clear all;

close all;

clc;

load diabetes\_scaled.mat;

% Creating test and train data sets

X\_tr = X(1:500,:);

X\_tt = X(501:end,:);

Y\_tr = y(1:500);

Y\_tt = y(501:end);

grid\_sigma = 2.^(0:5);

grid\_C = 2.^(6:11);

tol = 0.01;

[n, p] = size(X\_tr);

% Cauchy kernel

cauchy\_kernel = @(u,v,sigma) (1 + dist2(u, v)/(sigma^2)) .^-1;

num\_sv = zeros(length(grid\_sigma), length(grid\_C));

CV\_error\_grid = zeros(length(grid\_sigma), length(grid\_C));

for i = 1:length(grid\_sigma)

grid\_sigma\_iter = grid\_sigma(:,i);

for j = 1:length(grid\_C)

grid\_C\_iter = grid\_C(:,j);

CV\_error\_iter = 0;

for k = 1:5

ind = (k-1)\*100 + 1: k\*100;

X\_tr\_iter = X\_tr;

X\_tr\_iter( ind,:) = [];

X\_CV\_iter = X\_tr(ind,:);

y\_tr\_iter = Y\_tr;

y\_tr\_iter(ind,:) = [];

y\_CV\_iter = Y\_tr(ind,:);

kmat\_tr = cauchy\_kernel(X\_tr\_iter, X\_tr\_iter, grid\_sigma\_iter);

[alpha, bias] = smo(kmat\_tr, y\_tr\_iter', grid\_C\_iter, tol);

kmat\_CV = cauchy\_kernel(X\_CV\_iter, X\_tr\_iter, grid\_sigma\_iter);

y\_pred = sign(kmat\_CV \* (y\_tr\_iter .\* alpha') + bias);

CV\_error\_iter = 1 - sum((y\_pred == y\_CV\_iter))/100 + CV\_error\_iter;

end

CV\_error\_grid(i, j) = CV\_error\_iter / 5;

end

end

[min\_error, ind] = min(CV\_error\_grid(:));

[m,n] = ind2sub(size(CV\_error\_grid),ind);

sigma\_opt = grid\_sigma(m); %4

C\_opt = grid\_C(n); %512

% Selected parameters: (sigma, C) :: (4, 512)

% CV error: min\_error :: 0.2480

% Final model

kmat\_tr = cauchy\_kernel(X\_tr, X\_tr, sigma\_opt);

[alpha, bias] = smo(kmat\_tr, Y\_tr', C\_opt, tol);

kmat\_tt = cauchy\_kernel(X\_tt, X\_tr, sigma\_opt);

y\_pred = sign(kmat\_tt \* (Y\_tr .\* alpha') + bias);

error\_tt = 1 - sum((y\_pred == Y\_tt))/size(Y\_tt, 1);

% test error :: 0.182

500 - sum(alpha == 0);

%number of support vectors :: 342

Question 4

clear;

clc;

load yalefaces; % loads the 3-d array yalefaces

% for i=1:size(yalefaces,3)

% x = double(yalefaces(:,:,i));

% imagesc(x);

% colormap(gray)

% drawnow

% %pause(.1)

% % [U, S, V] = svd(x);

% end

yalefaces\_mat = double(reshape(yalefaces, [], 2414)');

x\_mean = mean(yalefaces\_mat);

x\_mean\_mat = ones(size(yalefaces\_mat))\* diag(x\_mean);

cov\_base = yalefaces\_mat - x\_mean\_mat;

cov\_mat = (cov\_base' \* cov\_base) ./ 2414;

[U, D] = eig(cov\_mat);

eig\_values = sum(D);

[sort\_eig\_values, index] = sort(eig\_values,'descend');

semilogy(sort\_eig\_values)

for i = 1:length(sort\_eig\_values)

var\_cap = sum(sort\_eig\_values(:, 1:i)) / sum(sort\_eig\_values);

if var\_cap >= .95

break

end

end

% .95 variation captured: 43

% % dim reduction: .9787

for i = 1:length(sort\_eig\_values)

var\_cap = sum(sort\_eig\_values(:, 1:i)) / sum(sort\_eig\_values);

if var\_cap >= .99

break

end

end

% .99 variation captured: 167

% % dim reduction: .9172

subplot(5,4, 1)

a = reshape(x\_mean, 48, 42);

imagesc(a);

colormap(gray)

drawnow

for i = 1:19

subplot(5, 4, i+1);

x = reshape(U(:, index(i)), 48, 42);

imagesc(x);

colormap(gray)

drawnow

end