INTERNSHIP STUDIO

Title: Implementation of PCA with ANN algorithm for Face recognition

CODE :

```
import os
import cv2
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.decomposition import PCA
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis as LDA
from sklearn.neural_network import MLPClassifier

# Helper function to plot a gallery of portraits
def plot_gallery(images, titles, h, w, n_row=3, n_col=4):
    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(())

# Use the absolute path to the dataset
dir_name = r"D:\code_all\intenship_studio\dataset\dataset\faces"

# Ensure the path exists
if not os.path.exists(dir_name):
    print(f"Directory {dir_name} does not exist!")
```

```
else:
    # Continue with processing the images
    y = []
    X = []
    target_names = []
    person_id = 0
    h = w = 300
    n_samples = 0
    class_names = []

    for person_name in os.listdir(dir_name):
        dir_path = os.path.join(dir_name, person_name)
        if os.path.isdir(dir_path):
            class_names.append(person_name)
            for image_name in os.listdir(dir_path):
                image_path = os.path.join(dir_path, image_name)
                img = cv2.imread(image_path)
                gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
                resized_image = cv2.resize(gray, (h, w))
                v = resized_image.flatten()
                X.append(v)
                y.append(person_id)
                n_samples += 1
            target_names.append(person_name)
            person_id += 1

    y = np.array(y)
    X = np.array(X)
    target_names = np.array(target_names)
    n_features = X.shape[1]
```

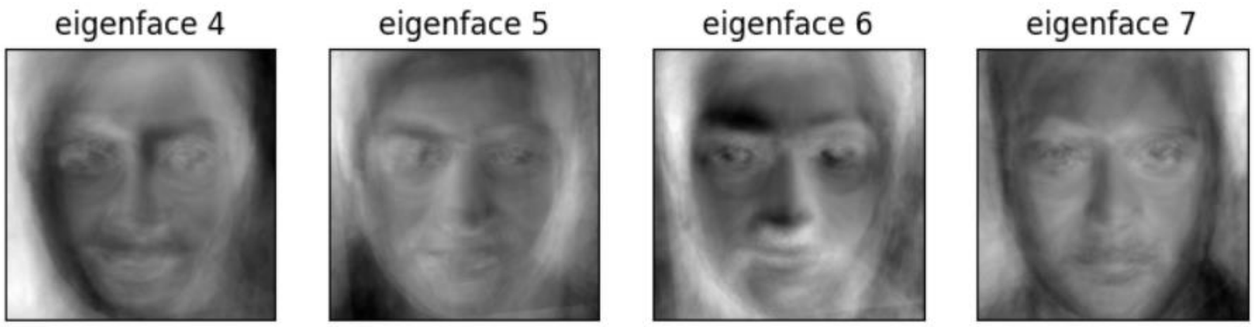
```
print("y shape:", y.shape)
print("X shape:", X.shape)
print("target_names shape:", target_names.shape)
print("Number of samples:", n_samples)
print("Total dataset size:")
print("n_samples: %d" % n_samples)
print("n_features: %d" % n_features)
print("n_classes: %d" % len(target_names))

# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_state=42)

# Set the number of components for PCA
n_components = 150

print(f"Extracting the top {n_components} eigenfaces from {X_train.shape[0]} faces")

# Applying PCA for dimensionality reduction
pca = PCA(n_components=n_components, svd_solver='randomized',
whiten=True).fit(X_train)

# Generating eigenfaces
eigenfaces = pca.components_.reshape((n_components, h, w))

# Plot the gallery of the most significant eigenfaces
eigenface_titles = [f"eigenface {i}" for i in range(eigenfaces.shape[0])]
plot_gallery(eigenfaces, eigenface_titles, h, w)
plt.show()
```

