

Notebook

December 16, 2024

1 Import libraries

```
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 GridSearchCV
from sklearn.metrics import classification_report, confusion_matrix
from scipy.spatial.distance import cityblock, cosine, sqeuclidean, euclidean
```

2 Load data

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

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

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

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

```

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)

```

```

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

```

```

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')

```

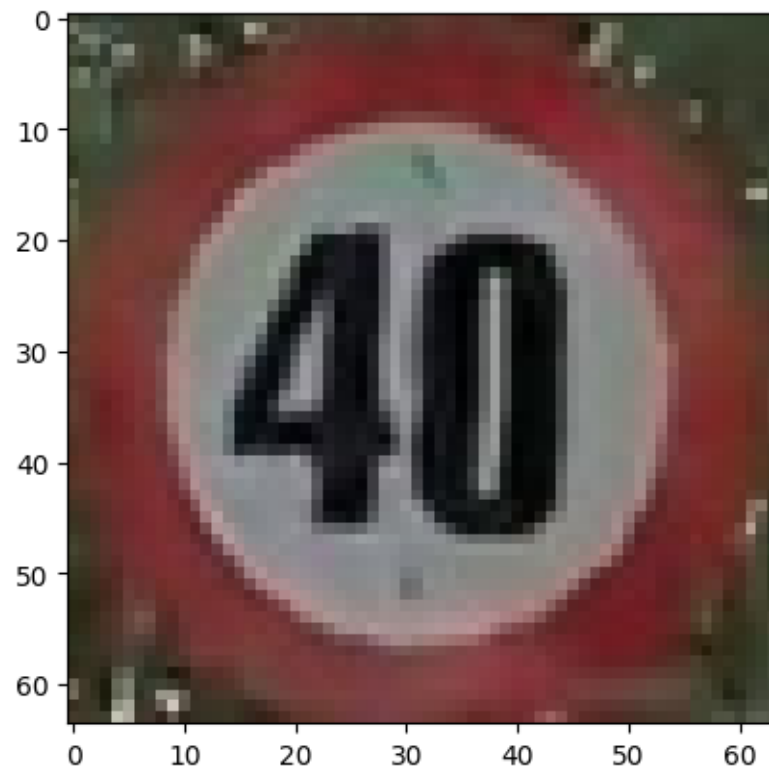
```

['e:\\Documents\\CS231\\project\\Traffic-Sign-Classification-through-
Images\\joblib\\label_encoder.joblib']

```

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

<matplotlib.image.AxesImage at 0x18e2e8357e0>



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

<matplotlib.image.AxesImage at 0x18e2e8dca90>



3 Extract features

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

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

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

```
def blur_image(image):  
    blurred_image = cv2.GaussianBlur(image, (5,5), 0)  
    return blurred_image
```

```
# plt.imshow(blur_image1(test_images[0]))
```

```
# plt.imshow(blur_image1(train_images[1]))
```

```
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

```

```

# def plot_color_histogram(image):
#     fig, axs = plt.subplots(2, 2, figsize=(12, 10))

#     color = ("r", "g", "b")
#     for k, clr in enumerate(color):
#         histogram = np.squeeze(cv2.calcHist([image], [k], None, [256], [0,
↪256]))
#         axs[0, 0].plot(histogram, color=clr)
#         axs[0, 0].set_xlim(0, 256)
#         axs[0, 0].set_title('Histogram tổng quát RGB')

#     titles = ['Red Channel', 'Green Channel', 'Blue Channel']
#     positions = [(0, 1), (1, 0), (1, 1)]

#     for idx, (clr, title, pos) in enumerate(zip(color, titles, positions)):
#         histogram = np.squeeze(cv2.calcHist([image], [idx], None, [256], [0,
↪256]))
#         axs[pos].plot(histogram, color=clr)
#         axs[pos].set_xlim(0, 256)
#         axs[pos].set_title(title)

#     plt.tight_layout()
#     plt.show()

```

```

# plot_color_histogram(train_images[0])

```

```

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

```

```

# _, image1 = hog(blur_image(train_images[1]))
# plt.imshow(image1, cmap=plt.cm.gray)

```

```
# _, image2 = hog(blur_image1(train_images[1]))
# plt.imshow(image2, cmap=plt.cm.gray)
```

```
def extract_features(images):
    blurred_images = [blur_image(image) for image in tqdm(images, desc="Blur_
    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
```

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

```
Blur Images: 100%|      | 1415/1415 [00:00<00:00, 51270.24it/s]
Extracting Color Features: 100%|      | 1415/1415 [00:00<00:00,
30818.53it/s]
Extracting HOG Features: 100%|      | 1415/1415 [00:02<00:00, 690.61it/s]
Combining Features: 1415it [00:00, 80802.45it/s]
```

```
['e:\\Documents\\CS231\\project\\Traffic-Sign-Classification-through-
Images\\joblib\\train_features.joblib']
```

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

```
Blur Images: 100%|      | 150/150 [00:00<00:00, 50011.57it/s]
Extracting Color Features: 100%|      | 150/150 [00:00<00:00, 37527.32it/s]
Extracting HOG Features: 100%|      | 150/150 [00:00<00:00, 704.06it/s]
Combining Features: 150it [00:00, 75184.70it/s]
```

```
['e:\\Documents\\CS231\\project\\Traffic-Sign-Classification-through-
Images\\joblib\\test_features.joblib']
```

4 Distance metrics KNN

```
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):
```

```

    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

```

# knn_model = joblib.load(project_dir + '\\joblib\\best_knn_model.joblib')
# svm_model = joblib.load(project_dir + '\\joblib\\best_svm_model.joblib')

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

```

```

# print("Tham số của KNN Model:")
# print(knn_model.get_params())

# print("\nTham số của SVM Model:")
# print(svm_model.get_params())

```

6 Gridsearch KNN

```

# knn_model = KNeighborsClassifier()
# knn_model.fit(train_features, train_labels_encoded)
# y_pred_knn = knn_model.predict(test_features)

```

