Question 4 (a)

In [3]:

```
import numpy as np
from PIL import Image
import os
from numpy import linalg as LA
import matplotlib.pyplot as plt
from sklearn import preprocessing
import numpy as np
import pandas as pd
from PIL import Image
import glob
from sklearn.decomposition import PCA
from sklearn.model_selection import GridSearchCV
from sklearn.svm import SVC
from sklearn.metrics import classification_report
from sklearn.svm import SVC
from sklearn.model_selection import StratifiedKFold
from sklearn.decomposition import PCA
from sklearn.ensemble import AdaBoostClassifier
from sklearn.mixture import GaussianMixture

import pandas as pd
import os
from sklearn.model_selection import train_test_split
directory = os.getcwd()
```

In [4]:

```
# --> import
all_data = np.arange(77760)

for filename in glob.glob('yalefaces/*.*'): #assuming gif

    img=Image.open(filename)  #打开图像
    im = np.asarray(img,dtype='float64')
    im = np.ndarray.flatten(im)
    all_data = np.vstack([all_data, im])

DF = pd.DataFrame(data=all_data[0:,0:])  # 1st row as the column names
DF = DF.iloc[1:]

import sys
import numpy as np
pd.set_option('display.max_colwidth', -1)

np.set_printoptions(threshold=sys.maxsize)

test = np.arange(77760)

for index, X in DF.iterrows():

    X = (X - X.min())/(X.max()-X.min())
    X = X - X.mean()
    X = X.fillna(X.mean())

    test = np.vstack([test, X])

input_data = pd.DataFrame(data=test[1:,0:])
input_data.shape
```

Out[4]:

```
(166, 77760)
```

In [12]:

```
test[0]
```

Out[12]:

```
0     -0.086900
1     -0.284658
2     -0.217159
3     -0.219498
4     -0.134718
         ...
161   -0.288550
162   -0.242689
163   -0.170048
164   -0.257351
165   -0.211183
Name: 0, Length: 166, dtype: float64
```

Test the maximum value

In [60]:

```
test.iloc[165].max()
```

Out[60]:

```
0.2803483290033276
```

In [55]:

```
test.to_csv(r'/Users/dior/Desktop/633/HW3/normalized_data.txt')
```

Begin PCA!!!

In [13]:

```
pca = PCA(n_components=30)
pca.fit(test)

X_trans = pca.transform(test)

eigenvalues = pca.explained_variance_

eigenvalues
```

Out[13]:

```
array([1615.28823735,  593.6792751 ,  399.27440711,  260.21898268,
        224.27999051,  164.62334522,  135.25024074,  123.10439526,
        101.15823201,   74.00017122,   69.61269972,   59.30165133,
         49.54111534,   47.86329136,   44.34499499,   38.88939432,
         36.67278132,   34.86204326,   32.61326437,   28.63296241,
         26.35334954,   24.70338738,   22.65098775,   20.93287521,
         20.43627003,   19.3384709 ,   17.86031645,   16.69315501,
         15.68355232,   14.62747126])
```

In [14]:

```

```

1

In [105]:

```
index = np.arange(0, 30, 1)
index.size
```

Out[105]:

```
30
```

In [104]:

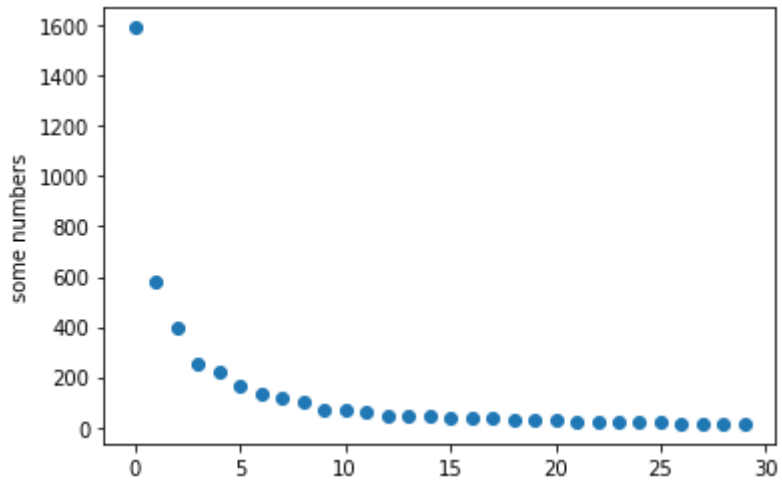
```
eigenvalues.size
```

Out[104]:

```
30
```

In [106]:

```
import matplotlib.pyplot as plt

plt.scatter(index,eigenvalues)

plt.ylabel('some numbers')

plt.show()
```



In [46]:

```
pca_all = PCA(n_components=165)
pca_all.fit(test)

X_trans_all = pca_all.transform(test)

eigenvalues_all = pca_all.explained_variance_

eigenfaces = pca_all.components_.reshape((165, 243, 320))
```

In [54]:

```
eigenfaces[1].shape
```

Out[54]:

```
(243, 320)
```

In [131]:

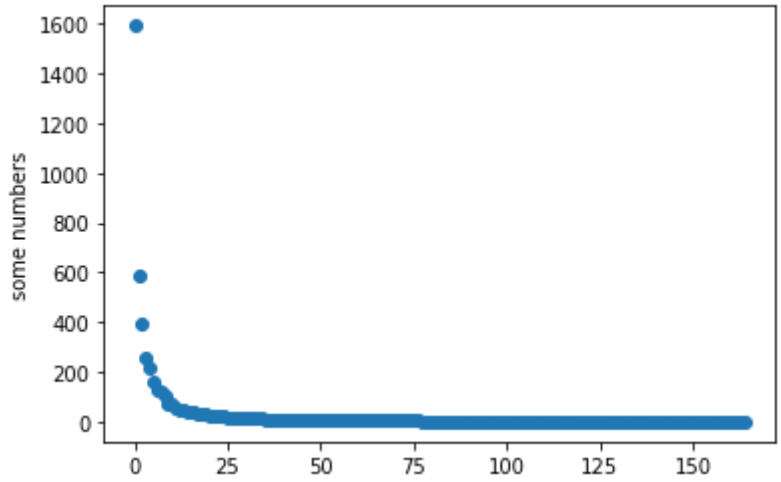
```
index = np.arange(0, 165, 1)
index.size
```

Out[131]:

```
165
```

In [132]:

```
import matplotlib.pyplot as plt

plt.scatter(index,eigenvalues_all)

plt.ylabel('some numbers')

plt.show()
```



In [130]:

```
sum = 0

for i in eigenvalues_all:
    sum = sum + i

print("sum is " + str(sum))

count = 0

half_energy = 0
for i in eigenvalues_all:

        half_energy = half_energy + i

        print(half_energy)

        if(half_energy > sum/2):
            count = count + 1
            print("50% energy from capturing : " + str(count) + " component")
            break

        count = count + 1
```

```
sum is 4704.075506937289
1591.2654718752708
2174.722873068933
2567.772734789077
50% energy from capturing : 3 component
```

In [ ]:

Question 4 (c)

Question 4 (c)

In [72]:

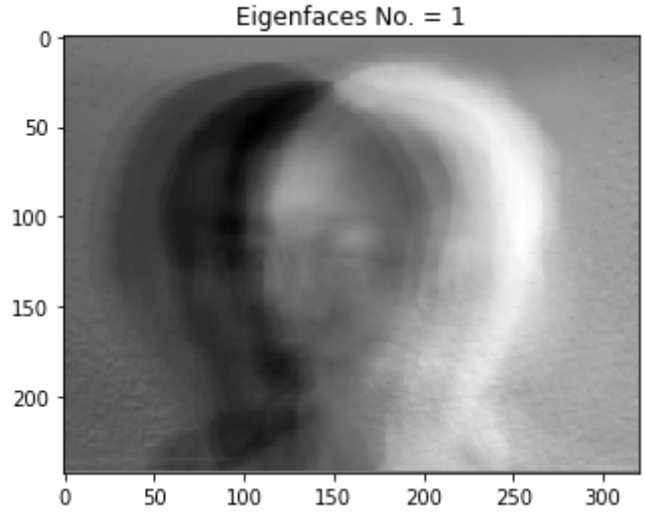
```
pca_all = PCA(n_components=166)
pca_all.fit(test)

X_trans_all = pca_all.transform(test)

eigenvalues_all = pca_all.explained_variance_

eigenvetor_all = pca_all.components_

eigenfaces = pca_all.components_.reshape((166, 243, 320))

eigenfaces[0].shape

# Reference: https://scikit-learn.org/stable/auto_examples/applications/plot_face_recognition.html
```