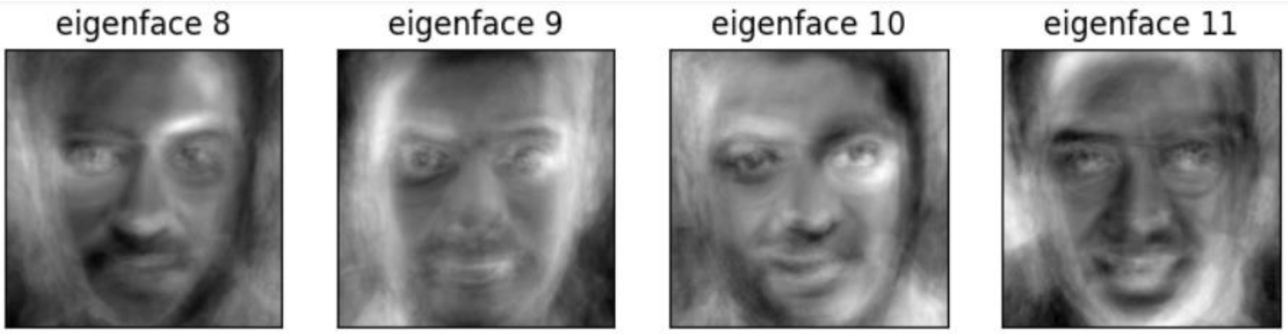
```
print("Projecting the input data on the eigenfaces orthonormal basis")

X_train_pca = pca.transform(X_train)
X_test_pca = pca.transform(X_test)

print(f"X_train_pca shape: {X_train_pca.shape}, X_test_pca shape: {X_test_pca.shape}")

# Compute Fisherfaces (LDA)
lda = LDA()
lda.fit(X_train_pca, y_train)

X_train_lda = lda.transform(X_train_pca)
X_test_lda = lda.transform(X_test_pca)

print("Project done...")

# Train a neural network classifier
clf = MLPClassifier(random_state=1, hidden_layer_sizes=(10, 10), max_iter=1000, verbose=True)
clf.fit(X_train_lda, y_train)

print("Model Weights:")
model_info = [coef.shape for coef in clf.coefs_]
print(model_info)

# Predicting and evaluating the model
y_pred = []
y_prob = []
for test_face in X_test_lda:
    prob = clf.predict_proba([test_face])[0]
```

```
    class_id = np.argmax(prob)
    y_pred.append(class_id)
    y_prob.append(np.max(prob))

# Transform the data
y_pred = np.array(y_pred)

prediction_titles = []
true_positive = 0

for i in range(y_pred.shape[0]):
    true_name = target_names[y_test[i]].split(' ', 1)[-1]
    pred_name = target_names[y_pred[i]].split(' ', 1)[-1]

    result = f'pred: {pred_name}, pr: {str(y_prob[i])[:4]} \ntrue: {true_name}'
    prediction_titles.append(result)

    if true_name == pred_name:
        true_positive += 1

accuracy = (true_positive * 100) / y_pred.shape[0]
print(f"Accuracy: {accuracy}%")

# Plot results
plot_gallery(X_test, prediction_titles, h, w)
plt.show()
```

OUTPUT :

y shape: (450,)
X shape: (450, 90000)
target_names shape: (9,)
Number of samples: 450
Total dataset size:
n_samples: 450
n_features: 90000
n_classes: 9
Extracting the top 150 eigenfaces from 337 faces





Projecting the input data on the eigenfaces orthonormal basis

X_train_pca shape: (337, 150), X_test_pca shape: (113, 150)
Project done...
Iteration 1, loss = 3.20688596
Iteration 2, loss = 3.15236574
Iteration 3, loss = 3.10368184
Iteration 4, loss = 3.05288240
Iteration 5, loss = 3.00418451
Iteration 6, loss = 2.95764773
Iteration 7, loss = 2.91160821
Iteration 8, loss = 2.86698189
Iteration 9, loss = 2.82466354
Iteration 10, loss = 2.78290044
Iteration 11, loss = 2.74171326
Iteration 12, loss = 2.70307209
Iteration 13, loss = 2.66436798
Iteration 14, loss = 2.62870456
Iteration 15, loss = 2.59200563
Iteration 16, loss = 2.55738750
Iteration 17, loss = 2.52485228
Iteration 18, loss = 2.49109059
Iteration 19, loss = 2.46176882
Iteration 20, loss = 2.43042715
Iteration 21, loss = 2.40192135
Iteration 22, loss = 2.37172280
Iteration 23, loss = 2.34367515
Iteration 24, loss = 2.31575457
Iteration 25, loss = 2.28840533
Iteration 26, loss = 2.26282327
Iteration 27, loss = 2.23576317
Iteration 28, loss = 2.21044675
Iteration 29, loss = 2.18523041
Iteration 30, loss = 2.16087615
Iteration 31, loss = 2.13743516
Iteration 32, loss = 2.11407135
Iteration 33, loss = 2.09167291
Iteration 34, loss = 2.06833463
Iteration 35, loss = 2.04703242
Iteration 36, loss = 2.02678255
Iteration 37, loss = 2.00673402
Iteration 38, loss = 1.98658231
Iteration 39, loss = 1.96800934
Iteration 40, loss = 1.94974079
Iteration 41, loss = 1.93189697
Iteration 42, loss = 1.91470839

