

Analysis:

(a) Since we need to train the classifier to distinguish 3's from 8's, we use the MNIST training data to fit the SVC and then use the MNIST test data to predict the labels for the test samples. Both the training and the test data contain data corresponding to 3's and 8's. The training data was fit to the SVC using a "linear" kernel and then the test data was used to predict the labels of the samples. This returned an accuracy of 0.968. The training data was also fit to the SVC using a "rbf" kernel and then the test data was used to predict the labels of the samples. This returned an accuracy of 0.969. The results are shown below:

```
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel
0.968121628249
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using RBF Kernel
0.969102501226
```

Figure 1 :Result of SVM Classification with Linear and RBF Kernels

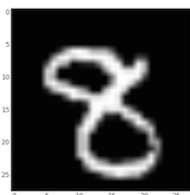
(b) The values of the regularization parameter "C" that were tested are [0.1, 0.01, 0.001, 0.0001, 1, 2, 5, 10, 100] and "linear" and "rbf" kernels were used to fit the data. The results are shown below:

```
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel with C= 0.1
0.97106424718
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using RBF Kernel with C= 0.1
0.954389406572
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel with C= 0.01
0.968612064738
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using RBF Kernel with C= 0.01
0.917606669936
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel with C= 0.001
0.96615982295
#####
Prediction: [3 3 3 ..., 3 3 3]
Accuracy using RBF Kernel with C= 0.001
0.505149583129
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel with C= 0.0001
0.94850416871
#####
Prediction: [3 3 3 ..., 3 3 3]
Accuracy using RBF Kernel with C= 0.0001
0.505149583129
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel with C= 1
0.968121628249
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using RBF Kernel with C= 1
0.969102501226
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel with C= 2
0.96615982295
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using RBF Kernel with C= 2
0.972535556645
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel with C= 5
0.96460857283
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using RBF Kernel with C= 5
0.978911230996
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel with C= 10
0.963707699853
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using RBF Kernel with C= 10
0.981363413438
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using Linear Kernel with C= 100
0.95831289848
#####
Prediction: [3 8 3 ..., 8 3 8]
Accuracy using RBF Kernel with C= 100
0.989700833742
#####
```

(a) Linear and RBF Kernels with C=0.1, 0.01, 0.001, 0.001 (b) Linear and RBF Kernels with C=1, 2, 5, 10, 100

Figure 2 :Linear and RBF kernels with different regularization parameter "C" values

(c) Examples of support vectors are shown below:



(a) Support Vector '8'



(b) Support Vector '3'

Figure 3 :Examples of Support Vectors