face_recognition_project

May 14, 2025

[7]:
```
import matplotlib.pyplot as plt

from sklearn.model_selection import train_test_split
from sklearn.datasets import fetch_lfw_people
from sklearn.decomposition import PCA
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
from sklearn.neural_network import MLPClassifier
from sklearn.preprocessing import StandardScaler

import numpy as np
import os, cv2
```

[8]:
```
def plot_gallery(images, titles, h, w, n_row=3, n_col=4):
    """Helper function to plot a gallery of portraits"""
    plt.figure(figsize=(2.0 * n_col, 2.5 *n_row))
    plt.subplots_adjust(bottom=0.05, left=0.02, right=0.98, top=0.90, hspace=0.
 ↪6)

    for i in range(n_row * n_col):
        if i >= len(images):
            break
        plt.subplot(n_row, n_col, i + 1)
        image = images[i].reshape((h,w))
        image = (image - image.min()) / (image.max() +1e-6)
        plt.imshow(image, cmap = plt.cm.gray)
        plt.title(titles[i], size = 12)
        plt.xticks(())
        plt.yticks(())
```

[ ]:
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[9]:
```
dir_name="dataset/faces/"
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 = dir_name+person_name+"/"
    class_names.append(person_name)
    for image_name in os.listdir(dir_path):
        image_path = 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().tolist()
        X.append(v)
        y.append(person_id)
        target_names.append(person_name)
        n_samples = n_samples+1
    person_id = 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, X.shape, target_names.shape)
print("Number of samples:", n_samples)
#lfw_people = fetch_lfw_people(min_faces_per_person = 70, resize = 0.4)

#n_samples, h,w, = lfw_people.images.shape
#print(n_samples, h, w)
#X = lfw_people.data
#n_features = X.shape[1]
#print(X.shape)
#y = lfw_people.target
#print(y)
#target_names = lfw_people.target_names
#print(target_names)
n_classes = target_names.shape[0]

print("Total dataset size:")
print("n_samples: %d" % n_samples)
print("n_features: %d" % n_features)
print("n_classes: %d" % n_classes)
```

```
(450,) (450, 90000) (450,)
Number of samples: 450
Total dataset size:
n_samples: 450
n_features: 90000
n_classes: 450
```

