

Homework 7

Name: Yuan Li

ID: N19728558 netID yl6606

Email: foxerlee1@gmail.com

Part II: Programming and Questions

7. (a)

Answer:

The fourth face in the dataset:



7. (b)

Answer:

The mean of all the examples in the dataset fea: [91.94698, 95.09418, 101.15502, ..., 117.36201, 110.7413, 104.42233]

```
# Compute the mean of all the examples in the dataset fea.
fea_mean = fea.mean(axis=0)
print("the mean of all the examples in the dataset fea: {}".format(fea_mean))

the mean of all the examples in the dataset fea: [ 91.94698  95.09418 101.15502 ... 117.36201 110.7413 104.42233]
```

7. (c)

Answer:

```
# Do dimensionality reduction with pca.
fea_centered = fea - fea_mean

u, s, vT = np.linalg.svd(fea_centered) #note that s contains only the diagonal elements
print("U.shape, S.shape, V.T.shape ->", u.shape, s.shape, vT.shape, end="\n\n")

fea_pca_5 = np.matmul(fea, np.transpose(vT[:5, :]))

# values of the associated 5 attributes of the fourth image
for i in range(5):
    print(vT[i])

U.shape, S.shape, V.T.shape -> (1288, 1288) (1288,) (2914, 2914)

[0.00537343 0.00569514 0.00613803 ... 0.01043273 0.00883074 0.00740469]
[ 0.01745991  0.01647563  0.01628433 ... -0.03319881 -0.03265479
 -0.03142723]
[0.01783969 0.01602544 0.01488798 ... 0.03723508 0.03316043 0.03093169]
[0.03351924 0.03528838 0.03671131 ... 0.0384081  0.03525075 0.02920213]
[ 0.0131453  0.01357961  0.01403794 ... -0.09058423 -0.08371089
 -0.07456545]
```

7. (d)

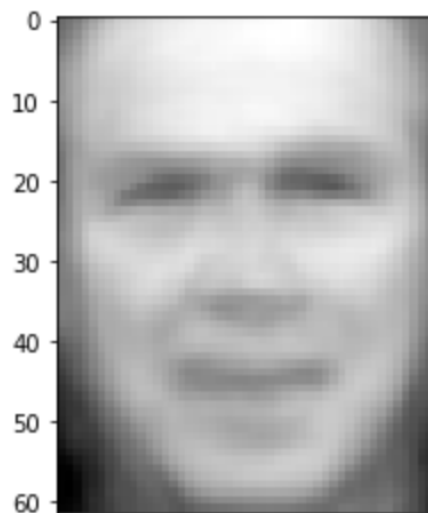
Answer:

The fourth face in the dataset onto the first 5 principle components: [6805.36, 315.574, 171.065, 1322.474, 772.015]

7. (e)

Answer:

The fourth face back into the original space based on the first 5 principle components:



The fourth face back into the original space based on the first 50 principle components:

