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% Homework 3 - Question 3
clear all;
data = readtable('bc_wisc.csv');
data = data.Variables;


y = data(:,2);
X = data(:,3:end);
methods = ["logistic" ;"lda"; "svm"];
disp("3a) Below is the average accuracy for each fold in 5-fold cross validation ");

average_accuracy=perform_cross_validation(X, y, 5, methods);
disp("Logistic Reg    LDA     SVM ");
disp(average_accuracy);

disp("Average accuracy of LDA is highest in the all the folds, so we should select LDA");
disp(" ");
%3b
fprintf("3b) Visualisation of data.\n");
X = data(:,[23,30]);
y = data(:,2);
hold on
gscatter(X(:,1),X(:,2),y, 'br','o+')

B_glm = glmfit(X,y,'binomial');
x_axis = [min(X(:,1)), max(X(:,1))];
y_axis_1 = -(B_glm(1)+B_glm(2) * x_axis)/B_glm(3);

[class,err,POSTERIOR,logp,B_lda] = classify(X, X, y);
y_axis_2 = -(B_lda(1,2).const+B_lda(1,2).linear(1) * x_axis)/B_lda(1,2).linear(2);

svm_mdl = fitcsvm(X,y);
y_axis_3 = -(svm_mdl.Bias+svm_mdl.Beta(1) * x_axis)/svm_mdl.Beta(2);

fprintf("Below is the scatter plot of data considering two featues: 21 and 28 \n");
plot(x_axis,y_axis_1, x_axis,y_axis_2, x_axis,y_axis_3);
ylim([-0.05 0.35]);
legend('Class 1', 'Class 2', 'Logistic Regression', 'LDA', 'SVM');

function average_accuracy=perform_cross_validation(X,Y,k, methods)
    average_accuracy = zeros(k,size(methods,1));
    for j = 1:length(methods)
        chunk_size = size(Y,1)/k;
        for i=1:k
            index = (i * chunk_size) - chunk_size;
            X_test = X(index+1:index+chunk_size, :);
            Y_test = Y(index+1:index+chunk_size, :);
            X_train = [X(1:index, :);X(index+chunk_size+1:end, :)];
            Y_train = [Y(1:index);Y(index+chunk_size+1:end)];
            if methods(j) == "logistic"
                B_glm = glmfit(X_train,Y_train,'binomial');
                X_test = [ones(size(Y_test)), X_test];
                y_pred = X_test*B_glm>=0;
                average_accuracy(i,j) = sum(y_pred==Y_test)/length(y_pred);
            elseif methods(j) == "lda"
                y_pred = classify(X_test, X_train, Y_train);
                average_accuracy(i,j) =  sum(y_pred==Y_test)/length(y_pred);
            else
                mdl = fitcsvm(X_train,Y_train);
                average_accuracy(i,j) = sum(Y_test==predict(mdl, X_test))/length(y_pred);
            end

        end
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    end
end
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3a) Below is the average accuracy for each fold in 5-fold cross validation
Logistic Reg    LDA     SVM
    0.9375    0.9732    0.9554
    0.9196    0.9286    0.9196
    0.9732    0.9732    0.9732
    0.9286    0.9554    0.9464
    0.9464    0.9643    0.9554

Average accuracy of LDA is highest in the all the folds, so we should select LDA

3b) Visualisation of data.
Below is the scatter plot of data considering two featues: 21 and 28
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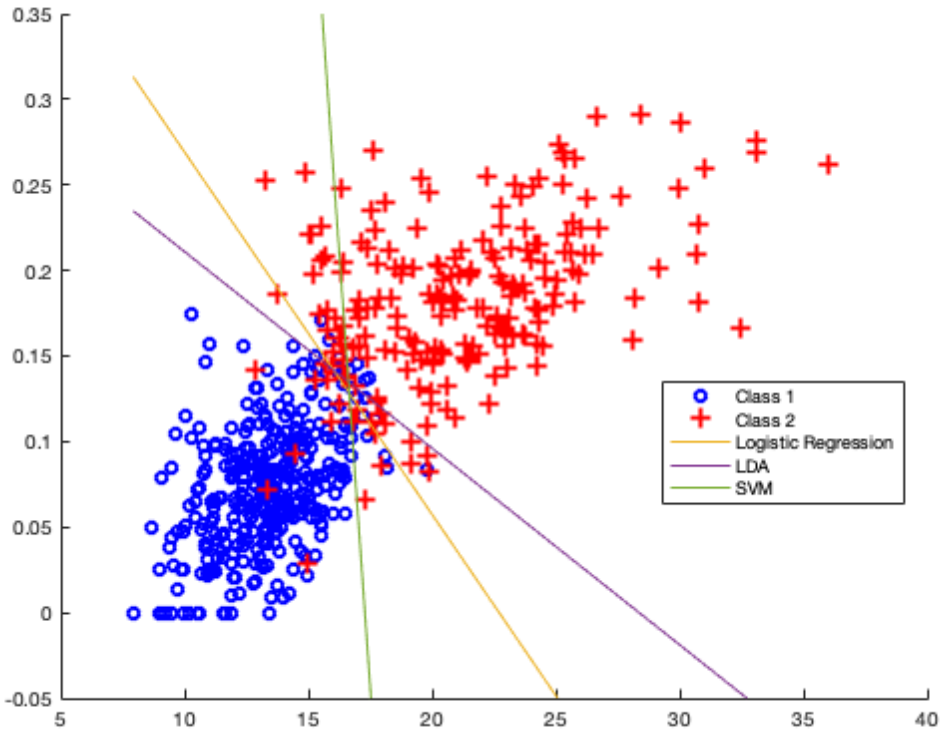

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