[10]:
```
X_train, X_test, y_train , y_test = train_test_split(
    X, y, test_size = 0.25, random_state = 42)
```

```
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
n_components = 150


print("Extracting the top %d eigenfaces from %d faces"%(n_components, X_train.
  ↪shape[0]))

pca = PCA(n_components=n_components, svd_solver = 'randomized', whiten= True).
  ↪fit(X_train)
eigenfaces = pca.components_.reshape((n_components, h, w))

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

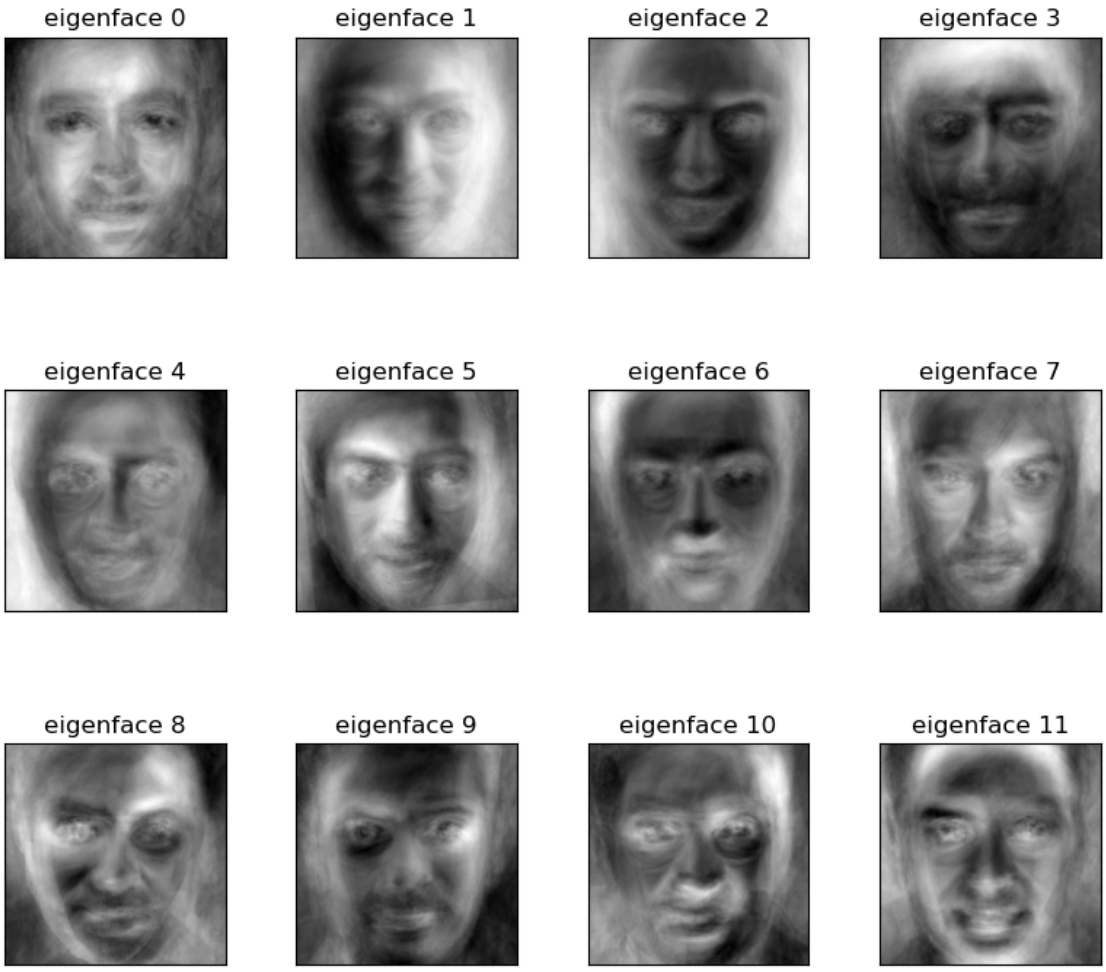
plt.show()

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(X_train_pca.shape, X_test_pca.shape)

lda = LinearDiscriminantAnalysis()
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...")
```

```
Extracting the top 150 eigenfaces from 337 faces
```




```
projecting the input data on the eigenfaces orthonormal basis
(337, 150) (113, 150)
project done…
```

[11]:
```
clf = MLPClassifier(random_state = 1, hidden_layer_sizes = (10, 5, 10),␣
  ↪max_iter = 1000, verbose = True).fit(X_train_lda, y_train)
print("Model weights:")
model_info = [coef.shape for coef in clf.coefs_]
print(model_info)
```

