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MACHINE LEARNING FOR VISUAL DATA ANALYSIS LAB - 2

1. Display the mean image. Code has been provided in lab2.m.

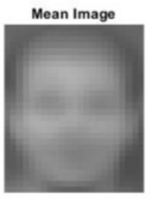

Fig 1: Mean Face

Mean image is obtained by taking the mean of every pixel of each image

2. Display the first 20 eigenfaces. You need to write this part of the code.

```
%----------------------------------------------------------------------------------------------------------
% 5 Display of the 20 first eigenfaces : Write your code here
%----------------------------------------------------------------------------------------------------------
A = V';
for i = 1:20
  min1 = min(A(i,:));
  max1 = max(A(i,:));
  for j = 1:644
     newImage(i,j) = 255*(A(i,j) - min1)/(max1-min1);
  end
end
Eigenface = uint8 (zeros(28, 23));
for i = 1:20
   for k = 0:643
      Eigenface(mod (k,28)+1, floor(k/28)+1 ) = newImage(i,k+1);
   end
   subplot (4, 5, i);
   imshow(Eigenface);
   title(['Eigenface ', num2str(i)]);
end
```

V is the EigenVector and it contains small and negative values
1.) The values of it are normalized between 0 and 255
2.) Every image contains new 644 features which has to be reshaped to 28 x 23
3.) Display first 20 eigenfaces.