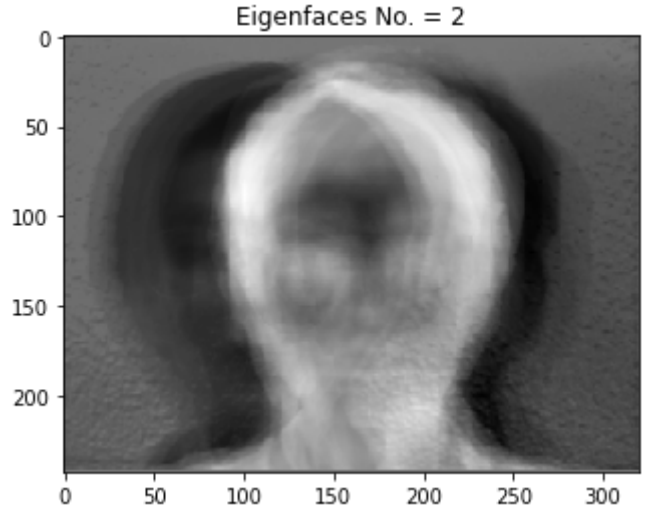
Out[72]:

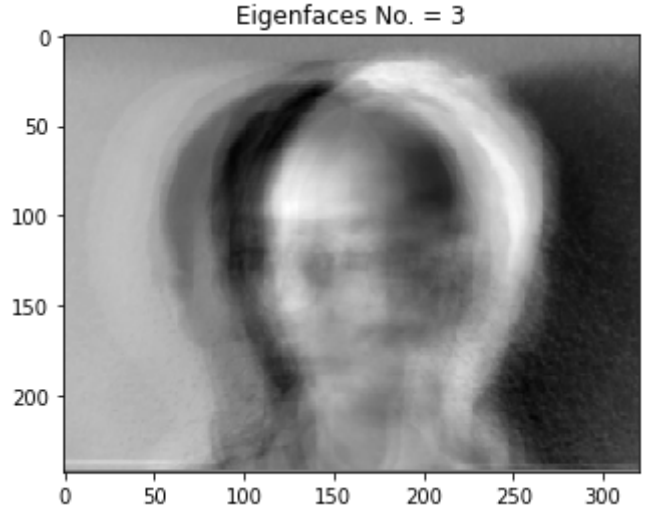
```
(243, 320)
```

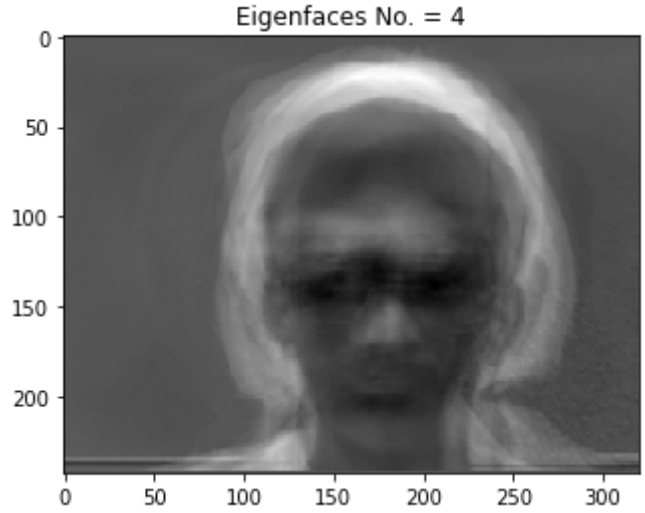
In [62]:

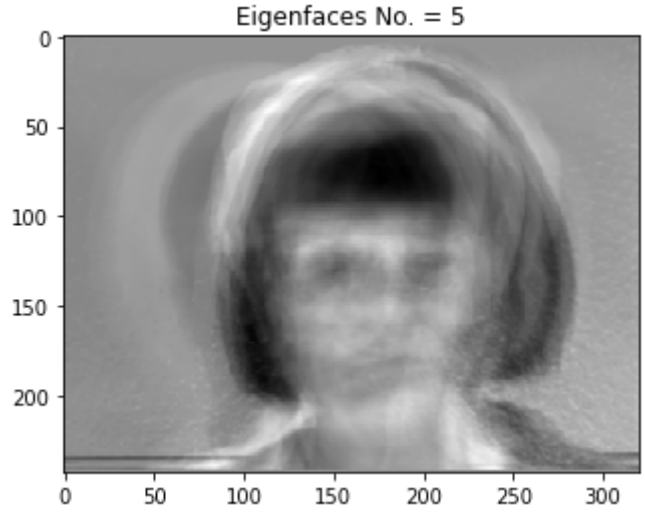
```
# m = (X_trans_all.transpose()).dot(test)
# m = m.transpose()

for i in range(10):
    plt.imshow(eigenfaces[i],cmap='gray')
    plt.title('Eigenfaces No. = {}'.format(1+i))
    plt.show()
```

