Contents

AMATH 584 Homework 2: Yale Faces B

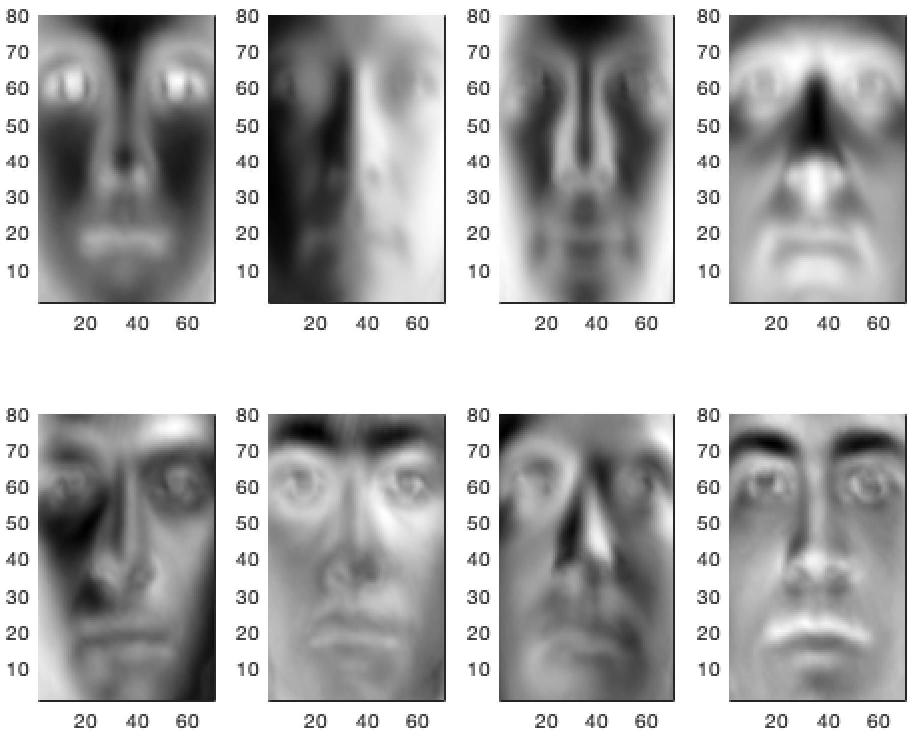
```
clear; clc; close all
```

Load data

```
% Make big, emtpy data matrices
A_cropped = [];
A_uncropped = [];

% Set up image dimensions
dim1 = 80;
dim2 = 70;

% Begin file reading iteration for the cropped images
count = 1;
for i = 1:39
    path = ['CroppedYale/yaleB' num2str(i, '%02.f')];
    P = path;
    addpath(genpath(P));
    dict = dir(P);

    for j = 1:numel(dict)
        file = dict(j).name;
        if length(file) > 3
            image = imread(file);
            data = imresize(double(im2gray(imread(file))), [dim1,dim2]);
            A_cropped(:,count) = data(:)';
            count = count + 1;
        end
    end
end

% Begin the file reading iteration for the uncropped images

%expressions = ['centerlight','glasses','happy','leftlight','noglasses',...
%    'normal','rightlight','sad','sleepy','surprised','wink'];

count = 1;
for i = 1:15
    path = 'yalefaces_uncropped/yalefaces';
    P = path;
    addpath(genpath(P));
    dict = dir(P);
    for j=1:numel(dict)
        file = dict(j).name;
        if length(file) > 3
            image = imread(file);
            data = imresize(double(im2gray(imread(file))), [dim1,dim2]);
            A_uncropped(:,count) = data(:)';
            count = count + 1;
        end
    end

end
```

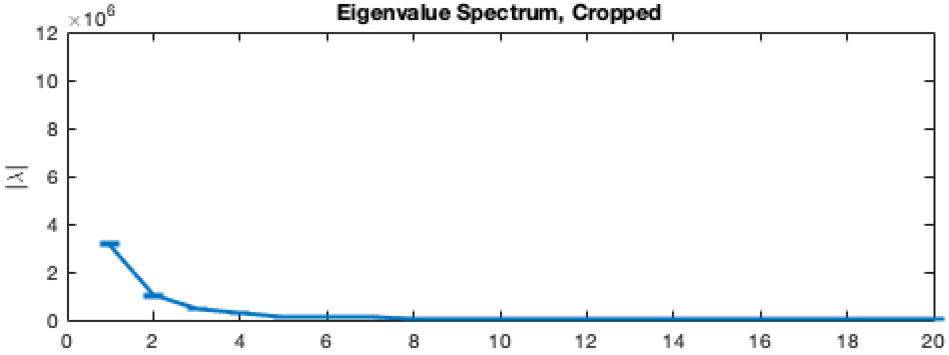
Perfrom a singular value decomposition on the cropped images

```
[U_c,S_c,V_st_c] = svd(A_cropped);

% U represents
% S represents
% V_st represents

% Plot the first few columns of U
figure(1);
for i = 1:8
    col = U_c(:, i);
    new_image = reshape(col, [dim1, dim2]);
    subplot(2,4,i);
    pcolor(flip(new_image)), shading interp, colormap gray
end
% suptitle('Eigenfaces, Cropped')
```



