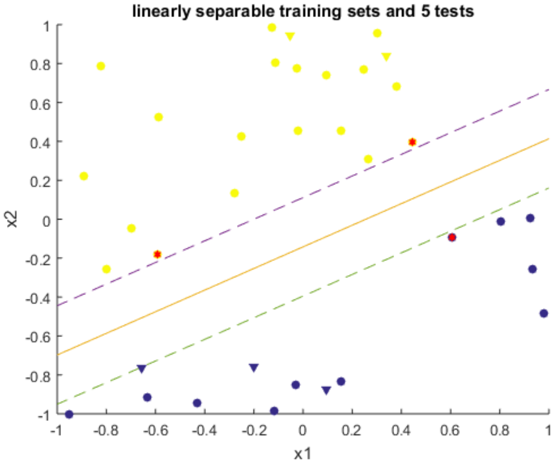
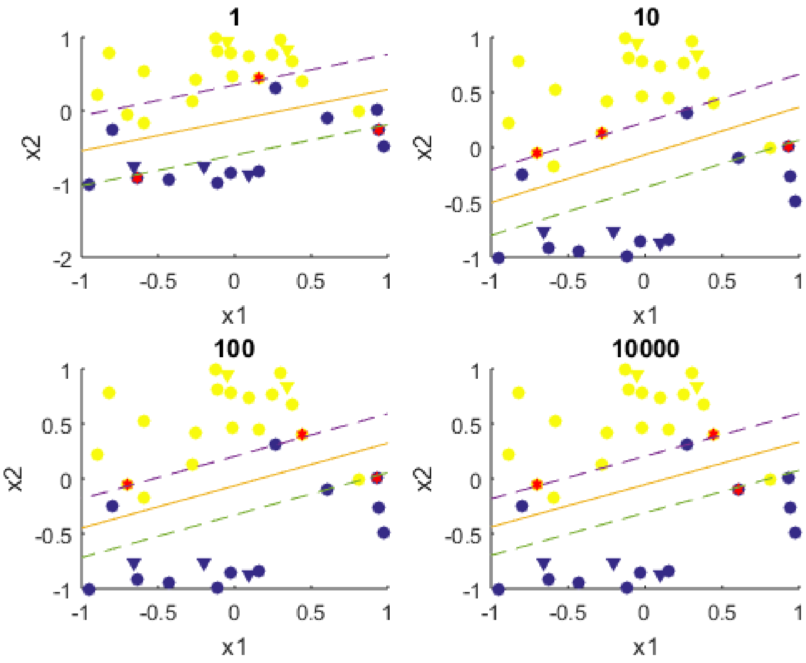
1. write a matlab code that:
   a) generate two linearly separable sets of points in two dimensions, plot the points and set up SVM for separating these two sets using a linear function. Solve the SVM problem with Mosek and plot the resulting hyperplane. Generate new point(s) and classify it (them) with this hyperplane. Find the support vectors and plot them with highlighted colors.
   ANS：



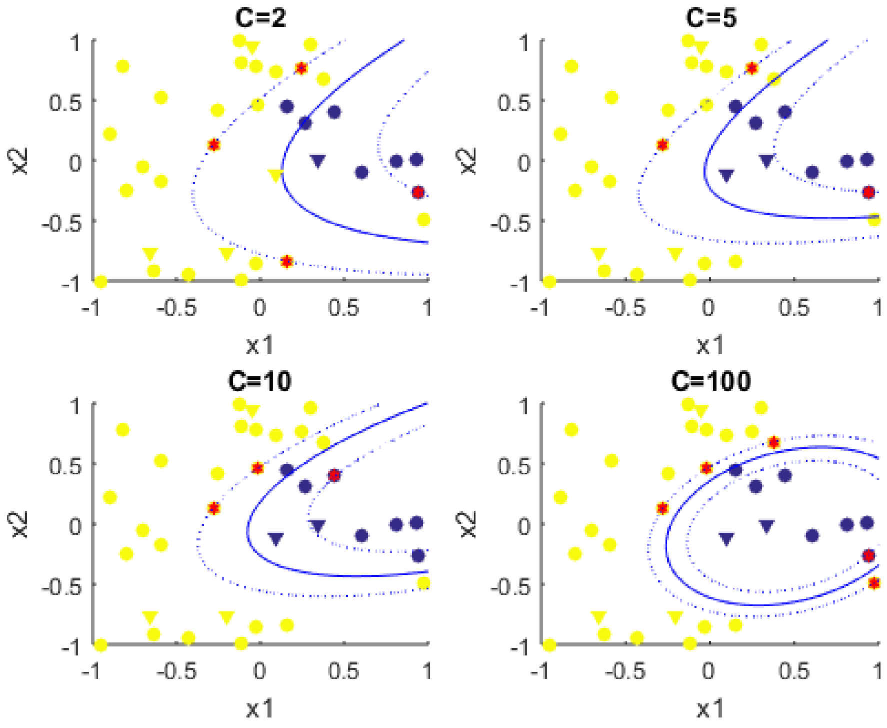
   b) Repeat the same as above for two sets that are not completely separable, but nearly so. Try different values of regularization parameters.
   ANS:
   By C= 1,10,100,10000