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Iteration 1, loss = 2.39913454
Iteration 2, loss = 2.37446710
Iteration 3, loss = 2.35073203
Iteration 4, loss = 2.32755901
Iteration 5, loss = 2.30575022
Iteration 6, loss = 2.28321473
Iteration 7, loss = 2.26275646
Iteration 8, loss = 2.24224631
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Iteration 9, loss = 2.22266169
Iteration 10, loss = 2.20233377
Iteration 11, loss = 2.18358864
Iteration 12, loss = 2.16522856
Iteration 13, loss = 2.14654891
Iteration 14, loss = 2.12734165
Iteration 15, loss = 2.10941776
Iteration 16, loss = 2.09111242
Iteration 17, loss = 2.07310314
Iteration 18, loss = 2.05491253
Iteration 19, loss = 2.03624645
Iteration 20, loss = 2.01764156
Iteration 21, loss = 1.99799334
Iteration 22, loss = 1.97935863
Iteration 23, loss = 1.95898593
Iteration 24, loss = 1.93930523
Iteration 25, loss = 1.91902878
Iteration 26, loss = 1.89806808
Iteration 27, loss = 1.87739880
Iteration 28, loss = 1.85623457
Iteration 29, loss = 1.83646583
Iteration 30, loss = 1.81671321
Iteration 31, loss = 1.79674187
Iteration 32, loss = 1.77678431
Iteration 33, loss = 1.75814106
Iteration 34, loss = 1.74046262
Iteration 35, loss = 1.72191249
Iteration 36, loss = 1.70457284
Iteration 37, loss = 1.68736078
Iteration 38, loss = 1.67092604
Iteration 39, loss = 1.65431404
Iteration 40, loss = 1.63815100
Iteration 41, loss = 1.62238342
Iteration 42, loss = 1.60648901
Iteration 43, loss = 1.59135848
Iteration 44, loss = 1.57575745
Iteration 45, loss = 1.56085470
Iteration 46, loss = 1.54603863
Iteration 47, loss = 1.53136876
Iteration 48, loss = 1.51678836
Iteration 49, loss = 1.50245903
Iteration 50, loss = 1.48809356
Iteration 51, loss = 1.47423094
Iteration 52, loss = 1.46022685
Iteration 53, loss = 1.44661340
Iteration 54, loss = 1.43301270
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Iteration 57, loss = 1.39373511
Iteration 58, loss = 1.38092495
Iteration 59, loss = 1.36803106
Iteration 60, loss = 1.35582157
Iteration 61, loss = 1.34356727
Iteration 62, loss = 1.33115246
Iteration 63, loss = 1.31911388
Iteration 64, loss = 1.30717328
Iteration 65, loss = 1.29522521
Iteration 66, loss = 1.28369835
Iteration 67, loss = 1.27228588
Iteration 68, loss = 1.26096447
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Iteration 70, loss = 1.23821807
Iteration 71, loss = 1.22743782
Iteration 72, loss = 1.21650088
Iteration 73, loss = 1.20586028
Iteration 74, loss = 1.19535325
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Iteration 78, loss = 1.15412290
Iteration 79, loss = 1.14452555
Iteration 80, loss = 1.13454799
Iteration 81, loss = 1.12504945
Iteration 82, loss = 1.11550917
Iteration 83, loss = 1.10631938
Iteration 84, loss = 1.09719073
