COGS 109: Assignment #3

Due on Sunday, October 25, 2015

Tu, Zhuowen 2pm

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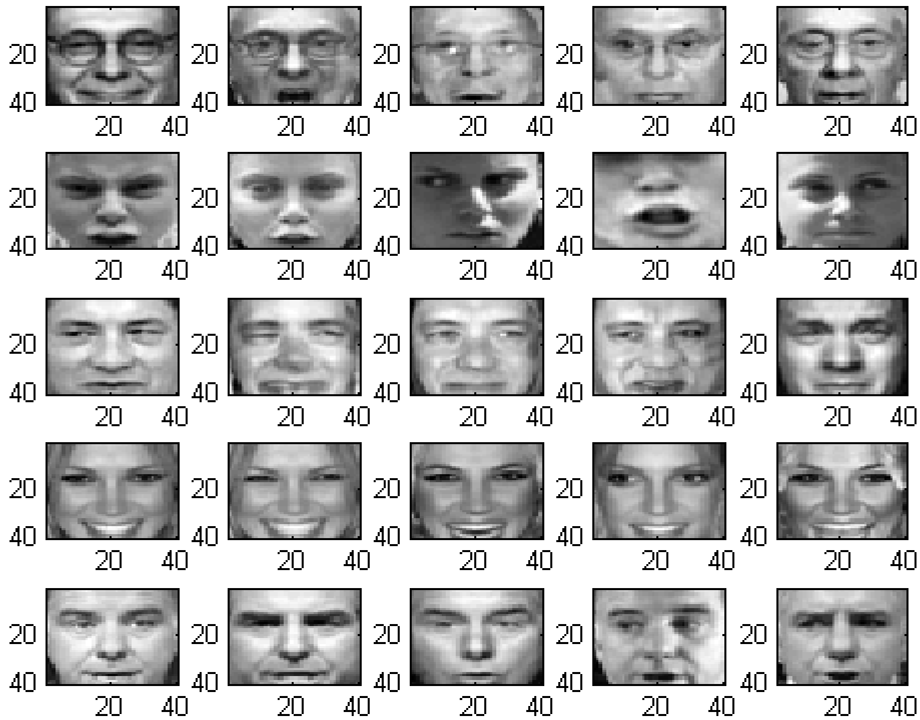
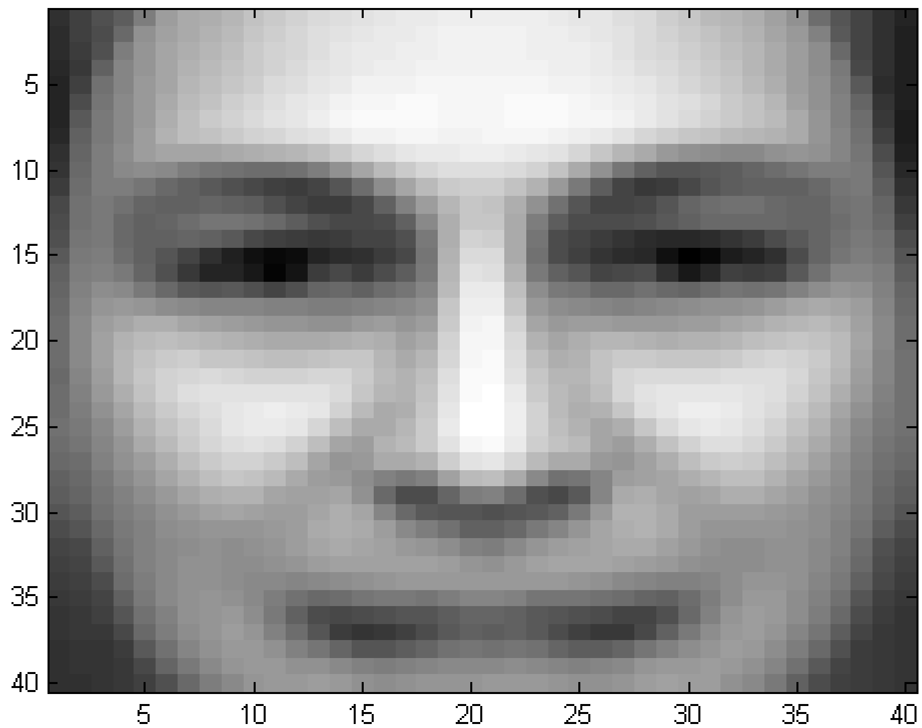
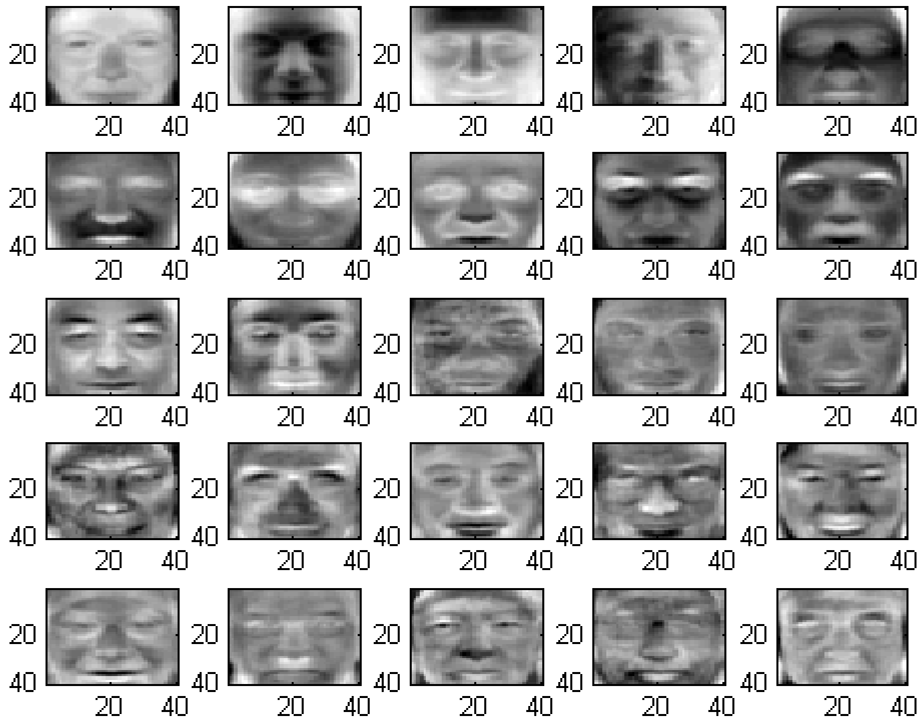
Problem 1