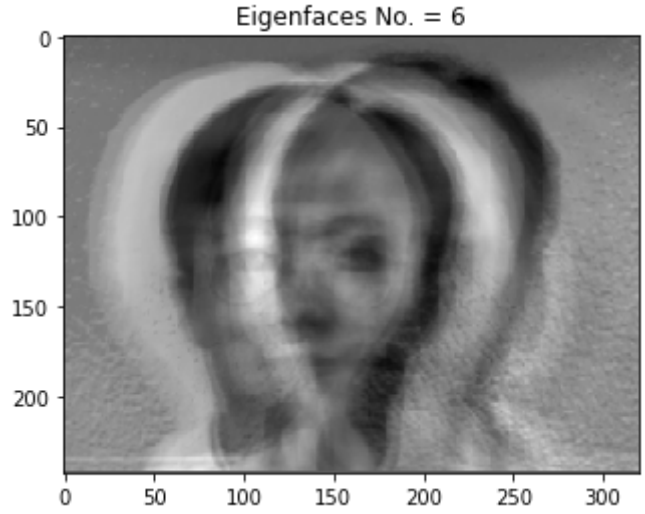

Eigenfaces No. = 1
0
50
100
150
200
0
50
100
150
200
250
300

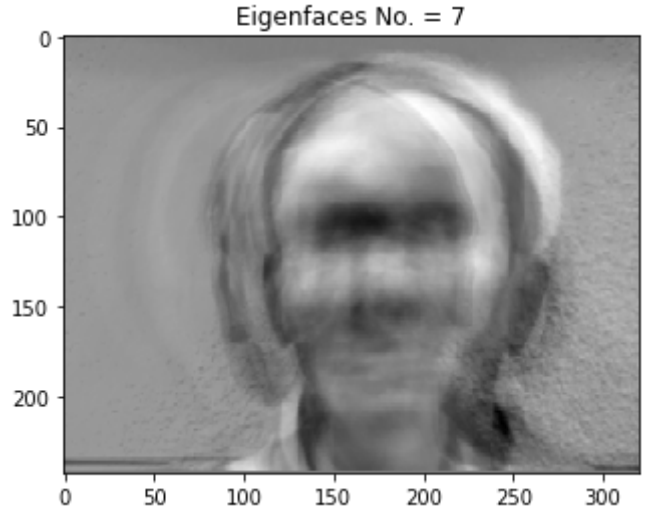

Eigenfaces No. = 2
0
50
100
150
200
0
50
100
150
200
250
300

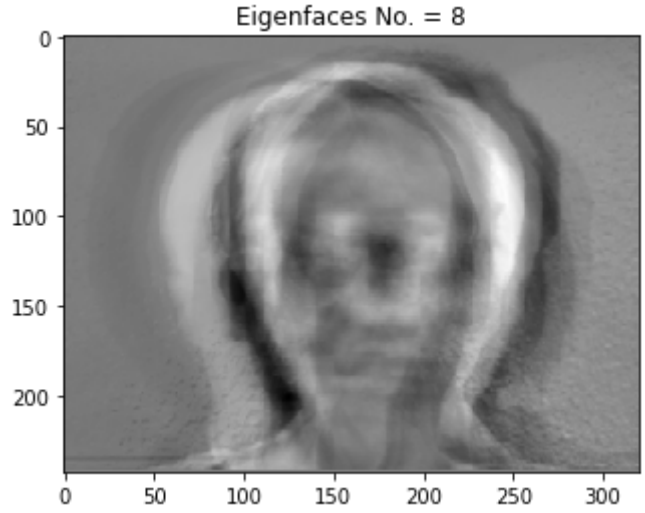

Eigenfaces No. = 3
0
50
100
150
200
0
50
100
150
200
250
300

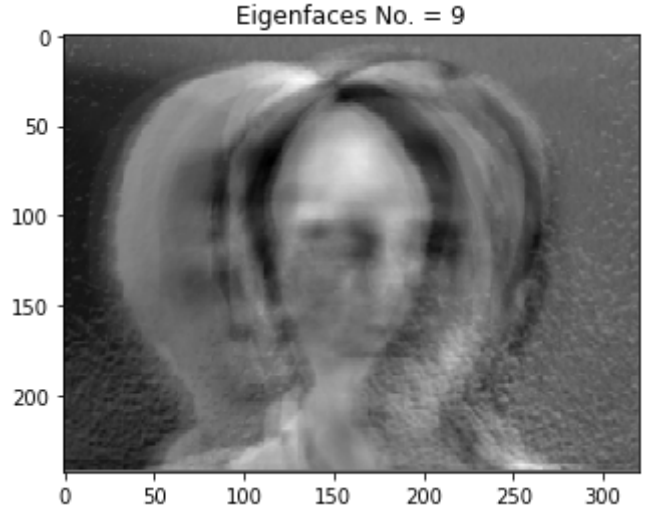

Eigenfaces No. = 4
0
50
100
150
200
0
50
100
150
200
250
300

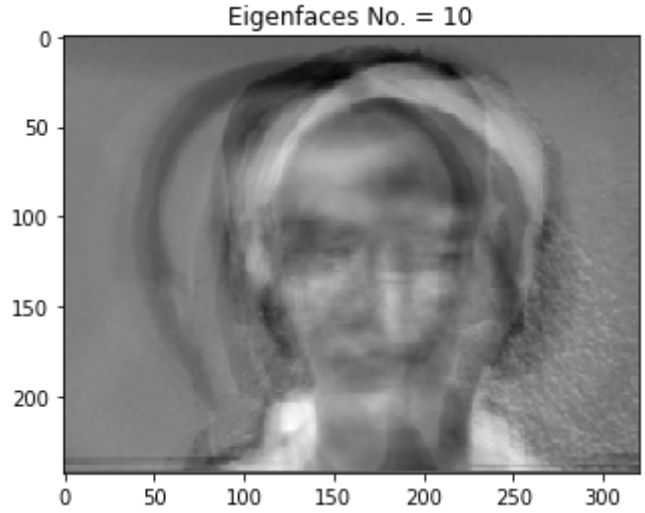

Eigenfaces No. = 5
0
50
100
150
200
0
50
100
150
200
250
300


Eigenfaces No. = 6
0
50
100
150
200
0
50
100
150
200
250
300


Eigenfaces No. = 7
0
50
100
150
200
0
50
100
150
200
250
300


Eigenfaces No. = 8
0
50
100
150
200
0
50
100
150
200
250
300


Eigenfaces No. = 9
0
50
100
150
200
0
50
100
150
200
250
300



Question 4 (d)

Question 4 (d)

In [7]:

```
pca_all = PCA(n_components=166)
pca_all.fit(input_data)

X_trans_all = pca_all.transform(input_data)

eigenvalues_all = pca_all.explained_variance_

eigen_Vector = pca_all.components_

eigenfaces = pca_all.components_.reshape((166, 243, 320))

eigen_Vector[1].shape

# Reference: https://scikit-learn.org/stable/auto_examples/applications/plot_face_recognition.html

# c_k = original_normalized_data.transpose().dot(X_trans_all)
```

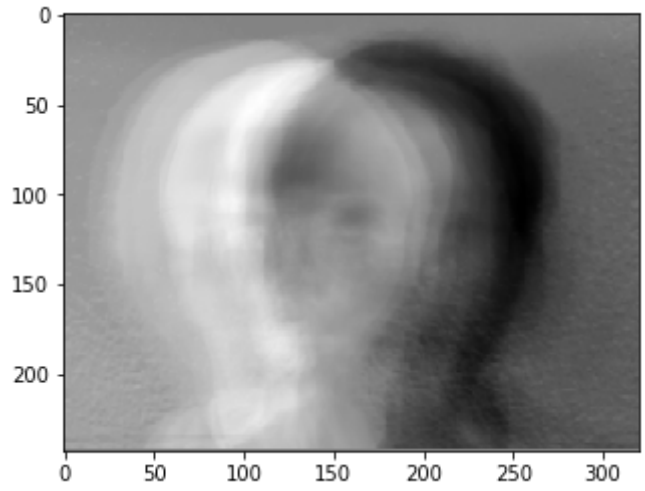
Out[7]:

```
(77760,)
```

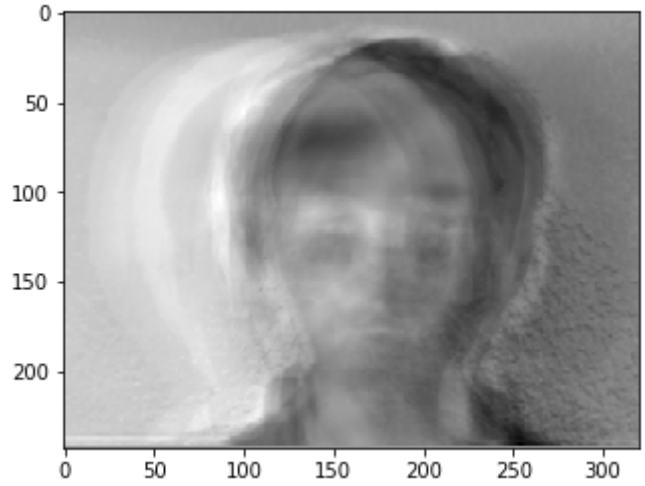
In [36]:

```
item = [1,10,20,30,40,50,70,90,120]

image_No = [0,50,100]

for k in image_No:
    for i in item:
        print("input_data.iloc[0].shape = " + str(input_data.iloc[0].shape))

        Z = np.dot(input_data.iloc[k],eigen_Vector[:i].transpose()) #PCA results, i
np_arr[1] is the index of person.

        print("Z.shape = " + str(Z.shape))

        recon = np.dot(Z,eigen_Vector[:i]) #do reconstruction

        print(recon.shape)
        plt.imshow(recon.reshape((243,320)),cmap='gray')

        plt.show()
```

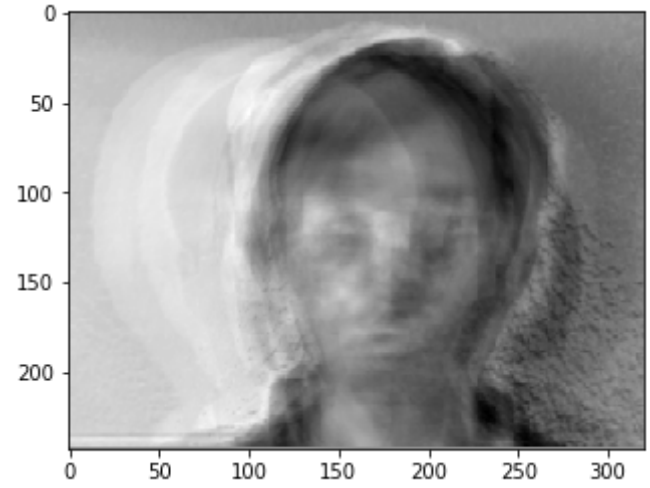
```
input_data.iloc[0].shape = (77760,)
Z.shape = (1,)
(77760,)
```



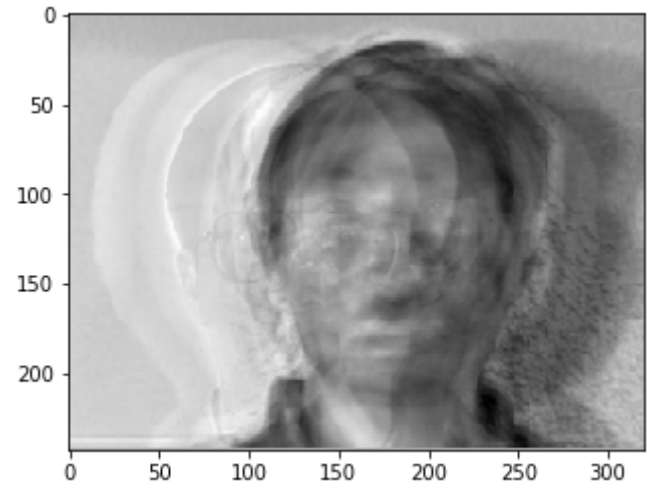

```
input_data.iloc[0].shape = (77760,)
Z.shape = (10,)
(77760,)
```