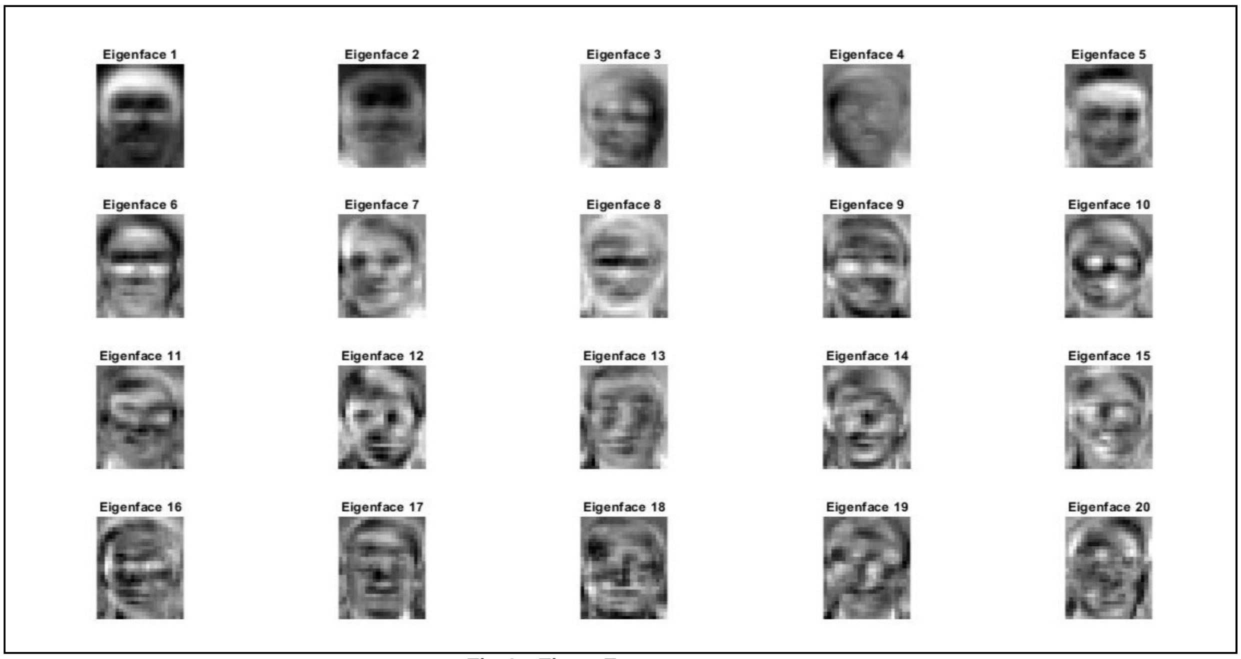

Fig 2 : Eigen Faces

3.Display the top 6 best matched training images for each test image. Code has been provided in lab2.m.

```
figure;
x=6;
y=2;
c=1;
for i=1:6
    Image = uint8 (zeros(28, 23));
    for k = 0:643
       Image( mod (k,28)+1, floor(k/28)+1 ) = Imagestest (i,k+1);
    end
    subplot (x,y,2*c-1);
    imshow (Image);
    title('Image tested');
    Imagerec = uint8 (zeros(28, 23));
    for k = 0:643
       Imagerec( mod (k,28)+1, floor(k/28)+1 ) = Imagestrain ((Indices(i,1)),k+1);
    end
    subplot (x,y,2*c);
    imshow (Imagerec);
    title(['Image recognised with ', num2str(Threshold), ' eigenfaces:',num2str((Indices(i,1))) ]);
    c=c+1;
end
```

<u>Note</u>: For every test image there is a corresponding nearest train image found with the help of eigen vectors and stored in indices which inturn is used to refer to matching train image

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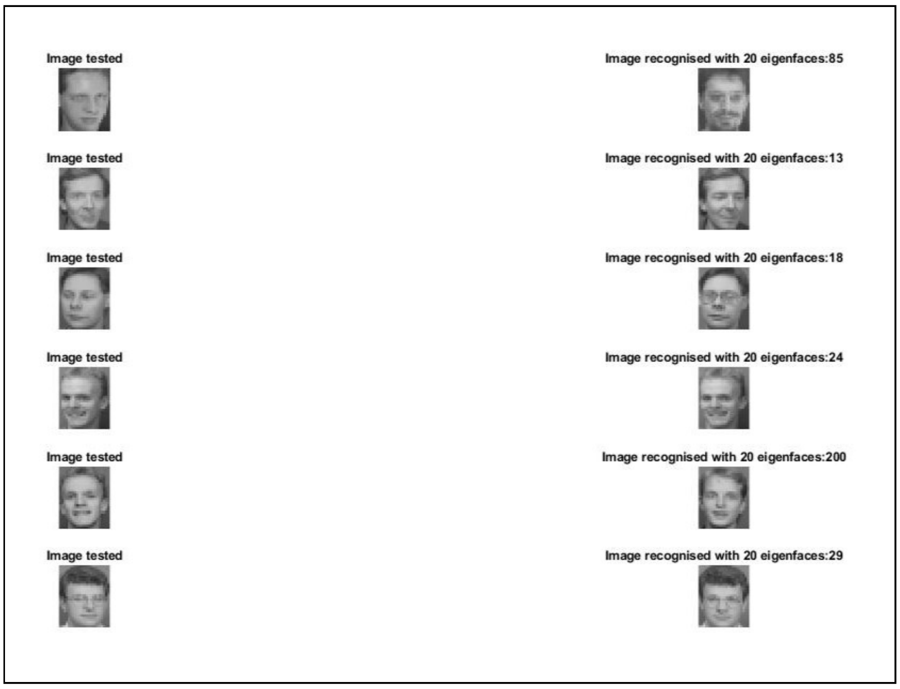
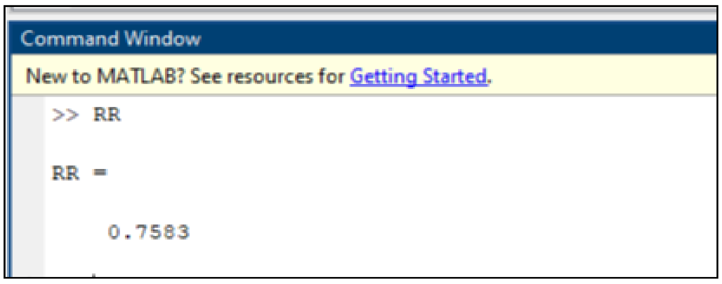