```

param_grid = {
    'n_neighbors': [3, 4, 5, 6, 7, 10],
    'weights': ['uniform', 'distance'],
    'metric': [
        cityblock,
        euclidean,
        cosine,
        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 84 candidates, totalling 252 fits
[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=3,
weights=uniform;; score=0.880 total time= 2.4s
[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=3,
weights=uniform;; score=0.845 total time= 2.4s
[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=3,
weights=uniform;; score=0.826 total time= 2.3s
[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=3,
weights=distance;; score=0.886 total time= 2.3s
[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=3,
weights=distance;; score=0.856 total time= 2.4s
[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=3,
weights=distance;; score=0.838 total time= 2.4s
[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=4,
weights=uniform;; score=0.872 total time= 2.4s
[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=4,
weights=uniform;; score=0.818 total time= 2.4s
[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=4,
weights=uniform;; score=0.814 total time= 2.4s
[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=4,
weights=distance;; score=0.899 total time= 2.4s
[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=4,
weights=distance;; score=0.863 total time= 2.3s
[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=4,
weights=distance;; score=0.828 total time= 2.4s
[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=5,
weights=uniform;; score=0.860 total time= 2.3s
[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=5,
weights=uniform;; score=0.831 total time= 2.4s
[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=5,
weights=uniform;; score=0.825 total time= 2.4s
[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=5,
weights=distance;; score=0.881 total time= 2.4s
[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=5,
weights=distance;; score=0.842 total time= 2.4s
[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=5,
weights=distance;; score=0.831 total time= 2.4s
[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=6,
weights=uniform;; score=0.854 total time= 2.4s
[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=6,
weights=uniform;; score=0.808 total time= 2.4s

```


[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=6,
weights=uniform;; score=0.803 total time= 2.4s

[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=6,
weights=distance;; score=0.883 total time= 2.4s

[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=6,
weights=distance;; score=0.847 total time= 2.4s

[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=6,
weights=distance;; score=0.828 total time= 2.4s

[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=7,
weights=uniform;; score=0.837 total time= 2.4s

[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=7,
weights=uniform;; score=0.807 total time= 2.4s

[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=7,
weights=uniform;; score=0.800 total time= 2.4s

[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=7,
weights=distance;; score=0.876 total time= 2.4s

[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=7,
weights=distance;; score=0.823 total time= 2.4s

[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=7,
weights=distance;; score=0.819 total time= 2.4s

[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=10,
weights=uniform;; score=0.814 total time= 2.4s

[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=10,
weights=uniform;; score=0.806 total time= 2.5s

[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=10,
weights=uniform;; score=0.755 total time= 2.4s

[CV 1/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=10,
weights=distance;; score=0.859 total time= 2.5s

[CV 2/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=10,
weights=distance;; score=0.832 total time= 2.6s

[CV 3/3] END metric=<function cityblock at 0x0000018E2AEC5630>, n_neighbors=10,
weights=distance;; score=0.802 total time= 2.5s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=3,
weights=uniform;; score=0.848 total time= 3.4s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=3,
weights=uniform;; score=0.812 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=3,
weights=uniform;; score=0.796 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=3,
weights=distance;; score=0.862 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=3,
weights=distance;; score=0.812 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=3,
weights=distance;; score=0.810 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=4,
weights=uniform;; score=0.846 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=4,
weights=uniform;; score=0.781 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=4,
weights=uniform;; score=0.764 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=4,
weights=distance;; score=0.884 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=4,
weights=distance;; score=0.817 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=4,
weights=distance;; score=0.792 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=5,
weights=uniform;; score=0.848 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=5,
weights=uniform;; score=0.799 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=5,
weights=uniform;; score=0.751 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=5,
weights=distance;; score=0.859 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=5,
weights=distance;; score=0.811 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=5,
weights=distance;; score=0.777 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=6,
weights=uniform;; score=0.832 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=6,
weights=uniform;; score=0.783 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=6,
weights=uniform;; score=0.740 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=6,
weights=distance;; score=0.867 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=6,
weights=distance;; score=0.818 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=6,
weights=distance;; score=0.767 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=7,
weights=uniform;; score=0.838 total time= 3.4s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=7,
weights=uniform;; score=0.780 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=7,
weights=uniform;; score=0.741 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=7,
weights=distance;; score=0.855 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=7,
weights=distance;; score=0.786 total time= 3.6s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=7,
weights=distance;; score=0.751 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=10,
weights=uniform;; score=0.800 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=10,
weights=uniform;; score=0.743 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=10, weights=uniform;; score=0.723 total time= 3.3s

[CV 1/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=10, weights=distance;; score=0.833 total time= 3.3s

[CV 2/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=10, weights=distance;; score=0.780 total time= 3.3s

[CV 3/3] END metric=<function euclidean at 0x0000018E2AEC51B0>, n_neighbors=10, weights=distance;; score=0.739 total time= 3.3s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=3, weights=uniform;; score=0.850 total time= 6.4s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=3, weights=uniform;; score=0.812 total time= 6.4s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=3, weights=uniform;; score=0.799 total time= 6.4s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=3, weights=distance;; score=0.871 total time= 6.4s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=3, weights=distance;; score=0.814 total time= 6.4s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=3, weights=distance;; score=0.817 total time= 6.4s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=4, weights=uniform;; score=0.844 total time= 6.5s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=4, weights=uniform;; score=0.778 total time= 6.9s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=4, weights=uniform;; score=0.767 total time= 6.9s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=4, weights=distance;; score=0.886 total time= 6.4s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=4, weights=distance;; score=0.819 total time= 6.4s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=4, weights=distance;; score=0.797 total time= 6.5s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=5, weights=uniform;; score=0.850 total time= 6.4s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=5, weights=uniform;; score=0.797 total time= 6.4s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=5, weights=uniform;; score=0.751 total time= 6.4s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=5, weights=distance;; score=0.868 total time= 6.4s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=5, weights=distance;; score=0.811 total time= 6.4s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=5, weights=distance;; score=0.788 total time= 6.5s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=6, weights=uniform;; score=0.834 total time= 6.6s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=6, weights=uniform;; score=0.782 total time= 6.4s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=6, weights=uniform;; score=0.738 total time= 6.5s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=6, weights=distance;; score=0.870 total time= 6.4s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=6, weights=distance;; score=0.825 total time= 6.5s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=6, weights=distance;; score=0.772 total time= 6.4s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=7, weights=uniform;; score=0.835 total time= 6.5s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=7, weights=uniform;; score=0.781 total time= 6.5s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=7, weights=uniform;; score=0.741 total time= 6.6s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=7, weights=distance;; score=0.867 total time= 7.8s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=7, weights=distance;; score=0.789 total time= 7.0s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=7, weights=distance;; score=0.770 total time= 9.5s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=10, weights=uniform;; score=0.795 total time= 6.7s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=10, weights=uniform;; score=0.761 total time= 6.5s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=10, weights=uniform;; score=0.725 total time= 6.6s

[CV 1/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=10, weights=distance;; score=0.835 total time= 6.5s

[CV 2/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=10, weights=distance;; score=0.798 total time= 6.5s

