load("test.mat");

load("training.mat");

faces = TRAINING;

numFaces = size(faces,2);

h = 36; w = 36;

meanFace = mean(faces, 2);

faces = faces - repmat(meanFace, 1, numFaces);

% Perform Singular Value Decomposition

[u,d,v] = svd(faces, 0);

% Pull out eigen values and vectors

eigVals = diag(d);

eigVecs = u;

% Plot the mean sample and the first three principal components

figure(1); imagesc(reshape(meanFace, h, w)); title('Mean Face');colormap(gray);

figure(2);

subplot(1, 3, 1); imagesc(reshape(u(:, 1), h, w)); colormap(gray);title('First Eigenface');

subplot(1, 3, 2); imagesc(reshape(u(:, 2), h, w)); colormap(gray);title('Second Eigenface');

subplot(1, 3, 3); imagesc(reshape(u(:, 3), h, w)); colormap(gray);title('Third Eigenface');

figure(4);

for i=1:16

subplot(4,4,i);

imagesc(reshape(u(:,i),h,w)); colormap(gray);

end

% The cumulative energy content for the m'th eigenvector is the sum of the energy content

%across eigenvalues 1:m

for i = 1:size(faces,1)

energy(i) = sum(eigVals(1:i));

end

propEnergy = energy./energy(end);

% Determine the number of principal components required to model 90% of data variance

percentMark = min(find(propEnergy > 0.9));

% Pick those principal components

eigenVecs = u(:, 1:percentMark);

% Do something with them; for example, project each of the neutral and smiling faces onto

% the corresponding eigenfaces

% eigenVecs(:,:) = -1 \* eigenVecs(:,:);

menFaces = faces(:,1:2500); womenFaces = faces(:,2501:end);

menWeights = eigenVecs' \* menFaces;

womenWeights = eigenVecs' \* womenFaces;

% menWeights = pca(menFaces);

% womenWeights = pca(womenFaces);

figure(3)

plot3(menWeights(1,:),menWeights(2,:),menWeights(3,:),'r.','MarkerSize',11);

hold on

plot3(womenWeights(1,:),womenWeights(2,:),womenWeights(3,:),'b.','MarkerSize',11);

xlabel('PCA 1')

ylabel('PCA 2')

zlabel('PCA 3')

legend('men','women')

%% TEST KISMI

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testFaces = TEST;

testMean = mean(testFaces,2);

testFaces = testFaces - repmat(testMean, 1, size(testFaces,2));

C = testFaces'\*testFaces;

testWeights = eigenVecs' \* testFaces;

% testWeights = pca(testFaces);

testMatch = zeros(1,400);

for i = 1:400

weightDiff = repmat(testWeights(:, i), 1, numFaces) - [menWeights,womenWeights];

[val, ind] = min(sum(abs(weightDiff), 1));

testMatch(i) = ind;

end

acc = sum(testMatch(1:200)<2500)/400 + sum(testMatch(201:end)>2500)/400

acc\_men = sum(testMatch(1:200)<2500)/200

acc\_women = sum(testMatch(201:end)>2500)/200