Notebook

November 22, 2024

1 Import libraries

```python
import os
import sys
import cv2
import math
import json
import joblib
import nbformat
import numpy as np
import pandas as pd
import seaborn as sns
from tqdm import tqdm
from sklearn.svm import SVC
from datetime import datetime
import matplotlib.pyplot as plt
from nbconvert.exporters import PDFExporter
from skimage.feature import hog as skimage_hog
from sklearn.preprocessing import LabelEncoder
from IPython.display import display, Javascript
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.metrics import classification_report, confusion_matrix
from scipy.spatial.distance import cityblock, cosine, correlation, sqeuclidean
```

2 Load data

```python
project_dir = os.getcwd()
project_dir = os.path.dirname(project_dir)
```

```python
width = 64
height = 64
```

```python
data_dir = project_dir + "\\data"

train_path = os.path.join(data_dir, "train")
```

```python
test_path = os.path.join(data_dir, "test")

train_images = []
test_images = []

train_labels = []
test_labels = []

for path in (train_path, test_path):
    if (path.split('\\')[-1] == "train"):
        for dir in os.listdir(path):
            label_path = os.path.join(path, dir)
            label = dir.split('\\')[-1]
            for image in os.listdir(label_path):
                image_path = os.path.join(label_path, image)
                image = cv2.imread(image_path)
                image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
                image = cv2.resize(image, (width, height))
                train_images.append(image)
                train_labels.append(label)
    else:
        for dir in os.listdir(path):
            label_path = os.path.join(path, dir)
            label = dir.split('\\')[-1]
            for image in os.listdir(label_path):
                image_path = os.path.join(label_path, image)
                image = cv2.imread(image_path)
                image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
                image = cv2.resize(image, (width, height))
                test_images.append(image)
                test_labels.append(label)
```

```python
label_encoder = LabelEncoder()
train_labels_encoded = label_encoder.fit_transform(train_labels)
test_labels_encoded = label_encoder.transform(test_labels)
```

```python
joblib.dump(train_images, project_dir + '\joblib\\train_images.joblib')
joblib.dump(test_images, project_dir + '\joblib\\test_images.joblib')
joblib.dump(train_labels_encoded, project_dir + '\joblib\\train_labels_encoded.
 ↪joblib')
joblib.dump(test_labels_encoded, project_dir + '\joblib\\test_labels_encoded.
 ↪joblib')
joblib.dump(label_encoder, project_dir + '\joblib\\label_encoder.joblib')
```
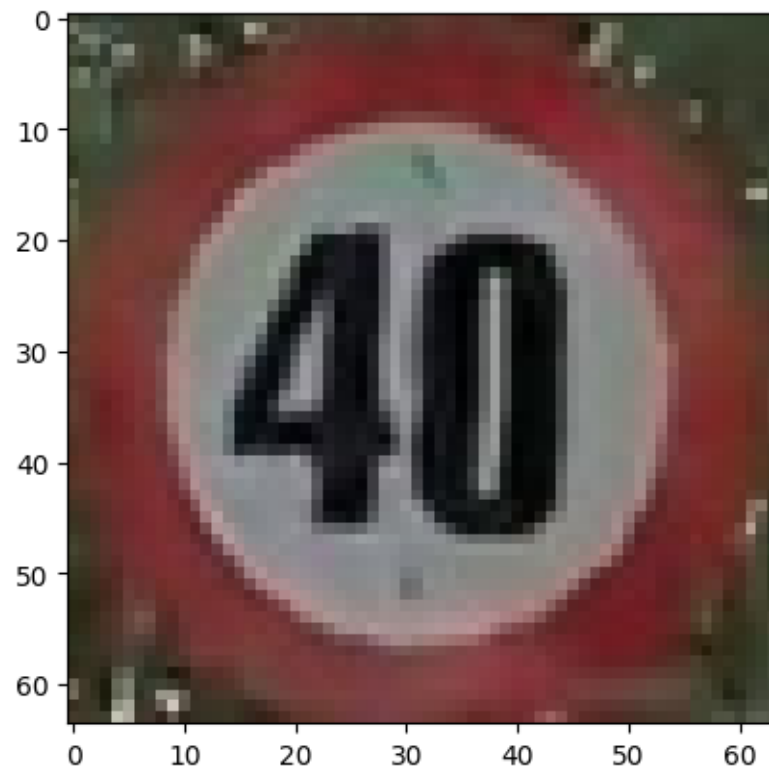
```
['d:\\ASUS\\Deploy-Traffic-Sign-Classification-through-
Images\\joblib\\label_encoder.joblib']
```

```
plt.imshow(test_images[0])
```

<matplotlib.image.AxesImage at 0x1cf822245d0>


```
plt.imshow(train_images[1])
```

<matplotlib.image.AxesImage at 0x1cf822ad510>

3   Extract features

```python
def blur_image(image):
    blurred_image = cv2.medianBlur(image, 5)
    return blurred_image
```

```python
def color_histogram(image):
    # image = cv2.cvtColor(image, cv2.COLOR_RGB2LUV)
    row, column, channel = image.shape[:3]
    size = row * column
    feature = []
    for k in range(channel):
        histogram = np.squeeze(cv2.calcHist([image], [k], None, [32], [0, 256]))
        histogram = histogram / size
        feature.extend(histogram)
    return feature
```

```python
def hog(image):
    # image = cv2.cvtColor(image, cv2.COLOR_RGB2LUV)
```

```python
    hog_features = skimage_hog(image, orientations=9, pixels_per_cell=(8, 8),␣
↪cells_per_block=(2, 2), visualize=False, block_norm='L2-Hys',␣
↪transform_sqrt=True, channel_axis=2)
    return hog_features
```

```python
def extract_features(images):
    blurred_images = [blur_image(image) for image in tqdm(images,␣
↪desc="Sharpening Images")]
    color_features = [color_histogram(image) for image in tqdm(blurred_images,␣
↪desc="Extracting Color Features")]
    hog_features = [hog(image) for image in tqdm(blurred_images,␣
↪desc="Extracting HOG Features")]
    combined_features = [np.concatenate((color_feature, hog_feature))
                        for color_feature, hog_feature in␣
↪tqdm(zip(color_features, hog_features), desc="Combining Features")]

    return combined_features
```

```python
train_features = extract_features(train_images)
joblib.dump(train_features, project_dir + '\joblib\\train_features.joblib')
```

```
Sharpening Images: 100%|      | 1415/1415 [00:00<00:00, 1613.84it/s]
Extracting Color Features: 100%|      | 1415/1415 [00:00<00:00, 7726.49it/s]
Extracting HOG Features: 100%|      | 1415/1415 [00:05<00:00, 268.00it/s]
Combining Features: 1415it [00:00, 38673.68it/s]

['d:\\ASUS\\Deploy-Traffic-Sign-Classification-through-
Images\\joblib\\train_features.joblib']
```

```python
test_features = extract_features(test_images)
joblib.dump(test_features, project_dir + '\joblib\\test_features.joblib')
```

```
Sharpening Images: 100%|      | 150/150 [00:00<00:00, 1967.66it/s]
Extracting Color Features: 100%|      | 150/150 [00:00<00:00, 14126.04it/s]
Extracting HOG Features: 100%|      | 150/150 [00:00<00:00, 277.82it/s]
Combining Features: 150it [00:00, 37254.00it/s]

['d:\\ASUS\\Deploy-Traffic-Sign-Classification-through-
Images\\joblib\\test_features.joblib']
```

4 Distance metrics KNN

```python
def chi_square_distance(x, y):
    return cv2.compareHist(np.array(x, dtype=np.float32), np.array(y, dtype=np.
↪float32), cv2.HISTCMP_CHISQR)

def bhattacharyya_distance(x, y):
```

```python
        return cv2.compareHist(np.array(x, dtype=np.float32), np.array(y, dtype=np.
 ↪float32), cv2.HISTCMP_BHATTACHARYYA)

def intersection_distance(x, y):
        return 1 - cv2.compareHist(np.array(x, dtype=np.float32), np.array(y,␣
 ↪dtype=np.float32), cv2.HISTCMP_INTERSECT)
```

5 Load Best Model

```python
# knn_model = joblib.load_model(project_dir + '\\joblib\\best_knn_model.joblib')
# svm_model = joblib.load_model(project_dir + '\\joblib\\best_svm_model.joblib')

# y_pred_knn = knn_model.predict(test_features)
# y_pred_svm = svm_model.predict(test_features)
```

6 Gridsearch KNN

```python
param_grid = {
    'n_neighbors': [3, 4, 5, 6, 7, 10],
    'weights': ['uniform', 'distance'],
    'leaf_size': [5, 10, 20, 30, 40, 50],
    'metric': [
        cityblock,
        cosine,
        # correlation,
        sqeuclidean,
        chi_square_distance,
        bhattacharyya_distance,
        intersection_distance
    ]
}

knn_model = KNeighborsClassifier()
grid_search_knn = GridSearchCV(
    knn_model,
    param_grid,
    cv=3,
    scoring='f1_macro',
    verbose=3
)

grid_search_knn.fit(train_features, train_labels_encoded)
```

```
Fitting 3 folds for each of 432 candidates, totalling 1296 fits
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=uniform;, score=0.857 total time=   5.9s
```

```
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=uniform;, score=0.814 total time=   5.5s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=uniform;, score=0.830 total time=   5.3s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=distance;, score=0.858 total time=   5.4s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=distance;, score=0.816 total time=   5.4s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=distance;, score=0.850 total time=   5.9s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=4, weights=uniform;, score=0.839 total time=   5.2s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=4, weights=uniform;, score=0.788 total time=   5.0s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=4, weights=uniform;, score=0.795 total time=   5.0s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=4, weights=distance;, score=0.877 total time=   5.8s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=4, weights=distance;, score=0.825 total time=   5.1s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=4, weights=distance;, score=0.830 total time=   5.2s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=5, weights=uniform;, score=0.838 total time=   6.4s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=5, weights=uniform;, score=0.787 total time=   5.1s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=5, weights=uniform;, score=0.808 total time=   6.5s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=5, weights=distance;, score=0.854 total time=   5.3s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=5, weights=distance;, score=0.808 total time=   4.9s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=5, weights=distance;, score=0.831 total time=   5.0s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=6, weights=uniform;, score=0.826 total time=   5.1s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=6, weights=uniform;, score=0.788 total time=   5.5s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=6, weights=uniform;, score=0.799 total time=   6.8s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=6, weights=distance;, score=0.862 total time=   5.9s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=6, weights=distance;, score=0.799 total time=   5.2s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=6, weights=distance;, score=0.824 total time=   6.1s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=7, weights=uniform;, score=0.847 total time=   5.5s
```

[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=uniform;, score=0.783 total time=   5.2s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=uniform;, score=0.778 total time=   5.2s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=distance;, score=0.855 total time=   5.7s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=distance;, score=0.795 total time=   5.7s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=distance;, score=0.809 total time=   5.4s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=uniform;, score=0.823 total time=   5.9s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=uniform;, score=0.766 total time=   5.3s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=uniform;, score=0.746 total time=   6.6s
[CV 1/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=distance;, score=0.861 total time=   5.9s
[CV 2/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=distance;, score=0.791 total time=   5.1s
[CV 3/3] END leaf_size=5, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=distance;, score=0.787 total time=   5.3s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=3, weights=uniform;, score=0.853 total time= 14.3s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=3, weights=uniform;, score=0.785 total time= 13.9s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=3, weights=uniform;, score=0.779 total time= 14.4s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=3, weights=distance;, score=0.864 total time= 14.1s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=3, weights=distance;, score=0.807 total time= 13.9s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=3, weights=distance;, score=0.797 total time= 15.7s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=uniform;, score=0.817 total time= 13.9s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=uniform;, score=0.749 total time= 14.8s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=uniform;, score=0.766 total time= 15.5s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=distance;, score=0.858 total time= 14.2s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=distance;, score=0.804 total time= 13.2s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=distance;, score=0.800 total time= 12.9s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=5, weights=uniform;, score=0.824 total time= 13.4s

[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=5, weights=uniform;, score=0.776 total time= 12.7s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=5, weights=uniform;, score=0.769 total time= 12.7s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=5, weights=distance;, score=0.854 total time= 12.7s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=5, weights=distance;, score=0.803 total time= 12.6s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=5, weights=distance;, score=0.797 total time= 13.1s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=uniform;, score=0.809 total time= 12.9s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=uniform;, score=0.759 total time= 12.9s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=uniform;, score=0.753 total time= 12.9s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=distance;, score=0.872 total time= 13.0s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=distance;, score=0.798 total time= 14.6s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=distance;, score=0.790 total time= 10.9s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=7, weights=uniform;, score=0.813 total time= 11.1s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=7, weights=uniform;, score=0.755 total time= 11.3s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=7, weights=uniform;, score=0.757 total time= 15.3s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=7, weights=distance;, score=0.846 total time= 11.9s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=7, weights=distance;, score=0.789 total time= 10.4s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=7, weights=distance;, score=0.773 total time= 12.1s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=10, weights=uniform;, score=0.802 total time= 15.0s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=10, weights=uniform;, score=0.758 total time= 14.9s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=10, weights=uniform;, score=0.733 total time= 12.8s
[CV 1/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=10, weights=distance;, score=0.836 total time= 12.0s
[CV 2/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=10, weights=distance;, score=0.776 total time= 11.6s
[CV 3/3] END leaf_size=5, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=10, weights=distance;, score=0.761 total time= 14.6s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=3, weights=uniform;, score=0.848 total time=   5.4s

[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=3, weights=uniform;, score=0.782 total time=   4.8s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=3, weights=uniform;, score=0.774 total time=   4.9s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=3, weights=distance;, score=0.858 total time=   4.3s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=3, weights=distance;, score=0.802 total time=   4.4s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=3, weights=distance;, score=0.793 total time=   4.4s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=4, weights=uniform;, score=0.812 total time=   4.4s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=4, weights=uniform;, score=0.752 total time=   5.1s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=4, weights=uniform;, score=0.763 total time=   5.2s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=4, weights=distance;, score=0.856 total time=   6.2s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=4, weights=distance;, score=0.797 total time=   4.9s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=4, weights=distance;, score=0.798 total time=   5.6s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=uniform;, score=0.824 total time=   5.1s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=uniform;, score=0.773 total time=   5.0s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=uniform;, score=0.767 total time=   4.2s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=distance;, score=0.850 total time=   4.3s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=distance;, score=0.791 total time=   4.3s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=distance;, score=0.792 total time=   4.9s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=uniform;, score=0.814 total time=   4.8s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=uniform;, score=0.759 total time=   4.5s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=uniform;, score=0.767 total time=   4.6s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=distance;, score=0.864 total time=   5.5s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=distance;, score=0.798 total time=   6.0s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=distance;, score=0.794 total time=   4.9s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=7, weights=uniform;, score=0.824 total time=   4.9s

[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=7, weights=uniform;, score=0.757 total time=   4.3s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=7, weights=uniform;, score=0.754 total time=   4.8s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=7, weights=distance;, score=0.843 total time=   4.8s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=7, weights=distance;, score=0.789 total time=   5.0s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=7, weights=distance;, score=0.773 total time=   5.6s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=uniform;, score=0.803 total time=   5.5s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=uniform;, score=0.747 total time=   5.8s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=uniform;, score=0.737 total time=   6.8s
[CV 1/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=distance;, score=0.836 total time=   6.9s
[CV 2/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=distance;, score=0.767 total time=   7.0s
[CV 3/3] END leaf_size=5, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=distance;, score=0.767 total time=   6.6s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=3, weights=uniform;, score=0.716 total time=
7.6s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=3, weights=uniform;, score=0.713 total time=
6.2s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=3, weights=uniform;, score=0.678 total time=
5.3s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=3, weights=distance;, score=0.728 total time=
5.4s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=3, weights=distance;, score=0.720 total time=
5.6s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=3, weights=distance;, score=0.692 total time=
7.5s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=4, weights=uniform;, score=0.713 total time=
6.3s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=4, weights=uniform;, score=0.698 total time=
6.2s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=4, weights=uniform;, score=0.686 total time=

5.0s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=4, weights=distance;, score=0.732 total time=
5.3s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=4, weights=distance;, score=0.734 total time=
4.8s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=4, weights=distance;, score=0.705 total time=
4.8s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=5, weights=uniform;, score=0.716 total time=
5.2s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=5, weights=uniform;, score=0.700 total time=
4.9s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=5, weights=uniform;, score=0.676 total time=
4.9s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=5, weights=distance;, score=0.730 total time=
6.1s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=5, weights=distance;, score=0.734 total time=
8.3s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=5, weights=distance;, score=0.707 total time=
7.5s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=uniform;, score=0.709 total time=
5.5s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=uniform;, score=0.692 total time=
5.5s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=uniform;, score=0.655 total time=
5.2s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=distance;, score=0.728 total time=
5.6s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=distance;, score=0.716 total time=
5.6s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=distance;, score=0.714 total time=
6.2s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=7, weights=uniform;, score=0.719 total time=

