## HW3

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均值脸程序与图像如下所示:

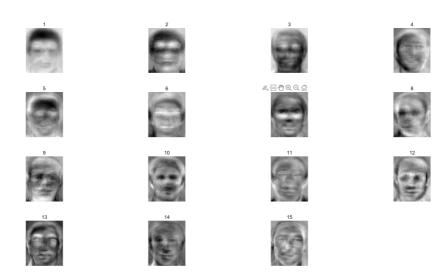
```
1 | filepath = "./att_faces/";
 2
   row = 112;
 3
   co1 = 92;
   total_image = zeros(row,col);
 4
 5
   count = 0;
 6
   for i=1:30
 7
        for j=1:10
 8
            image = imread(filepath+"s"+i+"/"+j+".pgm");
            image = im2double(image);
 9
            total_image = total_image + image;
10
            count = count + 1;
11
        end
12
13
    end
    mean_image = mat2gray(total_image/count);
14
    imshow(mean_image);
15
16 title("mean face");
```



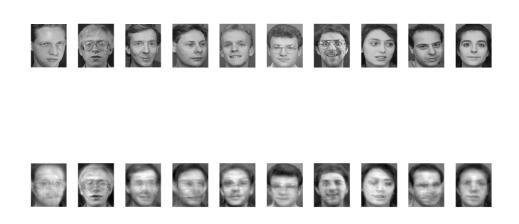
## 特征脸和重构脸的程序如下:

```
1 filepath = "./att_faces/";
 2
   row = 112;
    co1 = 92;
   image_matrix = zeros(row*col, 240);
 5
    count = 0;
 6
   for i=1:30
 7
        for j=1:8
            image = imread(filepath+"s"+i+"/"+j+".pgm");
 8
            image = im2double(image);
 9
10
            image = reshape(image,[row*col, 1]);
11
            count = count + 1;
12
            image_matrix(:,count) = image;
13
        end
14
    end
15
    mean_image = mean(image_matrix,2);
```

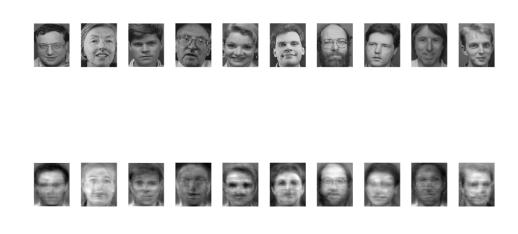
```
16 z_matrix = image_matrix - mean_image; %(10304,240)
    corr_matrix = z_matrix.' * z_matrix;
17
18
    [V, D] = eig(corr_matrix);
19
   [d, index] = sort(diag(D), 'descend');
20
   feature_array = V(:,index);
                                            % sorted feature vector
    max_num = 40;
21
22
    % feature vectors
23
    feature_array = z_matrix * feature_array(:,1:max_num); %(10304,40)
24
   figure(1);
25
    for i=1:15
        subplot(4, 4, i);
26
27
        imshow(mat2gray(reshape(feature_array(:,i),[row,col])));
28
        title(i);
29
    end
30
    % normalize feature vectors
31
    norm_feature = zeros(size(feature_array));
32
33
    for i=1:max_num
34
        norm_feature(:,i) = feature_array(:,i)/norm(feature_array(:,i));
35
    end
36
37
    % 重构前10个志愿者的第10张人脸
38
    show_n = 10;
39
   figure(2);
40
    for i=1:show_n
        image = imread(filepath+"s"+i+"/"+10+".pgm");
41
        subplot(2,show_n,i), imshow(image);
42
43
        image = im2double(image);
44
        image = reshape(image,[row*col, 1]);
45
        zi = image - mean_image; %(10304,1)
46
        yi = zeros(max_num, 1); %(40,1)
47
        for j=1:max_num
48
            yi(j,:) = norm_feature(:,j).'* zi;
49
        end
50
        yi_hat = norm_feature * yi + mean_image;
51
        subplot(2,show_n,show_n+i), imshow(mat2gray(reshape(yi_hat,[row,col])));
52
    end
53
    % 重构后10个志愿者的人脸
54
55
    figure(3);
    for i=1:show_n
56
57
        image = imread(filepath+"s"+(i+30)+"/"+1+".pgm");
58
        subplot(2,show_n,i), imshow(image);
59
        image = im2double(image);
60
        image = reshape(image,[row*col, 1]);
61
        zi = image - mean\_image; %(10304,1)
        yi = zeros(max_num, 1); %(40,1)
62
63
        for j=1:max_num
64
            yi(j,:) = norm_feature(:,j).'* zi;
65
        end
66
        yi_hat = norm_feature * yi + mean_image;
        subplot(2,show_n,show_n+i), imshow(mat2gray(reshape(yi_hat,[row,col])));
67
68
    end
```



对前10位志愿者的第10幅重构图像对比如下图:



对后10位志愿者的重构图像对比如下图:



可以看出, 重构后基本上恢复了人脸的重要特征。