Linear Classification
**Due:**

1   Linear Classifiers - Perceptrons

1. You have learned the following perceptron weights for a two attribute (x_1 and x_2) classification:

$$w = \begin{bmatrix} 0.3 \\ -0.2 \\ 0.8 \end{bmatrix}$$

Using the sign activation function, find the class (+1 or -1) for the following data:

x_1	x_2	Class
+1	+1	
+1	-1	
-1	-1	
-1	+1	

2. Find out appropriate values of the weight vector to represent the following boolean functions.
   a. AND function i.e. a function that will separate following data
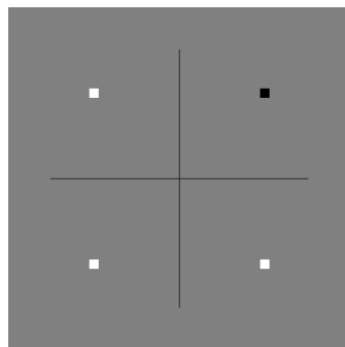
   -1 AND -1 = false

   -1 AND +1 = false

   +1 AND -1 = false

   +1 AND +1 = true

   b. OR function

   c. NOT i.e. represent NOT (A and B) function

   d. NOT of a single variable i.e. NOT (A)

    e. Can you represent the XOR function. Show graphically why it's not possible

3. You are given the following training data:

x_1	x_2	x_3	Class
-1	1	-1	1
1	1	-1	0

Assume initial weights as $\boldsymbol{w} = \begin{bmatrix} 0.5 \\ -1.0 \\ -0.5 \end{bmatrix}$. The bias (b) or w_0 is given to be: 0.5.

Note that the decision rule in this case would be (hardlimit transfer function)

$$\text{if } w^T x > 0 \text{ then class} = 1 \text{ else class} = 0$$

Apply the perceptron learning algorithm on this dataset and find the final values of the weights vector. Assume a learning rate of 1.

4. You are given the following training data and parameters as shown in figure below:
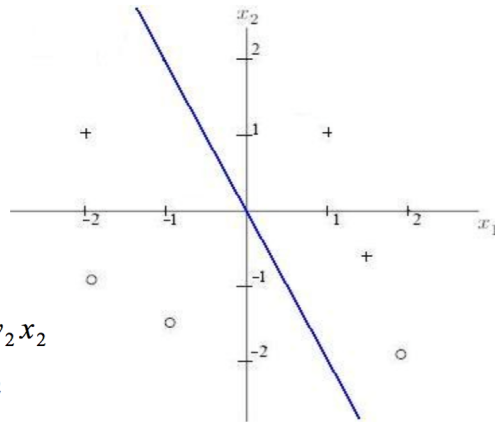
Learning Example

Initial Values:

$\eta = 0.2$

$$w = \begin{pmatrix} 0 \\ 1 \\ 0.5 \end{pmatrix}$$

$$0 = w_0 + w_1 x_1 + w_2 x_2$$
$$= 0 + x_1 + 0.5x_2$$
$$\Rightarrow x_2 = -2x_1$$

Note that the class labels are represented by + or dot symbols. The values of the attributes can be read from the figure.

Apply the perceptron learning algorithm on this dataset and find the final values of the weights vector.