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4.9s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=7, weights=uniform;, score=0.707 total time=
5.4s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=7, weights=uniform;, score=0.669 total time=
6.6s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=7, weights=distance;, score=0.751 total time=
9.4s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=7, weights=distance;, score=0.726 total time=
6.9s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=7, weights=distance;, score=0.713 total time=
5.0s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=10, weights=uniform;, score=0.684 total time=
5.2s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=10, weights=uniform;, score=0.697 total time=
4.9s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=10, weights=uniform;, score=0.678 total time=
6.1s
[CV 1/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=10, weights=distance;, score=0.725 total time=
6.4s
[CV 2/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=10, weights=distance;, score=0.712 total time=
6.3s
[CV 3/3] END leaf_size=5, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=10, weights=distance;, score=0.716 total time=
4.9s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=uniform;, score=0.827 total time=
4.8s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=uniform;, score=0.741 total time=
5.0s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=uniform;, score=0.731 total time=
7.2s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=distance;, score=0.846 total time=
5.1s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=distance;, score=0.749 total time=

5.2s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=distance;, score=0.750 total time=
5.9s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=4, weights=uniform;, score=0.797 total time=
6.4s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=4, weights=uniform;, score=0.719 total time=
5.7s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=4, weights=uniform;, score=0.719 total time=
5.8s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=4, weights=distance;, score=0.850 total time=
4.9s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=4, weights=distance;, score=0.762 total time=
4.4s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=4, weights=distance;, score=0.744 total time=
4.7s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.826 total time=
4.7s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.715 total time=
4.7s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.713 total time=
6.3s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.837 total time=
6.1s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.739 total time=
5.9s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.734 total time=
6.5s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.812 total time=
6.5s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.707 total time=
6.5s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.731 total time=

6.8s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=6, weights=distance;, score=0.832 total time=
6.3s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=6, weights=distance;, score=0.743 total time=
5.2s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=6, weights=distance;, score=0.741 total time=
5.1s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=7, weights=uniform;, score=0.812 total time=
6.2s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=7, weights=uniform;, score=0.719 total time=
5.1s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=7, weights=uniform;, score=0.718 total time=
4.8s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=7, weights=distance;, score=0.822 total time=
5.1s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=7, weights=distance;, score=0.729 total time=
5.3s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=7, weights=distance;, score=0.724 total time=
5.0s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=10, weights=uniform;, score=0.796 total time=
4.7s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=10, weights=uniform;, score=0.713 total time=
4.6s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=10, weights=uniform;, score=0.717 total time=
4.8s
[CV 1/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=10, weights=distance;, score=0.823 total time=
5.2s
[CV 2/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=10, weights=distance;, score=0.743 total time=
5.1s
[CV 3/3] END leaf_size=5, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=10, weights=distance;, score=0.721 total time=
5.1s
[CV 1/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=3, weights=uniform;, score=0.779 total time=

4.4s

[CV 2/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=3, weights=uniform;, score=0.664 total time= 5.1s

[CV 3/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=3, weights=uniform;, score=0.678 total time= 5.2s

[CV 1/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=3, weights=distance;, score=0.076 total time= 5.5s

[CV 2/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=3, weights=distance;, score=0.076 total time= 5.7s

[CV 3/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=3, weights=distance;, score=0.076 total time= 5.4s

[CV 1/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=4, weights=uniform;, score=0.761 total time= 5.8s

[CV 2/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=4, weights=uniform;, score=0.656 total time= 4.4s

[CV 3/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=4, weights=uniform;, score=0.683 total time= 5.1s

[CV 1/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=4, weights=distance;, score=0.076 total time= 4.5s

[CV 2/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=4, weights=distance;, score=0.076 total time= 5.1s

[CV 3/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=4, weights=distance;, score=0.076 total time= 5.7s

[CV 1/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=5, weights=uniform;, score=0.775 total time= 5.6s

[CV 2/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=5, weights=uniform;, score=0.666 total time= 5.7s

[CV 3/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=5, weights=uniform;, score=0.680 total time= 5.8s

[CV 1/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=5, weights=distance;, score=0.076 total time= 4.3s

[CV 2/3] END leaf_size=5, metric=<function intersection_distance at 0x000001CF822B3B00>, n_neighbors=5, weights=distance;, score=0.076 total time=

4.7s
[CV 3/3] END leaf_size=5, metric=<function intersection_distance at
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4.2s
[CV 1/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=6, weights=uniform;, score=0.755 total time=
5.8s
[CV 2/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=6, weights=uniform;, score=0.650 total time=
5.0s
[CV 3/3] END leaf_size=5, metric=<function intersection_distance at
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6.2s
[CV 1/3] END leaf_size=5, metric=<function intersection_distance at
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5.8s
[CV 2/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=6, weights=distance;, score=0.076 total time=
4.6s
[CV 3/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=6, weights=distance;, score=0.076 total time=
4.2s
[CV 1/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=7, weights=uniform;, score=0.728 total time=
4.3s
[CV 2/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=7, weights=uniform;, score=0.667 total time=
4.3s
[CV 3/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=7, weights=uniform;, score=0.676 total time=
4.6s
[CV 1/3] END leaf_size=5, metric=<function intersection_distance at
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4.7s
[CV 2/3] END leaf_size=5, metric=<function intersection_distance at
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4.7s
[CV 3/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=7, weights=distance;, score=0.076 total time=
4.7s
[CV 1/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=10, weights=uniform;, score=0.732 total time=
4.9s
[CV 2/3] END leaf_size=5, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=10, weights=uniform;, score=0.656 total time=
5.3s
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5.0s
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[CV 2/3] END leaf_size=5, metric=<function intersection_distance at
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4.4s
[CV 3/3] END leaf_size=5, metric=<function intersection_distance at
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4.1s
[CV 1/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=uniform;, score=0.857 total time=   4.7s
[CV 2/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=uniform;, score=0.814 total time=   5.7s
[CV 3/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=uniform;, score=0.830 total time=   5.5s
[CV 1/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=distance;, score=0.858 total time=   5.0s
[CV 2/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=distance;, score=0.816 total time=   5.6s
[CV 3/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=distance;, score=0.850 total time=   5.4s
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[CV 1/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=6, weights=uniform;, score=0.788 total time=   5.9s
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[CV 1/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=6, weights=distance;, score=0.862 total time=   6.2s
[CV 2/3] END leaf_size=10, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=6, weights=distance;, score=0.799 total time=   6.3s
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[CV 2/3] END leaf_size=10, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 3/3] END leaf_size=10, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 2/3] END leaf_size=10, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 3/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=3, weights=uniform;, score=0.774 total time=   4.7s
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[CV 2/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=3, weights=distance;, score=0.802 total time=   4.7s
[CV 3/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=3, weights=distance;, score=0.793 total time=   5.0s
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[CV 3/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=4, weights=uniform;, score=0.763 total time=   6.6s
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[CV 2/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=uniform;, score=0.773 total time=   4.1s
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[CV 3/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=distance;, score=0.792 total time=   6.6s
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[CV 2/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=uniform;, score=0.759 total time=   4.8s
[CV 3/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=uniform;, score=0.767 total time=   6.4s
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[CV 2/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=10, weights=distance;, score=0.767 total time=   5.0s
[CV 3/3] END leaf_size=10, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=10, weights=distance;, score=0.767 total time=   4.5s
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7.8s
[CV 3/3] END leaf_size=10, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=10, weights=distance;, score=0.716 total time=
13.0s
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0x000001CF822B3060>, n_neighbors=3, weights=uniform;, score=0.827 total time=

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11.9s
[CV 2/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=uniform;, score=0.741 total time=
8.3s
[CV 3/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=uniform;, score=0.731 total time=
6.9s
[CV 1/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=distance;, score=0.846 total time=
8.4s
[CV 2/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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[CV 3/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=distance;, score=0.750 total time=
8.4s
[CV 1/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=4, weights=uniform;, score=0.797 total time=
9.7s
[CV 2/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=4, weights=uniform;, score=0.719 total time=
8.1s
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0x000001CF822B3060>, n_neighbors=4, weights=uniform;, score=0.719 total time=
7.8s
[CV 1/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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7.8s
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8.3s
[CV 3/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=4, weights=distance;, score=0.744 total time=
7.9s
[CV 1/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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7.9s
[CV 2/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.715 total time=
8.1s
[CV 3/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.713 total time=
8.5s
[CV 1/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.837 total time=
8.1s
[CV 2/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.739 total time=
```

8.1s
[CV 3/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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8.2s
[CV 1/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.812 total time=
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[CV 2/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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7.9s
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7.8s
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8.0s
[CV 2/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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[CV 3/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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7.5s
[CV 1/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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7.7s
[CV 2/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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7.7s
[CV 3/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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7.7s
[CV 1/3] END leaf_size=10, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=7, weights=distance;, score=0.822 total time=
7.4s
[CV 2/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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7.7s
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7.9s
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8.2s
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7.6s
[CV 1/3] END leaf_size=10, metric=<function bhattacharyya_distance at
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7.3s
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7.4s
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7.4s
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7.2s
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7.6s
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7.4s
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7.1s
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7.3s
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7.2s
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7.2s
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7.3s
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6.9s
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n_neighbors=3, weights=distance;, score=0.816 total time=   6.9s
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[CV 3/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=5, weights=uniform;, score=0.787 total time=   7.7s
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[CV 1/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=5, weights=distance;, score=0.854 total time=   7.4s
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[CV 3/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=5, weights=distance;, score=0.831 total time=   7.7s
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[CV 3/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=6, weights=distance;, score=0.824 total time=   7.5s
[CV 1/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=uniform;, score=0.847 total time=   7.6s
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[CV 3/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=uniform;, score=0.778 total time=   7.7s
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[CV 3/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=distance;, score=0.809 total time=   8.4s
[CV 1/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=uniform;, score=0.823 total time=   7.5s
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[CV 3/3] END leaf_size=20, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=distance;, score=0.787 total time=   7.3s
[CV 1/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=3, weights=uniform;, score=0.853 total time= 20.8s

[CV 2/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=3, weights=uniform;, score=0.785 total time= 20.3s
[CV 3/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=3, weights=uniform;, score=0.779 total time= 20.1s
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[CV 3/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=uniform;, score=0.753 total time= 20.3s
[CV 1/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=distance;, score=0.872 total time= 19.5s
[CV 2/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=distance;, score=0.798 total time= 19.0s
[CV 3/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=distance;, score=0.790 total time= 20.9s
[CV 1/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=7, weights=uniform;, score=0.813 total time= 19.6s

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[CV 2/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=7, weights=uniform;, score=0.755 total time=   19.5s
[CV 3/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=7, weights=uniform;, score=0.757 total time=   20.6s
[CV 1/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=7, weights=distance;, score=0.846 total time=   18.8s
[CV 2/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=7, weights=distance;, score=0.789 total time=   19.4s
[CV 3/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=7, weights=distance;, score=0.773 total time=   19.3s
[CV 1/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=10, weights=uniform;, score=0.802 total time=   20.6s
[CV 2/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=10, weights=uniform;, score=0.758 total time=   19.8s
[CV 3/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=10, weights=uniform;, score=0.733 total time=   19.6s
[CV 1/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=10, weights=distance;, score=0.836 total time=   20.6s
[CV 2/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=10, weights=distance;, score=0.776 total time=   19.7s
[CV 3/3] END leaf_size=20, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=10, weights=distance;, score=0.761 total time=   19.6s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=uniform;, score=0.848 total time=    7.6s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=uniform;, score=0.782 total time=    8.3s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=uniform;, score=0.774 total time=    7.5s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=distance;, score=0.858 total time=    7.3s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=distance;, score=0.802 total time=    7.5s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=distance;, score=0.793 total time=    7.7s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=4, weights=uniform;, score=0.812 total time=    7.7s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=4, weights=uniform;, score=0.752 total time=    7.9s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=4, weights=uniform;, score=0.763 total time=    7.5s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=4, weights=distance;, score=0.856 total time=    7.4s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=4, weights=distance;, score=0.797 total time=    7.9s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=4, weights=distance;, score=0.798 total time=    7.4s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=5, weights=uniform;, score=0.824 total time=    7.3s
```

[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=uniform;, score=0.773 total time=   7.2s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=uniform;, score=0.767 total time=   7.3s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=distance;, score=0.850 total time=   7.3s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=distance;, score=0.791 total time=   7.2s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=5, weights=distance;, score=0.792 total time=   7.1s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=uniform;, score=0.814 total time=   7.9s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=uniform;, score=0.759 total time=   7.8s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=uniform;, score=0.767 total time=   7.5s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=distance;, score=0.864 total time=   7.2s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=distance;, score=0.798 total time=   7.5s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=6, weights=distance;, score=0.794 total time=   7.3s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=7, weights=uniform;, score=0.824 total time=   7.2s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=7, weights=uniform;, score=0.757 total time=   7.1s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=7, weights=uniform;, score=0.754 total time=   7.0s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=7, weights=distance;, score=0.843 total time=   7.9s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=7, weights=distance;, score=0.789 total time=   7.1s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=7, weights=distance;, score=0.773 total time=   7.7s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=10, weights=uniform;, score=0.803 total time=   7.4s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=10, weights=uniform;, score=0.747 total time=   7.6s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=10, weights=uniform;, score=0.737 total time=   7.7s
[CV 1/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=10, weights=distance;, score=0.836 total time=   7.7s
[CV 2/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=10, weights=distance;, score=0.767 total time=   7.7s
[CV 3/3] END leaf_size=20, metric=<function sqeuclidean at 0x000001CFFE86ED40>, n_neighbors=10, weights=distance;, score=0.767 total time=   7.8s
[CV 1/3] END leaf_size=20, metric=<function chi_square_distance at 0x000001CFDA19FE20>, n_neighbors=3, weights=uniform;, score=0.716 total time=

9.7s
[CV 2/3] END leaf_size=20, metric=<function chi_square_distance at
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9.1s
[CV 3/3] END leaf_size=20, metric=<function chi_square_distance at
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9.4s
[CV 1/3] END leaf_size=20, metric=<function chi_square_distance at
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9.4s
[CV 2/3] END leaf_size=20, metric=<function chi_square_distance at
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0x000001CFDA19FE20>, n_neighbors=4, weights=uniform;, score=0.713 total time=
9.8s
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[CV 1/3] END leaf_size=20, metric=<function chi_square_distance at
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9.7s
[CV 2/3] END leaf_size=20, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=5, weights=uniform;, score=0.700 total time=
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9.2s
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0x000001CFDA19FE20>, n_neighbors=6, weights=uniform;, score=0.709 total time=
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[CV 2/3] END leaf_size=20, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=uniform;, score=0.692 total time=
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0x000001CFDA19FE20>, n_neighbors=7, weights=uniform;, score=0.707 total time=
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9.7s
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[CV 1/3] END leaf_size=20, metric=<function bhattacharyya_distance at
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[CV 2/3] END leaf_size=20, metric=<function bhattacharyya_distance at
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[CV 3/3] END leaf_size=20, metric=<function bhattacharyya_distance at
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[CV 3/3] END leaf_size=20, metric=<function bhattacharyya_distance at
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[CV 1/3] END leaf_size=20, metric=<function bhattacharyya_distance at
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7.7s
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7.6s
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6.9s
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[CV 1/3] END leaf_size=20, metric=<function intersection_distance at
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n_neighbors=10, weights=distance;, score=0.767 total time=   7.7s
[CV 1/3] END leaf_size=30, metric=<function chi_square_distance at
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0x000001CFDA19FE20>, n_neighbors=3, weights=uniform;, score=0.678 total time=
9.2s
[CV 1/3] END leaf_size=30, metric=<function chi_square_distance at
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9.0s
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[CV 1/3] END leaf_size=30, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=4, weights=uniform;, score=0.713 total time=
9.9s
[CV 2/3] END leaf_size=30, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=4, weights=uniform;, score=0.698 total time=
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[CV 3/3] END leaf_size=30, metric=<function chi_square_distance at
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9.2s
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9.2s
[CV 2/3] END leaf_size=30, metric=<function chi_square_distance at
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0x000001CFDA19FE20>, n_neighbors=4, weights=distance;, score=0.705 total time=
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45

9.2s

[CV 2/3] END leaf_size=30, metric=<function chi_square_distance at
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9.8s

[CV 3/3] END leaf_size=30, metric=<function chi_square_distance at
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9.1s

[CV 1/3] END leaf_size=30, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=5, weights=distance;, score=0.730 total time=
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[CV 2/3] END leaf_size=30, metric=<function chi_square_distance at
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9.1s

[CV 3/3] END leaf_size=30, metric=<function chi_square_distance at
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[CV 1/3] END leaf_size=30, metric=<function chi_square_distance at
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[CV 2/3] END leaf_size=30, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=uniform;, score=0.692 total time=
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[CV 3/3] END leaf_size=30, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=uniform;, score=0.655 total time=
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[CV 1/3] END leaf_size=30, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=distance;, score=0.728 total time=
9.2s

[CV 2/3] END leaf_size=30, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=6, weights=distance;, score=0.716 total time=
9.1s

[CV 3/3] END leaf_size=30, metric=<function chi_square_distance at
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9.1s

[CV 1/3] END leaf_size=30, metric=<function chi_square_distance at
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9.2s

[CV 2/3] END leaf_size=30, metric=<function chi_square_distance at
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9.4s

