Introduction to Machine Learning *Ananth, AP68098*

HW4

Please note that only PDF submissions are accepted. We encourage using LaTeX to produce your writeups. You'll need *mydefs.sty* and *notes.sty* which can be downloaded from the course page.

Linear dimentionality reduction:

1. You have used MNIST dataset in the previous homeworks. This time, you will reduce the dimentionality of data to improve the accuracy of digit recognition. Please randomly choose 1000 training data points (a sample code is given in HW1).

2. LIBSVM is an off-the-shelf implementation for SVM. It is very powerfull and easy to use. It supports various formulations of SVM including kernel SVMs. Please download it, read the README file, and install it with Matlab interface. You can simply train a model by:

   model = svmtrain(training_label_vector, training_instance_matrix [, 'libsvm_options']);

   and test the model by:

   [predicted_label, accuracy, decision_values] = svmpredict(testing_label_vector, testing_instance_matrix, model [, 'libsvm_options']);

   Look at the README file to learn how to use it. Note that adding '-t' to the options in training, uses linear SVM formulation, the one you implemented in the previous homework.

3. Train an SVM on MNIST data using 1000 training data and test it on all testing data and report the accuracy. You may get the predictions from "svmpredict" and calculate the accuracy yourself.

   StartHere.m : Contains input data
   SVM.m
   Accuracy in percentage: 93

4. Use PCA on training data to reduce the dimensionality of data from 784 to 50. Note that you should subtract the mean of data first. To make it faster, please use the SVD trick that we discussed in the class to avoid calculating 784x784 size covariance matrix. Project all training data into the new 50D feature space, project back to reconstruct the data and compare it with the original data. Change the number of dimensions from 1 to 500, and plot the mean squares error vs. number of dimensions. Visualize the first 10 Eigen vectors by reshaping them and using "imagesc" and "subplot" commands in Matlab.

   PCA.m

5. Project both training and testing data onto the lower dimensional space and train an SVM to see if it improves the performance.

   There is an increase in performance when ran through PCA from 93 upto 97 percent.

6. Repeat the above item for different values of dimensions and plot the curve of SVM accuracy vs. number of dimensions. You may use the following number of dimensions:[2 5 10 20 30 50 70 100 150 200 250 300 400 500 748]

Figure 1: Q4: MSE of Original Data with reduced dimension Data vs Number of Dimensions

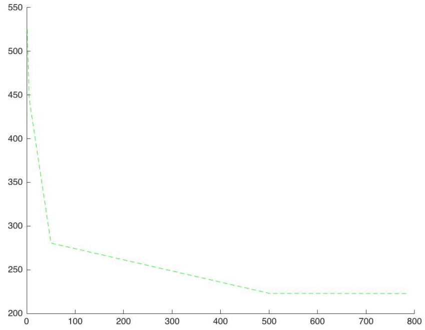
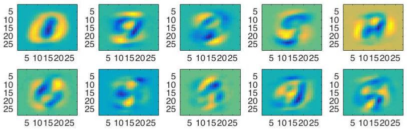
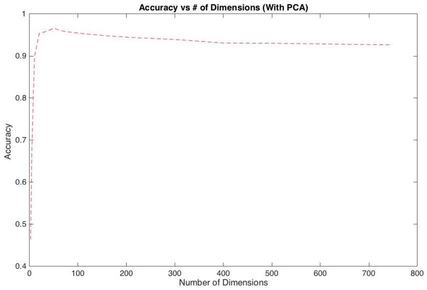


Figure 2: Q4: Visualization of top 10 EigenVectors



SVM_PCA.m

Figure 3: Q5 : SVM accuracy with PCA vs number of dimensions


Accuracy vs # of Dimensions (With PCA)
Accuracy
Number of Dimensions