Exercise1

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EigenFace is actually very simple in terms of thinking. It is equivalent to converting face from pixel space to another space, and doing similarity calculation in another space. The basic idea of image recognition is the same. First, choose a suitable subspace, transform all the images into this subspace, and then measure similarity or classify learning in this subspace. Converting to another space, the images of the same category converge together, and the images of different categories will be far away, or the distribution of different types of images in the original pixel space will be difficult to separate by a simple line or face. Then if you change to another space, you can very well separate them. The idea of EigenFace is to transform human face from pixel space to another space and do similarity calculation in another space. The spatial transformation method chosen by EigenFace is PCA, which is the famous principal component analysis. It is widely used in preprocessing to eliminate the correlation between sample feature dimensions. Of course, this is not to say this. The EigenFace method uses PCA to obtain the main components of face distribution. The specific implementation is to perform eigenvalue decomposition on the covariance matrix of all face images in the training set, and obtain the corresponding eigenvectors. These eigenvectors (feature vectors) are "Feature face". Each feature vector or feature face is equivalent to capturing or describing a change or characteristic between faces. This means that each human face can be represented as a linear combination of these feature faces.

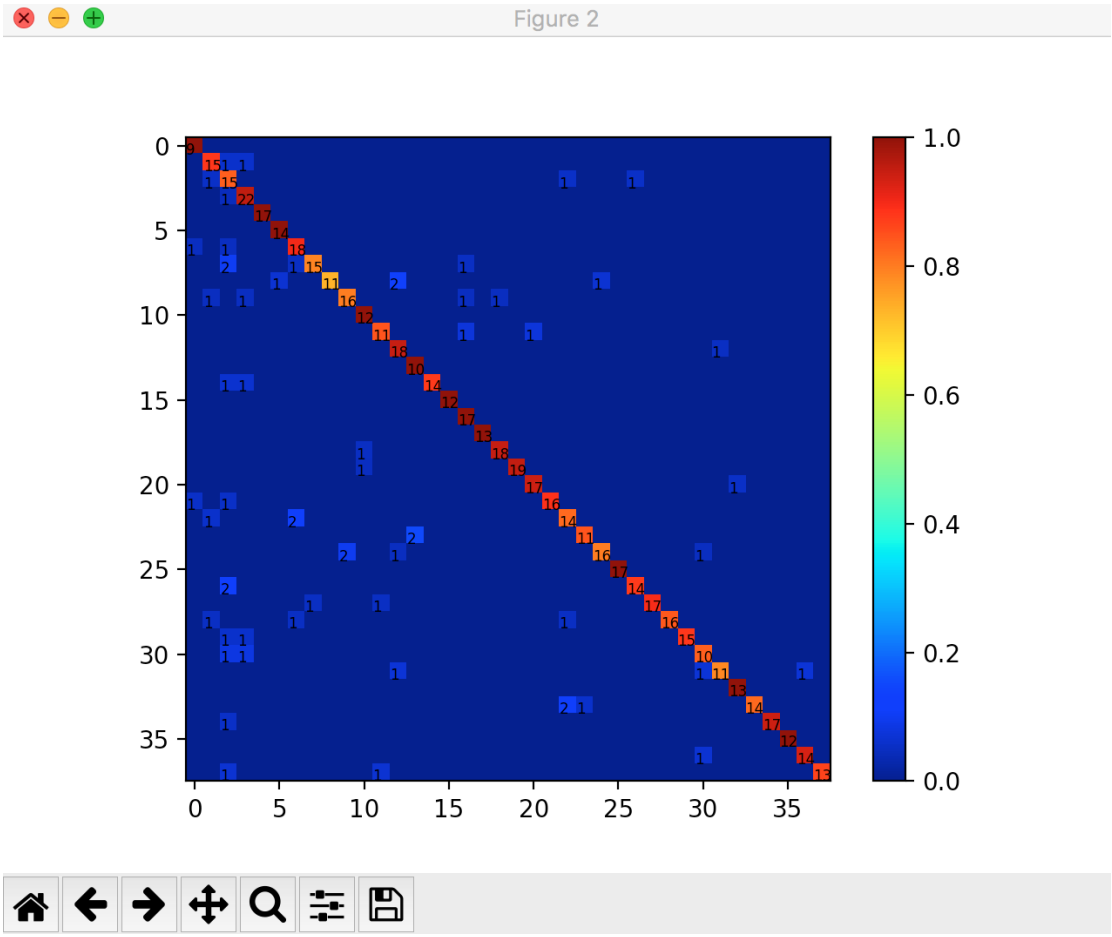
Use pca method, svm

```
X = face_profile_data
y = face_profile_name_index

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_state=42)
```