[CV 3/3] END leaf_size=30, metric=<function chi_square_distance at
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9.3s

[CV 1/3] END leaf_size=30, metric=<function chi_square_distance at
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9.4s
[CV 3/3] END leaf_size=30, metric=<function chi_square_distance at
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9.3s
[CV 1/3] END leaf_size=30, metric=<function chi_square_distance at
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9.3s
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9.3s
[CV 3/3] END leaf_size=30, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=10, weights=uniform;, score=0.678 total time=
9.4s
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9.8s
[CV 3/3] END leaf_size=30, metric=<function chi_square_distance at
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9.4s
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7.9s
[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=3, weights=uniform;, score=0.741 total time=
8.1s
[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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8.1s
[CV 1/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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8.0s
[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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8.1s
[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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8.6s
[CV 1/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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8.3s
[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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8.0s
[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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7.9s

[CV 1/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=4, weights=distance;, score=0.850 total time= 8.2s

[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=4, weights=distance;, score=0.762 total time= 8.0s

[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=4, weights=distance;, score=0.744 total time= 7.8s

[CV 1/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.826 total time= 8.0s

[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.715 total time= 8.7s

[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.713 total time= 7.8s

[CV 1/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.837 total time= 8.0s

[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.739 total time= 8.0s

[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.734 total time= 7.8s

[CV 1/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.812 total time= 8.0s

[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.707 total time= 8.2s

[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.731 total time= 7.9s

[CV 1/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=distance;, score=0.832 total time= 8.8s

[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=distance;, score=0.743 total time= 7.9s

[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=distance;, score=0.741 total time= 7.9s

[CV 1/3] END leaf_size=30, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=7, weights=uniform;, score=0.812 total time=

8.0s
[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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8.0s
[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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[CV 1/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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8.0s
[CV 2/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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8.2s
[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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7.9s
[CV 3/3] END leaf_size=30, metric=<function bhattacharyya_distance at
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7.5s

[CV 3/3] END leaf_size=30, metric=<function intersection_distance at
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[CV 1/3] END leaf_size=30, metric=<function intersection_distance at
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[CV 1/3] END leaf_size=30, metric=<function intersection_distance at
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[CV 1/3] END leaf_size=30, metric=<function intersection_distance at
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[CV 3/3] END leaf_size=30, metric=<function intersection_distance at
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7.1s
[CV 1/3] END leaf_size=30, metric=<function intersection_distance at
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7.2s
[CV 1/3] END leaf_size=30, metric=<function intersection_distance at
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[CV 3/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 1/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=6, weights=distance;, score=0.824 total time=   7.2s
[CV 1/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=7, weights=uniform;, score=0.847 total time=   7.4s

[CV 2/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=uniform;, score=0.783 total time=   7.5s
[CV 3/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=uniform;, score=0.778 total time=   7.7s
[CV 1/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=distance;, score=0.855 total time=   8.0s
[CV 2/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=distance;, score=0.795 total time=   7.3s
[CV 3/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=7, weights=distance;, score=0.809 total time=   7.3s
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[CV 2/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=uniform;, score=0.766 total time=   7.5s
[CV 3/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=uniform;, score=0.746 total time=   7.3s
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[CV 2/3] END leaf_size=40, metric=<function cityblock at 0x000001CFFE86F1A0>, n_neighbors=10, weights=distance;, score=0.791 total time=   7.8s
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[CV 3/3] END leaf_size=40, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=uniform;, score=0.766 total time= 18.5s
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0x000001CF822B3060>, n_neighbors=4, weights=distance;, score=0.744 total time=
5.6s
[CV 1/3] END leaf_size=40, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.826 total time=
5.5s
[CV 2/3] END leaf_size=40, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.715 total time=
6.1s
[CV 3/3] END leaf_size=40, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=uniform;, score=0.713 total time=
5.7s
[CV 1/3] END leaf_size=40, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.837 total time=
5.8s
[CV 2/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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5.8s
[CV 3/3] END leaf_size=40, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=5, weights=distance;, score=0.734 total time=
5.7s
[CV 1/3] END leaf_size=40, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.812 total time=
5.8s
[CV 2/3] END leaf_size=40, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.707 total time=
5.7s
[CV 3/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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5.7s
[CV 1/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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[CV 2/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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5.8s
[CV 3/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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5.7s
[CV 1/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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6.1s
[CV 2/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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5.8s
[CV 3/3] END leaf_size=40, metric=<function bhattacharyya_distance at
0x000001CF822B3060>, n_neighbors=7, weights=uniform;, score=0.718 total time=
5.8s
[CV 1/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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5.7s
[CV 2/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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5.7s
[CV 3/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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[CV 1/3] END leaf_size=40, metric=<function bhattacharyya_distance at
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5.7s
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[CV 2/3] END leaf_size=40, metric=<function intersection_distance at
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5.1s
[CV 3/3] END leaf_size=40, metric=<function intersection_distance at
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[CV 3/3] END leaf_size=40, metric=<function intersection_distance at
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[CV 3/3] END leaf_size=40, metric=<function intersection_distance at
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[CV 2/3] END leaf_size=40, metric=<function intersection_distance at
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4.9s
[CV 2/3] END leaf_size=40, metric=<function intersection_distance at
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4.9s
[CV 3/3] END leaf_size=40, metric=<function intersection_distance at
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[CV 1/3] END leaf_size=40, metric=<function intersection_distance at
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4.9s
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4.9s
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[CV 3/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=uniform;, score=0.830 total time=   5.1s
[CV 1/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
n_neighbors=3, weights=distance;, score=0.858 total time=   5.1s
[CV 2/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 1/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 1/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 1/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 1/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 1/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 1/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 3/3] END leaf_size=50, metric=<function cityblock at 0x000001CFFE86F1A0>,
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[CV 2/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 3/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 1/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 2/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 3/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=3, weights=distance;, score=0.797 total time= 13.3s
[CV 1/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>,
n_neighbors=4, weights=uniform;, score=0.817 total time= 12.9s

[CV 2/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=uniform;, score=0.749 total time= 12.6s
[CV 3/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=uniform;, score=0.766 total time= 12.8s
[CV 1/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=distance;, score=0.858 total time= 12.7s
[CV 2/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=distance;, score=0.804 total time= 13.3s
[CV 3/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=4, weights=distance;, score=0.800 total time= 12.9s
[CV 1/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=5, weights=uniform;, score=0.824 total time= 12.8s
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[CV 1/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=5, weights=distance;, score=0.854 total time= 13.3s
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[CV 3/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=uniform;, score=0.753 total time= 13.9s
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[CV 2/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=distance;, score=0.798 total time= 13.8s
[CV 3/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=6, weights=distance;, score=0.790 total time= 13.6s
[CV 1/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=7, weights=uniform;, score=0.813 total time= 13.6s
[CV 2/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=7, weights=uniform;, score=0.755 total time= 14.0s
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[CV 1/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>, n_neighbors=10, weights=uniform;, score=0.802 total time= 13.8s

[CV 2/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 2/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 3/3] END leaf_size=50, metric=<function cosine at 0x000001CFFE86EE80>,
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[CV 1/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=uniform;, score=0.848 total time=   5.1s
[CV 2/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=uniform;, score=0.782 total time=   5.0s
[CV 3/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=uniform;, score=0.774 total time=   5.0s
[CV 1/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=distance;, score=0.858 total time=   5.0s
[CV 2/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=distance;, score=0.802 total time=   4.9s
[CV 3/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=3, weights=distance;, score=0.793 total time=   5.0s
[CV 1/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=4, weights=uniform;, score=0.812 total time=   5.0s
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n_neighbors=4, weights=uniform;, score=0.752 total time=   4.9s
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[CV 2/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=4, weights=distance;, score=0.797 total time=   5.0s
[CV 3/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
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n_neighbors=5, weights=uniform;, score=0.824 total time=   5.0s
[CV 2/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=5, weights=uniform;, score=0.773 total time=   4.9s
[CV 3/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=5, weights=uniform;, score=0.767 total time=   5.2s
[CV 1/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=5, weights=distance;, score=0.850 total time=   5.0s
[CV 2/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=5, weights=distance;, score=0.791 total time=   5.2s
[CV 3/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=5, weights=distance;, score=0.792 total time=   5.2s
[CV 1/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=6, weights=uniform;, score=0.814 total time=   5.2s

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[CV 2/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=6, weights=uniform;, score=0.759 total time=   5.3s
[CV 3/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=6, weights=uniform;, score=0.767 total time=   5.2s
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[CV 2/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
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n_neighbors=6, weights=distance;, score=0.794 total time=   5.7s
[CV 1/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=7, weights=uniform;, score=0.824 total time=   5.5s
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[CV 3/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=7, weights=distance;, score=0.773 total time=   5.3s
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[CV 3/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=uniform;, score=0.737 total time=   5.1s
[CV 1/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=distance;, score=0.836 total time=   5.3s
[CV 2/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=distance;, score=0.767 total time=   5.3s
[CV 3/3] END leaf_size=50, metric=<function sqeuclidean at 0x000001CFFE86ED40>,
n_neighbors=10, weights=distance;, score=0.767 total time=   5.5s
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6.6s
[CV 2/3] END leaf_size=50, metric=<function chi_square_distance at
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6.3s
[CV 3/3] END leaf_size=50, metric=<function chi_square_distance at
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[CV 1/3] END leaf_size=50, metric=<function chi_square_distance at
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[CV 2/3] END leaf_size=50, metric=<function chi_square_distance at
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[CV 2/3] END leaf_size=50, metric=<function chi_square_distance at
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[CV 2/3] END leaf_size=50, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=7, weights=uniform;, score=0.707 total time=
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0x000001CFDA19FE20>, n_neighbors=10, weights=uniform;, score=0.684 total time=
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0x000001CFDA19FE20>, n_neighbors=10, weights=uniform;, score=0.678 total time=
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6.1s
[CV 3/3] END leaf_size=50, metric=<function chi_square_distance at
0x000001CFDA19FE20>, n_neighbors=10, weights=distance;, score=0.716 total time=
6.1s
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[CV 1/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.812 total time= 5.8s
[CV 2/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.707 total time= 5.7s
[CV 3/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=uniform;, score=0.731 total time= 5.7s
[CV 1/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=distance;, score=0.832 total time= 5.8s
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[CV 3/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=6, weights=distance;, score=0.741 total time= 5.8s
[CV 1/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=7, weights=uniform;, score=0.812 total time= 5.7s
[CV 2/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=7, weights=uniform;, score=0.719 total time= 5.8s
[CV 3/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=7, weights=uniform;, score=0.718 total time= 5.7s
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[CV 2/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=7, weights=distance;, score=0.729 total time= 6.3s
[CV 3/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=7, weights=distance;, score=0.724 total time= 5.7s
[CV 1/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=10, weights=uniform;, score=0.796 total time= 5.7s
[CV 2/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=10, weights=uniform;, score=0.713 total time= 5.7s
[CV 3/3] END leaf_size=50, metric=<function bhattacharyya_distance at 0x000001CF822B3060>, n_neighbors=10, weights=uniform;, score=0.717 total time=

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5.0s
[CV 2/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=6, weights=distance;, score=0.076 total time=
4.9s
[CV 3/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=6, weights=distance;, score=0.076 total time=
5.0s
[CV 1/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=7, weights=uniform;, score=0.728 total time=
5.0s
[CV 2/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=7, weights=uniform;, score=0.667 total time=
4.9s
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0x000001CF822B3B00>, n_neighbors=7, weights=uniform;, score=0.676 total time=
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0x000001CF822B3B00>, n_neighbors=7, weights=distance;, score=0.076 total time=
4.9s
[CV 2/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=7, weights=distance;, score=0.076 total time=

5.0s
[CV 3/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=7, weights=distance;, score=0.076 total time=
5.4s
[CV 1/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=10, weights=uniform;, score=0.732 total time=
5.1s
[CV 2/3] END leaf_size=50, metric=<function intersection_distance at
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4.9s
[CV 3/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=10, weights=uniform;, score=0.662 total time=
5.0s
[CV 1/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=10, weights=distance;, score=0.076 total time=
5.1s
[CV 2/3] END leaf_size=50, metric=<function intersection_distance at
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5.1s
[CV 3/3] END leaf_size=50, metric=<function intersection_distance at
0x000001CF822B3B00>, n_neighbors=10, weights=distance;, score=0.076 total time=
5.0s

c:\Users\hoang\AppData\Local\Programs\Python\Python311\Lib\site-
packages\numpy\ma\core.py:2820: RuntimeWarning: invalid value encountered in
cast
  _data = np.array(data, dtype=dtype, copy=copy,

GridSearchCV(cv=3, estimator=KNeighborsClassifier(),
             param_grid={'leaf_size': [5, 10, 20, 30, 40, 50],
                         'metric': [<function cityblock at 0x000001CFFE86F1A0>,
                                    <function cosine at 0x000001CFFE86EE80>,
                                    <function sqeuclidean at
0x000001CFFE86ED40>,
                                    <function chi_square_distance at
0x000001CFDA19FE20>,
                                    <function bhattacharyya_distance at
0x000001CF822B3060>,
                                    <function intersection_distance at
0x000001CF822B3B00>],
                         'n_neighbors': [3, 4, 5, 6, 7, 10],
                         'weights': ['uniform', 'distance']},
             scoring='f1_macro', verbose=3)

```
best_knn = grid_search_knn.best_estimator_
print(f"Best Params: {grid_search_knn.best_params_}")
```

```
y_pred_knn = best_knn.predict(test_features)

joblib.dump(best_knn, project_dir + '\joblib\\best_knn_model.joblib')
```

Best Params: {'leaf_size': 5, 'metric': <function cityblock at
0x000001CFFE86F1A0>, 'n_neighbors': 4, 'weights': 'distance'}

['d:\\ASUS\\Deploy-Traffic-Sign-Classification-through-
Images\\joblib\\best_knn_model.joblib']

7 Gridsearch SVM

```
# svm_model = SVC()
# svm_model.fit(train_features, train_labels_encoded)
```

```
param_grid = {
    'C': [0.1, 0.2, 0.3, 0.4],
    'kernel': ['rbf', 'linear', 'poly', 'sigmoid'],
    'gamma': ['scale', 'auto', 0.1, 0.01, 0.001],
    'degree': [2, 3, 4],
}

svm_model = SVC()

grid_search_svm = GridSearchCV(
    estimator=svm_model,
    param_grid=param_grid,
    cv=3,
    scoring='f1_macro',
    verbose=3,
)

grid_search_svm.fit(train_features, train_labels_encoded)
```

```
Fitting 3 folds for each of 240 candidates, totalling 720 fits
[CV 1/3] END C=0.1, degree=2, gamma=scale, kernel=rbf;, score=0.521 total time=
1.6s
[CV 2/3] END C=0.1, degree=2, gamma=scale, kernel=rbf;, score=0.538 total time=
1.7s
[CV 3/3] END C=0.1, degree=2, gamma=scale, kernel=rbf;, score=0.517 total time=
1.5s
[CV 1/3] END C=0.1, degree=2, gamma=scale, kernel=linear;, score=0.840 total
time=   0.7s
[CV 2/3] END C=0.1, degree=2, gamma=scale, kernel=linear;, score=0.805 total
time=   0.7s
[CV 3/3] END C=0.1, degree=2, gamma=scale, kernel=linear;, score=0.798 total
time=   0.7s
```

[CV 1/3] END C=0.1, degree=2, gamma=scale, kernel=poly;, score=0.755 total time=
1.1s
[CV 2/3] END C=0.1, degree=2, gamma=scale, kernel=poly;, score=0.734 total time=
1.0s
[CV 3/3] END C=0.1, degree=2, gamma=scale, kernel=poly;, score=0.660 total time=
1.0s
[CV 1/3] END C=0.1, degree=2, gamma=scale, kernel=sigmoid;, score=0.512 total
time=   1.2s
[CV 2/3] END C=0.1, degree=2, gamma=scale, kernel=sigmoid;, score=0.503 total
time=   1.4s
[CV 3/3] END C=0.1, degree=2, gamma=scale, kernel=sigmoid;, score=0.497 total
time=   1.3s
[CV 1/3] END C=0.1, degree=2, gamma=auto, kernel=rbf;, score=0.076 total time=
1.8s
[CV 2/3] END C=0.1, degree=2, gamma=auto, kernel=rbf;, score=0.076 total time=
1.9s
[CV 3/3] END C=0.1, degree=2, gamma=auto, kernel=rbf;, score=0.076 total time=
1.8s
[CV 1/3] END C=0.1, degree=2, gamma=auto, kernel=linear;, score=0.840 total
time=   0.6s
[CV 2/3] END C=0.1, degree=2, gamma=auto, kernel=linear;, score=0.805 total
time=   0.7s
[CV 3/3] END C=0.1, degree=2, gamma=auto, kernel=linear;, score=0.798 total
time=   0.7s
[CV 1/3] END C=0.1, degree=2, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
[CV 2/3] END C=0.1, degree=2, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 3/3] END C=0.1, degree=2, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
[CV 1/3] END C=0.1, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.7s
[CV 2/3] END C=0.1, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.8s
[CV 3/3] END C=0.1, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 1/3] END C=0.1, degree=2, gamma=0.1, kernel=rbf;, score=0.392 total time=
2.0s
[CV 2/3] END C=0.1, degree=2, gamma=0.1, kernel=rbf;, score=0.420 total time=
1.9s
[CV 3/3] END C=0.1, degree=2, gamma=0.1, kernel=rbf;, score=0.372 total time=
1.9s
[CV 1/3] END C=0.1, degree=2, gamma=0.1, kernel=linear;, score=0.840 total time=
0.7s
[CV 2/3] END C=0.1, degree=2, gamma=0.1, kernel=linear;, score=0.805 total time=
0.7s
[CV 3/3] END C=0.1, degree=2, gamma=0.1, kernel=linear;, score=0.798 total time=
0.7s