Iteration 43, loss = 1.89768063
Iteration 44, loss = 1.88138019
Iteration 45, loss = 1.86533904
Iteration 46, loss = 1.84947045
Iteration 47, loss = 1.83427705
Iteration 48, loss = 1.81889822
Iteration 49, loss = 1.80409740
Iteration 50, loss = 1.78946900
Iteration 51, loss = 1.77467957
Iteration 52, loss = 1.76001349
Iteration 53, loss = 1.74570777
Iteration 54, loss = 1.73076765
Iteration 55, loss = 1.71659368
Iteration 56, loss = 1.70247602
Iteration 57, loss = 1.68777566
Iteration 58, loss = 1.67348741
Iteration 59, loss = 1.65934526
Iteration 60, loss = 1.64477223
Iteration 61, loss = 1.63046429
Iteration 62, loss = 1.61661086
Iteration 63, loss = 1.60244230
Iteration 64, loss = 1.58822000
Iteration 65, loss = 1.57440119
Iteration 66, loss = 1.56016605
Iteration 67, loss = 1.54615433
Iteration 68, loss = 1.53250171
Iteration 69, loss = 1.51865321
Iteration 70, loss = 1.50516118
Iteration 71, loss = 1.49114218
Iteration 72, loss = 1.47733887
Iteration 73, loss = 1.46400546
Iteration 74, loss = 1.45037696
Iteration 75, loss = 1.43683284
Iteration 76, loss = 1.42356096
Iteration 77, loss = 1.41028377
Iteration 78, loss = 1.39674489
Iteration 79, loss = 1.38345069
Iteration 80, loss = 1.36967804
Iteration 81, loss = 1.35609459
Iteration 82, loss = 1.34261090
Iteration 83, loss = 1.32906761
Iteration 84, loss = 1.31508586
Iteration 85, loss = 1.30133885
Iteration 86, loss = 1.28731882
Iteration 87, loss = 1.27360185
Iteration 88, loss = 1.25972784
Iteration 89, loss = 1.24619313

Iteration 90, loss = 1.23254208
Iteration 91, loss = 1.21851543
Iteration 92, loss = 1.20503831
Iteration 93, loss = 1.19144551
Iteration 94, loss = 1.17803131
Iteration 95, loss = 1.16483587
Iteration 96, loss = 1.15148689
Iteration 97, loss = 1.13820937
Iteration 98, loss = 1.12515104
Iteration 99, loss = 1.11254986
Iteration 100, loss = 1.09923497
Iteration 101, loss = 1.08678521
Iteration 102, loss = 1.07370774
Iteration 103, loss = 1.06137176
Iteration 104, loss = 1.04903338
Iteration 105, loss = 1.03658813
Iteration 106, loss = 1.02477239
Iteration 107, loss = 1.01281099
Iteration 108, loss = 1.00100148
Iteration 109, loss = 0.98917956
Iteration 110, loss = 0.97757146
Iteration 111, loss = 0.96623265
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Iteration 456, loss = 0.04466789
Iteration 457, loss = 0.04446095
Iteration 458, loss = 0.04429406
Iteration 459, loss = 0.04410259
Iteration 460, loss = 0.04392340
Iteration 461, loss = 0.04376363
Iteration 462, loss = 0.04355334
Iteration 463, loss = 0.04338893
Iteration 464, loss = 0.04321430
Iteration 465, loss = 0.04302322

Iteration 466, loss = 0.04284943
Iteration 467, loss = 0.04267866
Iteration 468, loss = 0.04251086
Iteration 469, loss = 0.04232556
Iteration 470, loss = 0.04216302
Iteration 471, loss = 0.04200219
Iteration 472, loss = 0.04183305
Iteration 473, loss = 0.04167535
Iteration 474, loss = 0.04149348
Iteration 475, loss = 0.04133823
Iteration 476, loss = 0.04117175
Iteration 477, loss = 0.04100985
Iteration 478, loss = 0.04085328
Iteration 479, loss = 0.04068175
Iteration 480, loss = 0.04053216
Iteration 481, loss = 0.04037288
Iteration 482, loss = 0.04020990
Iteration 483, loss = 0.04005788
Iteration 484, loss = 0.03989616
Iteration 485, loss = 0.03973900
Iteration 486, loss = 0.03961333
Iteration 487, loss = 0.03943407
Iteration 488, loss = 0.03928766
Iteration 489, loss = 0.03912259
Iteration 490, loss = 0.03899036
Iteration 491, loss = 0.03883397
Iteration 492, loss = 0.03869200
Iteration 493, loss = 0.03853760
Iteration 494, loss = 0.03838223
Iteration 495, loss = 0.03824576
Iteration 496, loss = 0.03809778
Iteration 497, loss = 0.03795499
Iteration 498, loss = 0.03780535
Iteration 499, loss = 0.03767140
Iteration 500, loss = 0.03751994
Iteration 501, loss = 0.03739101
Iteration 502, loss = 0.03724866
Iteration 503, loss = 0.03710918
Iteration 504, loss = 0.03697347
Iteration 505, loss = 0.03683403
Iteration 506, loss = 0.03671516
Iteration 507, loss = 0.03656725
Iteration 508, loss = 0.03643714
Iteration 509, loss = 0.03631671
Iteration 510, loss = 0.03617812
Iteration 511, loss = 0.03604281
Iteration 512, loss = 0.03591620