random select data from the sample

```
Loading Database:
0       65  images are loaded from: ../face_profiles/yaleB33
1       65  images are loaded from: ../face_profiles/yaleB34
2       65  images are loaded from: ../face_profiles/yaleB02
3       65  images are loaded from: ../face_profiles/yaleB05
4       65  images are loaded from: ../face_profiles/yaleB04
5       65  images are loaded from: ../face_profiles/yaleB03
6       65  images are loaded from: ../face_profiles/yaleB35
7       65  images are loaded from: ../face_profiles/yaleB32
8       65  images are loaded from: ../face_profiles/yaleB10
9       64  images are loaded from: ../face_profiles/yaleB17
10      65  images are loaded from: ../face_profiles/yaleB28
11      65  images are loaded from: ../face_profiles/yaleB21
12      65  images are loaded from: ../face_profiles/yaleB26
13      65  images are loaded from: ../face_profiles/yaleB19
14      65  images are loaded from: ../face_profiles/yaleB27
15      64  images are loaded from: ../face_profiles/yaleB18
16      65  images are loaded from: ../face_profiles/yaleB20
17      63  images are loaded from: ../face_profiles/yaleB16
18      65  images are loaded from: ../face_profiles/yaleB29
19      61  images are loaded from: ../face_profiles/yaleB11
20      65  images are loaded from: ../face_profiles/yaleB08
21      65  images are loaded from: ../face_profiles/yaleB37
22      65  images are loaded from: ../face_profiles/yaleB30
23      65  images are loaded from: ../face_profiles/yaleB39
24      65  images are loaded from: ../face_profiles/yaleB06
25      65  images are loaded from: ../face_profiles/yaleB01
26      65  images are loaded from: ../face_profiles/yaleB38
27      65  images are loaded from: ../face_profiles/yaleB07
28      65  images are loaded from: ../face_profiles/yaleB31
29      65  images are loaded from: ../face_profiles/yaleB09
30      65  images are loaded from: ../face_profiles/yaleB36
31      61  images are loaded from: ../face_profiles/yaleB13
32      65  images are loaded from: ../face_profiles/yaleB25
33      65  images are loaded from: ../face_profiles/yaleB22
34      65  images are loaded from: ../face_profiles/yaleB23
35      65  images are loaded from: ../face_profiles/yaleB24
36      60  images are loaded from: ../face_profiles/yaleB12
37      64  images are loaded from: ../face_profiles/yaleB15

 2452  samples from  38  people are loaded

Extracting the top 150 eigenfaces from 1839 faces

Projecting the input data on the eigenfaces orthonormal basis

Fitting the classifier to the training set

Predicting people's names on the test set

Prediction took 0.00026580 second per sample on average

Test Error Rate: 8.8091 %
Test Recognition Rate: 91.1909 %
```

```
confusion matrix=
[[ 9  0  0 ...  0  0  0]
 [ 0 15  1 ...  0  0  0]
 [ 0  1 15 ...  0  0  0]
 ...
 [ 0  0  0 ... 12  0  0]
 [ 0  0  0 ...  0 14  0]
 [ 0  0  1 ...  0  0 13]]
```



confusion matrix


Figure 1
predicted: yaleB25
true: yaleB25
predicted: yaleB28
true: yaleB28
predicted: yaleB16
true: yaleB16
predicted: yaleB15
true: yaleB15
predicted: yaleB01
true: yaleB01
predicted: yaleB04
true: yaleB04
predicted: yaleB11
true: yaleB11
predicted: yaleB28
true: yaleB32
predicted: yaleB32
true: yaleB32
predicted: yaleB17
true: yaleB17
predicted: yaleB05
true: yaleB05
predicted: yaleB06
true: yaleB06

