SVM and Perceptron HW:

Table of Contents

q3 - svm_test and svm_train:

```
function [accuaracy] = svm_test( theta, X_test, y_test)

             predicted_y = theta' * X_test;
             comparison_y = sign(predicted_y) - y_test;
             accuaracy = sum(comparison_y ~= 0) / length(y_test);

end

function [theta] = svm_train( X, y )

d = size(X,2);
H = eye(d);
f = zeros(d,1);
Dy = diag(y);
A = Dy*X;
b = ones(size(y));

theta = quadprog(H, f, -A, -b);

end
```

q4-5 - Visualization of HyperPlane and Margin:

For both Perceptron and SVM.

```
clc; clear; close all;
addpath([genpath('./materials') ...
    genpath('libsvm/libsvm-3.22/matlab')])

load data1.mat
[normX, sDev, means] = data_normalization(X);

[perc_theta, k] = my_perceptron_train(normX, y);
svm_theta = svm_train(normX, y);

figure('Name', 'Data1')
set(gcf, 'Position', [300, 300, 1300, 650]);
```

```
subplot(1,2,1)
title('Data1'); hold on;
plot_data_svm_percep(normX, svm_theta, perc_theta);
subplot(1,2,2)
plot_data_svm_percep(normX, svm_theta, perc_theta);
legend('off');
xlim([-1 1]); ylim([-1 1]);

load data2.mat
[normX, sDev, means] = data_normalization(X);

[perc_theta, k] = my_perceptron_train(normX, y);
svm_theta = svm_train(normX, y);

figure('Name', 'Data2')
set(gcf, 'Position', [300, 300, 1300, 650]);
subplot(1,2,1)
title('Data2'); hold on;
plot_data_svm_percep(normX, svm_theta, perc_theta);
subplot(1,2,2)
plot_data_svm_percep(normX, svm_theta, perc_theta);
legend('off');
xlim([-0.5 0.5]); ylim([-0.5 0.5]);
```

```
Minimum found that satisfies the constraints.

Optimization completed because the objective function is non-
decreasing in
feasible directions, to within the default value of the optimality
 tolerance,
and constraints are satisfied to within the default value of the
 constraint tolerance.




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```
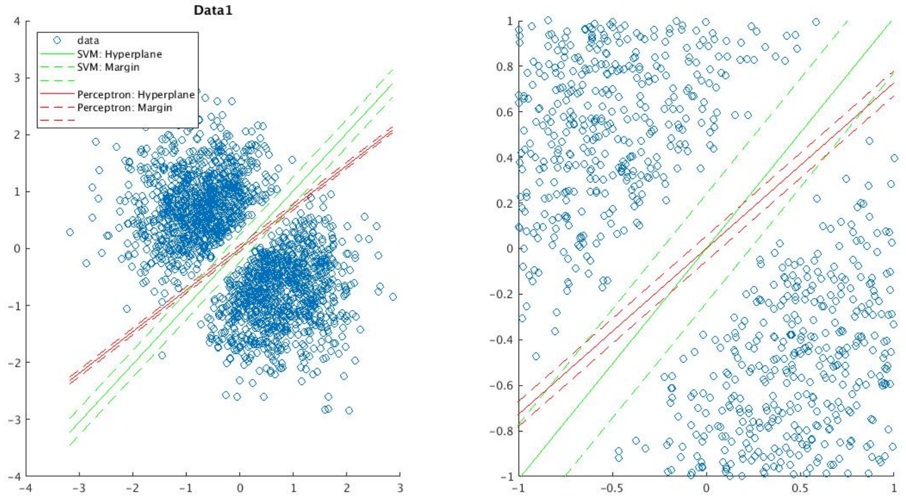
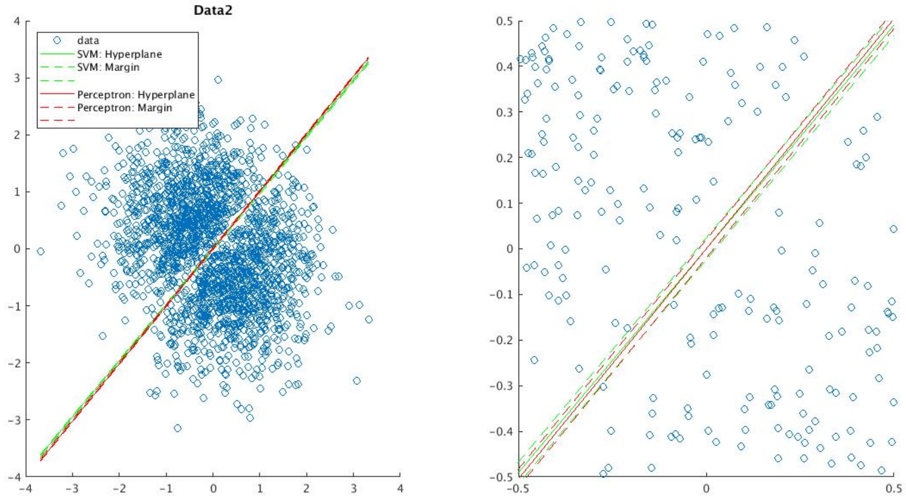



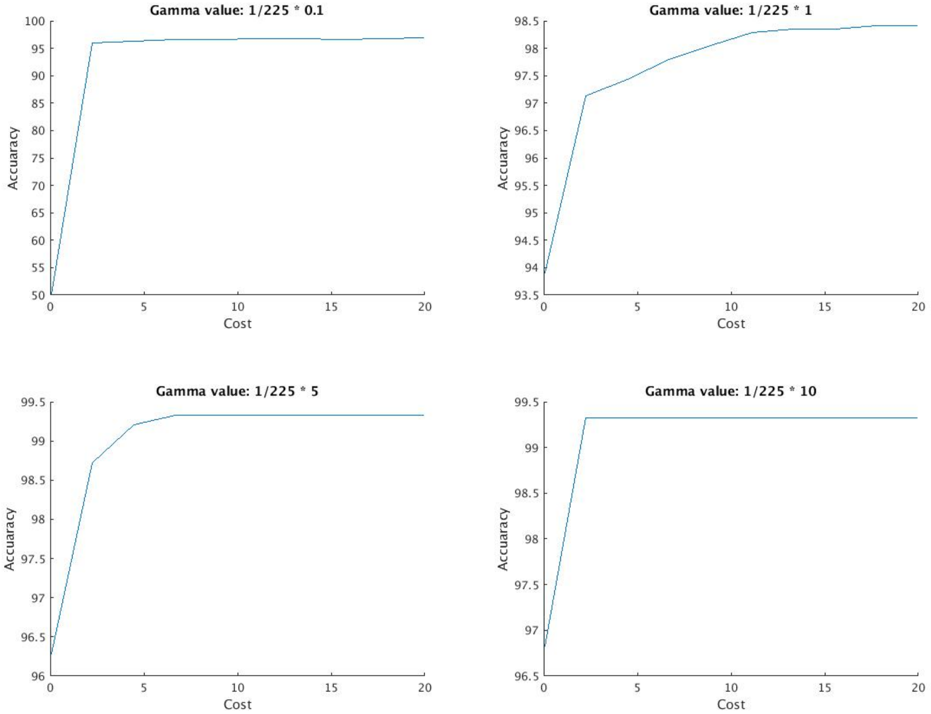


q6