[CV 3/3] END metric=<function cosine at 0x0000018E2AEC5360>, n_neighbors=10, weights=distance;; score=0.745 total time= 6.5s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=3, weights=uniform;; score=0.848 total time= 2.7s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=3, weights=uniform;; score=0.812 total time= 2.6s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=3, weights=uniform;; score=0.796 total time= 2.6s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=3, weights=distance;; score=0.869 total time= 2.5s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=3, weights=distance;; score=0.812 total time= 2.5s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=3, weights=distance;; score=0.817 total time= 2.5s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=4, weights=uniform;; score=0.846 total time= 2.5s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=4, weights=uniform;; score=0.781 total time= 2.5s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=4, weights=uniform;; score=0.764 total time= 2.5s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=4, weights=distance;; score=0.886 total time= 2.6s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=4, weights=distance;; score=0.819 total time= 2.6s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=4, weights=distance;; score=0.797 total time= 2.5s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=5, weights=uniform;; score=0.848 total time= 2.5s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=5, weights=uniform;; score=0.799 total time= 2.5s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=5, weights=uniform;; score=0.751 total time= 2.5s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=5, weights=distance;; score=0.866 total time= 2.6s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=5, weights=distance;; score=0.813 total time= 2.5s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=5, weights=distance;; score=0.788 total time= 2.5s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=6, weights=uniform;; score=0.832 total time= 2.5s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=6, weights=uniform;; score=0.783 total time= 2.5s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=6, weights=uniform;; score=0.740 total time= 2.4s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=6, weights=distance;; score=0.870 total time= 2.4s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=6, weights=distance;; score=0.823 total time= 2.5s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=6, weights=distance;; score=0.772 total time= 2.4s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=7, weights=uniform;; score=0.838 total time= 2.5s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=7, weights=uniform;; score=0.780 total time= 2.4s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=7, weights=uniform;; score=0.741 total time= 2.5s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=7, weights=distance;; score=0.865 total time= 2.5s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=7, weights=distance;; score=0.789 total time= 2.5s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=7, weights=distance;; score=0.768 total time= 2.5s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=10, weights=uniform;; score=0.800 total time= 2.5s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=10, weights=uniform;; score=0.743 total time= 2.5s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=10, weights=uniform;; score=0.723 total time= 2.5s

[CV 1/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=10, weights=distance;; score=0.833 total time= 2.5s

[CV 2/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=10, weights=distance;; score=0.789 total time= 2.5s

[CV 3/3] END metric=<function sqeuclidean at 0x0000018E2AEC5240>, n_neighbors=10, weights=distance;; score=0.743 total time= 2.5s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=3, weights=uniform;; score=0.717 total time= 3.3s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=3, weights=uniform;; score=0.694 total time= 3.5s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=3, weights=uniform;; score=0.694 total time= 3.6s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=3, weights=distance;; score=0.747 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=3, weights=distance;; score=0.710 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=3, weights=distance;; score=0.719 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=4, weights=uniform;; score=0.703 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=4, weights=uniform;; score=0.681 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=4, weights=uniform;; score=0.691 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=4, weights=distance;; score=0.769 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=4, weights=distance;; score=0.720 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=4, weights=distance;; score=0.727 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=5, weights=uniform;; score=0.703 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=5, weights=uniform;; score=0.705 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=5, weights=uniform;; score=0.685 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=5, weights=distance;; score=0.743 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=5, weights=distance;; score=0.741 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=5, weights=distance;; score=0.720 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=6, weights=uniform;; score=0.712 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=6, weights=uniform;; score=0.686 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=6, weights=uniform;; score=0.690 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=6, weights=distance;; score=0.760 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=6, weights=distance;; score=0.735 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=6, weights=distance;; score=0.734 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=7, weights=uniform;; score=0.714 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=7, weights=uniform;; score=0.689 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=7, weights=uniform;; score=0.675 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=7, weights=distance;; score=0.736 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=7, weights=distance;; score=0.739 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=7, weights=distance;; score=0.735 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=10, weights=uniform;; score=0.684 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=10, weights=uniform;; score=0.664 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=10, weights=uniform;; score=0.658 total time= 3.1s

[CV 1/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=10, weights=distance;; score=0.746 total time= 3.1s

[CV 2/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=10, weights=distance;; score=0.713 total time= 3.1s

[CV 3/3] END metric=<function chi_square_distance at 0x0000018E30931120>, n_neighbors=10, weights=distance;; score=0.725 total time= 3.1s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=3, weights=uniform;; score=0.854 total time= 3.2s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=3, weights=uniform;; score=0.779 total time= 3.3s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=3, weights=uniform;; score=0.741 total time= 3.3s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=3, weights=distance;; score=0.867 total time= 3.2s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=3, weights=distance;; score=0.794 total time= 3.2s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=3, weights=distance;; score=0.747 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=4, weights=uniform;; score=0.820 total time= 3.3s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=4, weights=uniform;; score=0.768 total time= 3.3s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=4, weights=uniform;; score=0.722 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=4, weights=distance;; score=0.864 total time= 3.3s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=4, weights=distance;; score=0.789 total time= 3.2s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=4, weights=distance;; score=0.732 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=5, weights=uniform;; score=0.840 total time= 3.2s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=5, weights=uniform;; score=0.767 total time= 3.2s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=5, weights=uniform;; score=0.725 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=5, weights=distance;; score=0.850 total time= 3.2s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=5, weights=distance;; score=0.772 total time= 3.2s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=5, weights=distance;; score=0.730 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=6, weights=uniform;; score=0.834 total time= 3.2s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=6, weights=uniform;; score=0.751 total time= 3.2s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=6, weights=uniform;; score=0.706 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=6, weights=distance;; score=0.868 total time= 3.2s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=6, weights=distance;; score=0.783 total time= 3.2s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=6, weights=distance;; score=0.718 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=7, weights=uniform;; score=0.815 total time= 3.2s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=7, weights=uniform;; score=0.756 total time= 3.2s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=7, weights=uniform;; score=0.689 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=7, weights=distance;; score=0.833 total time= 3.3s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=7, weights=distance;; score=0.745 total time= 3.3s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=7, weights=distance;; score=0.706 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=10, weights=uniform;; score=0.777 total time= 3.3s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>, n_neighbors=10, weights=uniform;; score=0.735 total time= 3.2s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>,
n_neighbors=10, weights=uniform;; score=0.685 total time= 3.2s

[CV 1/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>,
n_neighbors=10, weights=distance;; score=0.808 total time= 3.2s

[CV 2/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>,
n_neighbors=10, weights=distance;; score=0.735 total time= 3.2s

[CV 3/3] END metric=<function bhattacharyya_distance at 0x0000018E30930430>,
n_neighbors=10, weights=distance;; score=0.691 total time= 3.2s

[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=3, weights=uniform;; score=0.763 total time= 2.5s

[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=3, weights=uniform;; score=0.716 total time= 2.5s

[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=3, weights=uniform;; score=0.653 total time= 2.5s

[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=3, weights=distance;; score=0.076 total time= 2.5s

[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=3, weights=distance;; score=0.076 total time= 2.5s

[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=3, weights=distance;; score=0.076 total time= 2.5s

[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=4, weights=uniform;; score=0.773 total time= 2.5s

[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=4, weights=uniform;; score=0.707 total time= 2.5s

[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=4, weights=uniform;; score=0.650 total time= 2.5s

[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=4, weights=distance;; score=0.076 total time= 2.5s

[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=4, weights=distance;; score=0.076 total time= 2.5s

[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=4, weights=distance;; score=0.076 total time= 2.4s

[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=5, weights=uniform;; score=0.757 total time= 2.5s

[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=5, weights=uniform;; score=0.695 total time= 2.5s

[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=5, weights=uniform;; score=0.647 total time= 2.5s

[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=5, weights=distance;; score=0.076 total time= 2.5s

[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=5, weights=distance;; score=0.076 total time= 2.5s

[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=5, weights=distance;; score=0.076 total time= 2.5s

[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=6, weights=uniform;; score=0.737 total time= 2.5s

[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=6, weights=uniform;; score=0.680 total time= 2.5s