Problem 2

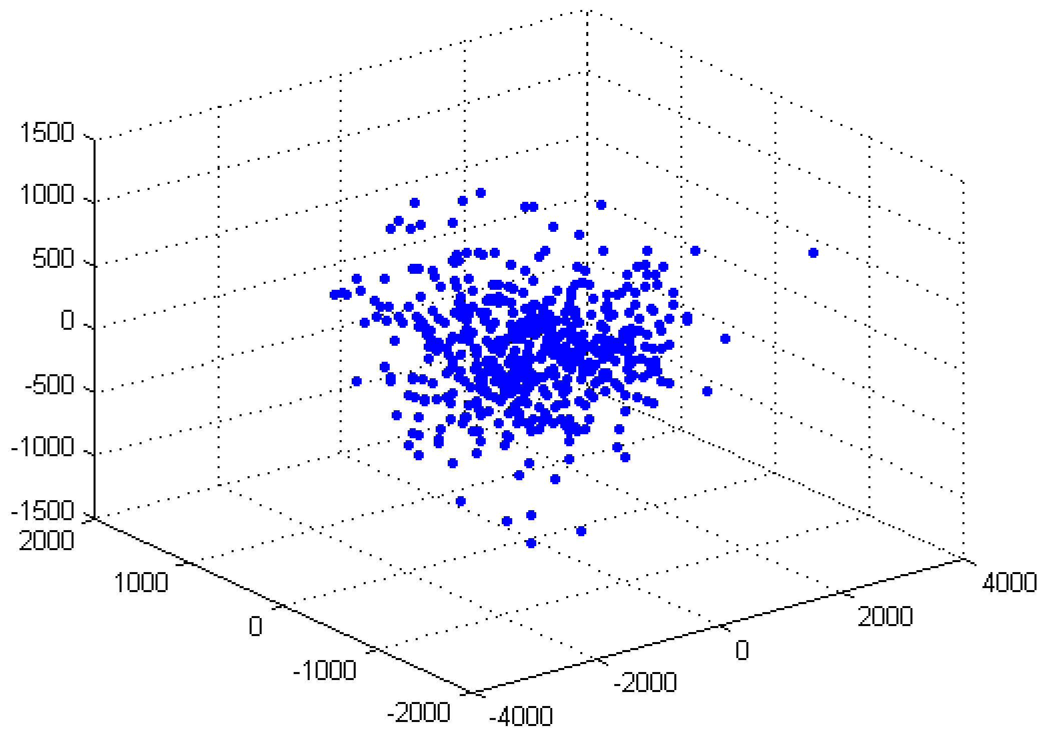


Problem 3

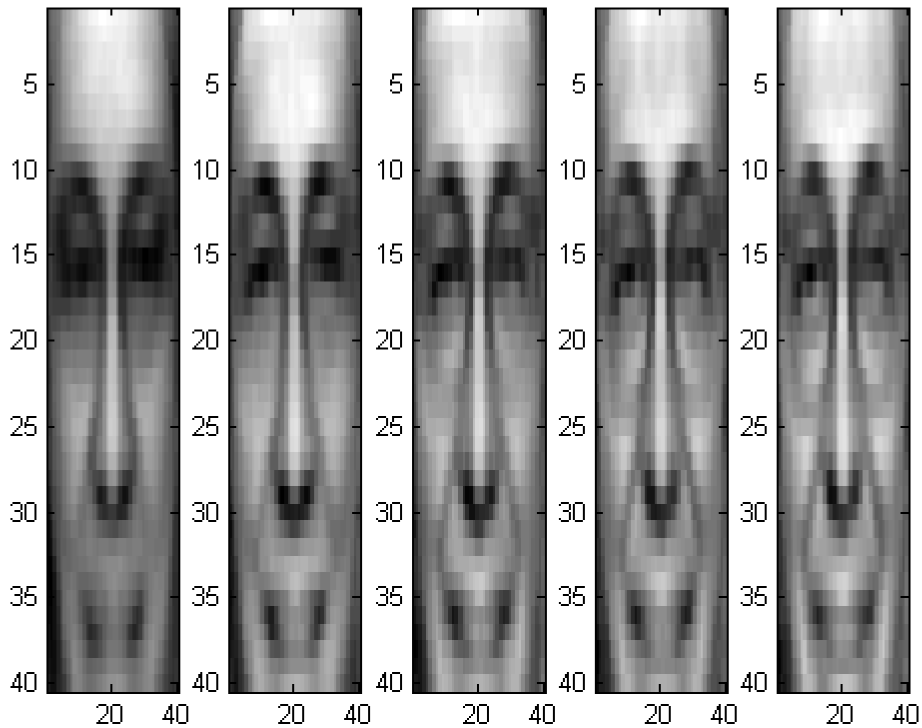


```
>> homework_3
Elapsed time is 0.807786 seconds.
```