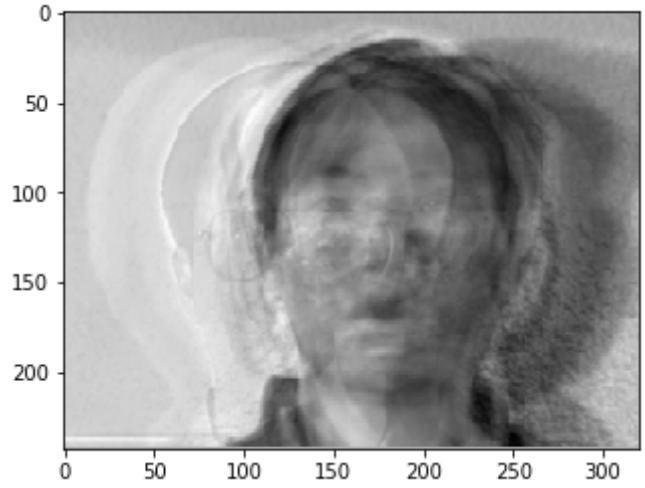

```
input_data.iloc[0].shape = (77760,)
Z.shape = (20,)
(77760,)
```



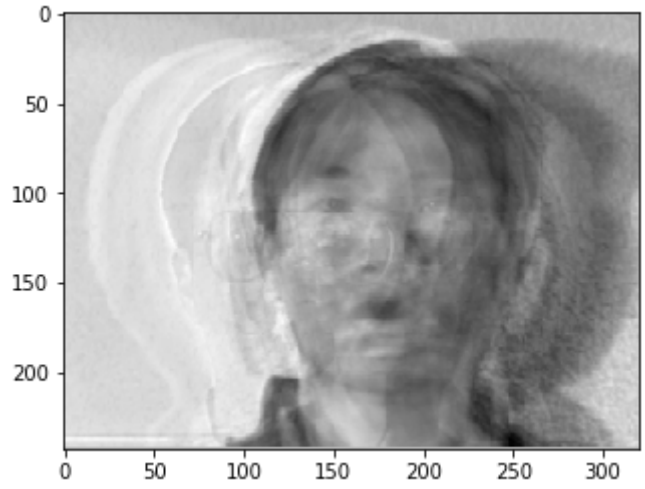

```
input_data.iloc[0].shape = (77760,)
Z.shape = (30,)
(77760,)
```



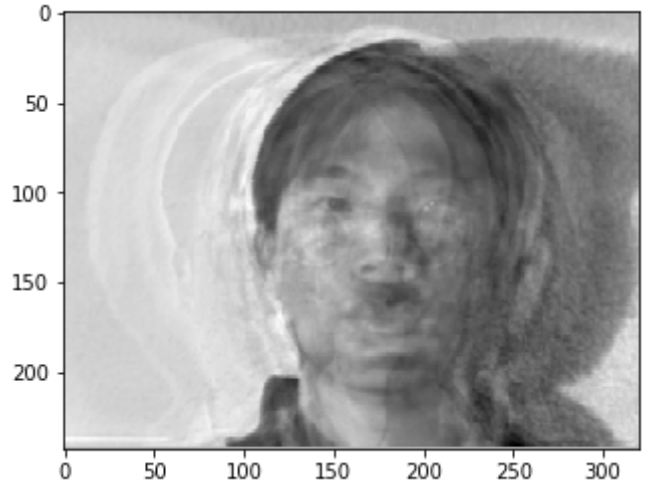

```
input_data.iloc[0].shape = (77760,)
Z.shape = (40,)
(77760,)
```



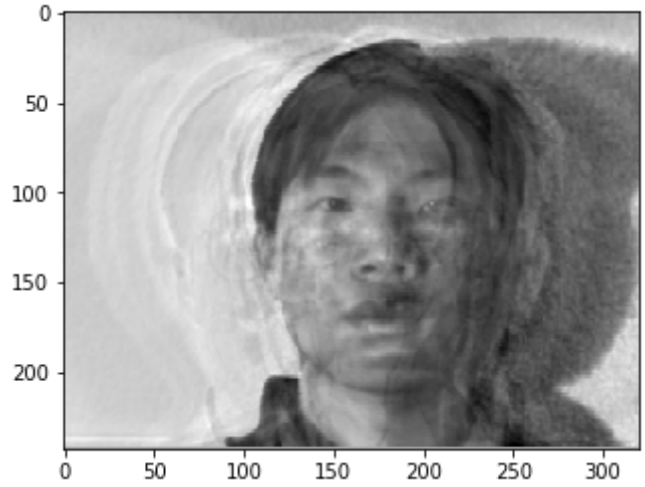

```
input_data.iloc[0].shape = (77760,)
Z.shape = (50,)
(77760,)
```



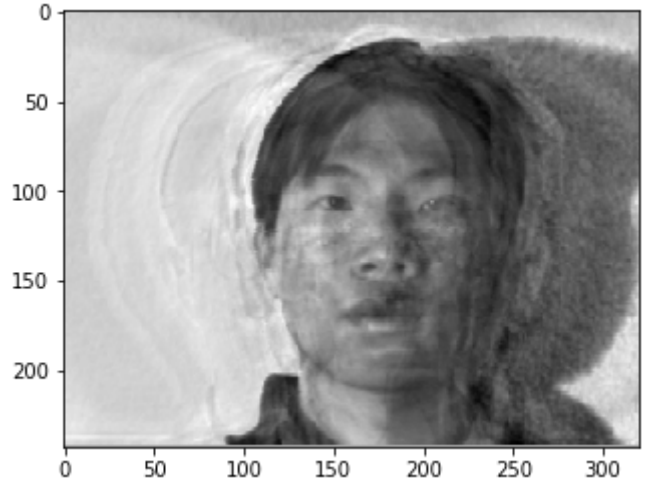

```
input_data.iloc[0].shape = (77760,)
Z.shape = (70,)
(77760,)
```



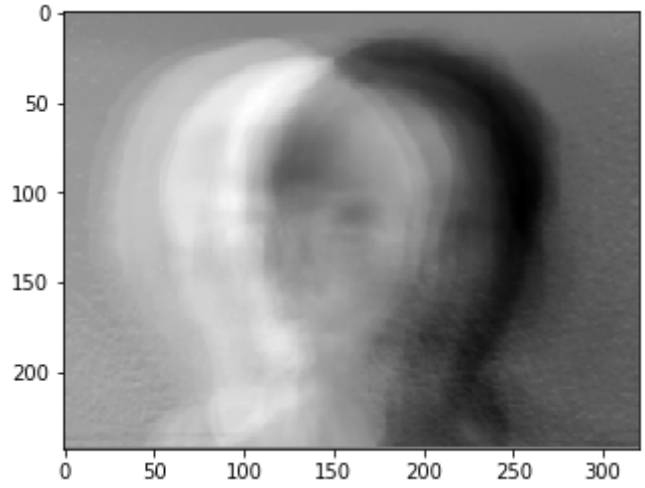
```
input_data.iloc[0].shape = (77760,)
Z.shape = (90,)
(77760,)
```



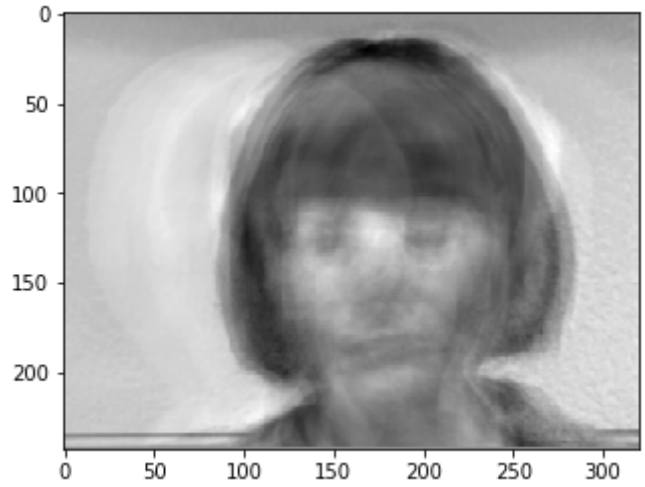

```
input_data.iloc[0].shape = (77760,)
Z.shape = (120,)
(77760,)
```



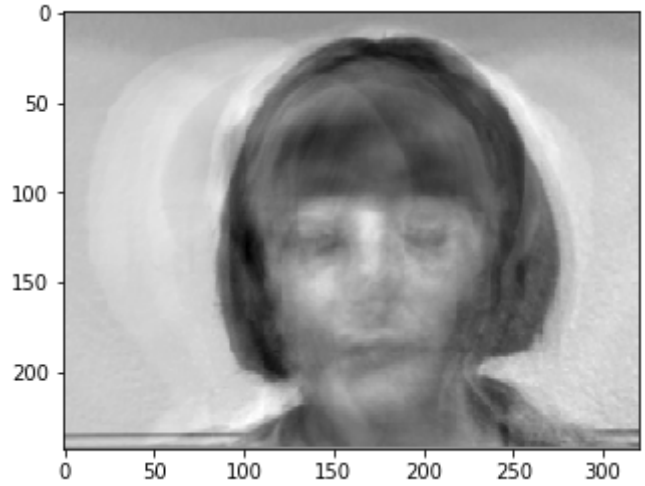

```
input_data.iloc[0].shape = (77760,)
Z.shape = (1,)
(77760,)
```