Iteration 85, loss = 1.08826553
Iteration 86, loss = 1.07927869
Iteration 87, loss = 1.07065930
Iteration 88, loss = 1.06209258
Iteration 89, loss = 1.05350104
Iteration 90, loss = 1.04537607
Iteration 91, loss = 1.03721507
Iteration 92, loss = 1.02905480
Iteration 93, loss = 1.02139366
Iteration 94, loss = 1.01344822
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Iteration 96, loss = 0.99827657
Iteration 97, loss = 0.99089658
Iteration 98, loss = 0.98346609
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Iteration 473, loss = 0.05127852
Iteration 474, loss = 0.05109621
Iteration 475, loss = 0.05087742
Iteration 476, loss = 0.05066276
Iteration 477, loss = 0.05047063
Iteration 478, loss = 0.05025952
Iteration 479, loss = 0.05006705
Iteration 480, loss = 0.04985742
Iteration 481, loss = 0.04966591
Iteration 482, loss = 0.04945789
Iteration 483, loss = 0.04928883
Iteration 484, loss = 0.04909973
Iteration 485, loss = 0.04892936
Iteration 486, loss = 0.04868053
Iteration 487, loss = 0.04848111
Iteration 488, loss = 0.04832286
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Iteration 489, loss = 0.04810843
Iteration 490, loss = 0.04794483
Iteration 491, loss = 0.04779279
Iteration 492, loss = 0.04759201
Iteration 493, loss = 0.04738001
Iteration 494, loss = 0.04721010
Iteration 495, loss = 0.04709085
Iteration 496, loss = 0.04685775
Iteration 497, loss = 0.04667665
Iteration 498, loss = 0.04648713
Iteration 499, loss = 0.04634625
Iteration 500, loss = 0.04613846
Iteration 501, loss = 0.04597068
Iteration 502, loss = 0.04581479
Iteration 503, loss = 0.04562639
Iteration 504, loss = 0.04547491
Iteration 505, loss = 0.04530101
Iteration 506, loss = 0.04514304
Iteration 507, loss = 0.04498200
Iteration 508, loss = 0.04479922
Iteration 509, loss = 0.04463220
Iteration 510, loss = 0.04445195
Iteration 511, loss = 0.04430827
Iteration 512, loss = 0.04415516
Iteration 513, loss = 0.04400507
Iteration 514, loss = 0.04382881
Iteration 515, loss = 0.04369207
Iteration 516, loss = 0.04351774
Iteration 517, loss = 0.04334511
Iteration 518, loss = 0.04319328
Iteration 519, loss = 0.04303925
Iteration 520, loss = 0.04289762
Iteration 521, loss = 0.04279803
Iteration 522, loss = 0.04261915
Iteration 523, loss = 0.04246958
Iteration 524, loss = 0.04229145
Iteration 525, loss = 0.04213384
Iteration 526, loss = 0.04202218
Iteration 527, loss = 0.04184867
Iteration 528, loss = 0.04171591
Iteration 529, loss = 0.04156387
Iteration 530, loss = 0.04140165
Iteration 531, loss = 0.04125240
Iteration 532, loss = 0.04113801
Iteration 533, loss = 0.04103973
Iteration 534, loss = 0.04083958
Iteration 535, loss = 0.04070543
Iteration 536, loss = 0.04055509
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Iteration 537, loss = 0.04043176
