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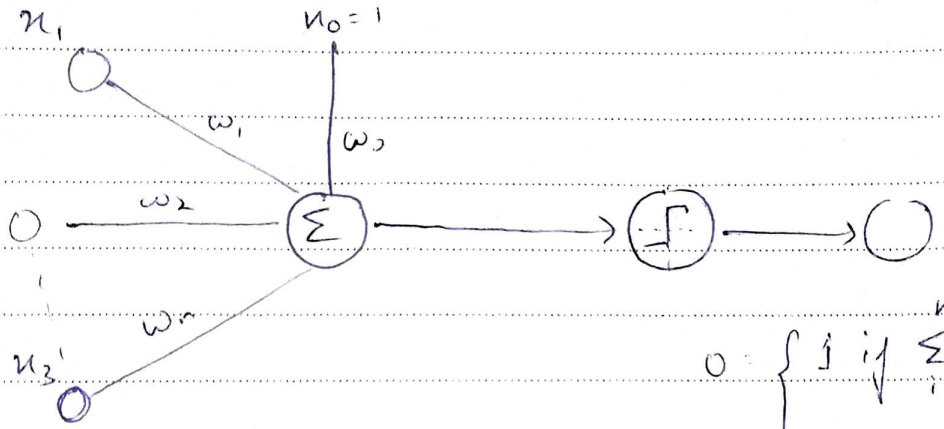
1CR17CS033 3rd

ML Assignment - 3

3) Perceptron

One type of ANN system is based on a unit called perceptron

Perceptron is a single layer neural network



$$o = \begin{cases} 1 & \text{if } \sum_{i=0}^{n} w_i x_i > 0 \\ -1 & \text{otherwise} \end{cases}$$

→ A perceptron takes a vector of real valued inputs, calculates linear combination of these inputs, then outputs a 1 if the result (+) is greater than some threshold and -1 otherwise

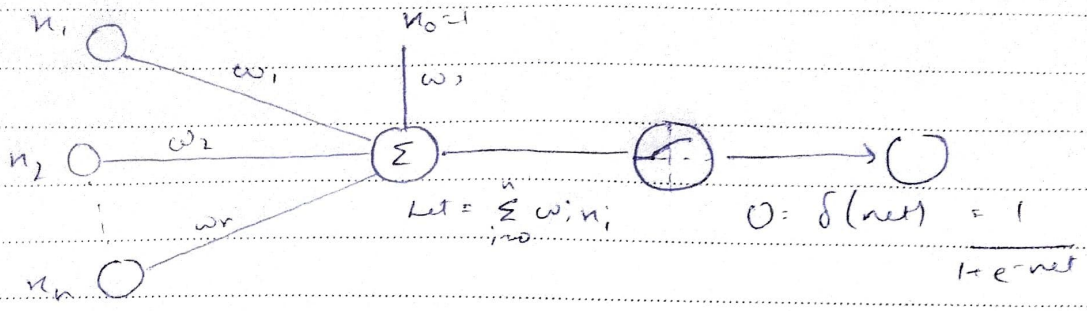
→ Given inputs x_1 through x_n, the output $o(x_1, \ldots x_n)$ computed by the perceptron is $o(x_1, \ldots x_n) = \begin{cases} 1, & \text{if } w_0 + w_1 x_1 + \ldots w_n x_n > 0 \\ -1, & \text{otherwise} \end{cases}$

where each w_i is a real valued constant.

$-w_0$ is a threshold that the weighted combination of inputs $w_1 x_1 + \ldots w_n x_n$ must surpass in order for perceptron to output a 1.

A differential threshold unit (Sigmoid Unit)

→ Sigmoid unit - a unit very much like a perceptron, but on a smoothed differential threshold function



→ The sigmoid function first computes a linear combination of its inputs, then applies a threshold to the result and the threshold output is a continuous function of input

→ More precisely the sigmoid unit computes its output O as

$$O = \sigma(\vec{w} \cdot \vec{x})$$

where $\sigma(y) = \frac{1}{1+e^{-y}}$, σ is sigmoid function

→ Solution of problem

True, Perceptron A is more general than perceptron B

x_1	x_2	$w_0 + w_1 x_1 + w_2 x_2$ Perceptron A	$w_0 + w_1 x_1 - w_2 x_2$ Perceptron B	A more general than B
0	0	1	0	1
0	1	2	1	1
1	0	3	2	1
1	1	4	3	1

$$B(\langle x_1, x_2 \rangle) = 1 \leftrightarrow 2x_1 + x_2 > 0 \rightarrow 1 + 2x_1 - x_2 > 0 \rightarrow A(\langle x_1, x_2 \rangle) = 1$$

True,

Here, perceptron A is more general than perceptron B because every instance of x_1 and x_2 that satisfies perceptron B also satisfies perceptron A.