```

[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=6, weights=uniform;; score=0.615 total time= 2.5s
[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=6, weights=distance;; score=0.076 total time= 2.5s
[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=6, weights=distance;; score=0.076 total time= 2.4s
[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=6, weights=distance;; score=0.076 total time= 2.5s
[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=7, weights=uniform;; score=0.737 total time= 2.5s
[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=7, weights=uniform;; score=0.670 total time= 2.5s
[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=7, weights=uniform;; score=0.605 total time= 2.4s
[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=7, weights=distance;; score=0.076 total time= 2.4s
[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=7, weights=distance;; score=0.076 total time= 2.4s
[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=7, weights=distance;; score=0.076 total time= 2.5s
[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=10, weights=uniform;; score=0.700 total time= 2.5s
[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=10, weights=uniform;; score=0.644 total time= 2.4s
[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=10, weights=uniform;; score=0.589 total time= 2.4s
[CV 1/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=10, weights=distance;; score=0.076 total time= 2.4s
[CV 2/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=10, weights=distance;; score=0.076 total time= 2.4s
[CV 3/3] END metric=<function intersection_distance at 0x0000018E30930550>,
n_neighbors=10, weights=distance;; score=0.076 total time= 2.4s

```

```

GridSearchCV(cv=3, estimator=KNeighborsClassifier(),
             param_grid=[<function cityblock at 0x0000018E2AEC5630>,
                        <function euclidean at 0x0000018E2AEC51B0>,
                        <function cosine at 0x0000018E2AEC5360>,
                        <function sqeuclidean at
0x0000018E2AEC5240>,
                        <function chi_square_distance at
0x0000018E30931120>,
                        <function bhattacharyya_distance at
0x0000018E30930430>,
                        <function intersection_distance at
0x0000018E30930550>],
             '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_}")  
  
print(f"Thuật toán sử dụng: {best_knn.algorithm}")  
  
y_pred_knn = best_knn.predict(test_features)  
  
joblib.dump(best_knn, project_dir + '\\joblib\\best_knn_model.joblib')
```

Best Params: {'metric': <function cityblock at 0x0000018E2AEC5630>, 'n_neighbors': 4, 'weights': 'distance'}

Thuật toán sử dụng: auto

```
['e:\\Documents\\CS231\\project\\Traffic-Sign-Classification-through-  
Images\\joblib\\best_knn_model.joblib']
```

7 Gridsearch SVM

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

```
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=0.542 total time=0.5s

[CV 2/3] END C=0.1, degree=2, gamma=scale, kernel=rbf;, score=0.551 total time=

0.5s
[CV 3/3] END C=0.1, degree=2, gamma=scale, kernel=rbf;; score=0.513 total time=0.5s
[CV 1/3] END C=0.1, degree=2, gamma=scale, kernel=linear;; score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=2, gamma=scale, kernel=linear;; score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=2, gamma=scale, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=2, gamma=scale, kernel=poly;; score=0.716 total time=0.2s
[CV 2/3] END C=0.1, degree=2, gamma=scale, kernel=poly;; score=0.729 total time=0.2s
[CV 3/3] END C=0.1, degree=2, gamma=scale, kernel=poly;; score=0.670 total time=0.2s
[CV 1/3] END C=0.1, degree=2, gamma=scale, kernel=sigmoid;; score=0.491 total time= 0.2s
[CV 2/3] END C=0.1, degree=2, gamma=scale, kernel=sigmoid;; score=0.497 total time= 0.3s
[CV 3/3] END C=0.1, degree=2, gamma=scale, kernel=sigmoid;; score=0.477 total time= 0.2s
[CV 1/3] END C=0.1, degree=2, gamma=auto, kernel=rbf;; score=0.076 total time=0.6s
[CV 2/3] END C=0.1, degree=2, gamma=auto, kernel=rbf;; score=0.076 total time=0.6s
[CV 3/3] END C=0.1, degree=2, gamma=auto, kernel=rbf;; score=0.076 total time=0.6s
[CV 1/3] END C=0.1, degree=2, gamma=auto, kernel=linear;; score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=2, gamma=auto, kernel=linear;; score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=2, gamma=auto, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=2, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.1, degree=2, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.1, degree=2, gamma=auto, kernel=poly;; score=0.076 total time=0.4s
[CV 1/3] END C=0.1, degree=2, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 2/3] END C=0.1, degree=2, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 3/3] END C=0.1, degree=2, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 1/3] END C=0.1, degree=2, gamma=0.1, kernel=rbf;; score=0.390 total time=0.6s
[CV 2/3] END C=0.1, degree=2, gamma=0.1, kernel=rbf;; score=0.427 total time=