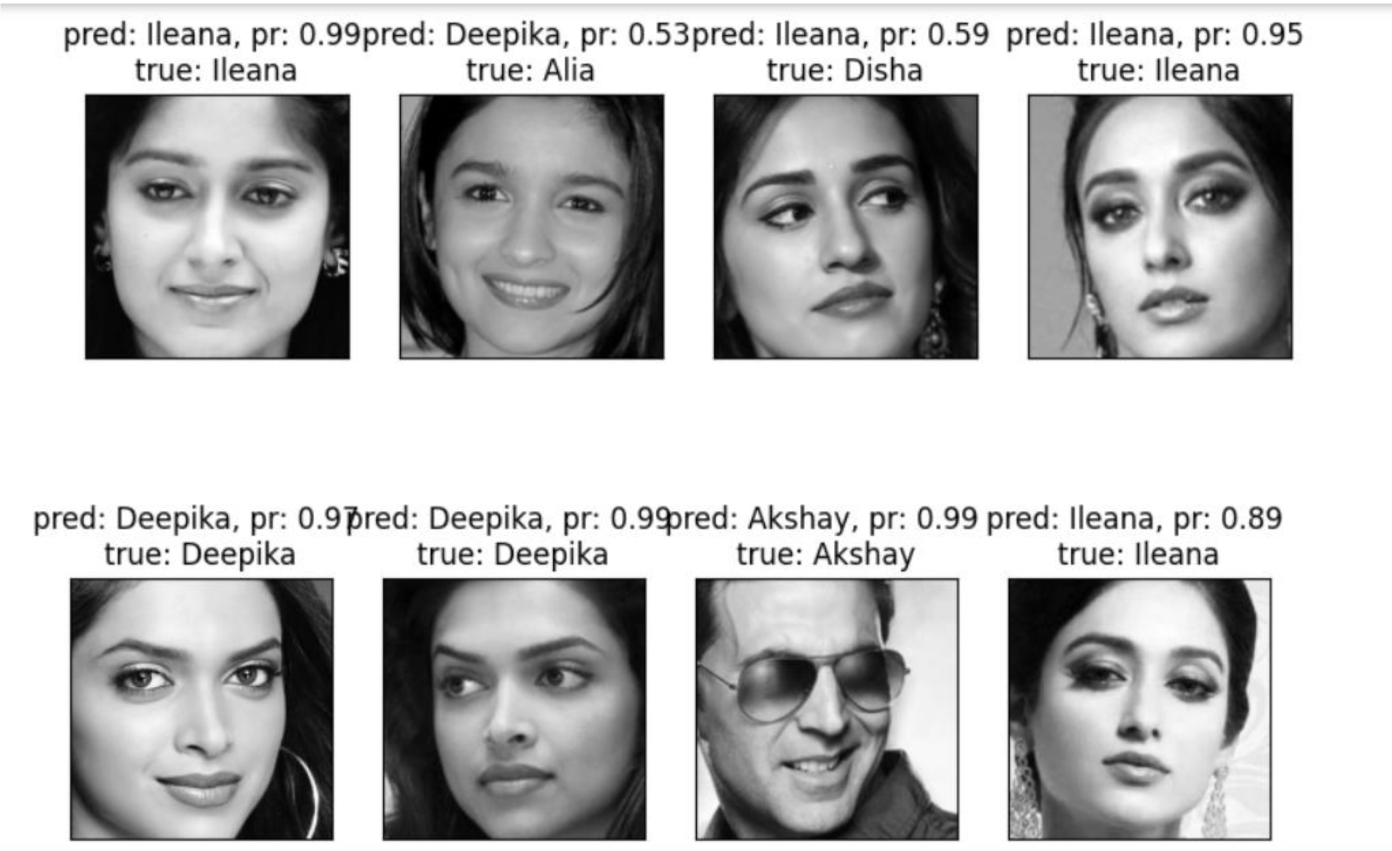
Iteration 513, loss = 0.03578294
Iteration 514, loss = 0.03565508
Iteration 515, loss = 0.03553703
Iteration 516, loss = 0.03542211
Iteration 517, loss = 0.03528318
Iteration 518, loss = 0.03514300
Iteration 519, loss = 0.03502566
Iteration 520, loss = 0.03490261
Iteration 521, loss = 0.03476851
Iteration 522, loss = 0.03466091
Iteration 523, loss = 0.03453226
Iteration 524, loss = 0.03440865
Iteration 525, loss = 0.03429113
Iteration 526, loss = 0.03416435
Iteration 527, loss = 0.03403850
Iteration 528, loss = 0.03392600
Iteration 529, loss = 0.03380191
Iteration 530, loss = 0.03369088
Iteration 531, loss = 0.03356477
Iteration 532, loss = 0.03345389
Iteration 533, loss = 0.03332495
Iteration 534, loss = 0.03321037
Iteration 535, loss = 0.03309221
Iteration 536, loss = 0.03298631
Iteration 537, loss = 0.03286114
Iteration 538, loss = 0.03275678
Iteration 539, loss = 0.03264013
Iteration 540, loss = 0.03252723
Iteration 541, loss = 0.03240700
Iteration 542, loss = 0.03230405
Iteration 543, loss = 0.03218510
Iteration 544, loss = 0.03208447
Iteration 545, loss = 0.03197353
Iteration 546, loss = 0.03185768
Iteration 547, loss = 0.03174837
Iteration 548, loss = 0.03164628
Iteration 549, loss = 0.03153502
Iteration 550, loss = 0.03142791
Iteration 551, loss = 0.03132368
Iteration 552, loss = 0.03121759
Iteration 553, loss = 0.03111275
Iteration 554, loss = 0.03100984
Iteration 555, loss = 0.03090809
Iteration 556, loss = 0.03080908
Iteration 557, loss = 0.03070389
Iteration 558, loss = 0.03060107
Iteration 559, loss = 0.03049886

```
Iteration 560, loss = 0.03041274
Iteration 561, loss = 0.03028398