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```
[CV 1/3] END C=0.1, degree=2, gamma=0.1, kernel=poly;, score=0.881 total time=
0.9s
[CV 2/3] END C=0.1, degree=2, gamma=0.1, kernel=poly;, score=0.852 total time=
0.9s
[CV 3/3] END C=0.1, degree=2, gamma=0.1, kernel=poly;, score=0.818 total time=
1.0s
[CV 1/3] END C=0.1, degree=2, gamma=0.1, kernel=sigmoid;, score=0.325 total
time=   1.9s
[CV 2/3] END C=0.1, degree=2, gamma=0.1, kernel=sigmoid;, score=0.313 total
time=   1.7s
[CV 3/3] END C=0.1, degree=2, gamma=0.1, kernel=sigmoid;, score=0.308 total
time=   1.7s
[CV 1/3] END C=0.1, degree=2, gamma=0.01, kernel=rbf;, score=0.475 total time=
1.6s
[CV 2/3] END C=0.1, degree=2, gamma=0.01, kernel=rbf;, score=0.513 total time=
1.6s
[CV 3/3] END C=0.1, degree=2, gamma=0.01, kernel=rbf;, score=0.487 total time=
1.5s
[CV 1/3] END C=0.1, degree=2, gamma=0.01, kernel=linear;, score=0.840 total
time=   0.6s
[CV 2/3] END C=0.1, degree=2, gamma=0.01, kernel=linear;, score=0.805 total
time=   0.8s
[CV 3/3] END C=0.1, degree=2, gamma=0.01, kernel=linear;, score=0.798 total
time=   0.7s
[CV 1/3] END C=0.1, degree=2, gamma=0.01, kernel=poly;, score=0.445 total time=
1.5s
[CV 2/3] END C=0.1, degree=2, gamma=0.01, kernel=poly;, score=0.460 total time=
1.5s
[CV 3/3] END C=0.1, degree=2, gamma=0.01, kernel=poly;, score=0.429 total time=
1.6s
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time=   1.4s
[CV 2/3] END C=0.1, degree=2, gamma=0.01, kernel=sigmoid;, score=0.469 total
time=   1.4s
[CV 3/3] END C=0.1, degree=2, gamma=0.01, kernel=sigmoid;, score=0.452 total
time=   1.4s
[CV 1/3] END C=0.1, degree=2, gamma=0.001, kernel=rbf;, score=0.076 total time=
1.9s
[CV 2/3] END C=0.1, degree=2, gamma=0.001, kernel=rbf;, score=0.076 total time=
1.7s
[CV 3/3] END C=0.1, degree=2, gamma=0.001, kernel=rbf;, score=0.076 total time=
1.8s
[CV 1/3] END C=0.1, degree=2, gamma=0.001, kernel=linear;, score=0.840 total
time=   0.6s
[CV 2/3] END C=0.1, degree=2, gamma=0.001, kernel=linear;, score=0.805 total
time=   0.6s
[CV 3/3] END C=0.1, degree=2, gamma=0.001, kernel=linear;, score=0.798 total
time=   0.7s
```

[CV 1/3] END C=0.1, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time=
1.6s
[CV 2/3] END C=0.1, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time=
1.4s
[CV 3/3] END C=0.1, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 1/3] END C=0.1, degree=2, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 2/3] END C=0.1, degree=2, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 3/3] END C=0.1, degree=2, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.7s
[CV 1/3] END C=0.1, degree=3, gamma=scale, kernel=rbf;, score=0.521 total time=
1.5s
[CV 2/3] END C=0.1, degree=3, gamma=scale, kernel=rbf;, score=0.538 total time=
1.6s
[CV 3/3] END C=0.1, degree=3, gamma=scale, kernel=rbf;, score=0.517 total time=
1.6s
[CV 1/3] END C=0.1, degree=3, gamma=scale, kernel=linear;, score=0.840 total
time=   0.6s
[CV 2/3] END C=0.1, degree=3, gamma=scale, kernel=linear;, score=0.805 total
time=   0.7s
[CV 3/3] END C=0.1, degree=3, gamma=scale, kernel=linear;, score=0.798 total
time=   0.8s
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[CV 2/3] END C=0.1, degree=3, gamma=scale, kernel=sigmoid;, score=0.503 total
time=   1.4s
[CV 3/3] END C=0.1, degree=3, gamma=scale, kernel=sigmoid;, score=0.497 total
time=   1.3s
[CV 1/3] END C=0.1, degree=3, gamma=auto, kernel=rbf;, score=0.076 total time=
1.9s
[CV 2/3] END C=0.1, degree=3, gamma=auto, kernel=rbf;, score=0.076 total time=
1.8s
[CV 3/3] END C=0.1, degree=3, gamma=auto, kernel=rbf;, score=0.076 total time=
1.9s
[CV 1/3] END C=0.1, degree=3, gamma=auto, kernel=linear;, score=0.840 total
time=   0.7s
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time=   0.7s
[CV 3/3] END C=0.1, degree=3, gamma=auto, kernel=linear;, score=0.798 total
time=   0.8s

[CV 1/3] END C=0.1, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
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time=   1.5s
[CV 3/3] END C=0.1, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 1/3] END C=0.1, degree=3, gamma=0.1, kernel=rbf;, score=0.392 total time=
1.8s
[CV 2/3] END C=0.1, degree=3, gamma=0.1, kernel=rbf;, score=0.420 total time=
2.0s
[CV 3/3] END C=0.1, degree=3, gamma=0.1, kernel=rbf;, score=0.372 total time=
1.9s
[CV 1/3] END C=0.1, degree=3, gamma=0.1, kernel=linear;, score=0.840 total time=
0.7s
[CV 2/3] END C=0.1, degree=3, gamma=0.1, kernel=linear;, score=0.805 total time=
0.7s
[CV 3/3] END C=0.1, degree=3, gamma=0.1, kernel=linear;, score=0.798 total time=
0.7s
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time=   1.6s
[CV 2/3] END C=0.1, degree=3, gamma=0.1, kernel=sigmoid;, score=0.313 total
time=   1.8s
[CV 3/3] END C=0.1, degree=3, gamma=0.1, kernel=sigmoid;, score=0.308 total
time=   1.6s
[CV 1/3] END C=0.1, degree=3, gamma=0.01, kernel=rbf;, score=0.475 total time=
1.6s
[CV 2/3] END C=0.1, degree=3, gamma=0.01, kernel=rbf;, score=0.513 total time=
1.7s
[CV 3/3] END C=0.1, degree=3, gamma=0.01, kernel=rbf;, score=0.487 total time=
1.5s
[CV 1/3] END C=0.1, degree=3, gamma=0.01, kernel=linear;, score=0.840 total
time=   0.7s
[CV 2/3] END C=0.1, degree=3, gamma=0.01, kernel=linear;, score=0.805 total
time=   0.8s
[CV 3/3] END C=0.1, degree=3, gamma=0.01, kernel=linear;, score=0.798 total
time=   0.6s

[CV 1/3] END C=0.1, degree=3, gamma=0.01, kernel=poly;, score=0.076 total time=
1.7s
[CV 2/3] END C=0.1, degree=3, gamma=0.01, kernel=poly;, score=0.076 total time=
1.6s
[CV 3/3] END C=0.1, degree=3, gamma=0.01, kernel=poly;, score=0.076 total time=
1.6s
[CV 1/3] END C=0.1, degree=3, gamma=0.01, kernel=sigmoid;, score=0.447 total
time=   1.5s
[CV 2/3] END C=0.1, degree=3, gamma=0.01, kernel=sigmoid;, score=0.469 total
time=   1.5s
[CV 3/3] END C=0.1, degree=3, gamma=0.01, kernel=sigmoid;, score=0.452 total
time=   1.4s
[CV 1/3] END C=0.1, degree=3, gamma=0.001, kernel=rbf;, score=0.076 total time=
1.9s
[CV 2/3] END C=0.1, degree=3, gamma=0.001, kernel=rbf;, score=0.076 total time=
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[CV 3/3] END C=0.1, degree=3, gamma=0.001, kernel=rbf;, score=0.076 total time=
1.8s
[CV 1/3] END C=0.1, degree=3, gamma=0.001, kernel=linear;, score=0.840 total
time=   0.6s
[CV 2/3] END C=0.1, degree=3, gamma=0.001, kernel=linear;, score=0.805 total
time=   0.8s
[CV 3/3] END C=0.1, degree=3, gamma=0.001, kernel=linear;, score=0.798 total
time=   0.8s
[CV 1/3] END C=0.1, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.6s
[CV 2/3] END C=0.1, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.7s
[CV 3/3] END C=0.1, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.7s
[CV 1/3] END C=0.1, degree=3, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 2/3] END C=0.1, degree=3, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.7s
[CV 3/3] END C=0.1, degree=3, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 1/3] END C=0.1, degree=4, gamma=scale, kernel=rbf;, score=0.521 total time=
1.6s
[CV 2/3] END C=0.1, degree=4, gamma=scale, kernel=rbf;, score=0.538 total time=
1.7s
[CV 3/3] END C=0.1, degree=4, gamma=scale, kernel=rbf;, score=0.517 total time=
1.6s
[CV 1/3] END C=0.1, degree=4, gamma=scale, kernel=linear;, score=0.840 total
time=   0.7s
[CV 2/3] END C=0.1, degree=4, gamma=scale, kernel=linear;, score=0.805 total
time=   0.7s
[CV 3/3] END C=0.1, degree=4, gamma=scale, kernel=linear;, score=0.798 total
time=   0.7s