0.6s
[CV 3/3] END C=0.1, degree=2, gamma=0.1, kernel=rbf;; score=0.373 total time=0.6s
0.6s
[CV 1/3] END C=0.1, degree=2, gamma=0.1, kernel=linear;; score=0.872 total time=0.1s
[CV 2/3] END C=0.1, degree=2, gamma=0.1, kernel=linear;; score=0.835 total time=0.1s
[CV 3/3] END C=0.1, degree=2, gamma=0.1, kernel=linear;; score=0.793 total time=0.1s
[CV 1/3] END C=0.1, degree=2, gamma=0.1, kernel=poly;; score=0.904 total time=0.1s
[CV 2/3] END C=0.1, degree=2, gamma=0.1, kernel=poly;; score=0.876 total time=0.1s
[CV 3/3] END C=0.1, degree=2, gamma=0.1, kernel=poly;; score=0.823 total time=0.1s
[CV 1/3] END C=0.1, degree=2, gamma=0.1, kernel=sigmoid;; score=0.393 total time= 0.3s
[CV 2/3] END C=0.1, degree=2, gamma=0.1, kernel=sigmoid;; score=0.395 total time= 0.3s
[CV 3/3] END C=0.1, degree=2, gamma=0.1, kernel=sigmoid;; score=0.385 total time= 0.3s
[CV 1/3] END C=0.1, degree=2, gamma=0.01, kernel=rbf;; score=0.506 total time=0.4s
[CV 2/3] END C=0.1, degree=2, gamma=0.01, kernel=rbf;; score=0.508 total time=0.5s
[CV 3/3] END C=0.1, degree=2, gamma=0.01, kernel=rbf;; score=0.480 total time=0.4s
[CV 1/3] END C=0.1, degree=2, gamma=0.01, kernel=linear;; score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=2, gamma=0.01, kernel=linear;; score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=2, gamma=0.01, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=2, gamma=0.01, kernel=poly;; score=0.430 total time=0.3s
[CV 2/3] END C=0.1, degree=2, gamma=0.01, kernel=poly;; score=0.459 total time=0.3s
[CV 3/3] END C=0.1, degree=2, gamma=0.01, kernel=poly;; score=0.403 total time=0.3s
[CV 1/3] END C=0.1, degree=2, gamma=0.01, kernel=sigmoid;; score=0.447 total time= 0.2s
[CV 2/3] END C=0.1, degree=2, gamma=0.01, kernel=sigmoid;; score=0.484 total time= 0.3s
[CV 3/3] END C=0.1, degree=2, gamma=0.01, kernel=sigmoid;; score=0.420 total time= 0.3s
[CV 1/3] END C=0.1, degree=2, gamma=0.001, kernel=rbf;; score=0.076 total time=0.6s
[CV 2/3] END C=0.1, degree=2, gamma=0.001, kernel=rbf;; score=0.076 total time=

0.6s
[CV 3/3] END C=0.1, degree=2, gamma=0.001, kernel=rbf;;, score=0.125 total time=0.6s
[CV 1/3] END C=0.1, degree=2, gamma=0.001, kernel=linear;;, score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=2, gamma=0.001, kernel=linear;;, score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=2, gamma=0.001, kernel=linear;;, score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=2, gamma=0.001, kernel=poly;;, score=0.076 total time=0.4s
[CV 2/3] END C=0.1, degree=2, gamma=0.001, kernel=poly;;, score=0.076 total time=0.3s
[CV 3/3] END C=0.1, degree=2, gamma=0.001, kernel=poly;;, score=0.076 total time=0.3s
[CV 1/3] END C=0.1, degree=2, gamma=0.001, kernel=sigmoid;;, score=0.076 total time= 0.3s
[CV 2/3] END C=0.1, degree=2, gamma=0.001, kernel=sigmoid;;, score=0.076 total time= 0.3s
[CV 3/3] END C=0.1, degree=2, gamma=0.001, kernel=sigmoid;;, score=0.076 total time= 0.3s
[CV 1/3] END C=0.1, degree=3, gamma=scale, kernel=rbf;;, score=0.542 total time=0.4s
[CV 2/3] END C=0.1, degree=3, gamma=scale, kernel=rbf;;, score=0.551 total time=0.4s
[CV 3/3] END C=0.1, degree=3, gamma=scale, kernel=rbf;;, score=0.513 total time=0.4s
[CV 1/3] END C=0.1, degree=3, gamma=scale, kernel=linear;;, score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=3, gamma=scale, kernel=linear;;, score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=3, gamma=scale, kernel=linear;;, score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=3, gamma=scale, kernel=poly;;, score=0.807 total time=0.2s
[CV 2/3] END C=0.1, degree=3, gamma=scale, kernel=poly;;, score=0.772 total time=0.2s
[CV 3/3] END C=0.1, degree=3, gamma=scale, kernel=poly;;, score=0.730 total time=0.2s
[CV 1/3] END C=0.1, degree=3, gamma=scale, kernel=sigmoid;;, score=0.491 total time= 0.2s
[CV 2/3] END C=0.1, degree=3, gamma=scale, kernel=sigmoid;;, score=0.497 total time= 0.3s
[CV 3/3] END C=0.1, degree=3, gamma=scale, kernel=sigmoid;;, score=0.477 total time= 0.2s
[CV 1/3] END C=0.1, degree=3, gamma=auto, kernel=rbf;;, score=0.076 total time=0.6s
[CV 2/3] END C=0.1, degree=3, gamma=auto, kernel=rbf;;, score=0.076 total time=

0.6s
[CV 3/3] END C=0.1, degree=3, gamma=auto, kernel=rbf;; score=0.076 total time=0.6s
[CV 1/3] END C=0.1, degree=3, gamma=auto, kernel=linear;; score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=3, gamma=auto, kernel=linear;; score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=3, gamma=auto, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=3, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.1, degree=3, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.1, degree=3, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.1, degree=3, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 2/3] END C=0.1, degree=3, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 3/3] END C=0.1, degree=3, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 1/3] END C=0.1, degree=3, gamma=0.1, kernel=rbf;; score=0.390 total time=0.6s
[CV 2/3] END C=0.1, degree=3, gamma=0.1, kernel=rbf;; score=0.427 total time=0.6s
[CV 3/3] END C=0.1, degree=3, gamma=0.1, kernel=rbf;; score=0.373 total time=0.6s
[CV 1/3] END C=0.1, degree=3, gamma=0.1, kernel=linear;; score=0.872 total time=0.1s
[CV 2/3] END C=0.1, degree=3, gamma=0.1, kernel=linear;; score=0.835 total time=0.1s
[CV 3/3] END C=0.1, degree=3, gamma=0.1, kernel=linear;; score=0.793 total time=0.1s
[CV 1/3] END C=0.1, degree=3, gamma=0.1, kernel=poly;; score=0.913 total time=0.2s
[CV 2/3] END C=0.1, degree=3, gamma=0.1, kernel=poly;; score=0.873 total time=0.2s
[CV 3/3] END C=0.1, degree=3, gamma=0.1, kernel=poly;; score=0.836 total time=0.2s
[CV 1/3] END C=0.1, degree=3, gamma=0.1, kernel=sigmoid;; score=0.393 total time= 0.3s
[CV 2/3] END C=0.1, degree=3, gamma=0.1, kernel=sigmoid;; score=0.395 total time= 0.3s
[CV 3/3] END C=0.1, degree=3, gamma=0.1, kernel=sigmoid;; score=0.385 total time= 0.3s
[CV 1/3] END C=0.1, degree=3, gamma=0.01, kernel=rbf;; score=0.506 total time=0.4s
[CV 2/3] END C=0.1, degree=3, gamma=0.01, kernel=rbf;; score=0.508 total time=

