**ENGR421 – HW6 report**

First, I read the .csv files for images and labels into numpy arrays, then divided them to train and test sets with first 1000 of images and labels being allocated to the training set and the remaining 4000 as the test set. This I did with basic array operations. Then I defined the Gaussian kernel (K) which is representative of:



Which we use it in the dual problem, to minimize the expression,



Subject to:



Then I also wrote a method called *generate\_one\_versus\_all\_labels(class\_no, labels)* which I used to make label 1 for a desired class and -1 for all other classes to do one-versus-all approach. After this, I used the binary classification SVM algorithm given in the Lab8 script to do these calculations, to generate scores with a given C in a method called *get\_class\_score(X,Y,C)* from which I return the scores and the learned alpha and w0 parameters.

I then generated scores using this get\_class\_score method for each class and get their learned alpha and w0s. These are individual classifiers only learned how to separatee a given class from all others.

I then generated the predicted labels by assigning the predicted class by the maximum score in all 5 classifiers for a datapoint. Then I generated the confusion matrix using pd.crosstab.

I wrote another method called the *test\_model(kernel, y\_train, alpha, w0)* in which I generate the scores for the test datapoints from the previously learned parameters. This is given with the kernel matrix multiplied by W and added w0, where W is the summation of multiplied alphas and training labels. After this I again made the confusion matrix of this classification. The predicted labels were again assigned by the maximum score.

This same methodology was used for different C values, in a single method called

*test\_for\_Cs(C) where I return the accuracies as a two-sized array with test accuracy in index*

*0, and training accuracy in index 1. I called this method with all the specified C values*

*(0.1, 1, 10, 100, 1000).* Then finally, I plotted the accuracies by the corresponding

regularization parameters for test and training datasets.