```
[CV 1/3] END C=0.1, degree=4, gamma=scale, kernel=poly;, score=0.834 total time=
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[CV 2/3] END C=0.1, degree=4, gamma=scale, kernel=poly;, score=0.814 total time=
1.2s
[CV 3/3] END C=0.1, degree=4, gamma=scale, kernel=poly;, score=0.751 total time=
1.2s
[CV 1/3] END C=0.1, degree=4, gamma=scale, kernel=sigmoid;, score=0.512 total
time=   1.3s
[CV 2/3] END C=0.1, degree=4, gamma=scale, kernel=sigmoid;, score=0.503 total
time=   1.3s
[CV 3/3] END C=0.1, degree=4, gamma=scale, kernel=sigmoid;, score=0.497 total
time=   1.3s
[CV 1/3] END C=0.1, degree=4, gamma=auto, kernel=rbf;, score=0.076 total time=
1.9s
[CV 2/3] END C=0.1, degree=4, gamma=auto, kernel=rbf;, score=0.076 total time=
1.8s
[CV 3/3] END C=0.1, degree=4, gamma=auto, kernel=rbf;, score=0.076 total time=
1.8s
[CV 1/3] END C=0.1, degree=4, gamma=auto, kernel=linear;, score=0.840 total
time=   0.7s
[CV 2/3] END C=0.1, degree=4, gamma=auto, kernel=linear;, score=0.805 total
time=   0.6s
[CV 3/3] END C=0.1, degree=4, gamma=auto, kernel=linear;, score=0.798 total
time=   0.7s
[CV 1/3] END C=0.1, degree=4, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
[CV 2/3] END C=0.1, degree=4, gamma=auto, kernel=poly;, score=0.076 total time=
1.8s
[CV 3/3] END C=0.1, degree=4, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
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time=   1.6s
[CV 2/3] END C=0.1, degree=4, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 3/3] END C=0.1, degree=4, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.5s
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1.9s
[CV 2/3] END C=0.1, degree=4, gamma=0.1, kernel=rbf;, score=0.420 total time=
1.9s
[CV 3/3] END C=0.1, degree=4, gamma=0.1, kernel=rbf;, score=0.372 total time=
1.8s
[CV 1/3] END C=0.1, degree=4, gamma=0.1, kernel=linear;, score=0.840 total time=
0.6s
[CV 2/3] END C=0.1, degree=4, gamma=0.1, kernel=linear;, score=0.805 total time=
0.7s
[CV 3/3] END C=0.1, degree=4, gamma=0.1, kernel=linear;, score=0.798 total time=
0.7s
```

[CV 1/3] END C=0.1, degree=4, gamma=0.1, kernel=poly;, score=0.873 total time=
1.2s
[CV 2/3] END C=0.1, degree=4, gamma=0.1, kernel=poly;, score=0.854 total time=
1.2s
[CV 3/3] END C=0.1, degree=4, gamma=0.1, kernel=poly;, score=0.825 total time=
1.2s
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time=   1.6s
[CV 2/3] END C=0.1, degree=4, gamma=0.1, kernel=sigmoid;, score=0.313 total
time=   1.8s
[CV 3/3] END C=0.1, degree=4, gamma=0.1, kernel=sigmoid;, score=0.308 total
time=   1.5s
[CV 1/3] END C=0.1, degree=4, gamma=0.01, kernel=rbf;, score=0.475 total time=
1.5s
[CV 2/3] END C=0.1, degree=4, gamma=0.01, kernel=rbf;, score=0.513 total time=
1.8s
[CV 3/3] END C=0.1, degree=4, gamma=0.01, kernel=rbf;, score=0.487 total time=
1.7s
[CV 1/3] END C=0.1, degree=4, gamma=0.01, kernel=linear;, score=0.840 total
time=   0.7s
[CV 2/3] END C=0.1, degree=4, gamma=0.01, kernel=linear;, score=0.805 total
time=   0.7s
[CV 3/3] END C=0.1, degree=4, gamma=0.01, kernel=linear;, score=0.798 total
time=   0.6s
[CV 1/3] END C=0.1, degree=4, gamma=0.01, kernel=poly;, score=0.076 total time=
1.7s
[CV 2/3] END C=0.1, degree=4, gamma=0.01, kernel=poly;, score=0.076 total time=
1.5s
[CV 3/3] END C=0.1, degree=4, gamma=0.01, kernel=poly;, score=0.076 total time=
1.7s
[CV 1/3] END C=0.1, degree=4, gamma=0.01, kernel=sigmoid;, score=0.447 total
time=   1.4s
[CV 2/3] END C=0.1, degree=4, gamma=0.01, kernel=sigmoid;, score=0.469 total
time=   1.5s
[CV 3/3] END C=0.1, degree=4, gamma=0.01, kernel=sigmoid;, score=0.452 total
time=   1.4s
[CV 1/3] END C=0.1, degree=4, gamma=0.001, kernel=rbf;, score=0.076 total time=
1.9s
[CV 2/3] END C=0.1, degree=4, gamma=0.001, kernel=rbf;, score=0.076 total time=
1.8s
[CV 3/3] END C=0.1, degree=4, gamma=0.001, kernel=rbf;, score=0.076 total time=
1.8s
[CV 1/3] END C=0.1, degree=4, gamma=0.001, kernel=linear;, score=0.840 total
time=   0.7s
[CV 2/3] END C=0.1, degree=4, gamma=0.001, kernel=linear;, score=0.805 total
time=   0.8s
[CV 3/3] END C=0.1, degree=4, gamma=0.001, kernel=linear;, score=0.798 total
time=   0.6s

[CV 1/3] END C=0.1, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time= 1.6s
[CV 2/3] END C=0.1, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time= 1.5s
[CV 3/3] END C=0.1, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time= 1.5s
[CV 1/3] END C=0.1, degree=4, gamma=0.001, kernel=sigmoid;, score=0.076 total time=   1.6s
[CV 2/3] END C=0.1, degree=4, gamma=0.001, kernel=sigmoid;, score=0.076 total time=   1.6s
[CV 3/3] END C=0.1, degree=4, gamma=0.001, kernel=sigmoid;, score=0.076 total time=   1.7s
[CV 1/3] END C=0.2, degree=2, gamma=scale, kernel=rbf;, score=0.610 total time= 1.3s
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[CV 3/3] END C=0.2, degree=2, gamma=scale, kernel=rbf;, score=0.584 total time= 1.4s
[CV 1/3] END C=0.2, degree=2, gamma=scale, kernel=linear;, score=0.853 total time=   0.7s
[CV 2/3] END C=0.2, degree=2, gamma=scale, kernel=linear;, score=0.792 total time=   0.8s
[CV 3/3] END C=0.2, degree=2, gamma=scale, kernel=linear;, score=0.802 total time=   0.7s
[CV 1/3] END C=0.2, degree=2, gamma=scale, kernel=poly;, score=0.806 total time= 0.9s
[CV 2/3] END C=0.2, degree=2, gamma=scale, kernel=poly;, score=0.786 total time= 0.9s
[CV 3/3] END C=0.2, degree=2, gamma=scale, kernel=poly;, score=0.735 total time= 0.9s
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[CV 2/3] END C=0.2, degree=2, gamma=scale, kernel=sigmoid;, score=0.527 total time=   1.1s
[CV 3/3] END C=0.2, degree=2, gamma=scale, kernel=sigmoid;, score=0.540 total time=   1.1s
[CV 1/3] END C=0.2, degree=2, gamma=auto, kernel=rbf;, score=0.076 total time= 1.8s
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[CV 3/3] END C=0.2, degree=2, gamma=auto, kernel=rbf;, score=0.076 total time= 1.8s
[CV 1/3] END C=0.2, degree=2, gamma=auto, kernel=linear;, score=0.853 total time=   0.6s
[CV 2/3] END C=0.2, degree=2, gamma=auto, kernel=linear;, score=0.792 total time=   0.7s
[CV 3/3] END C=0.2, degree=2, gamma=auto, kernel=linear;, score=0.802 total time=   0.7s

[CV 1/3] END C=0.2, degree=2, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
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1.6s
[CV 3/3] END C=0.2, degree=2, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 1/3] END C=0.2, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.5s
[CV 2/3] END C=0.2, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 3/3] END C=0.2, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 1/3] END C=0.2, degree=2, gamma=0.1, kernel=rbf;, score=0.417 total time=
1.9s
[CV 2/3] END C=0.2, degree=2, gamma=0.1, kernel=rbf;, score=0.440 total time=
2.0s
[CV 3/3] END C=0.2, degree=2, gamma=0.1, kernel=rbf;, score=0.382 total time=
1.9s
[CV 1/3] END C=0.2, degree=2, gamma=0.1, kernel=linear;, score=0.853 total time=
0.7s
[CV 2/3] END C=0.2, degree=2, gamma=0.1, kernel=linear;, score=0.792 total time=
0.8s
[CV 3/3] END C=0.2, degree=2, gamma=0.1, kernel=linear;, score=0.802 total time=
0.6s
[CV 1/3] END C=0.2, degree=2, gamma=0.1, kernel=poly;, score=0.887 total time=
0.9s
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0.9s
[CV 3/3] END C=0.2, degree=2, gamma=0.1, kernel=poly;, score=0.825 total time=
0.9s
[CV 1/3] END C=0.2, degree=2, gamma=0.1, kernel=sigmoid;, score=0.420 total
time=   1.5s
[CV 2/3] END C=0.2, degree=2, gamma=0.1, kernel=sigmoid;, score=0.432 total
time=   1.6s
[CV 3/3] END C=0.2, degree=2, gamma=0.1, kernel=sigmoid;, score=0.435 total
time=   1.5s
[CV 1/3] END C=0.2, degree=2, gamma=0.01, kernel=rbf;, score=0.558 total time=
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[CV 2/3] END C=0.2, degree=2, gamma=0.01, kernel=rbf;, score=0.547 total time=
1.5s
[CV 3/3] END C=0.2, degree=2, gamma=0.01, kernel=rbf;, score=0.537 total time=
1.4s
[CV 1/3] END C=0.2, degree=2, gamma=0.01, kernel=linear;, score=0.853 total
time=   0.6s
[CV 2/3] END C=0.2, degree=2, gamma=0.01, kernel=linear;, score=0.792 total
time=   0.7s
[CV 3/3] END C=0.2, degree=2, gamma=0.01, kernel=linear;, score=0.802 total
time=   0.7s

[CV 1/3] END C=0.2, degree=2, gamma=0.01, kernel=poly;, score=0.455 total time=
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time=   1.2s
[CV 2/3] END C=0.2, degree=2, gamma=0.01, kernel=sigmoid;, score=0.519 total
time=   1.4s
[CV 3/3] END C=0.2, degree=2, gamma=0.01, kernel=sigmoid;, score=0.516 total
time=   1.3s
[CV 1/3] END C=0.2, degree=2, gamma=0.001, kernel=rbf;, score=0.384 total time=
1.8s
[CV 2/3] END C=0.2, degree=2, gamma=0.001, kernel=rbf;, score=0.391 total time=
1.9s
[CV 3/3] END C=0.2, degree=2, gamma=0.001, kernel=rbf;, score=0.372 total time=
1.8s
[CV 1/3] END C=0.2, degree=2, gamma=0.001, kernel=linear;, score=0.853 total
time=   0.7s
[CV 2/3] END C=0.2, degree=2, gamma=0.001, kernel=linear;, score=0.792 total
time=   0.7s
[CV 3/3] END C=0.2, degree=2, gamma=0.001, kernel=linear;, score=0.802 total
time=   0.7s
[CV 1/3] END C=0.2, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time=
1.6s
[CV 2/3] END C=0.2, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 3/3] END C=0.2, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 1/3] END C=0.2, degree=2, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.7s
[CV 2/3] END C=0.2, degree=2, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 3/3] END C=0.2, degree=2, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 1/3] END C=0.2, degree=3, gamma=scale, kernel=rbf;, score=0.610 total time=
1.5s
[CV 2/3] END C=0.2, degree=3, gamma=scale, kernel=rbf;, score=0.585 total time=
1.4s
[CV 3/3] END C=0.2, degree=3, gamma=scale, kernel=rbf;, score=0.584 total time=
1.4s
[CV 1/3] END C=0.2, degree=3, gamma=scale, kernel=linear;, score=0.853 total
time=   0.7s
[CV 2/3] END C=0.2, degree=3, gamma=scale, kernel=linear;, score=0.792 total
time=   0.7s
[CV 3/3] END C=0.2, degree=3, gamma=scale, kernel=linear;, score=0.802 total
time=   0.7s

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[CV 1/3] END C=0.2, degree=3, gamma=scale, kernel=poly;, score=0.848 total time=
1.0s
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1.0s
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1.0s
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time=   1.1s
[CV 2/3] END C=0.2, degree=3, gamma=scale, kernel=sigmoid;, score=0.527 total
time=   1.3s
[CV 3/3] END C=0.2, degree=3, gamma=scale, kernel=sigmoid;, score=0.540 total
time=   1.1s
[CV 1/3] END C=0.2, degree=3, gamma=auto, kernel=rbf;, score=0.076 total time=
1.8s
[CV 2/3] END C=0.2, degree=3, gamma=auto, kernel=rbf;, score=0.076 total time=
2.0s
[CV 3/3] END C=0.2, degree=3, gamma=auto, kernel=rbf;, score=0.076 total time=
2.1s
[CV 1/3] END C=0.2, degree=3, gamma=auto, kernel=linear;, score=0.853 total
time=   0.8s
[CV 2/3] END C=0.2, degree=3, gamma=auto, kernel=linear;, score=0.792 total
time=   0.7s
[CV 3/3] END C=0.2, degree=3, gamma=auto, kernel=linear;, score=0.802 total
time=   0.7s
[CV 1/3] END C=0.2, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
[CV 2/3] END C=0.2, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
[CV 3/3] END C=0.2, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
[CV 1/3] END C=0.2, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.7s
[CV 2/3] END C=0.2, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 3/3] END C=0.2, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 1/3] END C=0.2, degree=3, gamma=0.1, kernel=rbf;, score=0.417 total time=
2.0s
[CV 2/3] END C=0.2, degree=3, gamma=0.1, kernel=rbf;, score=0.440 total time=
1.9s
[CV 3/3] END C=0.2, degree=3, gamma=0.1, kernel=rbf;, score=0.382 total time=
1.8s
[CV 1/3] END C=0.2, degree=3, gamma=0.1, kernel=linear;, score=0.853 total time=
0.7s
[CV 2/3] END C=0.2, degree=3, gamma=0.1, kernel=linear;, score=0.792 total time=
0.7s
[CV 3/3] END C=0.2, degree=3, gamma=0.1, kernel=linear;, score=0.802 total time=
0.6s
```

[CV 1/3] END C=0.2, degree=3, gamma=0.1, kernel=poly;, score=0.883 total time= 1.1s
[CV 2/3] END C=0.2, degree=3, gamma=0.1, kernel=poly;, score=0.865 total time= 1.1s
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[CV 2/3] END C=0.2, degree=3, gamma=0.1, kernel=sigmoid;, score=0.432 total time=   1.5s
[CV 3/3] END C=0.2, degree=3, gamma=0.1, kernel=sigmoid;, score=0.435 total time=   1.5s
[CV 1/3] END C=0.2, degree=3, gamma=0.01, kernel=rbf;, score=0.558 total time= 1.5s
[CV 2/3] END C=0.2, degree=3, gamma=0.01, kernel=rbf;, score=0.547 total time= 1.4s
[CV 3/3] END C=0.2, degree=3, gamma=0.01, kernel=rbf;, score=0.537 total time= 1.4s
[CV 1/3] END C=0.2, degree=3, gamma=0.01, kernel=linear;, score=0.853 total time=   0.7s
[CV 2/3] END C=0.2, degree=3, gamma=0.01, kernel=linear;, score=0.792 total time=   0.7s
[CV 3/3] END C=0.2, degree=3, gamma=0.01, kernel=linear;, score=0.802 total time=   0.6s
[CV 1/3] END C=0.2, degree=3, gamma=0.01, kernel=poly;, score=0.419 total time= 1.6s
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[CV 3/3] END C=0.2, degree=3, gamma=0.01, kernel=sigmoid;, score=0.516 total time=   1.2s
[CV 1/3] END C=0.2, degree=3, gamma=0.001, kernel=rbf;, score=0.384 total time= 1.9s
[CV 2/3] END C=0.2, degree=3, gamma=0.001, kernel=rbf;, score=0.391 total time= 1.8s
[CV 3/3] END C=0.2, degree=3, gamma=0.001, kernel=rbf;, score=0.372 total time= 1.8s
[CV 1/3] END C=0.2, degree=3, gamma=0.001, kernel=linear;, score=0.853 total time=   0.7s
[CV 2/3] END C=0.2, degree=3, gamma=0.001, kernel=linear;, score=0.792 total time=   0.7s
[CV 3/3] END C=0.2, degree=3, gamma=0.001, kernel=linear;, score=0.802 total time=   0.6s

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[CV 1/3] END C=0.2, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 2/3] END C=0.2, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 3/3] END C=0.2, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.6s
[CV 1/3] END C=0.2, degree=3, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.5s
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time=   1.6s
[CV 3/3] END C=0.2, degree=3, gamma=0.001, kernel=sigmoid;, score=0.076 total
time=   1.8s
[CV 1/3] END C=0.2, degree=4, gamma=scale, kernel=rbf;, score=0.610 total time=
1.5s
[CV 2/3] END C=0.2, degree=4, gamma=scale, kernel=rbf;, score=0.585 total time=
1.5s
[CV 3/3] END C=0.2, degree=4, gamma=scale, kernel=rbf;, score=0.584 total time=
1.5s
[CV 1/3] END C=0.2, degree=4, gamma=scale, kernel=linear;, score=0.853 total
time=   0.7s
[CV 2/3] END C=0.2, degree=4, gamma=scale, kernel=linear;, score=0.792 total
time=   0.7s
[CV 3/3] END C=0.2, degree=4, gamma=scale, kernel=linear;, score=0.802 total
time=   0.6s
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time=   1.2s
[CV 3/3] END C=0.2, degree=4, gamma=scale, kernel=sigmoid;, score=0.540 total
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time=   0.8s
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time=   0.7s
[CV 3/3] END C=0.2, degree=4, gamma=auto, kernel=linear;, score=0.802 total
time=   0.7s
```

[CV 1/3] END C=0.2, degree=4, gamma=auto, kernel=poly;, score=0.076 total time=
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1.6s
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time=   1.6s
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time=   1.6s
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time=   1.6s
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[CV 2/3] END C=0.2, degree=4, gamma=0.1, kernel=rbf;, score=0.440 total time=
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[CV 3/3] END C=0.2, degree=4, gamma=0.1, kernel=rbf;, score=0.382 total time=
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[CV 3/3] END C=0.2, degree=4, gamma=0.1, kernel=linear;, score=0.802 total time=
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[CV 1/3] END C=0.2, degree=4, gamma=0.1, kernel=poly;, score=0.873 total time=
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[CV 2/3] END C=0.2, degree=4, gamma=0.1, kernel=poly;, score=0.854 total time=
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[CV 3/3] END C=0.2, degree=4, gamma=0.1, kernel=poly;, score=0.825 total time=
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[CV 1/3] END C=0.2, degree=4, gamma=0.1, kernel=sigmoid;, score=0.420 total
time=   1.6s
[CV 2/3] END C=0.2, degree=4, gamma=0.1, kernel=sigmoid;, score=0.432 total
time=   1.5s
[CV 3/3] END C=0.2, degree=4, gamma=0.1, kernel=sigmoid;, score=0.435 total
time=   1.5s
[CV 1/3] END C=0.2, degree=4, gamma=0.01, kernel=rbf;, score=0.558 total time=
1.3s
[CV 2/3] END C=0.2, degree=4, gamma=0.01, kernel=rbf;, score=0.547 total time=
1.4s
[CV 3/3] END C=0.2, degree=4, gamma=0.01, kernel=rbf;, score=0.537 total time=
1.3s
[CV 1/3] END C=0.2, degree=4, gamma=0.01, kernel=linear;, score=0.853 total
time=   0.7s
[CV 2/3] END C=0.2, degree=4, gamma=0.01, kernel=linear;, score=0.792 total
time=   0.8s
[CV 3/3] END C=0.2, degree=4, gamma=0.01, kernel=linear;, score=0.802 total
time=   0.7s

[CV 1/3] END C=0.2, degree=4, gamma=0.01, kernel=poly;, score=0.076 total time= 1.6s
[CV 2/3] END C=0.2, degree=4, gamma=0.01, kernel=poly;, score=0.076 total time= 1.7s
[CV 3/3] END C=0.2, degree=4, gamma=0.01, kernel=poly;, score=0.076 total time= 1.7s
[CV 1/3] END C=0.2, degree=4, gamma=0.01, kernel=sigmoid;, score=0.533 total time=   1.3s
[CV 2/3] END C=0.2, degree=4, gamma=0.01, kernel=sigmoid;, score=0.519 total time=   1.2s
[CV 3/3] END C=0.2, degree=4, gamma=0.01, kernel=sigmoid;, score=0.516 total time=   1.4s
[CV 1/3] END C=0.2, degree=4, gamma=0.001, kernel=rbf;, score=0.384 total time= 2.1s
[CV 2/3] END C=0.2, degree=4, gamma=0.001, kernel=rbf;, score=0.391 total time= 2.0s
[CV 3/3] END C=0.2, degree=4, gamma=0.001, kernel=rbf;, score=0.372 total time= 1.9s
[CV 1/3] END C=0.2, degree=4, gamma=0.001, kernel=linear;, score=0.853 total time=   0.7s
[CV 2/3] END C=0.2, degree=4, gamma=0.001, kernel=linear;, score=0.792 total time=   0.7s
[CV 3/3] END C=0.2, degree=4, gamma=0.001, kernel=linear;, score=0.802 total time=   0.7s
[CV 1/3] END C=0.2, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time= 1.6s
[CV 2/3] END C=0.2, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time= 1.7s
[CV 3/3] END C=0.2, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time= 1.6s
[CV 1/3] END C=0.2, degree=4, gamma=0.001, kernel=sigmoid;, score=0.076 total time=   1.6s
[CV 2/3] END C=0.2, degree=4, gamma=0.001, kernel=sigmoid;, score=0.076 total time=   1.6s
[CV 3/3] END C=0.2, degree=4, gamma=0.001, kernel=sigmoid;, score=0.076 total time=   1.6s
[CV 1/3] END C=0.3, degree=2, gamma=scale, kernel=rbf;, score=0.743 total time= 1.3s
[CV 2/3] END C=0.3, degree=2, gamma=scale, kernel=rbf;, score=0.714 total time= 1.5s
[CV 3/3] END C=0.3, degree=2, gamma=scale, kernel=rbf;, score=0.668 total time= 1.5s
[CV 1/3] END C=0.3, degree=2, gamma=scale, kernel=linear;, score=0.842 total time=   0.7s
[CV 2/3] END C=0.3, degree=2, gamma=scale, kernel=linear;, score=0.796 total time=   0.7s
[CV 3/3] END C=0.3, degree=2, gamma=scale, kernel=linear;, score=0.792 total time=   0.7s

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[CV 1/3] END C=0.3, degree=2, gamma=scale, kernel=poly;, score=0.836 total time= 0.9s
[CV 2/3] END C=0.3, degree=2, gamma=scale, kernel=poly;, score=0.811 total time= 1.0s
[CV 3/3] END C=0.3, degree=2, gamma=scale, kernel=poly;, score=0.763 total time= 0.8s
[CV 1/3] END C=0.3, degree=2, gamma=scale, kernel=sigmoid;, score=0.588 total time=   1.0s
[CV 2/3] END C=0.3, degree=2, gamma=scale, kernel=sigmoid;, score=0.607 total time=   1.1s
[CV 3/3] END C=0.3, degree=2, gamma=scale, kernel=sigmoid;, score=0.604 total time=   1.0s
[CV 1/3] END C=0.3, degree=2, gamma=auto, kernel=rbf;, score=0.347 total time= 1.9s
[CV 2/3] END C=0.3, degree=2, gamma=auto, kernel=rbf;, score=0.318 total time= 2.0s
[CV 3/3] END C=0.3, degree=2, gamma=auto, kernel=rbf;, score=0.267 total time= 1.9s
[CV 1/3] END C=0.3, degree=2, gamma=auto, kernel=linear;, score=0.842 total time=   0.7s
[CV 2/3] END C=0.3, degree=2, gamma=auto, kernel=linear;, score=0.796 total time=   0.7s
[CV 3/3] END C=0.3, degree=2, gamma=auto, kernel=linear;, score=0.792 total time=   0.6s
[CV 1/3] END C=0.3, degree=2, gamma=auto, kernel=poly;, score=0.076 total time= 1.6s
[CV 2/3] END C=0.3, degree=2, gamma=auto, kernel=poly;, score=0.076 total time= 1.6s
[CV 3/3] END C=0.3, degree=2, gamma=auto, kernel=poly;, score=0.076 total time= 1.6s
[CV 1/3] END C=0.3, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total time=   1.6s
[CV 2/3] END C=0.3, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total time=   1.6s
[CV 3/3] END C=0.3, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total time=   1.6s
[CV 1/3] END C=0.3, degree=2, gamma=0.1, kernel=rbf;, score=0.450 total time= 1.8s
[CV 2/3] END C=0.3, degree=2, gamma=0.1, kernel=rbf;, score=0.465 total time= 1.9s
[CV 3/3] END C=0.3, degree=2, gamma=0.1, kernel=rbf;, score=0.420 total time= 1.8s
[CV 1/3] END C=0.3, degree=2, gamma=0.1, kernel=linear;, score=0.842 total time= 0.7s
[CV 2/3] END C=0.3, degree=2, gamma=0.1, kernel=linear;, score=0.796 total time= 0.7s
[CV 3/3] END C=0.3, degree=2, gamma=0.1, kernel=linear;, score=0.792 total time= 0.7s

[CV 1/3] END C=0.3, degree=2, gamma=0.1, kernel=poly;, score=0.887 total time=
0.9s
[CV 2/3] END C=0.3, degree=2, gamma=0.1, kernel=poly;, score=0.846 total time=
1.0s
[CV 3/3] END C=0.3, degree=2, gamma=0.1, kernel=poly;, score=0.818 total time=
0.9s
[CV 1/3] END C=0.3, degree=2, gamma=0.1, kernel=sigmoid;, score=0.432 total
time=   1.5s
[CV 2/3] END C=0.3, degree=2, gamma=0.1, kernel=sigmoid;, score=0.446 total
time=   1.6s
[CV 3/3] END C=0.3, degree=2, gamma=0.1, kernel=sigmoid;, score=0.453 total
time=   1.6s
[CV 1/3] END C=0.3, degree=2, gamma=0.01, kernel=rbf;, score=0.593 total time=
1.5s
[CV 2/3] END C=0.3, degree=2, gamma=0.01, kernel=rbf;, score=0.604 total time=
1.3s
[CV 3/3] END C=0.3, degree=2, gamma=0.01, kernel=rbf;, score=0.574 total time=
1.3s
[CV 1/3] END C=0.3, degree=2, gamma=0.01, kernel=linear;, score=0.842 total
time=   0.6s
[CV 2/3] END C=0.3, degree=2, gamma=0.01, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.3, degree=2, gamma=0.01, kernel=linear;, score=0.792 total
time=   0.7s
[CV 1/3] END C=0.3, degree=2, gamma=0.01, kernel=poly;, score=0.531 total time=
1.3s
[CV 2/3] END C=0.3, degree=2, gamma=0.01, kernel=poly;, score=0.533 total time=
1.2s
[CV 3/3] END C=0.3, degree=2, gamma=0.01, kernel=poly;, score=0.518 total time=
1.2s
[CV 1/3] END C=0.3, degree=2, gamma=0.01, kernel=sigmoid;, score=0.553 total
time=   1.1s
[CV 2/3] END C=0.3, degree=2, gamma=0.01, kernel=sigmoid;, score=0.531 total
time=   1.1s
[CV 3/3] END C=0.3, degree=2, gamma=0.01, kernel=sigmoid;, score=0.535 total
time=   1.1s
[CV 1/3] END C=0.3, degree=2, gamma=0.001, kernel=rbf;, score=0.442 total time=
1.9s
[CV 2/3] END C=0.3, degree=2, gamma=0.001, kernel=rbf;, score=0.462 total time=
1.8s
[CV 3/3] END C=0.3, degree=2, gamma=0.001, kernel=rbf;, score=0.443 total time=
1.8s
[CV 1/3] END C=0.3, degree=2, gamma=0.001, kernel=linear;, score=0.842 total
time=   0.8s
[CV 2/3] END C=0.3, degree=2, gamma=0.001, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.3, degree=2, gamma=0.001, kernel=linear;, score=0.792 total
time=   0.7s

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[CV 1/3] END C=0.3, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 2/3] END C=0.3, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 3/3] END C=0.3, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 1/3] END C=0.3, degree=2, gamma=0.001, kernel=sigmoid;, score=0.323 total
time=   1.5s
[CV 2/3] END C=0.3, degree=2, gamma=0.001, kernel=sigmoid;, score=0.286 total
time=   1.5s
[CV 3/3] END C=0.3, degree=2, gamma=0.001, kernel=sigmoid;, score=0.247 total
time=   1.6s
[CV 1/3] END C=0.3, degree=3, gamma=scale, kernel=rbf;, score=0.743 total time=
1.3s
[CV 2/3] END C=0.3, degree=3, gamma=scale, kernel=rbf;, score=0.714 total time=
1.3s
[CV 3/3] END C=0.3, degree=3, gamma=scale, kernel=rbf;, score=0.668 total time=
1.3s
[CV 1/3] END C=0.3, degree=3, gamma=scale, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.3, degree=3, gamma=scale, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.3, degree=3, gamma=scale, kernel=linear;, score=0.792 total
time=   0.7s
[CV 1/3] END C=0.3, degree=3, gamma=scale, kernel=poly;, score=0.868 total time=
1.0s
[CV 2/3] END C=0.3, degree=3, gamma=scale, kernel=poly;, score=0.854 total time=
1.1s
[CV 3/3] END C=0.3, degree=3, gamma=scale, kernel=poly;, score=0.806 total time=
1.1s
[CV 1/3] END C=0.3, degree=3, gamma=scale, kernel=sigmoid;, score=0.588 total
time=   1.0s
[CV 2/3] END C=0.3, degree=3, gamma=scale, kernel=sigmoid;, score=0.607 total
time=   1.1s
[CV 3/3] END C=0.3, degree=3, gamma=scale, kernel=sigmoid;, score=0.604 total
time=   1.0s
[CV 1/3] END C=0.3, degree=3, gamma=auto, kernel=rbf;, score=0.347 total time=
1.9s
[CV 2/3] END C=0.3, degree=3, gamma=auto, kernel=rbf;, score=0.318 total time=
1.8s
[CV 3/3] END C=0.3, degree=3, gamma=auto, kernel=rbf;, score=0.267 total time=
1.8s
[CV 1/3] END C=0.3, degree=3, gamma=auto, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.3, degree=3, gamma=auto, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.3, degree=3, gamma=auto, kernel=linear;, score=0.792 total
time=   0.7s
```