0.5s
[CV 3/3] END C=0.1, degree=3, gamma=0.01, kernel=rbf;; score=0.480 total time=0.5s
[CV 1/3] END C=0.1, degree=3, gamma=0.01, kernel=linear;; score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=3, gamma=0.01, kernel=linear;; score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=3, gamma=0.01, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=3, gamma=0.01, kernel=poly;; score=0.076 total time=0.4s
[CV 2/3] END C=0.1, degree=3, gamma=0.01, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.1, degree=3, gamma=0.01, kernel=poly;; score=0.145 total time=0.3s
[CV 1/3] END C=0.1, degree=3, gamma=0.01, kernel=sigmoid;; score=0.447 total time= 0.2s
[CV 2/3] END C=0.1, degree=3, gamma=0.01, kernel=sigmoid;; score=0.484 total time= 0.3s
[CV 3/3] END C=0.1, degree=3, gamma=0.01, kernel=sigmoid;; score=0.420 total time= 0.2s
[CV 1/3] END C=0.1, degree=3, gamma=0.001, kernel=rbf;; score=0.076 total time=0.6s
[CV 2/3] END C=0.1, degree=3, gamma=0.001, kernel=rbf;; score=0.076 total time=0.6s
[CV 3/3] END C=0.1, degree=3, gamma=0.001, kernel=rbf;; score=0.125 total time=0.6s
[CV 1/3] END C=0.1, degree=3, gamma=0.001, kernel=linear;; score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=3, gamma=0.001, kernel=linear;; score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=3, gamma=0.001, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=3, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.1, degree=3, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.1, degree=3, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.1, degree=3, gamma=0.001, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 2/3] END C=0.1, degree=3, gamma=0.001, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 3/3] END C=0.1, degree=3, gamma=0.001, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 1/3] END C=0.1, degree=4, gamma=scale, kernel=rbf;; score=0.542 total time=0.4s
[CV 2/3] END C=0.1, degree=4, gamma=scale, kernel=rbf;; score=0.551 total time=

0.4s
[CV 3/3] END C=0.1, degree=4, gamma=scale, kernel=rbf;;, score=0.513 total time=0.5s
[CV 1/3] END C=0.1, degree=4, gamma=scale, kernel=linear;;, score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=4, gamma=scale, kernel=linear;;, score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=4, gamma=scale, kernel=linear;;, score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=4, gamma=scale, kernel=poly;;, score=0.862 total time=0.2s
[CV 2/3] END C=0.1, degree=4, gamma=scale, kernel=poly;;, score=0.834 total time=0.2s
[CV 3/3] END C=0.1, degree=4, gamma=scale, kernel=poly;;, score=0.766 total time=0.2s
[CV 1/3] END C=0.1, degree=4, gamma=scale, kernel=sigmoid;;, score=0.491 total time= 0.2s
[CV 2/3] END C=0.1, degree=4, gamma=scale, kernel=sigmoid;;, score=0.497 total time= 0.2s
[CV 3/3] END C=0.1, degree=4, gamma=scale, kernel=sigmoid;;, score=0.477 total time= 0.2s
[CV 1/3] END C=0.1, degree=4, gamma=auto, kernel=rbf;;, score=0.076 total time=0.6s
[CV 2/3] END C=0.1, degree=4, gamma=auto, kernel=rbf;;, score=0.076 total time=0.6s
[CV 3/3] END C=0.1, degree=4, gamma=auto, kernel=rbf;;, score=0.076 total time=0.6s
[CV 1/3] END C=0.1, degree=4, gamma=auto, kernel=linear;;, score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=4, gamma=auto, kernel=linear;;, score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=4, gamma=auto, kernel=linear;;, score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=4, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 2/3] END C=0.1, degree=4, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 3/3] END C=0.1, degree=4, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 1/3] END C=0.1, degree=4, gamma=auto, kernel=sigmoid;;, score=0.076 total time= 0.3s
[CV 2/3] END C=0.1, degree=4, gamma=auto, kernel=sigmoid;;, score=0.076 total time= 0.3s
[CV 3/3] END C=0.1, degree=4, gamma=auto, kernel=sigmoid;;, score=0.076 total time= 0.3s
[CV 1/3] END C=0.1, degree=4, gamma=0.1, kernel=rbf;;, score=0.390 total time=0.6s
[CV 2/3] END C=0.1, degree=4, gamma=0.1, kernel=rbf;;, score=0.427 total time=

0.6s
[CV 3/3] END C=0.1, degree=4, gamma=0.1, kernel=rbf;; score=0.373 total time=0.6s
0.6s
[CV 1/3] END C=0.1, degree=4, gamma=0.1, kernel=linear;; score=0.872 total time=0.1s
[CV 2/3] END C=0.1, degree=4, gamma=0.1, kernel=linear;; score=0.835 total time=0.1s
[CV 3/3] END C=0.1, degree=4, gamma=0.1, kernel=linear;; score=0.793 total time=0.1s
[CV 1/3] END C=0.1, degree=4, gamma=0.1, kernel=poly;; score=0.906 total time=0.2s
[CV 2/3] END C=0.1, degree=4, gamma=0.1, kernel=poly;; score=0.870 total time=0.2s
[CV 3/3] END C=0.1, degree=4, gamma=0.1, kernel=poly;; score=0.850 total time=0.2s
[CV 1/3] END C=0.1, degree=4, gamma=0.1, kernel=sigmoid;; score=0.393 total time= 0.4s
[CV 2/3] END C=0.1, degree=4, gamma=0.1, kernel=sigmoid;; score=0.395 total time= 0.4s
[CV 3/3] END C=0.1, degree=4, gamma=0.1, kernel=sigmoid;; score=0.385 total time= 0.3s
[CV 1/3] END C=0.1, degree=4, gamma=0.01, kernel=rbf;; score=0.506 total time=0.5s
[CV 2/3] END C=0.1, degree=4, gamma=0.01, kernel=rbf;; score=0.508 total time=0.5s
[CV 3/3] END C=0.1, degree=4, gamma=0.01, kernel=rbf;; score=0.480 total time=0.4s
[CV 1/3] END C=0.1, degree=4, gamma=0.01, kernel=linear;; score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=4, gamma=0.01, kernel=linear;; score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=4, gamma=0.01, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=4, gamma=0.01, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.1, degree=4, gamma=0.01, kernel=poly;; score=0.076 total time=0.4s
[CV 3/3] END C=0.1, degree=4, gamma=0.01, kernel=poly;; score=0.076 total time=0.4s
[CV 1/3] END C=0.1, degree=4, gamma=0.01, kernel=sigmoid;; score=0.447 total time= 0.3s
[CV 2/3] END C=0.1, degree=4, gamma=0.01, kernel=sigmoid;; score=0.484 total time= 0.3s
[CV 3/3] END C=0.1, degree=4, gamma=0.01, kernel=sigmoid;; score=0.420 total time= 0.3s
[CV 1/3] END C=0.1, degree=4, gamma=0.001, kernel=rbf;; score=0.076 total time=0.6s
[CV 2/3] END C=0.1, degree=4, gamma=0.001, kernel=rbf;; score=0.076 total time=