PCA analysis- cropped

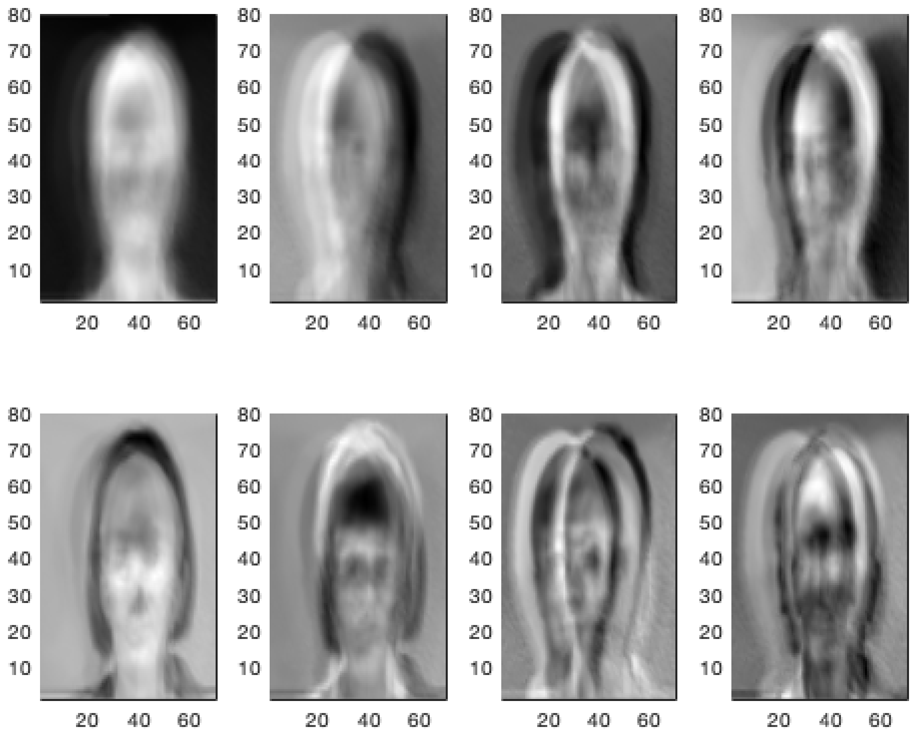
```
[~,~,Spca] = pca(A_cropped);
eigvals_c = Spca;
%eigvals_c = svd(C_c);

%N_st = trace(C_c)^2/trace(C_c.^2);

% Plot the eigenvalue spectrum
N_st = dim1*dim2;
err_c = eigvals_c*sqrt((2/N_st));

figure(2);
subplot(2,1,1);
errorbar(eigvals_c(1:20), err_c(1:20), 'linewi', 2)
ylim([0 12E6]);
ylabel('|\lambda|')
title('Eigenvalue Spectrum, Cropped')
% subplot(2,1,2);
% semilogy(eigvals_c(1:20), 'linewi', 2)
% ylim([0 10E7]);
% ylabel('|\lambda|')
```



Perform a singular value decomposition on the uncropped images

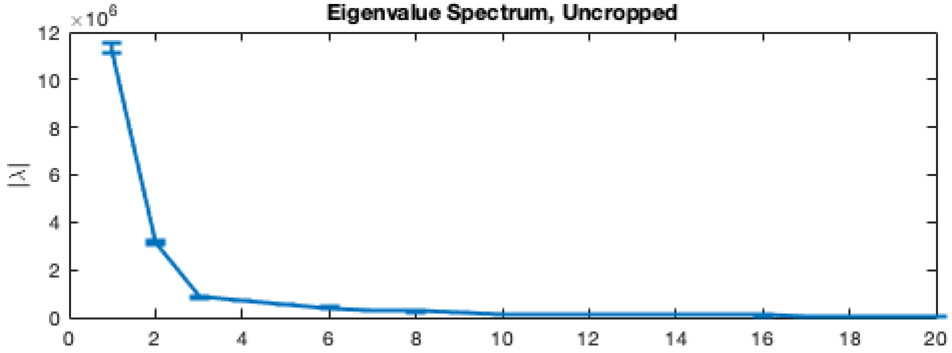
```
[U_uc,S_uc,V_st_uc] = svd(A_uncropped);

% U represents
% S represents
% V_st represents

% Plot the first few columns of U
figure(3);
```

```
for i = 1:8
    col = U_uc(:, i);
    new_image = reshape(col, [dim1, dim2]);
    subplot(2,4,i);
    pcolor(flip(new_image)), shading interp, colormap gray
end
%suptitle('Eigenfaces, Uncropped')
```