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[CV 1/3] END C=0.3, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 2/3] END C=0.3, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 3/3] END C=0.3, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
1.7s
[CV 1/3] END C=0.3, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.4s
[CV 2/3] END C=0.3, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 3/3] END C=0.3, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.8s
[CV 1/3] END C=0.3, degree=3, gamma=0.1, kernel=rbf;, score=0.450 total time=
1.9s
[CV 2/3] END C=0.3, degree=3, gamma=0.1, kernel=rbf;, score=0.465 total time=
1.9s
[CV 3/3] END C=0.3, degree=3, gamma=0.1, kernel=rbf;, score=0.420 total time=
1.9s
[CV 1/3] END C=0.3, degree=3, gamma=0.1, kernel=linear;, score=0.842 total time=
0.7s
[CV 2/3] END C=0.3, degree=3, gamma=0.1, kernel=linear;, score=0.796 total time=
0.7s
[CV 3/3] END C=0.3, degree=3, gamma=0.1, kernel=linear;, score=0.792 total time=
0.6s
[CV 1/3] END C=0.3, degree=3, gamma=0.1, kernel=poly;, score=0.883 total time=
1.0s
[CV 2/3] END C=0.3, degree=3, gamma=0.1, kernel=poly;, score=0.865 total time=
1.1s
[CV 3/3] END C=0.3, degree=3, gamma=0.1, kernel=poly;, score=0.823 total time=
1.2s
[CV 1/3] END C=0.3, degree=3, gamma=0.1, kernel=sigmoid;, score=0.432 total
time=   1.4s
[CV 2/3] END C=0.3, degree=3, gamma=0.1, kernel=sigmoid;, score=0.446 total
time=   1.4s
[CV 3/3] END C=0.3, degree=3, gamma=0.1, kernel=sigmoid;, score=0.453 total
time=   1.5s
[CV 1/3] END C=0.3, degree=3, gamma=0.01, kernel=rbf;, score=0.593 total time=
1.4s
[CV 2/3] END C=0.3, degree=3, gamma=0.01, kernel=rbf;, score=0.604 total time=
1.4s
[CV 3/3] END C=0.3, degree=3, gamma=0.01, kernel=rbf;, score=0.574 total time=
1.3s
[CV 1/3] END C=0.3, degree=3, gamma=0.01, kernel=linear;, score=0.842 total
time=   0.6s
[CV 2/3] END C=0.3, degree=3, gamma=0.01, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.3, degree=3, gamma=0.01, kernel=linear;, score=0.792 total
time=   0.6s
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[CV 1/3] END C=0.3, degree=3, gamma=0.01, kernel=poly;, score=0.448 total time=
1.5s
[CV 2/3] END C=0.3, degree=3, gamma=0.01, kernel=poly;, score=0.465 total time=
1.5s
[CV 3/3] END C=0.3, degree=3, gamma=0.01, kernel=poly;, score=0.425 total time=
1.5s
[CV 1/3] END C=0.3, degree=3, gamma=0.01, kernel=sigmoid;, score=0.553 total
time=   1.1s
[CV 2/3] END C=0.3, degree=3, gamma=0.01, kernel=sigmoid;, score=0.531 total
time=   1.1s
[CV 3/3] END C=0.3, degree=3, gamma=0.01, kernel=sigmoid;, score=0.535 total
time=   1.2s
[CV 1/3] END C=0.3, degree=3, gamma=0.001, kernel=rbf;, score=0.442 total time=
1.7s
[CV 2/3] END C=0.3, degree=3, gamma=0.001, kernel=rbf;, score=0.462 total time=
1.9s
[CV 3/3] END C=0.3, degree=3, gamma=0.001, kernel=rbf;, score=0.443 total time=
1.7s
[CV 1/3] END C=0.3, degree=3, gamma=0.001, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.3, degree=3, gamma=0.001, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.3, degree=3, gamma=0.001, kernel=linear;, score=0.792 total
time=   0.7s
[CV 1/3] END C=0.3, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 2/3] END C=0.3, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 3/3] END C=0.3, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 1/3] END C=0.3, degree=3, gamma=0.001, kernel=sigmoid;, score=0.323 total
time=   1.7s
[CV 2/3] END C=0.3, degree=3, gamma=0.001, kernel=sigmoid;, score=0.286 total
time=   1.6s
[CV 3/3] END C=0.3, degree=3, gamma=0.001, kernel=sigmoid;, score=0.247 total
time=   1.5s
[CV 1/3] END C=0.3, degree=4, gamma=scale, kernel=rbf;, score=0.743 total time=
1.4s
[CV 2/3] END C=0.3, degree=4, gamma=scale, kernel=rbf;, score=0.714 total time=
1.3s
[CV 3/3] END C=0.3, degree=4, gamma=scale, kernel=rbf;, score=0.668 total time=
1.3s
[CV 1/3] END C=0.3, degree=4, gamma=scale, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.3, degree=4, gamma=scale, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.3, degree=4, gamma=scale, kernel=linear;, score=0.792 total
time=   0.8s

[CV 1/3] END C=0.3, degree=4, gamma=scale, kernel=poly;, score=0.871 total time=
1.1s
[CV 2/3] END C=0.3, degree=4, gamma=scale, kernel=poly;, score=0.854 total time=
1.2s
[CV 3/3] END C=0.3, degree=4, gamma=scale, kernel=poly;, score=0.827 total time=
1.2s
[CV 1/3] END C=0.3, degree=4, gamma=scale, kernel=sigmoid;, score=0.588 total
time=   1.0s
[CV 2/3] END C=0.3, degree=4, gamma=scale, kernel=sigmoid;, score=0.607 total
time=   1.1s
[CV 3/3] END C=0.3, degree=4, gamma=scale, kernel=sigmoid;, score=0.604 total
time=   0.9s
[CV 1/3] END C=0.3, degree=4, gamma=auto, kernel=rbf;, score=0.347 total time=
2.0s
[CV 2/3] END C=0.3, degree=4, gamma=auto, kernel=rbf;, score=0.318 total time=
2.1s
[CV 3/3] END C=0.3, degree=4, gamma=auto, kernel=rbf;, score=0.267 total time=
2.0s
[CV 1/3] END C=0.3, degree=4, gamma=auto, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.3, degree=4, gamma=auto, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.3, degree=4, gamma=auto, kernel=linear;, score=0.792 total
time=   0.6s
[CV 1/3] END C=0.3, degree=4, gamma=auto, kernel=poly;, score=0.076 total time=
1.7s
[CV 2/3] END C=0.3, degree=4, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 3/3] END C=0.3, degree=4, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
[CV 1/3] END C=0.3, degree=4, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.8s
[CV 2/3] END C=0.3, degree=4, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 3/3] END C=0.3, degree=4, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.7s
[CV 1/3] END C=0.3, degree=4, gamma=0.1, kernel=rbf;, score=0.450 total time=
1.9s
[CV 2/3] END C=0.3, degree=4, gamma=0.1, kernel=rbf;, score=0.465 total time=
1.8s
[CV 3/3] END C=0.3, degree=4, gamma=0.1, kernel=rbf;, score=0.420 total time=
1.8s
[CV 1/3] END C=0.3, degree=4, gamma=0.1, kernel=linear;, score=0.842 total time=
0.8s
[CV 2/3] END C=0.3, degree=4, gamma=0.1, kernel=linear;, score=0.796 total time=
0.7s
[CV 3/3] END C=0.3, degree=4, gamma=0.1, kernel=linear;, score=0.792 total time=
0.7s

[CV 1/3] END C=0.3, degree=4, gamma=0.1, kernel=poly;, score=0.873 total time= 1.2s
[CV 2/3] END C=0.3, degree=4, gamma=0.1, kernel=poly;, score=0.854 total time= 1.2s
[CV 3/3] END C=0.3, degree=4, gamma=0.1, kernel=poly;, score=0.825 total time= 1.3s
[CV 1/3] END C=0.3, degree=4, gamma=0.1, kernel=sigmoid;, score=0.432 total time=   1.5s
[CV 2/3] END C=0.3, degree=4, gamma=0.1, kernel=sigmoid;, score=0.446 total time=   1.5s
[CV 3/3] END C=0.3, degree=4, gamma=0.1, kernel=sigmoid;, score=0.453 total time=   1.5s
[CV 1/3] END C=0.3, degree=4, gamma=0.01, kernel=rbf;, score=0.593 total time= 1.3s
[CV 2/3] END C=0.3, degree=4, gamma=0.01, kernel=rbf;, score=0.604 total time= 1.3s
[CV 3/3] END C=0.3, degree=4, gamma=0.01, kernel=rbf;, score=0.574 total time= 1.3s
[CV 1/3] END C=0.3, degree=4, gamma=0.01, kernel=linear;, score=0.842 total time=   0.7s
[CV 2/3] END C=0.3, degree=4, gamma=0.01, kernel=linear;, score=0.796 total time=   0.8s
[CV 3/3] END C=0.3, degree=4, gamma=0.01, kernel=linear;, score=0.792 total time=   0.7s
[CV 1/3] END C=0.3, degree=4, gamma=0.01, kernel=poly;, score=0.112 total time= 1.5s
[CV 2/3] END C=0.3, degree=4, gamma=0.01, kernel=poly;, score=0.076 total time= 1.8s
[CV 3/3] END C=0.3, degree=4, gamma=0.01, kernel=poly;, score=0.121 total time= 1.7s
[CV 1/3] END C=0.3, degree=4, gamma=0.01, kernel=sigmoid;, score=0.553 total time=   1.1s
[CV 2/3] END C=0.3, degree=4, gamma=0.01, kernel=sigmoid;, score=0.531 total time=   1.1s
[CV 3/3] END C=0.3, degree=4, gamma=0.01, kernel=sigmoid;, score=0.535 total time=   1.2s
[CV 1/3] END C=0.3, degree=4, gamma=0.001, kernel=rbf;, score=0.442 total time= 2.0s
[CV 2/3] END C=0.3, degree=4, gamma=0.001, kernel=rbf;, score=0.462 total time= 1.8s
[CV 3/3] END C=0.3, degree=4, gamma=0.001, kernel=rbf;, score=0.443 total time= 1.7s
[CV 1/3] END C=0.3, degree=4, gamma=0.001, kernel=linear;, score=0.842 total time=   0.8s
[CV 2/3] END C=0.3, degree=4, gamma=0.001, kernel=linear;, score=0.796 total time=   0.7s
[CV 3/3] END C=0.3, degree=4, gamma=0.001, kernel=linear;, score=0.792 total time=   0.7s

