PES1UG20CS385, G section.
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Assignment - 2

① Output of the perception, $O = sgn(w_0 + w_1x_1 + w_2x_2)$

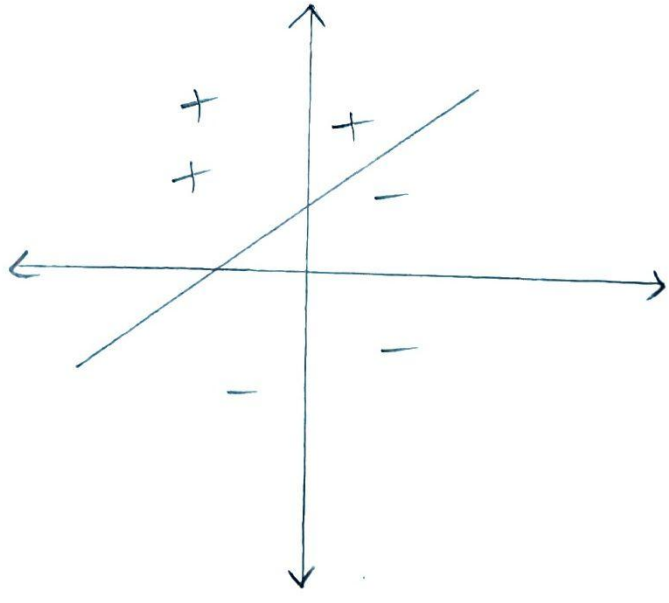
The equation of decision surface is $w_0 + w_1x_1 + w_2x_2 = 0$

$A = (-1, 0)$, $B = (0, 2)$

$$\frac{x_1 - x_{1A}}{x_{1B} - x_{1A}} = \frac{x_2 - x_{2A}}{x_{2B} - x_{2A}} \Rightarrow \frac{x_1 - (-1)}{0 - (-1)} = \frac{x_2 - 0}{2 - 0}$$

$$\Rightarrow 2 + 2x_1 - x_2 = 0$$

$w_0 = -2$, $w_1 = -2$, $w_2 = 1$ is one of the positive values. To check if their signs are correct, consider a point on one side of the line for the instance the origin $O = (0, 0)$. The output of perception for this point ~~is~~ has to be negative. Let the output of the perception using the candidate weights is positive. Therefore we need to negate the previous values and conclude that $w_0 = -2$, $w_1 = -2$ $w_2 = 1$

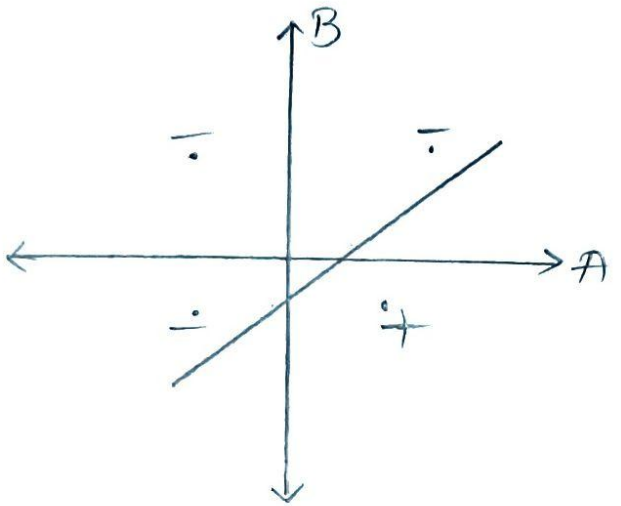


(2)

A	B	$O = A \wedge \neg B$
-1	-1	-1
-1	1	-1
1	-1	1
1	1	-1

The value of A and B are 1 (True) and -1 (False)

One of the correct surface is shown in following picture.



Line crosses A axis at 1 and B axis at -1. There equation is

$$\frac{A-0}{1-0} = \frac{B-(-1)}{0-(-1)} \Rightarrow A = B+1$$
$$\Rightarrow 1 - A + B = 0$$

So 1, -1, 1 are possible values for weights w_0, w_1, w_2 Using values the output of perception for A=1, B=-1, is negative Therefore we need to negate the weights and therefore we can conclude that $w_0 = -1$, $w_1 = 1$, $w_2 = -1$

③ A is more general than B if and only if $\forall$ instances $\langle x_1, x_2 \rangle$,

$B(\langle x_1, x_2 \rangle) \rightarrow A(\langle x_1, x_2 \rangle) = 1$

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

$\rightarrow A(\langle x_1, x_2 \rangle) = 1$

④ The gradient descent ~~for~~ traning rule specifies how the weight are to be changed at each step of learning procedure so that prediction error of the unit decreases the most The The derivation of the rule of the linear unit can be adapted and consider the output 0.

$$\frac{\partial E}{\partial w_i} = \sum_{x \in X} (out_x - O_x) \frac{\partial}{\partial w_i} (out_x - (w_0 + w_1 x_{1x} + w_2 x_{1x}^2 + \cdots + w_n x_{nx} + w_n x_{nx}^2))$$

$$= \sum_{x \in X} (out_x - O_x)(-x_{ix} - x_{ix}^2)$$

Gradient descent traning rule is

$$\frac{\partial E}{\partial w_i} = \sum_{x \in X} (out_x - O_x) \frac{\partial}{\partial w_i} (out_x - (w_0 + w_1 x_{1x} + w_1 x_{1x}^2 + \cdots + w_n x_{n2} + w_n x_{nx}^2)) =$$

$$\sum_{x \in X} (out_x - O_x)(-x_{ix} - x_{ix}^2)$$