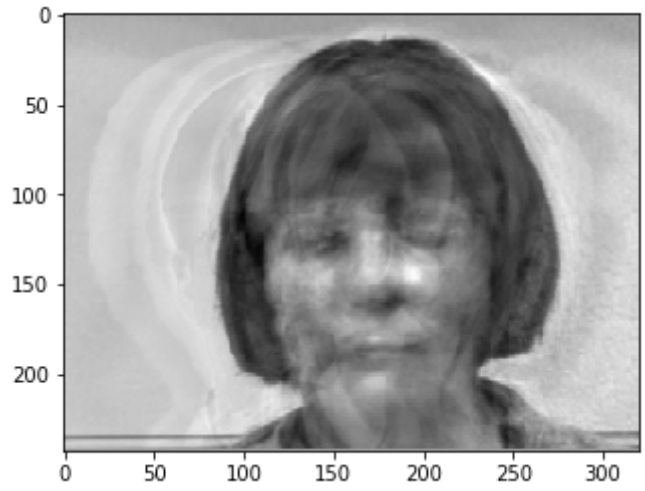

```
input_data.iloc[0].shape = (77760,)
Z.shape = (10,)
(77760,)
```



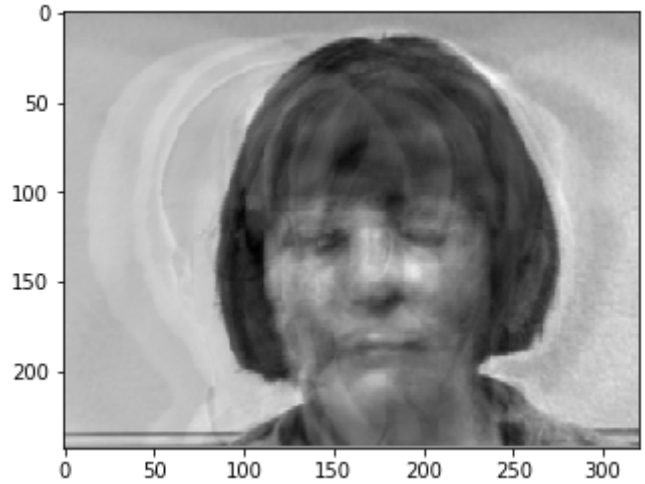

```
input_data.iloc[0].shape = (77760,)
Z.shape = (20,)
(77760,)
```



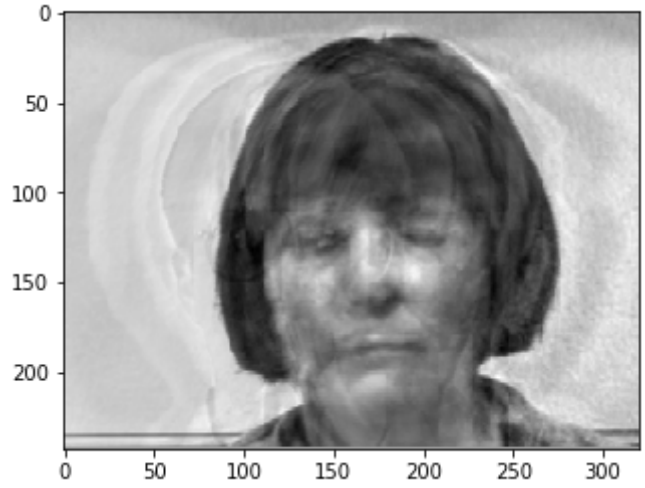
```
input_data.iloc[0].shape = (77760,)
Z.shape = (30,)
(77760,)
```



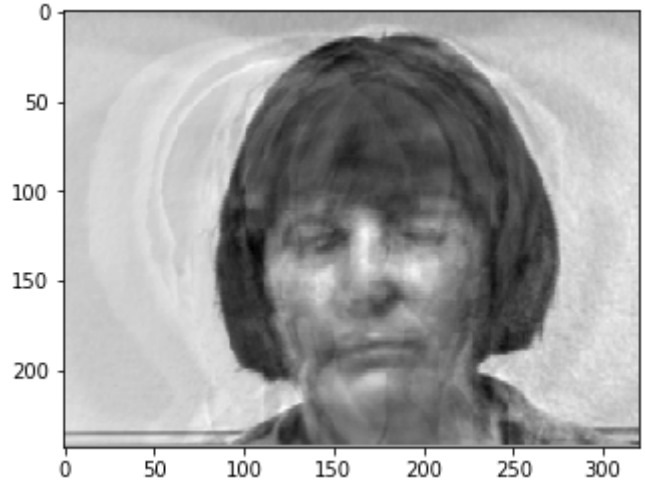

```
input_data.iloc[0].shape = (77760,)
Z.shape = (40,)
(77760,)
```



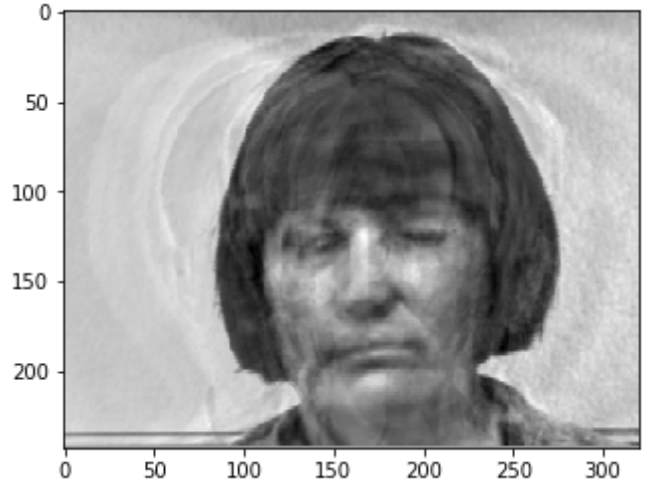

```
input_data.iloc[0].shape = (77760,)
Z.shape = (50,)
(77760,)
```



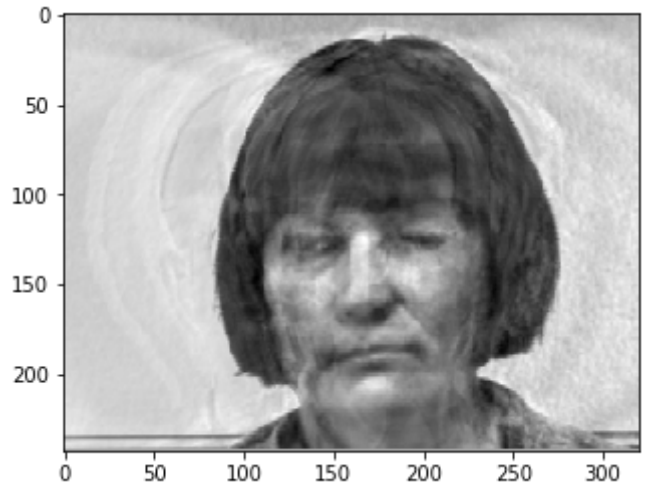

```
input_data.iloc[0].shape = (77760,)
Z.shape = (70,)
(77760,)
```



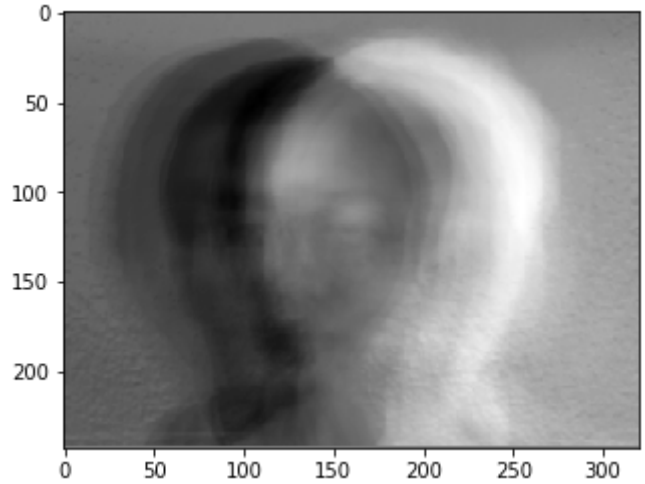

```
input_data.iloc[0].shape = (77760,)
Z.shape = (90,)
(77760,)
```