Problem 4

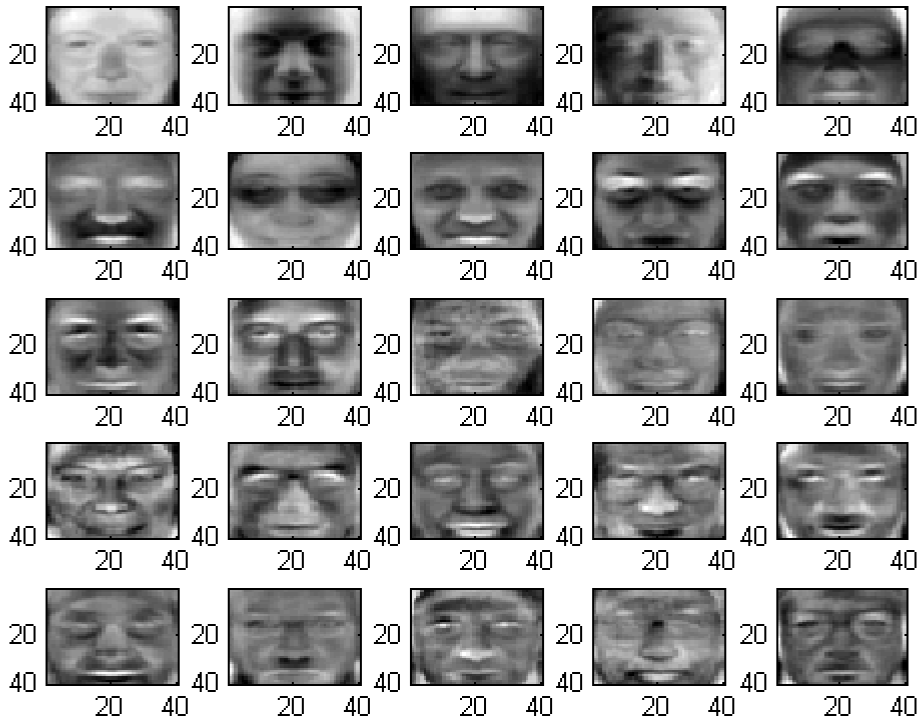


Problem 4 continued on next page. . .

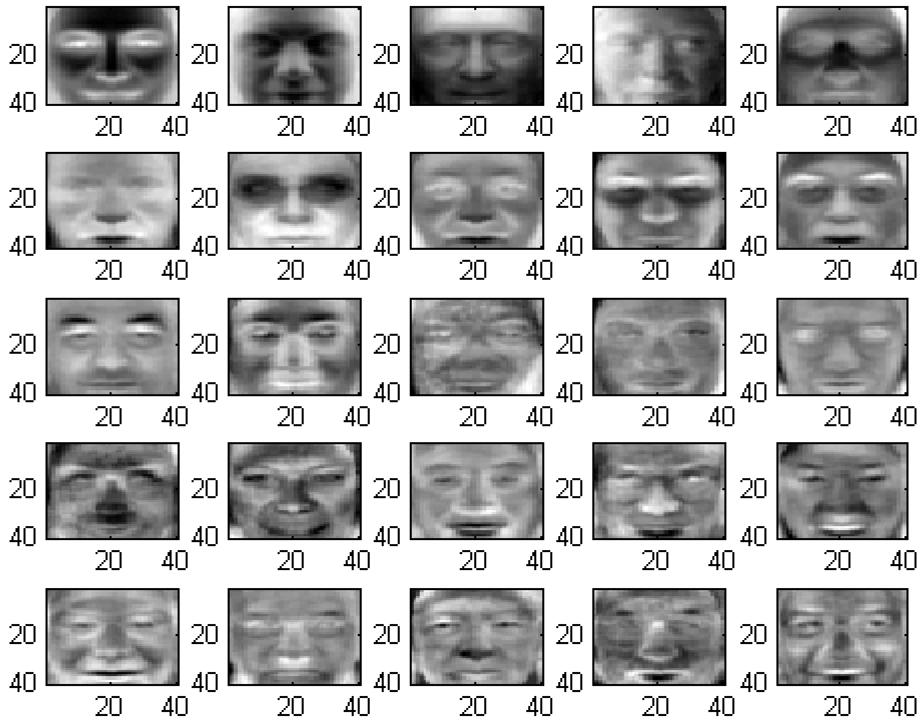


As we use higher and higher levels of principal components, we get closer to reconstructing the original face.

