Question 2 - Eigenfaces

```
from scipy.io import loadmat
from matplotlib import pyplot as plt
import numpy as np

def pca_fun(input_data, target_d):

    # Center the data
    mean = np.mean(input_data, axis=0)
    centered_data = input_data - mean

    # Covariance matrix
    cov_matrix = np.cov(centered_data, rowvar=False)

    # Eigen decomposition
    eigvals, eigvecs = np.linalg.eigh(cov_matrix)

    # Sort eigenvectors by eigenvalues in descending order
    sorted_indices = np.argsort(eigvals)[::-1]
    top_eigvecs = eigvecs[:, sorted_indices[:target_d]]

    return top_eigvecs


### Data loading and plotting the image ###
import os
print(os.path.exists('face_data.mat'))
data = loadmat('face_data.mat')
images = data['image'][0]
person_id = data['personID'][0]
```

```
True
```

Computing Eigenfaces

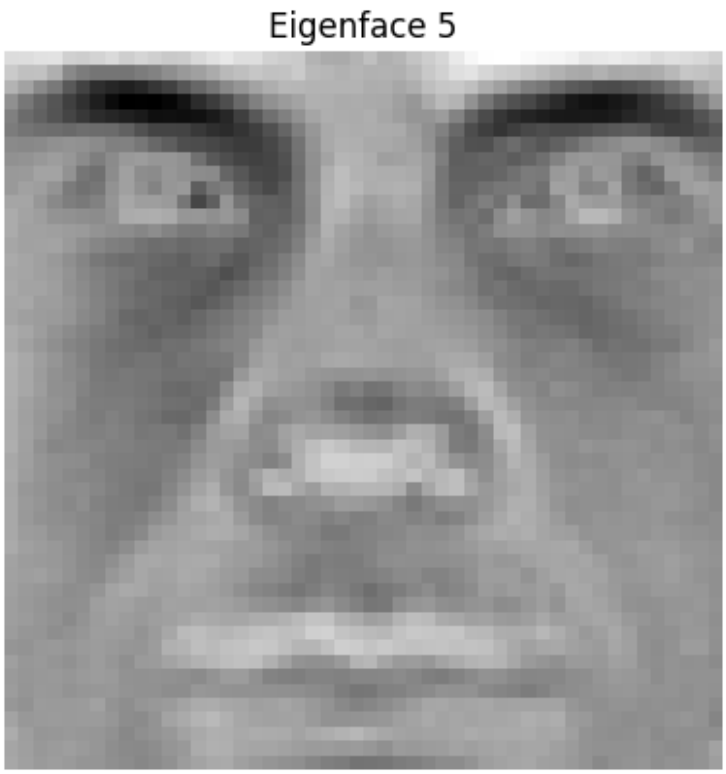
```
image_vecs = np.array([img.flatten() for img in images])

top_eigvecs = pca_fun(image_vecs, target_d=200)  # Shape: (2500, 200)

# Step 3: Display the top 5 eigenfaces
for i in range(5):
    eigenface = top_eigvecs[:, i].reshape(50, 50)
    plt.imshow(eigenface, cmap='gray')
    plt.title(f"Eigenface {i+1}")
    plt.axis('off')
    plt.show()
```

Eigenface 1

Eigenface 2

Eigenface 3

Eigenface 4




```
top_eigvecs.shape
```

```
(2500, 200)
```