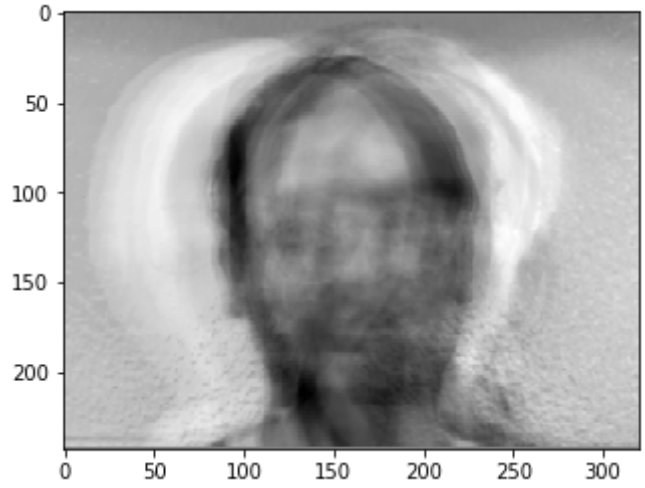
```
input_data.iloc[0].shape = (77760,)
Z.shape = (120,)
(77760,)
```



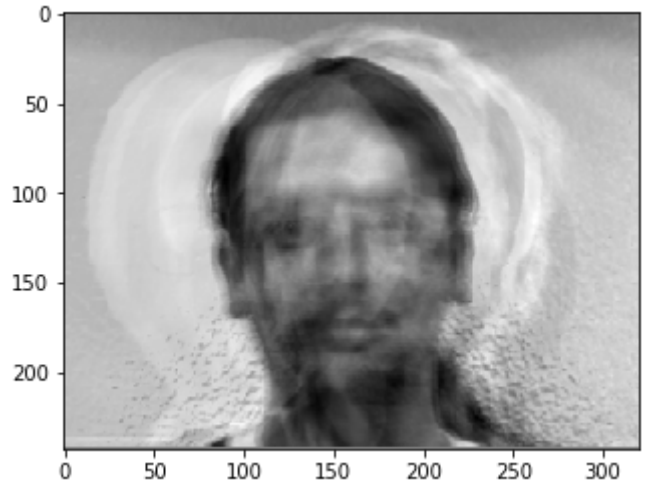

```
input_data.iloc[0].shape = (77760,)
Z.shape = (1,)
(77760,)
```



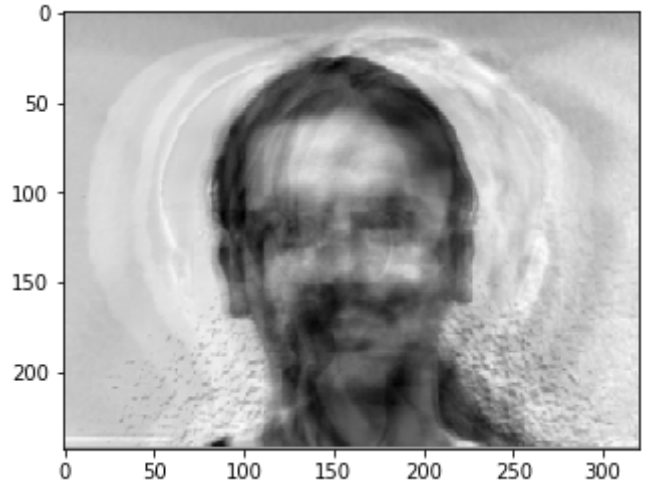

```
input_data.iloc[0].shape = (77760,)
Z.shape = (10,)
(77760,)
```



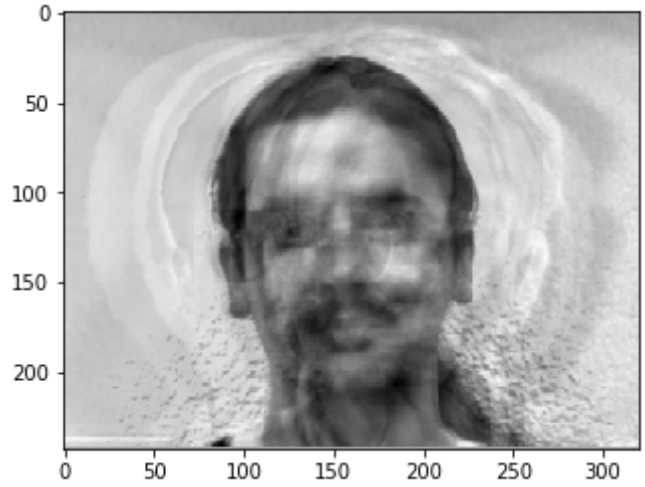

```
input_data.iloc[0].shape = (77760,)
Z.shape = (20,)
(77760,)
```



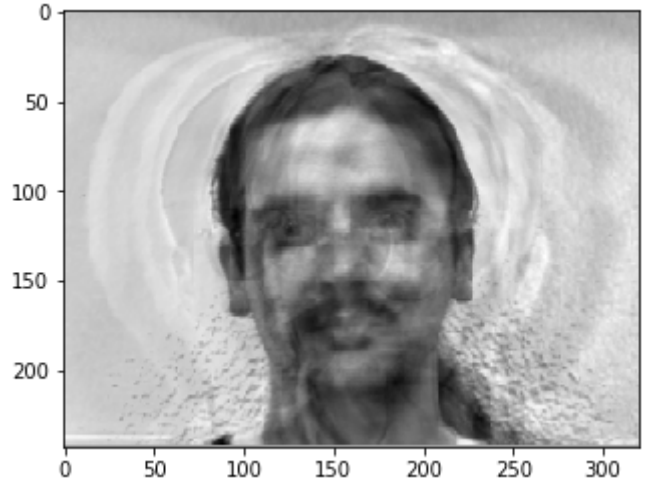

```
input_data.iloc[0].shape = (77760,)
Z.shape = (30,)
(77760,)
```



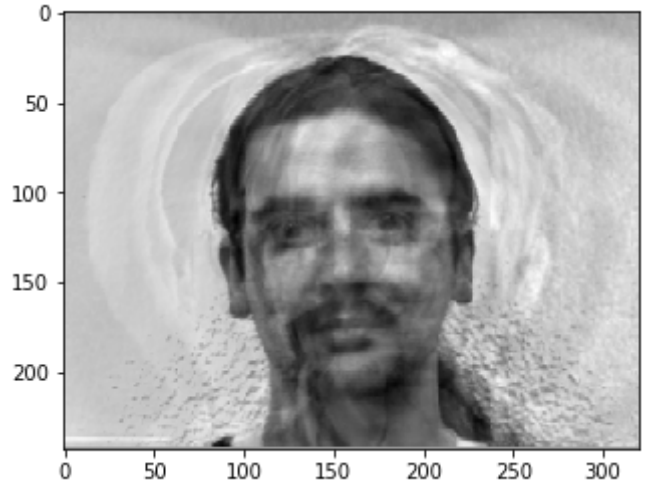
```
input_data.iloc[0].shape = (77760,)
Z.shape = (40,)
(77760,)
```



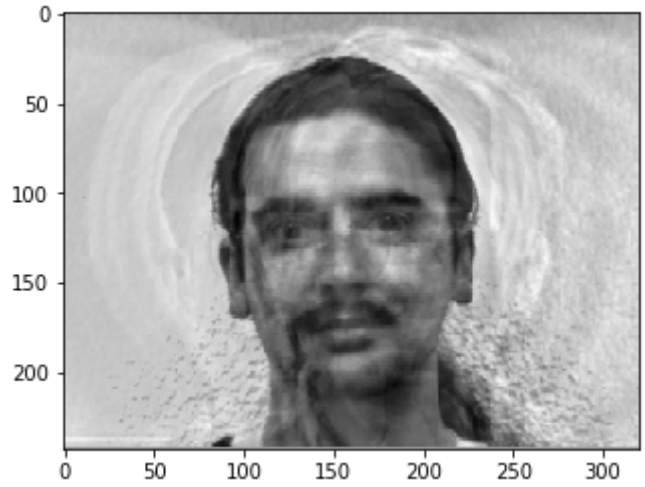

```
input_data.iloc[0].shape = (77760,)
Z.shape = (50,)
(77760,)
```



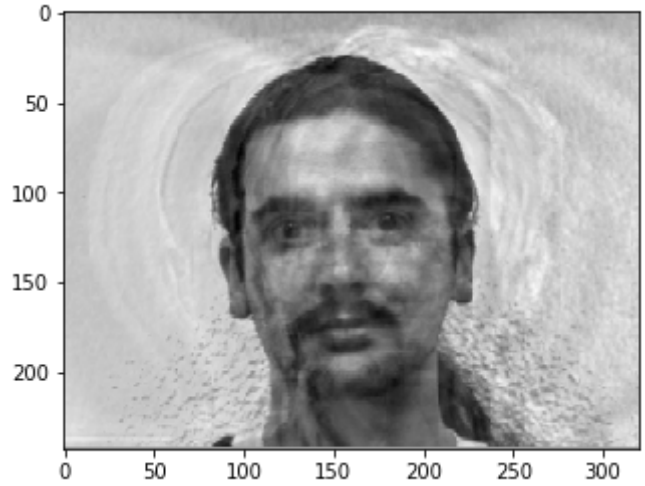

```
input_data.iloc[0].shape = (77760,)
Z.shape = (70,)
(77760,)
```




```
input_data.iloc[0].shape = (77760,)
Z.shape = (90,)
(77760,)
```




```
input_data.iloc[0].shape = (77760,)
Z.shape = (120,)
(77760,)
```