```
img2 = imread('test2.jpg');
digit2 = image2blocks(img2);
img3 = imread('test3.jpg');
digit3 = image2blocks(img3);

X = [digit2; digit3];
y = [ones(size(digit2,1),1) ; -1 * ones(size(digit3,1),1)];

p = cvpartition( y, 'Holdout', 0.20);
X_train = X(p.training, :);
y_train = y(p.training);
X_test = X(p.test, :);
y_test = y(p.test);
```

```
[X_train_n, X_test_n] = normalizeTrainAndTest(X_train, X_test);

svmStruct = svmtrain(y_train, X_train_n, '-q');
[predicted_labels, accuracy, dec_values] = svmpredict(y_train,
 X_train_n, svmStruct,'-q');

fprintf('\nThe accuracy for the training data is: %.4g%%\n',
 accuracy(1))
fprintf('Its not 100%% because data is not linear seprable.\n')

[predicted_labels, accuracy, dec_values] = svmpredict(y_test,
 X_test_n, svmStruct,'-q');
fprintf('The accuracy for the test data is: %.4g%%\n', accuracy(1))


fprintf('\n***** GAMMA C PLAYGROUND *******\n')

def_c = 1;
def_gamma = 1/size(X,2);
gamma_coef = [1/10 1 5 10];
c_vals = linspace(def_c/20, def_c*20, 10);

min_error = [0 0 0];   % min_error = [error-value gamma-value cost-
value]

ACC = zeros(size(c_vals));
figure('Name', 'SVM Accuracy to cost');
set(gcf, 'Position', [200, 200, 1300, 1300]);
for j = 1:length(gamma_coef)
    for i = 1:length(c_vals)
        svmoptions = ['-c ', num2str(c_vals(i)), ' -g ',
 num2str(gamma_coef(j) * def_gamma) , ' -q'];
        svmStruct = svmtrain(y_train, X_train_n, svmoptions);
        [predicted_labels, accuracy, dec_values] = svmpredict(y_train,
 X_train_n, svmStruct,'-q');
        ACC(i) = accuracy(1);
        if accuracy(1) > min_error(1)
            min_error = [ accuracy(1) gamma_coef(j) * def_gamma
 c_vals(i) ];
        end
    end
    subplot(2,2,j); hold on;
    title(sprintf('Gamma value: 1/%g * %.4g', size(X,2),
 gamma_coef(j)))
    plot(c_vals, ACC); xlabel('Cost'), ylabel('Accuaracy')
end


fprintf('Minimal Error Parameters:\n')
fprintf('Gamma = %g | Cost = %g:\n', min_error(2:3))
fprintf('We achived training accuaracy of: %g\n', min_error(1))

fprintf('\nWe can use the Gradiant Decent method to optimize the
 parameters\n')
```

```
The accuracy for the training data is: 96.64%
Its not 100% because data is not linear seprable.
The accuracy for the test data is: 97.07%

***** GAMMA C PLAYGROUND *******
Minimal Error Parameters:
Gamma = 0.0222222 | Cost = 6.7:
We achived training accuaracy of: 99.3289

We can use the Gradiant Decent method to optimize the parameters
```



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