Iteration 538, loss = 0.04029445
Iteration 539, loss = 0.04014568
Iteration 540, loss = 0.04003050
Iteration 541, loss = 0.03987966
Iteration 542, loss = 0.03974062
Iteration 543, loss = 0.03961785
Iteration 544, loss = 0.03948322
Iteration 545, loss = 0.03933148
Iteration 546, loss = 0.03919218
Iteration 547, loss = 0.03907338
Iteration 548, loss = 0.03894430
Iteration 549, loss = 0.03885368
Iteration 550, loss = 0.03873582
Iteration 551, loss = 0.03858742
Iteration 552, loss = 0.03842667
Iteration 553, loss = 0.03830800
Iteration 554, loss = 0.03817756
Iteration 555, loss = 0.03805505
Iteration 556, loss = 0.03792081
Iteration 557, loss = 0.03779648
Iteration 558, loss = 0.03767256
Iteration 559, loss = 0.03758475
Iteration 560, loss = 0.03744702
Iteration 561, loss = 0.03734207
Iteration 562, loss = 0.03719484
Iteration 563, loss = 0.03710128
Iteration 564, loss = 0.03695385
Iteration 565, loss = 0.03682480
Iteration 566, loss = 0.03669619
Iteration 567, loss = 0.03658670
Iteration 568, loss = 0.03644885
Iteration 569, loss = 0.03636758
Iteration 570, loss = 0.03623846
Iteration 571, loss = 0.03610420
Iteration 572, loss = 0.03599066
Iteration 573, loss = 0.03588266
Iteration 574, loss = 0.03576539
Iteration 575, loss = 0.03566077
Iteration 576, loss = 0.03555650
Iteration 577, loss = 0.03544459
Iteration 578, loss = 0.03531043
Iteration 579, loss = 0.03519917
Iteration 580, loss = 0.03508382
Iteration 581, loss = 0.03498526
Iteration 582, loss = 0.03486027
Iteration 583, loss = 0.03475080
Iteration 584, loss = 0.03465281
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Iteration 585, loss = 0.03456892
Iteration 586, loss = 0.03443214
Iteration 587, loss = 0.03434683
Iteration 588, loss = 0.03421582
Iteration 589, loss = 0.03411530
Iteration 590, loss = 0.03401344
Iteration 591, loss = 0.03391088
Iteration 592, loss = 0.03379928
Iteration 593, loss = 0.03369847
Iteration 594, loss = 0.03358212
Iteration 595, loss = 0.03353547
Iteration 596, loss = 0.03337834
Iteration 597, loss = 0.03326872
Iteration 598, loss = 0.03318126
Iteration 599, loss = 0.03307430
Iteration 600, loss = 0.03297452
Iteration 601, loss = 0.03290774
Iteration 602, loss = 0.03280006
Iteration 603, loss = 0.03269030
Iteration 604, loss = 0.03257475
Iteration 605, loss = 0.03247089
Iteration 606, loss = 0.03237187
Iteration 607, loss = 0.03226509
Iteration 608, loss = 0.03217839
Iteration 609, loss = 0.03207899
Iteration 610, loss = 0.03198963
Iteration 611, loss = 0.03188224
Iteration 612, loss = 0.03179636
Iteration 613, loss = 0.03174727
Iteration 614, loss = 0.03162354
Iteration 615, loss = 0.03151916
Iteration 616, loss = 0.03142367
Iteration 617, loss = 0.03133338
Iteration 618, loss = 0.03123347
Iteration 619, loss = 0.03115229
Iteration 620, loss = 0.03104839