Question 4 (e)

In [8]:

```
# --> import
all_data = np.arange(77760)
all_label = []
for filename in sorted(glob.glob('yalefaces/*.*')): #assuming gif

    # print(filename)
    all_label.append(filename[20:])
    img=Image.open(filename)  #打开图像
    im = np.asarray(img,dtype='float64')
    im = np.ndarray.flatten(im)
    all_data = np.vstack([all_data, im])

DF = pd.DataFrame(data=all_data[0:,0:])  # 1st row as the column names
DF = DF.iloc[1:]

all_label = pd.DataFrame(all_label)


import sys
import numpy as np
pd.set_option('display.max_colwidth', -1)

np.set_printoptions(threshold=sys.maxsize)

test = np.arange(77760)

for index, X in DF.iterrows():

    X = (X - X.min())/(X.max()-X.min())
    X = X - X.mean()
    X = X.fillna(X.mean())

    test = np.vstack([test, X])

input_data = pd.DataFrame(data=test[1:,0:])
input_data.shape
```

Out[8]:

```
(165, 77760)
```

In [4]:

```
a = "yalefaces/subject14.sad"
print(a[20:])
```

```
sad
```

In [164]:

```
nComp = [1,10,20,30,40,50]

for item in nComp:
    Z = np.dot(inp_arr[0],U[:,:item]) #PCA results, inp_arr[1] is the index of pers
on.
    # print(Z.shape)
    recon = np.dot(Z,U[:,:item].T) #do reconstruction
    # print(recon.shape)
    plt.imshow(recon.reshape((160,160)),cmap='gray')
    plt.show()
```

```
---------------------------------------------------------------------------
----
NameError                                 Traceback (most recent call l
ast)
<ipython-input-164-226ab97306ee> in <module>
      2
      3 for item in nComp:
----> 4     Z = np.dot(inp_arr[0],U[:,:item]) #PCA results, inp_arr[1]
 is the index of person.
      5     # print(Z.shape)
      6     recon = np.dot(Z,U[:,:item].T) #do reconstruction

NameError: name 'inp_arr' is not defined
```

In [26]:

```
def num_to_string(num):
    numbers = {
        0 : "glasses",
        1 : "happy",
        2 : "leftlight",
        3 : "noglasses",
        4 : "centerlight",
        5 : "normal",
        6 : "rightlight",
        7 : "sad",
        8 : "sleepy",
        9 : "surprised",
        10 : "wink"
    }

    return numbers.get(num, None)

print(num_to_string(2))
print(num_to_string(5))
```

```
leftlight
normal
```

In [ ]:

In [210]:

```
print(10)
```

```
10
```

In [39]:

```
all_label = pd.DataFrame(all_label)
```

Prepare the dataset which inlcudes all persons' data

In [285]:

```
i = 0
j = 11

X_train_all = np.arange(77760)
X_test_all  = np.arange(77760)
y_train_all = np.arange(1)
y_test_all  = np.arange(1)

for k in range(15):  # for 15 people

    X_train, X_test, y_train, y_test = train_test_split(
                                                        input_data[0:11],
                                                        all_label[0:11],
                                                        test_size=0.25,
                                                        random_state=0,
                                                       )
    j = j + 11
    i = i + 11

    X_train_all = np.vstack([X_train_all, X_train])
    X_test_all = np.vstack([X_test_all, X_test])
    y_train_all = np.vstack([y_train_all, y_train])
    y_test_all = np.vstack([y_test_all, y_test])

X_train_all = pd.DataFrame(data=X_train_all[1:,0:])
X_test_all = pd.DataFrame(data=X_test_all[1:,0:])
y_train_all = pd.DataFrame(data=y_train_all[1:,0:])
y_test_all = pd.DataFrame(data=y_test_all[1:,0:])
```

In [284]:

```

```

In [314]:

```
print("X_train_all.shape = " + str(X_train_all.shape))
print("X_test_all.shape = " + str(X_test_all.shape))
print("y_train_all.shape = " + str(y_train_all.shape))
print("y_test_all.shape = " + str(y_test_all.shape))
```

```
X_train_all.shape = (120, 77760)
X_test_all.shape = (45, 77760)
y_train_all.shape = (120, 1)
y_test_all.shape = (45, 1)
```

pca

In [288]:

```
n_components = 50

pca = PCA(n_components=n_components, svd_solver='randomized', whiten=True).fit(X_tr
ain_all)

eigenfaces = pca.components_.reshape((n_components, 243, 320))

print("Projecting the input data on the eigenfaces orthonormal basis")

X_train_pca = pca.transform(X_train_all)
X_test_pca = pca.transform(X_test_all)

print(1)
```

```
Projecting the input data on the eigenfaces orthonormal basis
1
```

In [289]:

```
print("Fitting the classifier to the training set")

param_grid = {'C': [1e3, 5e3, 1e4, 5e4, 1e5],
              'gamma': [0.0001, 0.0005, 0.001, 0.005, 0.01, 0.1], }

clf = GridSearchCV( SVC(kernel='rbf', class_weight='balanced'),param_grid, cv=5, ii
d=False )
```

```
Fitting the classifier to the training set
```

In [291]:

```
clf = clf.fit(X_train_pca, y_train_all.values.ravel())

print("Best estimator found by grid search:")
print(clf.best_estimator_)
```

```
Best estimator found by grid search:
SVC(C=1000.0, cache_size=200, class_weight='balanced', coef0=0.0,
    decision_function_shape='ovr', degree=3, gamma=0.0001, kernel='rb
f',
    max_iter=-1, probability=False, random_state=None, shrinking=True,
    tol=0.001, verbose=False)
```

In [305]:

```
print("Predicting face")

y_pred = clf.predict(X_test_pca)
```

```
Predicting face
```

In [306]:

```
y_pred = pd.DataFrame(y_pred)
```

In [ ]:

```

```

In [178]:

```
y_test
```

Out[178]:

	0
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses

	0
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy
0	noglasses
1	surprised
2	happy

In [109]:

```
def plot_gallery(images, titles, h, w, n_row=3, n_col=4):
    """Helper function to plot a gallery of portraits"""
    plt.figure(figsize=(1.8 * n_col, 2.4 * n_row))
    plt.subplots_adjust(bottom=0, left=.01, right=.99, top=.90, hspace=.35)
    for i in range(n_row * n_col):
        plt.subplot(n_row, n_col, i + 1)
        plt.imshow(images[i].reshape((h, w)), cmap=plt.cm.gray)
        plt.title(titles[i], size=12)
        plt.xticks(())
        plt.yticks(())

# plot the result of the prediction on a portion of the test set

def title(y_pred, y_test, target_names, i):
    pred_name = target_names[y_pred[i]].rsplit(' ', 1)[-1]
    true_name = target_names[y_test[i]].rsplit(' ', 1)[-1]
    return 'predicted: %s\ntrue:      %s' % (pred_name, true_name)

prediction_titles = [title(y_pred, y_test, target_names, i)
                     for i in range(y_pred.shape[0])]

plot_gallery(X_test, prediction_titles, h, w)

# plot the gallery of the most significative eigenfaces

eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
plot_gallery(eigenfaces, eigenface_titles, h, w)

plt.show()
```

```
---------------------------------------------------------------------------
----
NameError                                 Traceback (most recent call l
ast)
<ipython-input-109-21e9a6c59361> in <module>
     18
     19 prediction_titles = [title(y_pred, y_test, target_names, i)
---> 20                      for i in range(y_pred.shape[0])]
     21
     22 plot_gallery(X_test, prediction_titles, h, w)

<ipython-input-109-21e9a6c59361> in <listcomp>(.0)
     18
     19 prediction_titles = [title(y_pred, y_test, target_names, i)
---> 20                      for i in range(y_pred.shape[0])]
     21
     22 plot_gallery(X_test, prediction_titles, h, w)

NameError: name 'target_names' is not defined
```