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```
[CV 1/3] END C=0.3, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 2/3] END C=0.3, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time=
1.6s
[CV 3/3] END C=0.3, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time=
1.6s
[CV 1/3] END C=0.3, degree=4, gamma=0.001, kernel=sigmoid;, score=0.323 total
time=   1.5s
[CV 2/3] END C=0.3, degree=4, gamma=0.001, kernel=sigmoid;, score=0.286 total
time=   1.7s
[CV 3/3] END C=0.3, degree=4, gamma=0.001, kernel=sigmoid;, score=0.247 total
time=   1.8s
[CV 1/3] END C=0.4, degree=2, gamma=scale, kernel=rbf;, score=0.787 total time=
1.3s
[CV 2/3] END C=0.4, degree=2, gamma=scale, kernel=rbf;, score=0.769 total time=
1.3s
[CV 3/3] END C=0.4, degree=2, gamma=scale, kernel=rbf;, score=0.697 total time=
1.4s
[CV 1/3] END C=0.4, degree=2, gamma=scale, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.4, degree=2, gamma=scale, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.4, degree=2, gamma=scale, kernel=linear;, score=0.792 total
time=   0.7s
[CV 1/3] END C=0.4, degree=2, gamma=scale, kernel=poly;, score=0.849 total time=
0.8s
[CV 2/3] END C=0.4, degree=2, gamma=scale, kernel=poly;, score=0.832 total time=
0.9s
[CV 3/3] END C=0.4, degree=2, gamma=scale, kernel=poly;, score=0.781 total time=
0.8s
[CV 1/3] END C=0.4, degree=2, gamma=scale, kernel=sigmoid;, score=0.664 total
time=   1.0s
[CV 2/3] END C=0.4, degree=2, gamma=scale, kernel=sigmoid;, score=0.681 total
time=   1.0s
[CV 3/3] END C=0.4, degree=2, gamma=scale, kernel=sigmoid;, score=0.643 total
time=   0.9s
[CV 1/3] END C=0.4, degree=2, gamma=auto, kernel=rbf;, score=0.408 total time=
1.9s
[CV 2/3] END C=0.4, degree=2, gamma=auto, kernel=rbf;, score=0.417 total time=
1.9s
[CV 3/3] END C=0.4, degree=2, gamma=auto, kernel=rbf;, score=0.405 total time=
1.8s
[CV 1/3] END C=0.4, degree=2, gamma=auto, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.4, degree=2, gamma=auto, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.4, degree=2, gamma=auto, kernel=linear;, score=0.792 total
time=   0.7s
```

```
[CV 1/3] END C=0.4, degree=2, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 2/3] END C=0.4, degree=2, gamma=auto, kernel=poly;, score=0.076 total time=
1.6s
[CV 3/3] END C=0.4, degree=2, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 1/3] END C=0.4, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.5s
[CV 2/3] END C=0.4, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 3/3] END C=0.4, degree=2, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.5s
[CV 1/3] END C=0.4, degree=2, gamma=0.1, kernel=rbf;, score=0.474 total time=
1.9s
[CV 2/3] END C=0.4, degree=2, gamma=0.1, kernel=rbf;, score=0.498 total time=
1.8s
[CV 3/3] END C=0.4, degree=2, gamma=0.1, kernel=rbf;, score=0.466 total time=
1.8s
[CV 1/3] END C=0.4, degree=2, gamma=0.1, kernel=linear;, score=0.842 total time=
0.7s
[CV 2/3] END C=0.4, degree=2, gamma=0.1, kernel=linear;, score=0.796 total time=
0.7s
[CV 3/3] END C=0.4, degree=2, gamma=0.1, kernel=linear;, score=0.792 total time=
0.6s
[CV 1/3] END C=0.4, degree=2, gamma=0.1, kernel=poly;, score=0.887 total time=
0.9s
[CV 2/3] END C=0.4, degree=2, gamma=0.1, kernel=poly;, score=0.846 total time=
0.9s
[CV 3/3] END C=0.4, degree=2, gamma=0.1, kernel=poly;, score=0.818 total time=
0.9s
[CV 1/3] END C=0.4, degree=2, gamma=0.1, kernel=sigmoid;, score=0.430 total
time=   1.6s
[CV 2/3] END C=0.4, degree=2, gamma=0.1, kernel=sigmoid;, score=0.453 total
time=   1.4s
[CV 3/3] END C=0.4, degree=2, gamma=0.1, kernel=sigmoid;, score=0.474 total
time=   1.4s
[CV 1/3] END C=0.4, degree=2, gamma=0.01, kernel=rbf;, score=0.706 total time=
1.3s
[CV 2/3] END C=0.4, degree=2, gamma=0.01, kernel=rbf;, score=0.691 total time=
1.3s
[CV 3/3] END C=0.4, degree=2, gamma=0.01, kernel=rbf;, score=0.649 total time=
1.2s
[CV 1/3] END C=0.4, degree=2, gamma=0.01, kernel=linear;, score=0.842 total
time=   0.6s
[CV 2/3] END C=0.4, degree=2, gamma=0.01, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.4, degree=2, gamma=0.01, kernel=linear;, score=0.792 total
time=   0.7s
```

[CV 1/3] END C=0.4, degree=2, gamma=0.01, kernel=poly;, score=0.565 total time= 1.2s
[CV 2/3] END C=0.4, degree=2, gamma=0.01, kernel=poly;, score=0.548 total time= 1.1s
[CV 3/3] END C=0.4, degree=2, gamma=0.01, kernel=poly;, score=0.534 total time= 1.2s
[CV 1/3] END C=0.4, degree=2, gamma=0.01, kernel=sigmoid;, score=0.569 total time=   1.1s
[CV 2/3] END C=0.4, degree=2, gamma=0.01, kernel=sigmoid;, score=0.566 total time=   1.1s
[CV 3/3] END C=0.4, degree=2, gamma=0.01, kernel=sigmoid;, score=0.561 total time=   1.0s
[CV 1/3] END C=0.4, degree=2, gamma=0.001, kernel=rbf;, score=0.445 total time= 1.7s
[CV 2/3] END C=0.4, degree=2, gamma=0.001, kernel=rbf;, score=0.469 total time= 2.0s
[CV 3/3] END C=0.4, degree=2, gamma=0.001, kernel=rbf;, score=0.443 total time= 2.1s
[CV 1/3] END C=0.4, degree=2, gamma=0.001, kernel=linear;, score=0.842 total time=   0.7s
[CV 2/3] END C=0.4, degree=2, gamma=0.001, kernel=linear;, score=0.796 total time=   0.7s
[CV 3/3] END C=0.4, degree=2, gamma=0.001, kernel=linear;, score=0.792 total time=   0.7s
[CV 1/3] END C=0.4, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time= 1.5s
[CV 2/3] END C=0.4, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time= 1.7s
[CV 3/3] END C=0.4, degree=2, gamma=0.001, kernel=poly;, score=0.076 total time= 1.5s
[CV 1/3] END C=0.4, degree=2, gamma=0.001, kernel=sigmoid;, score=0.396 total time=   1.5s
[CV 2/3] END C=0.4, degree=2, gamma=0.001, kernel=sigmoid;, score=0.404 total time=   1.6s
[CV 3/3] END C=0.4, degree=2, gamma=0.001, kernel=sigmoid;, score=0.382 total time=   1.5s
[CV 1/3] END C=0.4, degree=3, gamma=scale, kernel=rbf;, score=0.787 total time= 1.4s
[CV 2/3] END C=0.4, degree=3, gamma=scale, kernel=rbf;, score=0.769 total time= 1.3s
[CV 3/3] END C=0.4, degree=3, gamma=scale, kernel=rbf;, score=0.697 total time= 1.4s
[CV 1/3] END C=0.4, degree=3, gamma=scale, kernel=linear;, score=0.842 total time=   0.7s
[CV 2/3] END C=0.4, degree=3, gamma=scale, kernel=linear;, score=0.796 total time=   0.7s
[CV 3/3] END C=0.4, degree=3, gamma=scale, kernel=linear;, score=0.792 total time=   0.7s

[CV 1/3] END C=0.4, degree=3, gamma=scale, kernel=poly;, score=0.874 total time=
1.1s
[CV 2/3] END C=0.4, degree=3, gamma=scale, kernel=poly;, score=0.856 total time=
1.2s
[CV 3/3] END C=0.4, degree=3, gamma=scale, kernel=poly;, score=0.824 total time=
1.0s
[CV 1/3] END C=0.4, degree=3, gamma=scale, kernel=sigmoid;, score=0.664 total
time=   1.0s
[CV 2/3] END C=0.4, degree=3, gamma=scale, kernel=sigmoid;, score=0.681 total
time=   1.0s
[CV 3/3] END C=0.4, degree=3, gamma=scale, kernel=sigmoid;, score=0.643 total
time=   0.9s
[CV 1/3] END C=0.4, degree=3, gamma=auto, kernel=rbf;, score=0.408 total time=
1.9s
[CV 2/3] END C=0.4, degree=3, gamma=auto, kernel=rbf;, score=0.417 total time=
1.7s
[CV 3/3] END C=0.4, degree=3, gamma=auto, kernel=rbf;, score=0.405 total time=
1.9s
[CV 1/3] END C=0.4, degree=3, gamma=auto, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.4, degree=3, gamma=auto, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.4, degree=3, gamma=auto, kernel=linear;, score=0.792 total
time=   0.7s
[CV 1/3] END C=0.4, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 2/3] END C=0.4, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 3/3] END C=0.4, degree=3, gamma=auto, kernel=poly;, score=0.076 total time=
1.5s
[CV 1/3] END C=0.4, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 2/3] END C=0.4, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.6s
[CV 3/3] END C=0.4, degree=3, gamma=auto, kernel=sigmoid;, score=0.076 total
time=   1.7s
[CV 1/3] END C=0.4, degree=3, gamma=0.1, kernel=rbf;, score=0.474 total time=
1.8s
[CV 2/3] END C=0.4, degree=3, gamma=0.1, kernel=rbf;, score=0.498 total time=
1.9s
[CV 3/3] END C=0.4, degree=3, gamma=0.1, kernel=rbf;, score=0.466 total time=
1.8s
[CV 1/3] END C=0.4, degree=3, gamma=0.1, kernel=linear;, score=0.842 total time=
0.7s
[CV 2/3] END C=0.4, degree=3, gamma=0.1, kernel=linear;, score=0.796 total time=
0.7s
[CV 3/3] END C=0.4, degree=3, gamma=0.1, kernel=linear;, score=0.792 total time=
0.6s

```
[CV 1/3] END C=0.4, degree=3, gamma=0.1, kernel=poly;, score=0.883 total time=
1.0s
[CV 2/3] END C=0.4, degree=3, gamma=0.1, kernel=poly;, score=0.865 total time=
1.2s
[CV 3/3] END C=0.4, degree=3, gamma=0.1, kernel=poly;, score=0.823 total time=
1.1s
[CV 1/3] END C=0.4, degree=3, gamma=0.1, kernel=sigmoid;, score=0.430 total
time=   1.4s
[CV 2/3] END C=0.4, degree=3, gamma=0.1, kernel=sigmoid;, score=0.453 total
time=   1.5s
[CV 3/3] END C=0.4, degree=3, gamma=0.1, kernel=sigmoid;, score=0.474 total
time=   1.5s
[CV 1/3] END C=0.4, degree=3, gamma=0.01, kernel=rbf;, score=0.706 total time=
1.4s
[CV 2/3] END C=0.4, degree=3, gamma=0.01, kernel=rbf;, score=0.691 total time=
1.5s
[CV 3/3] END C=0.4, degree=3, gamma=0.01, kernel=rbf;, score=0.649 total time=
1.4s
[CV 1/3] END C=0.4, degree=3, gamma=0.01, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.4, degree=3, gamma=0.01, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.4, degree=3, gamma=0.01, kernel=linear;, score=0.792 total
time=   0.7s
[CV 1/3] END C=0.4, degree=3, gamma=0.01, kernel=poly;, score=0.452 total time=
1.4s
[CV 2/3] END C=0.4, degree=3, gamma=0.01, kernel=poly;, score=0.472 total time=
1.5s
[CV 3/3] END C=0.4, degree=3, gamma=0.01, kernel=poly;, score=0.433 total time=
1.4s
[CV 1/3] END C=0.4, degree=3, gamma=0.01, kernel=sigmoid;, score=0.569 total
time=   1.0s
[CV 2/3] END C=0.4, degree=3, gamma=0.01, kernel=sigmoid;, score=0.566 total
time=   1.1s
[CV 3/3] END C=0.4, degree=3, gamma=0.01, kernel=sigmoid;, score=0.561 total
time=   1.1s
[CV 1/3] END C=0.4, degree=3, gamma=0.001, kernel=rbf;, score=0.445 total time=
1.7s
[CV 2/3] END C=0.4, degree=3, gamma=0.001, kernel=rbf;, score=0.469 total time=
1.8s
[CV 3/3] END C=0.4, degree=3, gamma=0.001, kernel=rbf;, score=0.443 total time=
1.8s
[CV 1/3] END C=0.4, degree=3, gamma=0.001, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.4, degree=3, gamma=0.001, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.4, degree=3, gamma=0.001, kernel=linear;, score=0.792 total
time=   0.7s
```

[CV 1/3] END C=0.4, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.6s
[CV 2/3] END C=0.4, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.7s
[CV 3/3] END C=0.4, degree=3, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 1/3] END C=0.4, degree=3, gamma=0.001, kernel=sigmoid;, score=0.396 total
time=   1.6s
[CV 2/3] END C=0.4, degree=3, gamma=0.001, kernel=sigmoid;, score=0.404 total
time=   1.5s
[CV 3/3] END C=0.4, degree=3, gamma=0.001, kernel=sigmoid;, score=0.382 total
time=   1.6s
[CV 1/3] END C=0.4, degree=4, gamma=scale, kernel=rbf;, score=0.787 total time=
1.4s
[CV 2/3] END C=0.4, degree=4, gamma=scale, kernel=rbf;, score=0.769 total time=
1.3s
[CV 3/3] END C=0.4, degree=4, gamma=scale, kernel=rbf;, score=0.697 total time=
1.3s
[CV 1/3] END C=0.4, degree=4, gamma=scale, kernel=linear;, score=0.842 total
time=   0.8s
[CV 2/3] END C=0.4, degree=4, gamma=scale, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.4, degree=4, gamma=scale, kernel=linear;, score=0.792 total
time=   0.6s
[CV 1/3] END C=0.4, degree=4, gamma=scale, kernel=poly;, score=0.873 total time=
1.1s
[CV 2/3] END C=0.4, degree=4, gamma=scale, kernel=poly;, score=0.854 total time=
1.2s
[CV 3/3] END C=0.4, degree=4, gamma=scale, kernel=poly;, score=0.825 total time=
1.2s
[CV 1/3] END C=0.4, degree=4, gamma=scale, kernel=sigmoid;, score=0.664 total
time=   0.9s
[CV 2/3] END C=0.4, degree=4, gamma=scale, kernel=sigmoid;, score=0.681 total
time=   1.0s
[CV 3/3] END C=0.4, degree=4, gamma=scale, kernel=sigmoid;, score=0.643 total
time=   1.0s
[CV 1/3] END C=0.4, degree=4, gamma=auto, kernel=rbf;, score=0.408 total time=
1.9s
[CV 2/3] END C=0.4, degree=4, gamma=auto, kernel=rbf;, score=0.417 total time=
1.8s
[CV 3/3] END C=0.4, degree=4, gamma=auto, kernel=rbf;, score=0.405 total time=
1.8s
[CV 1/3] END C=0.4, degree=4, gamma=auto, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.4, degree=4, gamma=auto, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.4, degree=4, gamma=auto, kernel=linear;, score=0.792 total
time=   0.7s

[CV 1/3] END C=0.4, degree=4, gamma=auto, kernel=poly;, score=0.076 total time= 1.5s
[CV 2/3] END C=0.4, degree=4, gamma=auto, kernel=poly;, score=0.076 total time= 1.6s
[CV 3/3] END C=0.4, degree=4, gamma=auto, kernel=poly;, score=0.076 total time= 1.5s
[CV 1/3] END C=0.4, degree=4, gamma=auto, kernel=sigmoid;, score=0.076 total time=   1.5s
[CV 2/3] END C=0.4, degree=4, gamma=auto, kernel=sigmoid;, score=0.076 total time=   1.5s
[CV 3/3] END C=0.4, degree=4, gamma=auto, kernel=sigmoid;, score=0.076 total time=   1.6s
[CV 1/3] END C=0.4, degree=4, gamma=0.1, kernel=rbf;, score=0.474 total time= 1.9s
[CV 2/3] END C=0.4, degree=4, gamma=0.1, kernel=rbf;, score=0.498 total time= 1.9s
[CV 3/3] END C=0.4, degree=4, gamma=0.1, kernel=rbf;, score=0.466 total time= 1.9s
[CV 1/3] END C=0.4, degree=4, gamma=0.1, kernel=linear;, score=0.842 total time= 0.7s
[CV 2/3] END C=0.4, degree=4, gamma=0.1, kernel=linear;, score=0.796 total time= 0.7s
[CV 3/3] END C=0.4, degree=4, gamma=0.1, kernel=linear;, score=0.792 total time= 0.8s
[CV 1/3] END C=0.4, degree=4, gamma=0.1, kernel=poly;, score=0.873 total time= 1.2s
[CV 2/3] END C=0.4, degree=4, gamma=0.1, kernel=poly;, score=0.854 total time= 1.3s
[CV 3/3] END C=0.4, degree=4, gamma=0.1, kernel=poly;, score=0.825 total time= 1.2s
[CV 1/3] END C=0.4, degree=4, gamma=0.1, kernel=sigmoid;, score=0.430 total time=   1.4s
[CV 2/3] END C=0.4, degree=4, gamma=0.1, kernel=sigmoid;, score=0.453 total time=   1.5s
[CV 3/3] END C=0.4, degree=4, gamma=0.1, kernel=sigmoid;, score=0.474 total time=   1.5s
[CV 1/3] END C=0.4, degree=4, gamma=0.01, kernel=rbf;, score=0.706 total time= 1.2s
[CV 2/3] END C=0.4, degree=4, gamma=0.01, kernel=rbf;, score=0.691 total time= 1.3s
[CV 3/3] END C=0.4, degree=4, gamma=0.01, kernel=rbf;, score=0.649 total time= 1.3s
[CV 1/3] END C=0.4, degree=4, gamma=0.01, kernel=linear;, score=0.842 total time=   0.7s
[CV 2/3] END C=0.4, degree=4, gamma=0.01, kernel=linear;, score=0.796 total time=   0.7s
[CV 3/3] END C=0.4, degree=4, gamma=0.01, kernel=linear;, score=0.792 total time=   0.6s