Problem 5

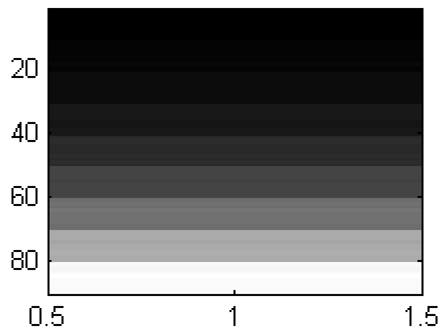


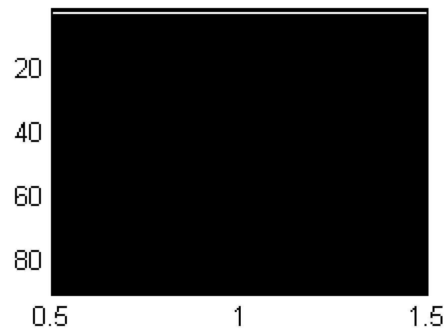
Problem 6



```
>> homework_3
Elapsed time is 0.236226 seconds.
```

Problem 7





SVD is slower than the eigenvalue function in MATLAB since SVD is much more accurate. SVD retains more information of the original data since we are calculating 3 matrices (which the calculation gets heavier by which we can decompose the original data while using the eigenvalue() function retains just the eigenvalues. Using the properties of eigenvalues, we can derive similar extrapolations like what we see in svd().

Homework Code

```
%% Homework #3 %%
%% Problem 1 %%
figure
for i = 1:25
    % Plot each face to each index
    faceI = reshape(facemat(:,i),40,40);
    subplot(5,5,i);
    imagesc(faceI);
end
colormap(gray);

%% Problem 2 %%
figure
meanFace = mean(facemat,2);
aveFace = reshape(mean(facemat,2),40,40);
imagesc(aveFace);
```

```
colormap(gray);

%% Problem 3 %%
%% Part A %%
Z = facemat - repmat(meanFace, [1, size(facemat,2)]);
%% Part B %%
C = Z*Z'/size(facemat,2);
%% Part C %%
[V, D] = eig(C);

%% Part D %%
[sv si] = sort(diag(D),'descend');
Vs = V(:,si);

%% Part E %%
figure
for i = 1:25
    % Plot each face to each index
    faceI = reshape(Vs(:,i),40,40);
    subplot(5,5,i);
    imagesc(faceI);
end
colormap(gray);
%%% QUESTION 4 %%%
%% Part A %%
figure
Proj = Vs(:,1:3)'*Z;
scatter3(Proj(1,:),Proj(2,:),Proj(3,:),20,'filled');

%% Part B %%
figure
for i=1:5
    subplot(1,5,i);
    ReFace = Vs(:,1:20*i)*Vs(:,1:20*i)'*Z(:,1) + meanFace;
    aveFace2 = reshape(ReFace,40,40);
    imagesc(aveFace2);
colormap(gray);
end

%%% QUESTION 5 %%%
COEFF = pca(facemat', 'Algorithm', 'eig');

figure
for i = 1:25
    subplot(5,5,i);
    % Plot each face to each index
    faceI = reshape(COEFF(:,i),40,40);
    imagesc(faceI);
end
colormap(gray);


%%% QUESTION 6 %%%
```

```
[U,S,V] = svd(facemat);
figure
for i = 1:25
    % Plot each face to each index
    faceSVD = reshape(U(:,i),40,40);
    subplot(5,5,i);
    imagesc(faceSVD);
end
colormap(gray);


%%% QUESTION 7 %%%
[W,X,Y] = svd(ygain(1:90));
figure
for i = 1:2
    % Plot each face to each index
    gainSVD = W(:,i)
    subplot(2,2,i);
    imagesc(gainSVD);
end
colormap(gray);
```