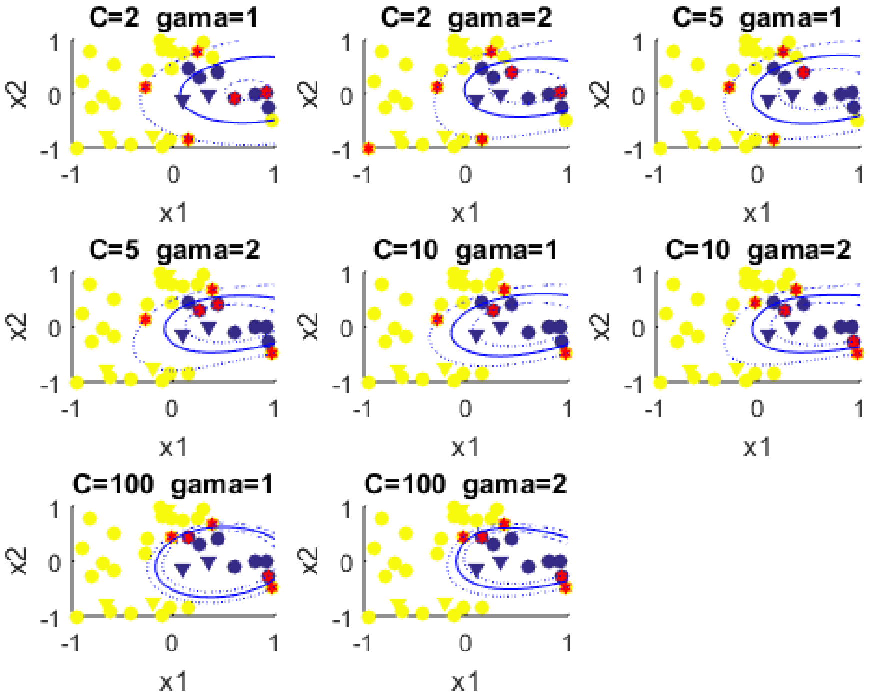
c) Repeat above but with two sets that are not linearly separable but can be separated by an ellipsoidal curve. Apply quadratic and RBF kernels and solve appropriate SVMs. Note that your Kernel matrix will be positive semidefinite and Mosek may think it is not, because some of the eigenvalues will be very small negative numbers – you can check it by running eig(Q) for your matrix Q. A simple fix is to add an identity matrix to Q multiplied by a small number such as 10^(-14) to make all eigenvalues slightly positive. See if you can plot the resulting curves. At least you can plot the support vectors. Try this with different values of C and sigma.

ANS:

Quadratic Kernel, by C= 2,5,10,100



RBF kernel by C=2,5,10,100; gama = 1,2



2. Consider the optical character recognition data (enclosed). There is a training set, testing set and optdigits.names file that describes the properties of these data files. Apply linear and nonlinear SVM to the train sets and use the resulting classifier on the testing set. Compute the average error (using hinge loss and using 0-1 loss) for each of your classifiers on the test set and make conclusions about best classifier.

ANS:

Linear

C	01_loss	hinge loss
0. 001	0. 008904	0. 015171585
0. 01	0. 010573	0. 020183827
0. 1	0. 014469	0. 045595318
1	0. 021146	0. 10685606
10	0. 020033	0. 143022965

quadratic Kernel

C	01_loss	hinge loss
0. 000001	0. 005565	0. 00920972
0. 001	0. 006121	0. 011237022
100	0. 006121	0. 011235802

Quadratic Kernel with C=0.000001 is a good SVM classifier