Iteration 621, loss = 0.03098225
Iteration 622, loss = 0.03088510
Iteration 623, loss = 0.03077382
Iteration 624, loss = 0.03070869
Iteration 625, loss = 0.03061083
Iteration 626, loss = 0.03053318
Iteration 627, loss = 0.03044960
Iteration 628, loss = 0.03033897
Iteration 629, loss = 0.03027979
Iteration 630, loss = 0.03019325
Iteration 631, loss = 0.03008175
Iteration 632, loss = 0.03000802
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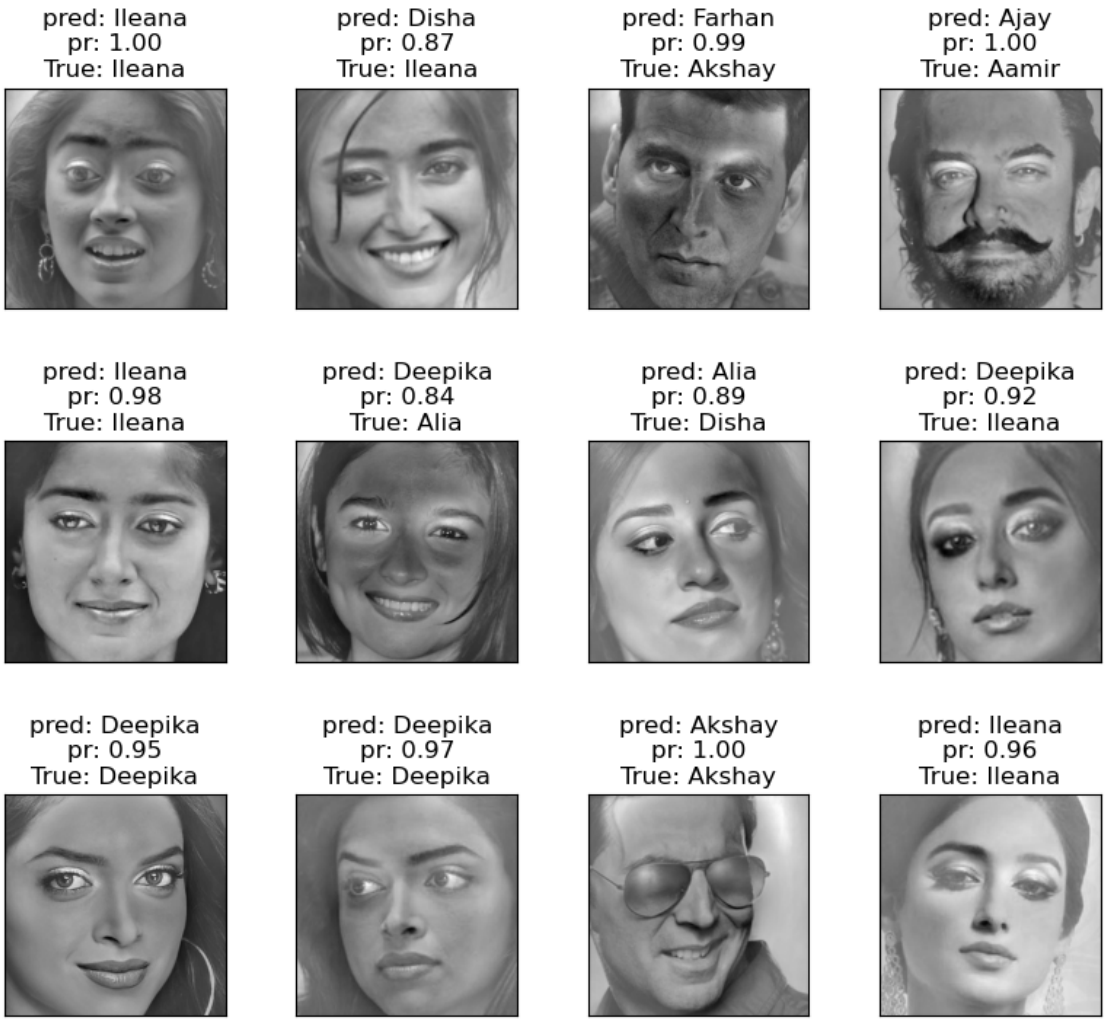
Iteration 633, loss = 0.02997272
Iteration 634, loss = 0.02983133
Iteration 635, loss = 0.02975464
Iteration 636, loss = 0.02967179
Iteration 637, loss = 0.02958662
Iteration 638, loss = 0.02949151
Iteration 639, loss = 0.02942720
Iteration 640, loss = 0.02934351
Iteration 641, loss = 0.02923509
Iteration 642, loss = 0.02919817
Iteration 643, loss = 0.02907985
Iteration 644, loss = 0.02898388
Iteration 645, loss = 0.02893242
Iteration 646, loss = 0.02884413
Iteration 647, loss = 0.02874854
Iteration 648, loss = 0.02873173
Iteration 649, loss = 0.02865360
Iteration 650, loss = 0.02851084
Iteration 651, loss = 0.02843537
Iteration 652, loss = 0.02838583
Iteration 653, loss = 0.02827631
Iteration 654, loss = 0.02818646
Iteration 655, loss = 0.02811054
Iteration 656, loss = 0.02802594
Iteration 657, loss = 0.02795260
Iteration 658, loss = 0.02787484
Iteration 659, loss = 0.02779323
Iteration 660, loss = 0.02771580
Iteration 661, loss = 0.02764606
Iteration 662, loss = 0.02759169
Iteration 663, loss = 0.02749929
Iteration 664, loss = 0.02741045
Training loss did not improve more than tol=0.000100 for 10 consecutive epochs.
Stopping.
Model weights:
[(8, 10), (10, 5), (5, 10), (10, 9)]
```

[12]:
```python
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))

y_pred = np.array(y_pred)
```

```
prediction_titles = []
true_positive = 0
for i in range(len(y_pred)):
    true_name = class_names[y_test[i]]
    pred_name = class_names[y_pred[i]]

    title = f"pred: {pred_name}\npr: {y_prob[i]:.2f}\nTrue: {true_name}"
    prediction_titles.append(title)

    if true_name == pred_name:
        true_positive +=1

accuracy = true_positive * 100 / len(y_pred)
print(f"Accuracy: {accuracy:.2f}%")

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

```
Accuracy: 72.57%
```


pred: Ileana
pr: 1.00
True: Ileana
pred: Disha
pr: 0.87
True: Ileana
pred: Farhan
pr: 0.99
True: Akshay
pred: Ajay
pr: 1.00
True: Aamir
pred: Ileana
pr: 0.98
True: Ileana
pred: Deepika
pr: 0.84
True: Alia
pred: Alia
pr: 0.89
True: Disha
pred: Deepika
pr: 0.92
True: Ileana
pred: Deepika
pr: 0.95
True: Deepika
pred: Deepika
pr: 0.97
True: Deepika
pred: Akshay
pr: 1.00
True: Akshay
pred: Ileana
pr: 0.96
True: Ileana

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