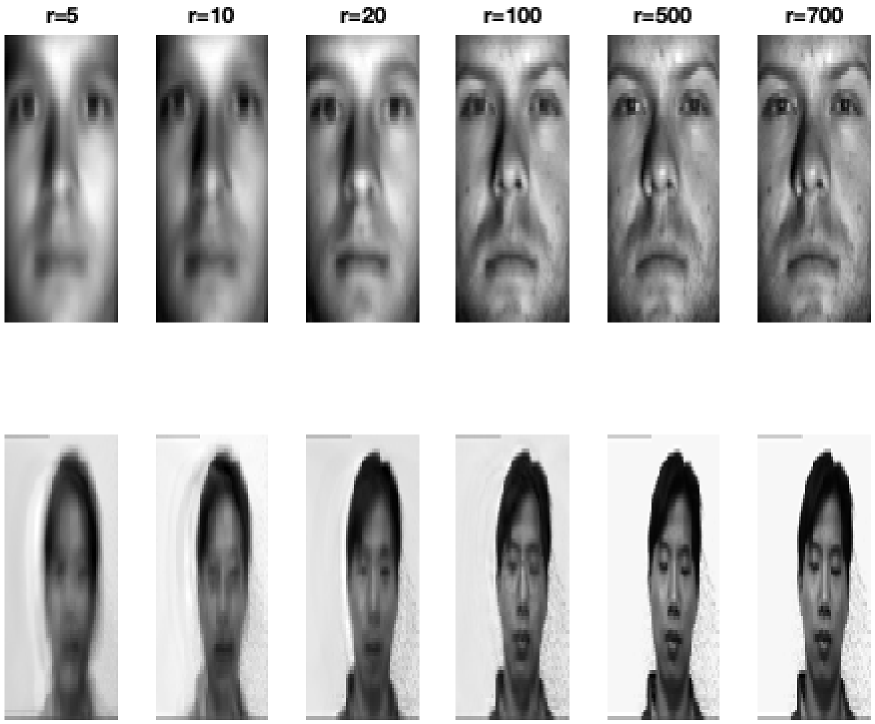
PCA analysis- uncropped

```
% Calculated SVD on the covariance matrix

[~,~,Spcau] = pca(A_uncropped);
eigvals_uc = Spcau;

N_st = dim1*dim2;
%N_st = trace(C_uc)^2/trace(C_uc.^2);

% Plot the eigenvalue spectrum
err_uc = eigvals_uc*sqrt((2/N_st));

figure(2);
subplot(2,1,2);
errorbar(eigvals_uc(1:20), err_uc(1:20), 'linewi', 2)
ylim([0 12E6])
ylabel('|\lambda|')
title('Eigenvalue Spectrum, Uncropped')
% subplot(2,1,2);
% semilogy(eigvals_uc(1:20), 'linewi', 2)
% ylim([0 10E7]);
% ylabel('|\lambda|')
```



Rank-based Reconstructions- uncropped

```
figure();
count = 1;
r = [5 10 20 100 500 700];
for ri= 1:length(r) % Truncation value
    face = 42;
     Xapprox_c  = U_c(:,1:r(ri)) * S_c(1:r(ri),1:r(ri)) * V_st_c(:,1:r(ri))';
     Xapprox_uc = U_uc(:,1:r(ri))*S_uc(1:r(ri),1:r(ri))*V_st_uc(:,1:r(ri))'; % Approx. image
    face_c = reshape(Xapprox_c(:,face), [dim1, dim2]);
    face_uc = reshape(Xapprox_uc(:,face),[dim1,dim2]);
    subplot(2,length(r),count)
    imagesc(face_c), axis off, colormap gray;
    title(['r=',num2str(r(ri),'%d') ]);
    subplot(2,length(r), count+length(r))
    imagesc(face_uc), axis off, colormap gray;
    count = count + 1;
end
```



Published with MATLAB® R2020b