0.6s
[CV 3/3] END C=0.1, degree=4, gamma=0.001, kernel=rbf;;, score=0.125 total time=0.6s
[CV 1/3] END C=0.1, degree=4, gamma=0.001, kernel=linear;;, score=0.872 total time= 0.1s
[CV 2/3] END C=0.1, degree=4, gamma=0.001, kernel=linear;;, score=0.835 total time= 0.1s
[CV 3/3] END C=0.1, degree=4, gamma=0.001, kernel=linear;;, score=0.793 total time= 0.1s
[CV 1/3] END C=0.1, degree=4, gamma=0.001, kernel=poly;;, score=0.076 total time=0.4s
[CV 2/3] END C=0.1, degree=4, gamma=0.001, kernel=poly;;, score=0.076 total time=0.4s
[CV 3/3] END C=0.1, degree=4, gamma=0.001, kernel=poly;;, score=0.076 total time=0.4s
[CV 1/3] END C=0.1, degree=4, gamma=0.001, kernel=sigmoid;;, score=0.076 total time= 0.4s
[CV 2/3] END C=0.1, degree=4, gamma=0.001, kernel=sigmoid;;, score=0.076 total time= 0.4s
[CV 3/3] END C=0.1, degree=4, gamma=0.001, kernel=sigmoid;;, score=0.076 total time= 0.4s
[CV 1/3] END C=0.2, degree=2, gamma=scale, kernel=rbf;;, score=0.613 total time=0.4s
[CV 2/3] END C=0.2, degree=2, gamma=scale, kernel=rbf;;, score=0.612 total time=0.4s
[CV 3/3] END C=0.2, degree=2, gamma=scale, kernel=rbf;;, score=0.614 total time=0.5s
[CV 1/3] END C=0.2, degree=2, gamma=scale, kernel=linear;;, score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=2, gamma=scale, kernel=linear;;, score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=2, gamma=scale, kernel=linear;;, score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=2, gamma=scale, kernel=poly;;, score=0.820 total time=0.1s
[CV 2/3] END C=0.2, degree=2, gamma=scale, kernel=poly;;, score=0.790 total time=0.2s
[CV 3/3] END C=0.2, degree=2, gamma=scale, kernel=poly;;, score=0.744 total time=0.2s
[CV 1/3] END C=0.2, degree=2, gamma=scale, kernel=sigmoid;;, score=0.532 total time= 0.2s
[CV 2/3] END C=0.2, degree=2, gamma=scale, kernel=sigmoid;;, score=0.544 total time= 0.2s
[CV 3/3] END C=0.2, degree=2, gamma=scale, kernel=sigmoid;;, score=0.525 total time= 0.2s
[CV 1/3] END C=0.2, degree=2, gamma=auto, kernel=rbf;;, score=0.219 total time=0.6s
[CV 2/3] END C=0.2, degree=2, gamma=auto, kernel=rbf;;, score=0.128 total time=

0.6s
[CV 3/3] END C=0.2, degree=2, gamma=auto, kernel=rbf;; score=0.192 total time=0.6s
[CV 1/3] END C=0.2, degree=2, gamma=auto, kernel=linear;; score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=2, gamma=auto, kernel=linear;; score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=2, gamma=auto, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=2, gamma=auto, kernel=poly;; score=0.076 total time=0.4s
[CV 2/3] END C=0.2, degree=2, gamma=auto, kernel=poly;; score=0.076 total time=0.4s
[CV 3/3] END C=0.2, degree=2, gamma=auto, kernel=poly;; score=0.076 total time=0.4s
[CV 1/3] END C=0.2, degree=2, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.4s
[CV 2/3] END C=0.2, degree=2, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.4s
[CV 3/3] END C=0.2, degree=2, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.4s
[CV 1/3] END C=0.2, degree=2, gamma=0.1, kernel=rbf;; score=0.408 total time=0.6s
[CV 2/3] END C=0.2, degree=2, gamma=0.1, kernel=rbf;; score=0.433 total time=0.6s
[CV 3/3] END C=0.2, degree=2, gamma=0.1, kernel=rbf;; score=0.383 total time=0.5s
[CV 1/3] END C=0.2, degree=2, gamma=0.1, kernel=linear;; score=0.857 total time=0.1s
[CV 2/3] END C=0.2, degree=2, gamma=0.1, kernel=linear;; score=0.838 total time=0.1s
[CV 3/3] END C=0.2, degree=2, gamma=0.1, kernel=linear;; score=0.793 total time=0.1s
[CV 1/3] END C=0.2, degree=2, gamma=0.1, kernel=poly;; score=0.904 total time=0.1s
[CV 2/3] END C=0.2, degree=2, gamma=0.1, kernel=poly;; score=0.872 total time=0.1s
[CV 3/3] END C=0.2, degree=2, gamma=0.1, kernel=poly;; score=0.821 total time=0.1s
[CV 1/3] END C=0.2, degree=2, gamma=0.1, kernel=sigmoid;; score=0.411 total time= 0.3s
[CV 2/3] END C=0.2, degree=2, gamma=0.1, kernel=sigmoid;; score=0.445 total time= 0.3s
[CV 3/3] END C=0.2, degree=2, gamma=0.1, kernel=sigmoid;; score=0.433 total time= 0.3s
[CV 1/3] END C=0.2, degree=2, gamma=0.01, kernel=rbf;; score=0.563 total time=0.4s
[CV 2/3] END C=0.2, degree=2, gamma=0.01, kernel=rbf;; score=0.553 total time=

