Machine Learning - Homework 03

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Exercise 1:

1. For the first question we choose the following values:

   - $w_0 = 1$
   - $w_1 =$ -2
   - $w_2 = 1$

   Figure 1 illustrates the separating line, given by the equation:

$$x_2 = -\frac{w_0}{w_2} - \frac{w_1}{w_2} x_1$$

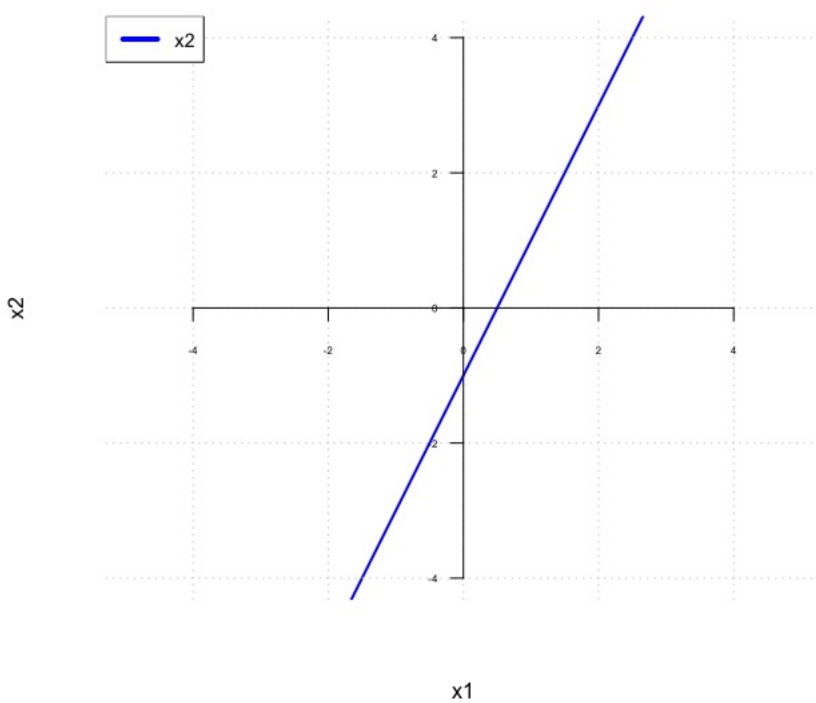

Figure 1: Representation of x_2 as a function of x_1

2. In figure 2 we plot the vector (w_1, w_2). Clearly, the vector intersects the separating line at a right angle.

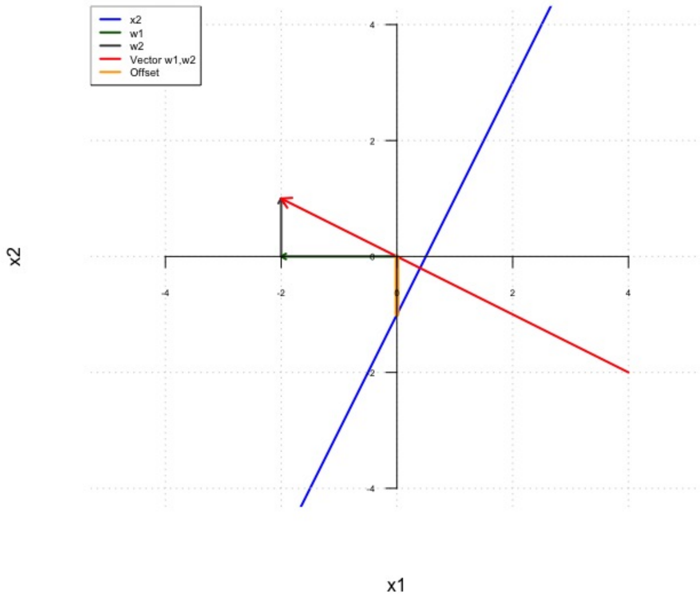

Figure 2: Representation of x_2 and the vector (w_1, w_2)

3. We increase w_0 from 1 to 2, and keep w_1 and w_2 constant. The offset increases (in absolute value) since it is given by $-\frac{w_0}{w_2}$. On the other hand, the slope does not change, given that $-\frac{w_1}{w_2}$ is not affected by w_0. See Figure 3.

4. We increase w_1 from -2 to -1, and keep w_0 and w_2 constant at 1. We see that the offset is not affected by the change (the offset is define by $-\frac{w_0}{w_2}$ which remains equal to -1). Nevertheless, the new slope is less steep (i.e. decreases in absolute value), in line with our expectation since the slope is obtained with $-\frac{w_1}{w_2}$. See Figure 4.

5. We increase w_2 from 1 to 2, and keep w_0 and w_1 constant at 1 and -2 respectively. We observe that both the offset and the slope change. The offset, given by $-\frac{w_0}{w_2}$, will decrease (in absolute value) for an increase in w_2. The slope, given by $-\frac{w_1}{w_2}$ will also decrease in absolute value (i.e. become less steep) when we increase w_2. See Figure 5.