Image tested
Image recognised with 20 eigenfaces:85
Image tested
Image recognised with 20 eigenfaces:13
Image tested
Image recognised with 20 eigenfaces:18
Image tested
Image recognised with 20 eigenfaces:24
Image tested
Image recognised with 20 eigenfaces:200
Image tested
Image recognised with 20 eigenfaces:29

Fig 3 : Top 6 best matched image

4. Compute the recognition rate using 20 eigenfaces. Write your own code here

```
%--------------------------------------------------------------------------------------------------------------
% 9 recognition rate compared to the number of test images: Write your code here to
compute the recognition rate using top 20 eigenfaces.
%--------------------------------------------------------------------------------------------------------------
recognised_person=zeros(1,40);
recognitionrate=zeros(1,5);
number_per_number=zeros(1,5);
number_of_test_images=zeros(1,40);
 for i=1:70
    number_of_test_images(1,Identity(1,i))= number_of_test_images(1,Identity(1,i))+1;
    [Values(i,:), Indices(i,:)] = sort(Distances(i,:));
 end
i=1;
while (i<70)
   id=Identity(1,i);
   distmin=Values(id,1);
   indicemin=Indices(id,1);
   while (i<70)&&(Identity(1,i)==id)
      if (Values(i,1)<distmin)
         distmin=Values(i,1);
         indicemin=Indices(i,1);
      end
      i=i+1;
   end
   recognised_person(1,id)=indicemin;
number_per_number(number_of_test_images(1,id))=number_per_number(number_of_test_images(1,i
```


Command Window

New to MATLAB? See resources for Getting Started.

```
>> RR

RR =

    0.7583
```

```
d))+1;
    if (id==floor((indicemin-1)/5)+1) %the good person was recognised
recognitionrate(number_of_test_images(1,id))=recognitionrate(number_of_test_images(1,id))+1;
    end
end
for  i=1:5
   recognitionrate(1,i)=recognitionrate(1,i)/number_per_number(1,i);
end
RR = mean(recognitionrate(1,:));
figure;
plot (recognitionrate(1,:));
title('Recognitionrate for 20');
```

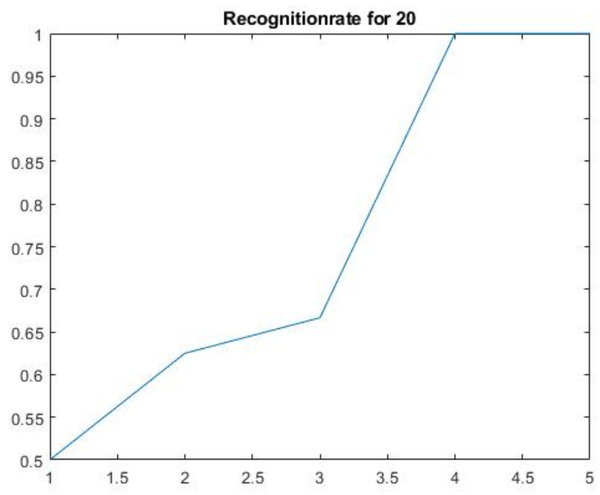


Fig 4: Recognition rate graph for no of eigenfaces =20

1)The test labels are stored in Identity matrix
2) Distance between every test and train sample is calculated
3)The number of correctly recognised persons are saved in recognitionrate
4)Mean of recognitionrate is calculated

5. Investigate the effect of using different number of eigenfaces for recognition (e.g. plot the recognition rate against the number of eigenfaces). Code has been provided in lab2.m.