```
[CV 1/3] END C=0.4, degree=4, gamma=0.01, kernel=poly;, score=0.359 total time=
1.5s
[CV 2/3] END C=0.4, degree=4, gamma=0.01, kernel=poly;, score=0.344 total time=
1.5s
[CV 3/3] END C=0.4, degree=4, gamma=0.01, kernel=poly;, score=0.334 total time=
1.5s
[CV 1/3] END C=0.4, degree=4, gamma=0.01, kernel=sigmoid;, score=0.569 total
time=   1.1s
[CV 2/3] END C=0.4, degree=4, gamma=0.01, kernel=sigmoid;, score=0.566 total
time=   1.0s
[CV 3/3] END C=0.4, degree=4, gamma=0.01, kernel=sigmoid;, score=0.561 total
time=   1.1s
[CV 1/3] END C=0.4, degree=4, gamma=0.001, kernel=rbf;, score=0.445 total time=
1.8s
[CV 2/3] END C=0.4, degree=4, gamma=0.001, kernel=rbf;, score=0.469 total time=
1.7s
[CV 3/3] END C=0.4, degree=4, gamma=0.001, kernel=rbf;, score=0.443 total time=
1.8s
[CV 1/3] END C=0.4, degree=4, gamma=0.001, kernel=linear;, score=0.842 total
time=   0.7s
[CV 2/3] END C=0.4, degree=4, gamma=0.001, kernel=linear;, score=0.796 total
time=   0.7s
[CV 3/3] END C=0.4, degree=4, gamma=0.001, kernel=linear;, score=0.792 total
time=   0.6s
[CV 1/3] END C=0.4, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 2/3] END C=0.4, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time=
1.6s
[CV 3/3] END C=0.4, degree=4, gamma=0.001, kernel=poly;, score=0.076 total time=
1.5s
[CV 1/3] END C=0.4, degree=4, gamma=0.001, kernel=sigmoid;, score=0.396 total
time=   1.5s
[CV 2/3] END C=0.4, degree=4, gamma=0.001, kernel=sigmoid;, score=0.404 total
time=   1.6s
[CV 3/3] END C=0.4, degree=4, gamma=0.001, kernel=sigmoid;, score=0.382 total
time=   1.7s

 GridSearchCV(cv=3, estimator=SVC(),
             param_grid={'C': [0.1, 0.2, 0.3, 0.4], 'degree': [2, 3, 4],
                         'gamma': ['scale', 'auto', 0.1, 0.01, 0.001],
                         'kernel': ['rbf', 'linear', 'poly', 'sigmoid']},
             scoring='f1_macro', verbose=3)
```

```python
best_svm = grid_search_svm.best_estimator_
# Get the best parameters and score
print("Best parameters:", grid_search_svm.best_params_)
```

```
y_pred_svm = best_svm.predict(test_features)

joblib.dump(best_svm, project_dir + '\joblib\\best_svm_model.joblib')
```

Best parameters: {'C': 0.1, 'degree': 3, 'gamma': 0.1, 'kernel': 'poly'}

['d:\\ASUS\\Deploy-Traffic-Sign-Classification-through-Images\\joblib\\best_svm_model.joblib']

8 Predict on test images for KNN

```
report_knn = classification_report(test_labels_encoded, y_pred_knn,␣
 ↪target_names=label_encoder.classes_)
print(report_knn)
```

	precision	recall	f1-score	support
Cam	0.87	0.97	0.92	34
Chidan	0.92	0.70	0.79	33
Hieulenh	0.85	0.74	0.79	31
Nguyhiem	0.91	1.00	0.95	29
Phu	0.79	0.96	0.86	23
accuracy			0.87	150
macro avg	0.87	0.87	0.86	150
weighted avg	0.87	0.87	0.86	150

```
heatmap_label_knn = confusion_matrix(test_labels_encoded, y_pred_knn)

plt.figure(figsize=(10, 8))
sns.heatmap(heatmap_label_knn, annot=True, fmt='d', cmap='Blues',␣
 ↪xticklabels=label_encoder.classes_, yticklabels=label_encoder.classes_)
plt.title('Confusion Matrix')
plt.xlabel('Predicted Labels')
plt.ylabel('True Labels')
plt.show()
```

Confusion Matrix
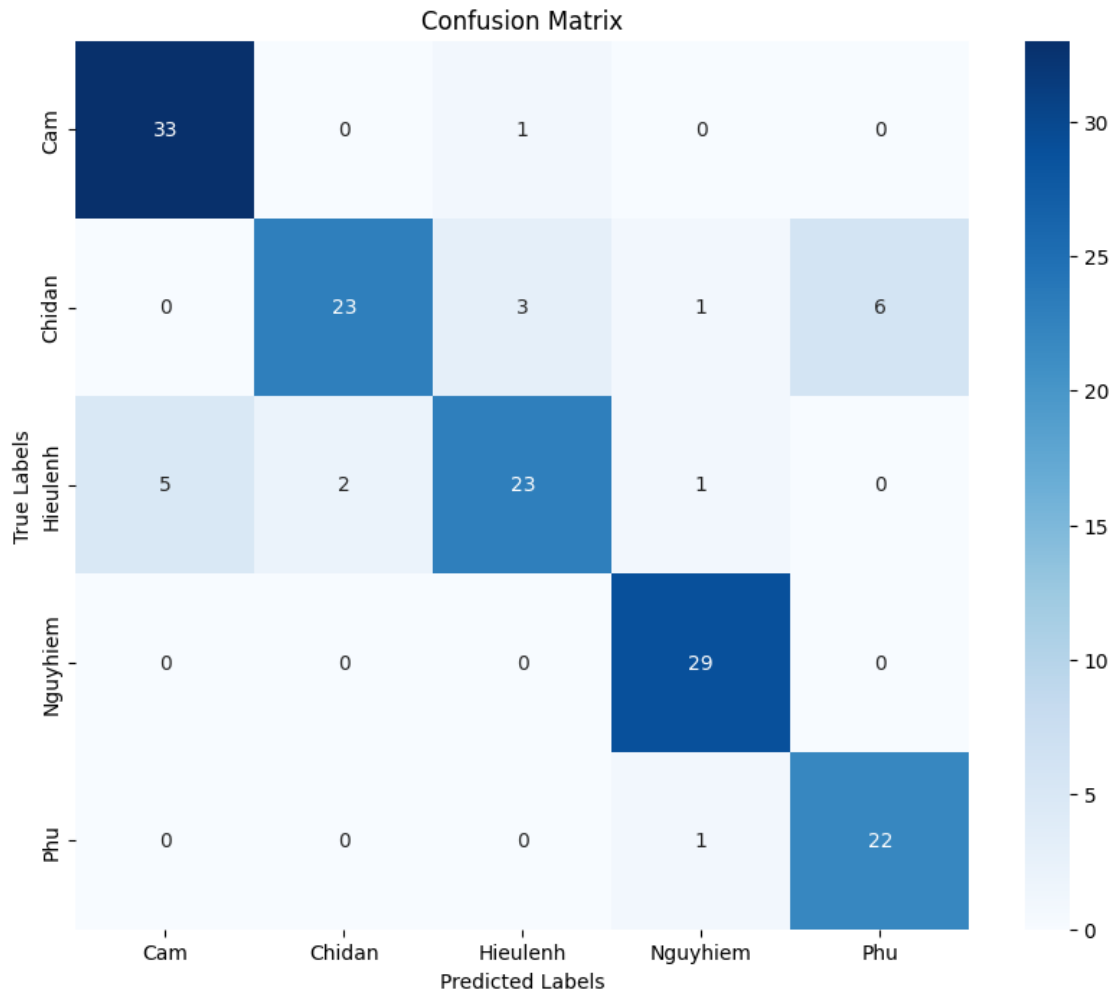
```
n_columns = 10
n_rows = math.ceil(len(test_images) / n_columns)

fig, axes = plt.subplots(n_rows, n_columns, figsize=(30, n_rows * 3))

for idx, (image, true_label, pred_label) in enumerate(zip(test_images,␣
 ↪test_labels_encoded, y_pred_knn)):
    row = idx // n_columns
    col = idx % n_columns

    axes[row, col].imshow(image)
    axes[row, col].set_title(f'True: {label_encoder.classes_[true_label]}\nPred:
 ↪ {label_encoder.classes_[pred_label]}')
    axes[row, col].axis('off')
```

```python
for ax in axes.flat:
    if not ax.has_data():
        ax.axis('off')

plt.tight_layout()
plt.show()
```

9 Predict on test images for SVM

```
report_svm = classification_report(test_labels_encoded, y_pred_svm,␣
 ↪target_names=label_encoder.classes_)
print(report_svm)
```

```
              precision    recall  f1-score   support

         Cam       0.89      0.97      0.93        34
       Chidan      0.88      0.88      0.88        33
     Hieulenh      0.92      0.77      0.84        31
     Nguyhiem      0.97      1.00      0.98        29
          Phu      0.88      0.91      0.89        23

    accuracy                          0.91       150
   macro avg       0.91      0.91      0.91       150
weighted avg       0.91      0.91      0.91       150
```

```
heatmap_label_svm = confusion_matrix(test_labels_encoded, y_pred_svm)

plt.figure(figsize=(10, 8))
sns.heatmap(heatmap_label_svm, annot=True, fmt='d', cmap='Blues',␣
 ↪xticklabels=label_encoder.classes_, yticklabels=label_encoder.classes_)
plt.title('Confusion Matrix')
plt.xlabel('Predicted Labels')
plt.ylabel('True Labels')
plt.show()
```

Confusion Matrix
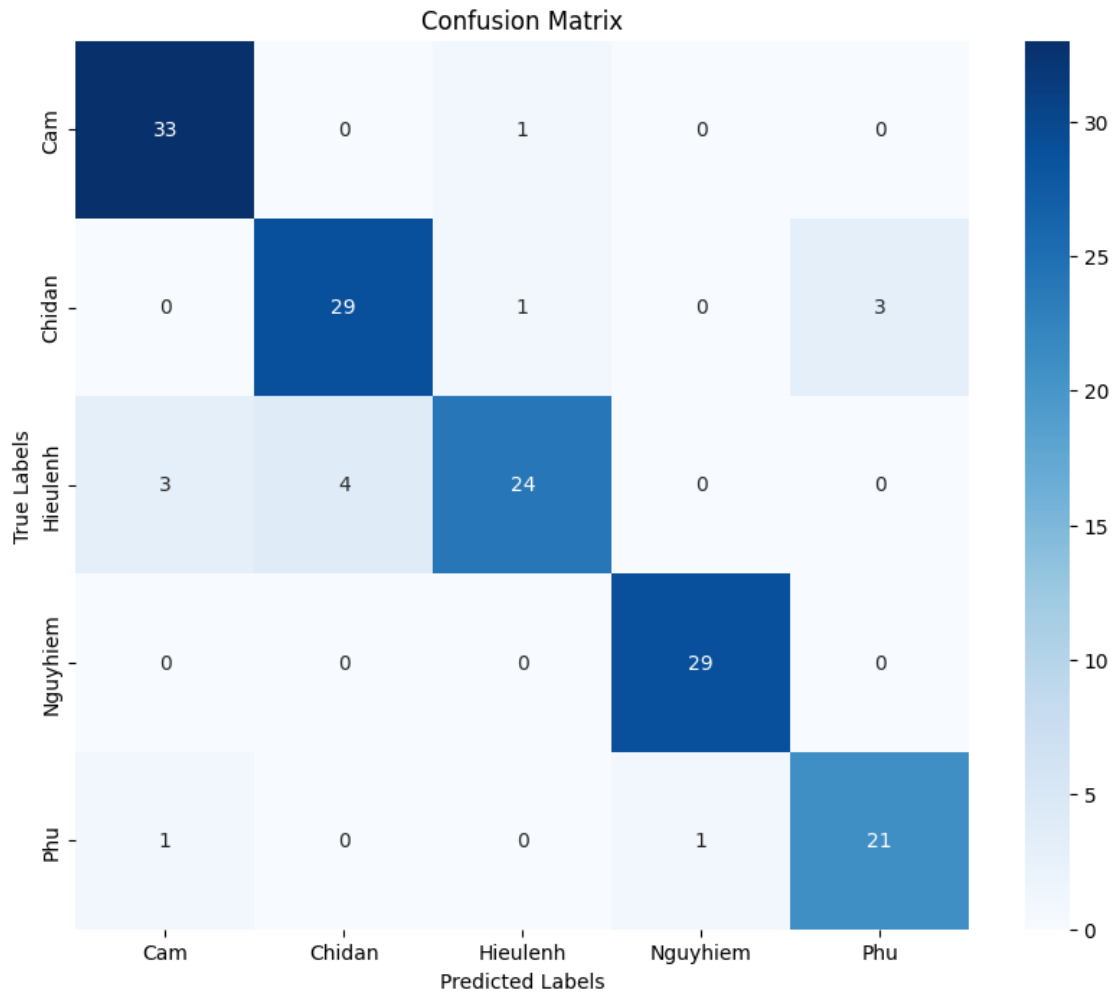
```
n_columns = 10
n_rows = math.ceil(len(test_images) / n_columns)

fig, axes = plt.subplots(n_rows, n_columns, figsize=(30, n_rows * 3))

for idx, (image, true_label, pred_label) in enumerate(zip(test_images,␣
↪test_labels_encoded, y_pred_svm)):
    row = idx // n_columns
    col = idx % n_columns

    axes[row, col].imshow(image)
    axes[row, col].set_title(f'True: {label_encoder.classes_[true_label]}\nPred:
↪ {label_encoder.classes_[pred_label]}')
    axes[row, col].axis('off')
```

```python
for ax in axes.flat:
    if not ax.has_data():
        ax.axis('off')

plt.tight_layout()
plt.show()
```

10   Save grid search results

```python
def export_notebook_to_pdf(notebook_path, project_dir):
    results_dir = os.path.join(project_dir)
    os.makedirs(results_dir, exist_ok=True)

    # Đọc notebook
    with open(notebook_path, 'r', encoding='utf-8') as f:
        nb = nbformat.read(f, as_version=4)

    # Cấu hình PDF exporter
    pdf_exporter = PDFExporter()
    pdf_exporter.exclude_input_prompt = True
    pdf_exporter.exclude_output_prompt = True

    # Thêm template và style cơ bản
    pdf_exporter.template_name = 'classic'

    # Chuyển đổi sang PDF
    pdf_data, resources = pdf_exporter.from_notebook_node(nb)

    # Tạo tên file với timestamp
    current_time = datetime.now().strftime('%Y-%m-%d_%H_%M_%S')
    pdf_file = os.path.join(results_dir, f"notebook_export_{current_time}.pdf")

    # Lưu file PDF
    with open(pdf_file, 'wb') as f:
        f.write(pdf_data)

    print(f"Đã xuất file PDF thành công: {pdf_file}")
    return pdf_file
```

```python
# project_dir = os.path.dirname(project_dir)
notebook_path = project_dir + "\\model\\main.ipynb"
proj_dir = project_dir + "\\grid_search_results"

export_notebook_to_pdf(notebook_path, proj_dir)
```