Iteration 562, loss = 0.03018865
Iteration 563, loss = 0.03009526
Iteration 564, loss = 0.02999930
Iteration 565, loss = 0.02989188
Iteration 566, loss = 0.02979212
Iteration 567, loss = 0.02970767
Iteration 568, loss = 0.02959928
Iteration 569, loss = 0.02951640
Iteration 570, loss = 0.02940258
Iteration 571, loss = 0.02930674
Iteration 572, loss = 0.02921002
Iteration 573, loss = 0.02911356
Iteration 574, loss = 0.02902006
Iteration 575, loss = 0.02893137
Iteration 576, loss = 0.02883883
Iteration 577, loss = 0.02873659
Iteration 578, loss = 0.02864533
Iteration 579, loss = 0.02856235
Iteration 580, loss = 0.02847847
Iteration 581, loss = 0.02837672
Iteration 582, loss = 0.02828354
Iteration 583, loss = 0.02819807
Iteration 584, loss = 0.02810797
Iteration 585, loss = 0.02801626
Iteration 586, loss = 0.02792370
Iteration 587, loss = 0.02784129
Iteration 588, loss = 0.02775751
Iteration 589, loss = 0.02766933
Iteration 590, loss = 0.02757656
Iteration 591, loss = 0.02749274
Iteration 592, loss = 0.02740352

Training loss did not improve more than tol=0.000100 for 10 consecutive epochs. Stopping.

Model Weights:
[(8, 10), (10, 10), (10, 9)]

Accuracy: 66.3716814159292%
```


pred: Ileana, pr: 0.99
true: Ileana
pred: Deepika, pr: 0.53
true: Alia
pred: Ileana, pr: 0.59
true: Disha
pred: Ileana, pr: 0.95
true: Ileana
pred: Deepika, pr: 0.97
true: Deepika
pred: Deepika, pr: 0.99
true: Deepika
pred: Akshay, pr: 0.99
true: Akshay
pred: Ileana, pr: 0.89
true: Ileana


pred: Ileana, pr: 0.99
true: Ileana
pred: Alia, pr: 0.96
true: Ileana
pred: Akshay, pr: 0.21
true: Akshay
pred: Ajay, pr: 0.99
true: Aamir

By

B.AKILESH