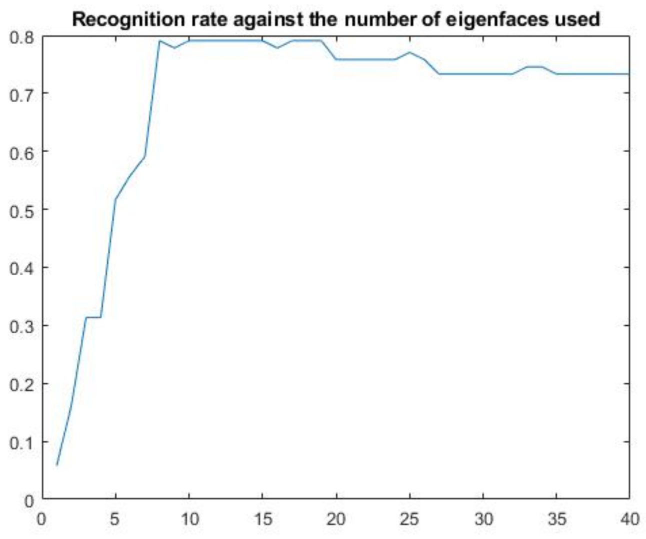


Fig 5: Recognition rate graph

1.)Recognition rate initially increases till a certain number of eigenfaces and then the values remain almost near to constant
2.)This is because the eigenvectors are sorted in the order of importance and after a certain value the eigenvectors are not much important and hence the recognition rate remains constant.

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6. Investigate the effect of K in K-Nearest-Neighbour (KNN) classifier. Plot the average recognition rate against K). You need to write your own code here.

```
averageRR=zeros(1,20);
Threshold = 20;  %No of eigenfaces
Distances=zeros(TestSizes(1),TrainSizes(1));
%--------Calculates the distance of all test images to train images------
for i=1:TestSizes(1)
   for j=1: TrainSizes(1)
      Sum=0;
      for k=1: Threshold
         Sum=Sum+((Locationstrain(j,k)-Locationstest(i,k)).^2);
      end
      Distances(i,j)=Sum;
   end
end
%--------Sorts the Distances and the values of distances are in Values
%and the corresponding train image index is in Indices
Values=zeros(TestSizes(1),TrainSizes(1));
Indices=zeros(TestSizes(1),TrainSizes(1));
for i=1:70
   [Values(i,:), Indices(i,:)] = sort(Distances(i,:));
end
%-------Nearby values are concatenated to limited values by putting them in 40 clusters (ie. every
%person has 40 sets of images)
person=zeros(70,200);
person(:,:)=floor((Indices(:,:)-1)/5)+1;
%------Loop Run for KNN from k=1 to k=20---------------
for K=1:20
  recog_person = zeros(1,70);
  recognitionrate = 0;
  number_of_occurance=zeros(70,K);
  %-----Loop run for every test image----------------
  for i=1:70
    max=0;
    %---------Loop run to check the k nearest occurances------
    for j=1:K
      for k=j:K
        if (person(i,k)==person(i,j))
          number_of_occurance(i,j)=number_of_occurance(i,j)+1;
        end
      end
      if (number_of_occurance(i,j)>max)
        max=number_of_occurance(i,j);
        jmax=j;
      end
    end
   recog_person(1,i)=person(i,jmax);
```

```
    %--------------If the identity matches increment the recongnitionrate--------
    if (Identity(1,i)==recog_person(1,i))
        recognitionrate=recognitionrate+1;
    end
    averageRR(1,K)=recognitionrate/70;
  end
end
figure;
plot(averageRR(1,:));
title('Recognition rate for different values of k in KNN');
```

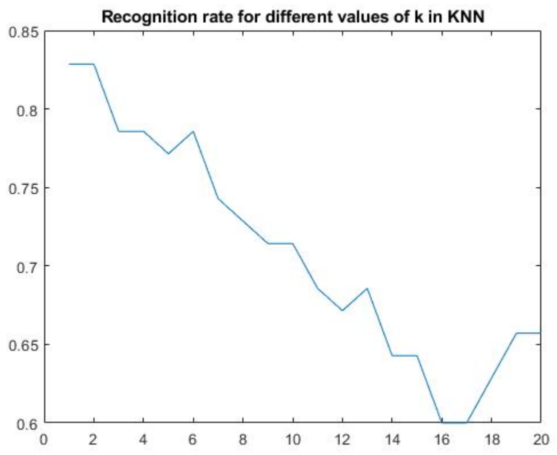

Fig 6: Recognition rate graph