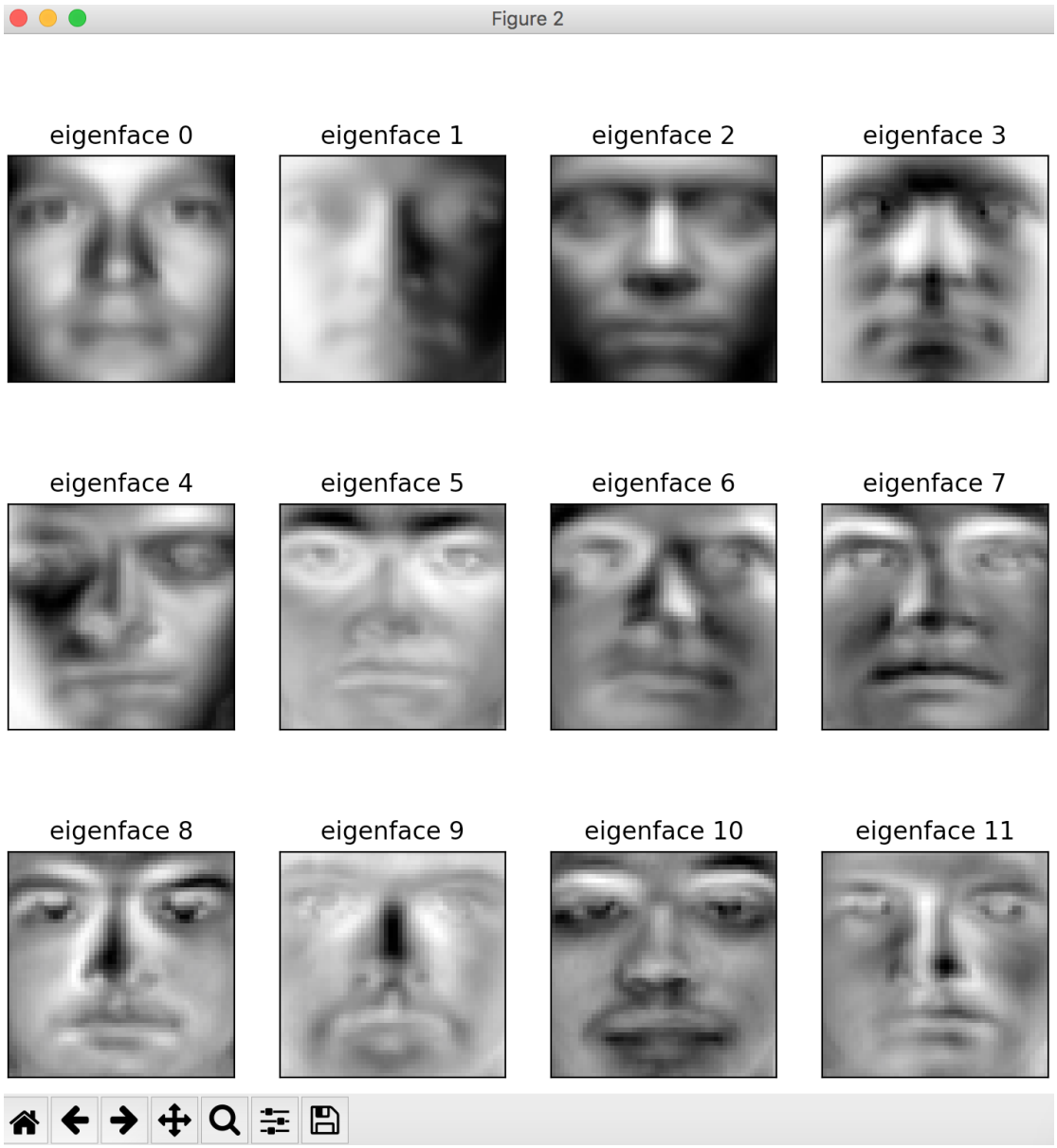


Figure 2
eigenface 0
eigenface 1
eigenface 2
eigenface 3
eigenface 4
eigenface 5
eigenface 6
eigenface 7
eigenface 8
eigenface 9
eigenface 10
eigenface 11