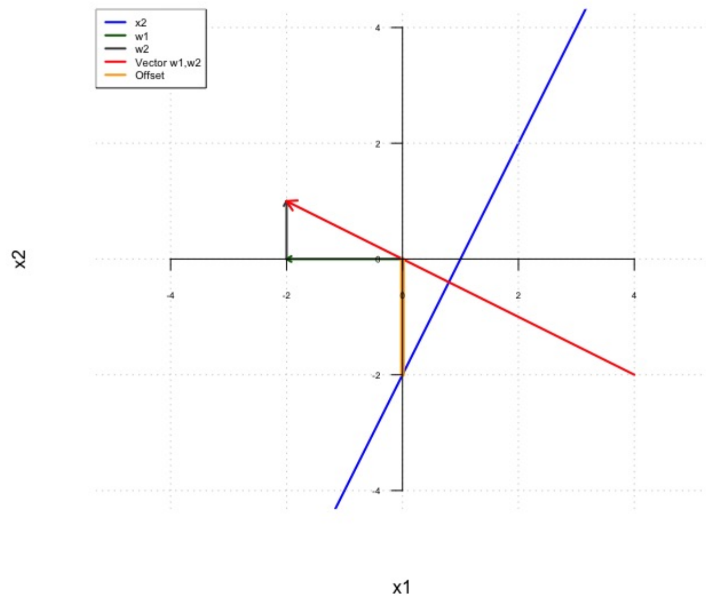

Figure 3: Representation of x_2 and the vector$(w_1,\, w_2)$, with the new w_0

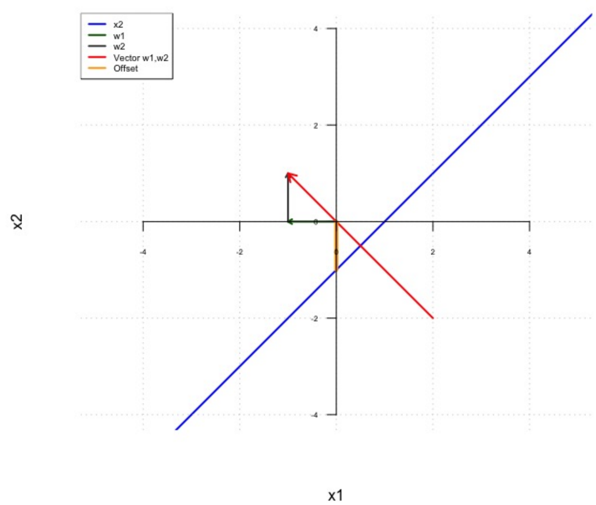

Figure 4: Representation of x_2 and the vector$(w_1,\, w_2)$, with the new w_1

Exercise 2:

Starting with the weights: $w_0 = w_1 = w_2 = 0.5$, and $w_3 = 0$, we obtain the solution weights $w_0 = w_1 = w_2 = 0.3$, and $w_3 = 0.6$. Please find the algorithm attached in the e-mail.

Exercise 3:

Figure 6 illustrates the separating plane in 3d of the XOR-problem.

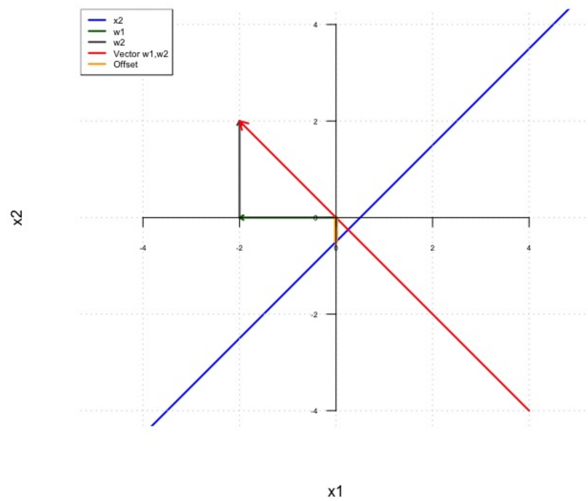

Figure 5: Representation of x_2 and the vector(w_1, w_2), with the new w_2

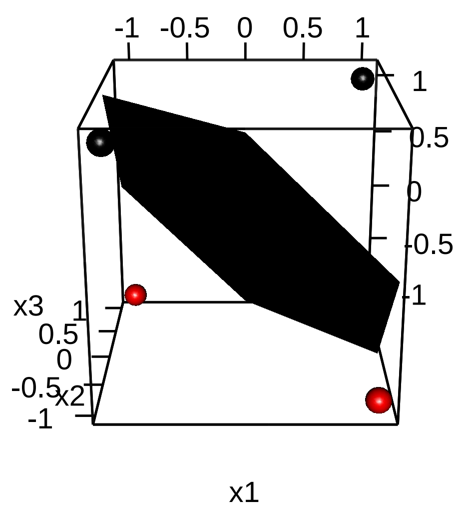

Figure 6: Representation of x_2 and the vector(w_1, w_2), with the new w_2