PAC with another approach

In [ ]:

```
y = all_label;
X = input_data;

def cross_validate_svd(c, n):

    accuracy = 0

    skf = StratifiedKFold( n_splits= 5, shuffle=True )

    for train_index, test_index in skf.split(X, y):

        X_train, X_test = X.transpose()[train_index], X.transpose()[test_index]

        y_train, y_test = y.transpose()[train_index], y.transpose()[test_index]

        # --> PCA
        P_train,_,_ = LA.svd(X_train.transpose())
        P_test,_,_  = LA.svd(X_test.transpose())

        pca_train = np.dot(X_train, P_train[:,:n+1])
        pca_test = np.dot(X_test, P_test[:,:n+1])

        # --> SVM
        svm = SVC(kernel= 'radial',C = c)

        svm.fit(pca_train, y_train)

        pred = svm.predict(pca_test)

        accuracy = accuracy + accuracy_score(y_test, pred)/5

        print(77)

    return accuracy

cross_validate_svd(15,50)
```

```
/usr/local/lib/python3.7/site-packages/sklearn/model_selection/_split.p
y:657: Warning: The least populated class in y has only 1 members, whic
h is too few. The minimum number of members in any class cannot be less
than n_splits=5.
  % (min_groups, self.n_splits)), Warning)
```

Adaboost a bit

In [ ]:

```
y = all_label;
X = input_data;

def cross_validate_ada(c, n):

    accuracy = 0

    skf = StratifiedKFold( n_splits= 5, shuffle=True )

    for train_index, test_index in skf.split(X, y):

        X_train, X_test = X.transpose()[train_index], X.transpose()[test_index]

        y_train, y_test = y.transpose()[train_index], y.transpose()[test_index]

        # --> PCA
        P_train,_,_ = LA.svd(X_train.transpose())
        P_test,_,_  = LA.svd(X_test.transpose())

        pca_train = np.dot(X_train, P_train[:,:n+1])
        pca_test = np.dot(X_test, P_test[:,:n+1])

        # --> SVM
        svm = SVC(kernel= 'radial',C = c)

        svm.fit(pca_train, y_train)
        pred = svm.predict(pca_test)

        k = 0
        for i in range(len(pred)):
            if pred[i] == y_test[i]:
                k = k + 1

        accuracy = accuracy + accuracy_score(y_test, pred)/5

    return accuracy

cross_validate_ada(15,50)
```

--> Q4(f)

In [27]:

```
all_ims = os.listdir("/Users/dior/Desktop/633/HW3/yalefaces")
print(all_ims)
```

```
['subject04.leftlight', 'subject01.wink', 'subject06.surprised', 'subje
ct07.glasses', 'subject15.rightlight', 'subject12.surprised', 'subject1
0.leftlight', 'subject06.happy', 'subject03.centerlight', 'subject09.ri
ghtlight', 'subject01.normal', 'subject09.leftlight', 'subject13.norma
l', 'subject04.happy', 'subject14.noglasses', 'subject15.sleepy', 'subj
ect04.rightlight', 'subject07.sleepy', 'subject11.normal', 'subject13.c
enterlight', 'subject03.normal', 'subject02.leftlight', 'subject05.slee
py', 'subject01.rightlight', 'subject14.surprised', 'subject09.sleepy',
'subject01.centerlight.gif', 'subject06.glasses', 'subject02.happy', 's
ubject12.noglasses', 'subject10.rightlight', 'subject06.noglasses', 'su
bject09.sad', 'subject06.centerlight', 'subject08.sad', 'subject13.slee
py', 'subject13.surprised', 'subject11.leftlight', 'subject05.happy',
'subject05.leftlight', 'subject05.centerlight', 'subject07.surprised',
'subject01.sleepy', 'subject07.normal', 'subject15.normal', 'subject07.
wink', 'subject06.rightlight', 'subject04.glasses', 'subject14.glasse
s', 'subject08.leftlight', 'subject11.wink', 'subject10.centerlight',
'subject01.noglasses', 'subject15.noglasses', 'subject07.happy', 'subje
ct09.centerlight', 'subject03.rightlight', 'subject03.happy', 'subject1
5.glasses', 'subject05.glasses', 'subject15.surprised', 'subject10.win
k', 'subject06.wink', 'subject03.leftlight', 'subject15.centerlight',
'subject01.surprised', 'subject03.sleepy', 'subject07.noglasses', 'subj
ect11.sleepy', 'subject13.noglasses', 'subject01.happy', 'subject09.nor
mal', 'subject12.rightlight', 'subject05.normal', 'subject14.sleepy',
'subject07.centerlight', 'subject06.sleepy', 'subject04.surprised', 'su
bject06.leftlight', 'subject09.glasses', 'subject12.normal', 'subject1
4.happy', 'subject12.leftlight', 'subject10.surprised', 'subject09.win
k', 'subject02.noglasses', 'subject11.rightlight', 'subject13.wink', 's
ubject09.surprised', 'subject12.centerlight', 'subject05.wink', 'subjec
t10.glasses', 'subject04.wink', 'subject02.surprised', 'subject14.right
light', 'subject14.leftlight', 'subject12.wink', 'subject12.happy', 'su
bject08.rightlight', 'subject09.noglasses', 'subject11.glasses', 'subje
ct01.glasses', 'subject08.wink', 'subject04.sleepy', 'subject10.happy',
'subject02.centerlight', 'subject08.sleepy', 'subject10.normal', 'subje
ct08.glasses', 'subject10.noglasses', 'subject02.normal', 'subject04.no
glasses', 'subject05.rightlight', 'subject09.happy', 'subject02.rightli
ght', 'subject11.sad', 'subject05.sad', 'subject03.glasses', 'subject1
3.glasses', 'subject15.wink', 'subject13.leftlight', 'subject04.sad',
'subject10.sad', 'subject11.surprised', 'subject05.surprised', 'subject
07.leftlight', 'subject03.wink', 'subject06.normal', 'subject03.noglass
es', 'subject14.centerlight', 'subject06.sad', 'subject12.sad', 'subjec
t14.normal', 'subject15.happy', 'subject12.sleepy', 'subject13.sad', 's
ubject07.sad', 'subject08.centerlight', 'subject08.surprised', 'subject
13.rightlight', 'subject15.leftlight', 'subject08.normal', 'subject11.c
enterlight', 'subject11.happy', 'subject03.sad', 'subject03.surprised',
'subject01.leftlight', 'subject04.normal', 'subject08.noglasses', 'subj
ect08.happy', 'subject02.sleepy', 'subject02.sad', 'subject10.sleepy',
'subject02.wink', 'subject14.sad', 'subject07.rightlight', 'subject14.w
ink', 'subject05.noglasses', 'subject12.glasses', 'subject02.glasses',
'subject01.sad', 'subject15.sad', 'subject11.noglasses', 'subject13.hap
py', 'subject04.centerlight']
```

In [28]:

```
data = []

for title in os.listdir("/Users/dior/Desktop/633/HW3/yalefaces"):

    if not title.endswith('.ipynb_checkponts'):
        row = {}
        row['f'] = title
        row['s'] = title.split('.')[0]
        row['e'] = title.split('.')[1]
        data.append(row)

data = pd.DataFrame.from_records(data)

data['e'].value_counts()
```

Out[28]:

```
happy          15
centerlight    15
normal         15
noglasses      15
wink           15
sad            15
sleepy         15
glasses        15
leftlight      15
rightlight     15
surprised      15
Name: e, dtype: int64
```

In [41]:

```
e = {
          'leftlight' : 0,
          'happy' : 1,
          'normal' : 2,
          'surprised' : 3,
          'gif' : 4,
          'noglasses' : 5,
          'sad' : 6,
          'glasses' : 7,
          'rightlight' : 8,
          'sleepy' : 9,
          'centerlight' : 10,
          'wink' :11
    }

data['e'] = [ e[item] for item in data['e'] ]

#split
train, test = train_test_split(data.e, test_size=0.1)
y_train, y_test = [], []

for item in train:
    y_train.append(item)

for item in test:
    y_test.append(item)

x_train_d = list(np.array(train.values.tolist()).reshape(-1,1))
x_test_d = list(np.array(test.values.tolist()).reshape(-1,1))

gau = GaussianMixture(n_components=11).fit(x_train_d,y_train_d)

pred = gau.predict(x_test_d)

k = 0

for i in range(len(pred)):
    if y_test[i] == pred[i]:
        k = k + 1

print('result!!')
print((accuracy_score(pred, y_test))*100)
```

```
---------------------------------------------------------------------------
----
KeyError                                  Traceback (most recent call l
ast)
<ipython-input-41-a5ce521f0994> in <module>
     14     }
     15
---> 16 data['e'] = [ e[item] for item in data['e'] ]
     17
     18 #split

<ipython-input-41-a5ce521f0994> in <listcomp>(.0)
     14     }
     15
---> 16 data['e'] = [ e[item] for item in data['e'] ]
     17
     18 #split

KeyError: 7
```

In [1]:

```
print(2)
```

```
2
```

In [ ]: