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`Information Retrieval in High Dimensional Data`

`Lab #8, 5.7.2018`

SVM

Task 1. In this task, we will once again work with the MNIST set. Prepare a training set matrix `X_train` consisting of the first 500 vectorized training samples of digits 1 and 2 each, and a corresponding label vector `y_train`. Use 1 and -1 for the labels.

a) Consider the equation (8.30) in the lecture notes. Implement a function `solvedualsvm(H,y)` that returns the solution `lambda_star` of the dual SVM problem by means of CVXOPT. Test your function with the training data

$$\mathbf{x}_1 = \begin{bmatrix} -1 \\ -1 \end{bmatrix}, y_1 = -1, \mathbf{x}_2 = \begin{bmatrix} -2 \\ -2 \end{bmatrix}, y_2 = -1,$$
$$\mathbf{x}_3 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, y_3 = 1, \mathbf{x}_4 = \begin{bmatrix} 2 \\ 2 \end{bmatrix}, y_4 = 1,$$

Verify that the KKT conditions with respect to the support vectors are in line with what you expect.

b) Write the function `simplesvm` which expects a training data matrix `X_train`, a training label vector `y_train` and a test data matrix `X_train` as its input. As a result, it returns the estimated test label vector `y_test`. To this end, employ `solvedualsvm` from the last lab course. Note that (8.29) in the lecture notes is overdetermined. You can exploit this to get a more robust estimation of b. Test your implementation with another 800 images from the MNIST data set.