbf{w}^T x^{(n)}) \in (0,1)$, $\mathbf{w}^T = (w_1, w_2, w_3)^T$ and $\sigma(z)$ is a **Hard-threshold function** in Lecture7 PPT:

$$\sigma(z) = \begin{cases} 1, & z \geq 0 \\ 0, & z < 0 \end{cases}$$

2. Solution:

Because there are three base learners and the three base learners are independent of each other and each base learner has an error rate ε . So the error rate of the ensemble model in terms of ε is:

$$\varepsilon_{ens} = \sum_{i=floor(\frac{3}{2})+1}^3 \binom{3}{i} \varepsilon^i (1 - \varepsilon)^{3-i}$$

When $\varepsilon = 0.3$, the value of the error rate of the ensemble model will become:

$$\varepsilon_{ens} = \sum_{i=floor(\frac{3}{2})+1}^3 \binom{3}{i} 0.3^i (1 - 0.3)^{3-i} = 3 * 0.3^2 * 0.7 + 0.3^3 = 0.216$$

Therefore, when $\varepsilon = 0.3$, the value of the error rate of the ensemble model is 0.216.

3. Solution:

The codes, results and report are in a folder which will also be submitted simultaneously.