CSU44061 Machine Learning - Week 2
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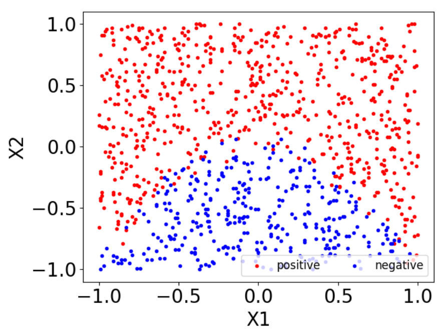
Dataset # id:9–9–9

# Question a

Code for all questions provided in the appendix.

## Part i

Using matplotlib with python to generate graphs, I plotted X2 against X1 (both features) and made the colour of the marker different based on the prediction. The red colour represents a positive prediction (+1) and the blue colour represents a negative prediction (-1)




## Part ii

Using code provided in the appendix, I trained a logistic regression classifier which gave me the following model:

$$\theta_0 + \theta_1 x_1 + \theta_2 x_2 = -1.91100581 - 0.18987022 * x_1 - 5.76650534 * x_2$$

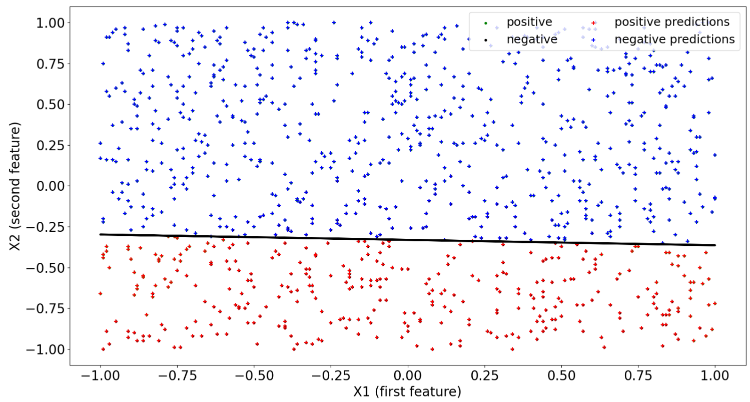
## Part iii

The following plot plots X1 against X2, using the predictions and the actual y output from the dataset. the y output and predictions use different colours and markers to attempt to marke this graph more readible.

It is a bit hard to see however we can clearly see that the predictions are quite rough and very inacurrate on the edges as well as the top of the slope.

As for the slope representing the classifier separation, I used the following equation. It is obtained by computing the sum of the linear function which uses $\theta_0$ and $\theta_1$ and dividing the result by the 3rd value of the model: $\theta_2$.

$$y = -\frac{\theta_1 * x_1^i + \theta_0}{\theta_2}$$




# Question b

## Part i

Using code provided in the appendix, I trained a linear SVM classifier with 3 different C values. I obtained the following parameters:

C = 0.001

$$-0.21517665 - 0.00849777 * x_1 - 0.47908454 * x_2$$

C = 1

$$-0.61452025 - 0.06661916 * x_1 - 1.88463746 * x_2$$

C = 1000

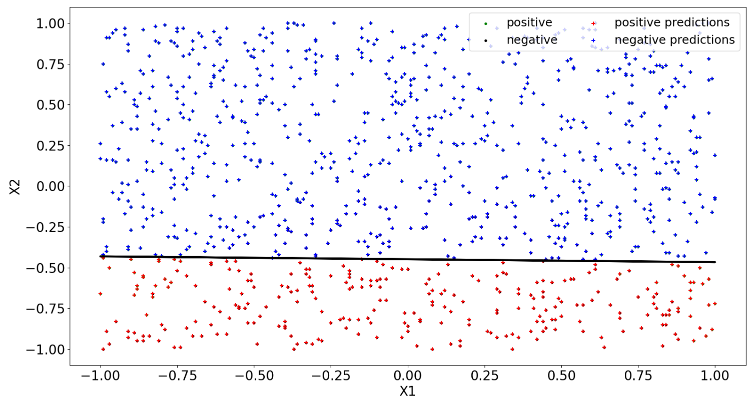
$$-0.62224281 - 0.06807451 * x_1 - 1.90613439 * x_2$$

It is worth noting that using C = 1000 required a maximum amount of iterations when training the model to be much higher. I used a maximum of 100000 iterations for this algorithm.

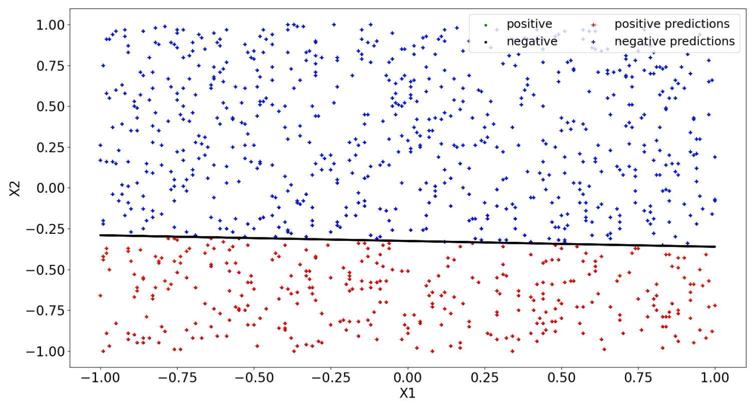
## Part ii

Using the same method for plotting as in the previous question, I plot the predictions on top of the actual values in order to try detect inconsistencies on the predictions. The separation line is also plotted using the same function as explained in a previous question. Using the different values for C we obtain the following graphs:

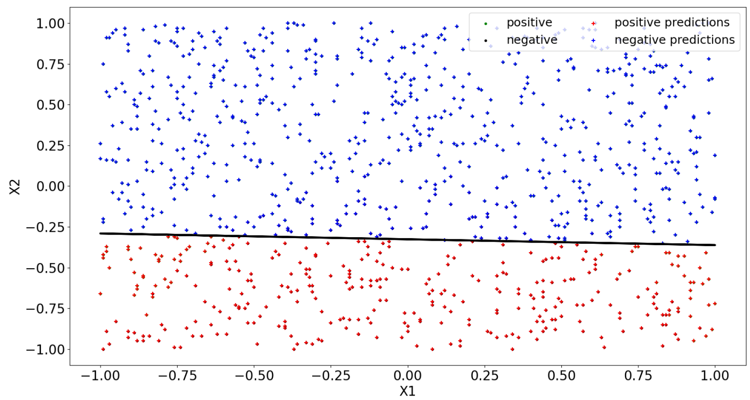
C = 0.001




C = 1




C = 1000




### Part iii

A larger value for C will choose a smaller margin for the hyperplane separating our data. In this case this results in a higher intercept value and smaller coefficient. A smaller value for C will make the margin for data separation bigger, potentially resulting in more misclassifications.

Looking at the plot, a higher value for C makes the separating line for the predictions higher on the y axis (representing X2), thus prediciting more values as positive ($y = 1$).

A lower value for C makes the separating line lower on the y axis, thus predicting less values as positive ($y = 1$).

In our situation it seems that a larger value for C works best.

## Appendix

ADD CODE AND STUFF HERE