0.4s
[CV 3/3] END C=0.2, degree=2, gamma=0.01, kernel=rbf;; score=0.542 total time=0.4s
[CV 1/3] END C=0.2, degree=2, gamma=0.01, kernel=linear;; score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=2, gamma=0.01, kernel=linear;; score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=2, gamma=0.01, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=2, gamma=0.01, kernel=poly;; score=0.458 total time=0.3s
[CV 2/3] END C=0.2, degree=2, gamma=0.01, kernel=poly;; score=0.496 total time=0.3s
[CV 3/3] END C=0.2, degree=2, gamma=0.01, kernel=poly;; score=0.460 total time=0.2s
[CV 1/3] END C=0.2, degree=2, gamma=0.01, kernel=sigmoid;; score=0.520 total time= 0.2s
[CV 2/3] END C=0.2, degree=2, gamma=0.01, kernel=sigmoid;; score=0.520 total time= 0.2s
[CV 3/3] END C=0.2, degree=2, gamma=0.01, kernel=sigmoid;; score=0.503 total time= 0.2s
[CV 1/3] END C=0.2, degree=2, gamma=0.001, kernel=rbf;; score=0.429 total time=0.5s
[CV 2/3] END C=0.2, degree=2, gamma=0.001, kernel=rbf;; score=0.445 total time=0.6s
[CV 3/3] END C=0.2, degree=2, gamma=0.001, kernel=rbf;; score=0.417 total time=0.6s
[CV 1/3] END C=0.2, degree=2, gamma=0.001, kernel=linear;; score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=2, gamma=0.001, kernel=linear;; score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=2, gamma=0.001, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=2, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.2, degree=2, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.2, degree=2, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.2, degree=2, gamma=0.001, kernel=sigmoid;; score=0.142 total time= 0.4s
[CV 2/3] END C=0.2, degree=2, gamma=0.001, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 3/3] END C=0.2, degree=2, gamma=0.001, kernel=sigmoid;; score=0.183 total time= 0.3s
[CV 1/3] END C=0.2, degree=3, gamma=scale, kernel=rbf;; score=0.613 total time=0.4s
[CV 2/3] END C=0.2, degree=3, gamma=scale, kernel=rbf;; score=0.612 total time=

0.4s
[CV 3/3] END C=0.2, degree=3, gamma=scale, kernel=rbf;; score=0.614 total time=0.4s
[CV 1/3] END C=0.2, degree=3, gamma=scale, kernel=linear;; score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=3, gamma=scale, kernel=linear;; score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=3, gamma=scale, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=3, gamma=scale, kernel=poly;; score=0.887 total time=0.2s
[CV 2/3] END C=0.2, degree=3, gamma=scale, kernel=poly;; score=0.854 total time=0.2s
[CV 3/3] END C=0.2, degree=3, gamma=scale, kernel=poly;; score=0.801 total time=0.2s
[CV 1/3] END C=0.2, degree=3, gamma=scale, kernel=sigmoid;; score=0.532 total time= 0.2s
[CV 2/3] END C=0.2, degree=3, gamma=scale, kernel=sigmoid;; score=0.544 total time= 0.2s
[CV 3/3] END C=0.2, degree=3, gamma=scale, kernel=sigmoid;; score=0.525 total time= 0.2s
[CV 1/3] END C=0.2, degree=3, gamma=auto, kernel=rbf;; score=0.219 total time=0.6s
[CV 2/3] END C=0.2, degree=3, gamma=auto, kernel=rbf;; score=0.128 total time=0.6s
[CV 3/3] END C=0.2, degree=3, gamma=auto, kernel=rbf;; score=0.192 total time=0.6s
[CV 1/3] END C=0.2, degree=3, gamma=auto, kernel=linear;; score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=3, gamma=auto, kernel=linear;; score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=3, gamma=auto, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=3, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.2, degree=3, gamma=auto, kernel=poly;; score=0.076 total time=0.4s
[CV 3/3] END C=0.2, degree=3, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.2, degree=3, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 2/3] END C=0.2, degree=3, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 3/3] END C=0.2, degree=3, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 1/3] END C=0.2, degree=3, gamma=0.1, kernel=rbf;; score=0.408 total time=0.5s
[CV 2/3] END C=0.2, degree=3, gamma=0.1, kernel=rbf;; score=0.433 total time=

0.5s
[CV 3/3] END C=0.2, degree=3, gamma=0.1, kernel=rbf;; score=0.383 total time=0.5s
[CV 1/3] END C=0.2, degree=3, gamma=0.1, kernel=linear;; score=0.857 total time=0.1s
[CV 2/3] END C=0.2, degree=3, gamma=0.1, kernel=linear;; score=0.838 total time=0.1s
[CV 3/3] END C=0.2, degree=3, gamma=0.1, kernel=linear;; score=0.793 total time=0.1s
[CV 1/3] END C=0.2, degree=3, gamma=0.1, kernel=poly;; score=0.913 total time=0.2s
[CV 2/3] END C=0.2, degree=3, gamma=0.1, kernel=poly;; score=0.873 total time=0.2s
[CV 3/3] END C=0.2, degree=3, gamma=0.1, kernel=poly;; score=0.836 total time=0.2s
[CV 1/3] END C=0.2, degree=3, gamma=0.1, kernel=sigmoid;; score=0.411 total time= 0.3s
[CV 2/3] END C=0.2, degree=3, gamma=0.1, kernel=sigmoid;; score=0.445 total time= 0.3s
[CV 3/3] END C=0.2, degree=3, gamma=0.1, kernel=sigmoid;; score=0.433 total time= 0.3s
[CV 1/3] END C=0.2, degree=3, gamma=0.01, kernel=rbf;; score=0.563 total time=0.4s
[CV 2/3] END C=0.2, degree=3, gamma=0.01, kernel=rbf;; score=0.553 total time=0.4s
[CV 3/3] END C=0.2, degree=3, gamma=0.01, kernel=rbf;; score=0.542 total time=0.4s
[CV 1/3] END C=0.2, degree=3, gamma=0.01, kernel=linear;; score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=3, gamma=0.01, kernel=linear;; score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=3, gamma=0.01, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=3, gamma=0.01, kernel=poly;; score=0.417 total time=0.3s
[CV 2/3] END C=0.2, degree=3, gamma=0.01, kernel=poly;; score=0.440 total time=0.3s
[CV 3/3] END C=0.2, degree=3, gamma=0.01, kernel=poly;; score=0.391 total time=0.3s
[CV 1/3] END C=0.2, degree=3, gamma=0.01, kernel=sigmoid;; score=0.520 total time= 0.2s
[CV 2/3] END C=0.2, degree=3, gamma=0.01, kernel=sigmoid;; score=0.520 total time= 0.2s
[CV 3/3] END C=0.2, degree=3, gamma=0.01, kernel=sigmoid;; score=0.503 total time= 0.2s
[CV 1/3] END C=0.2, degree=3, gamma=0.001, kernel=rbf;; score=0.429 total time=0.5s
[CV 2/3] END C=0.2, degree=3, gamma=0.001, kernel=rbf;; score=0.445 total time=

0.6s
[CV 3/3] END C=0.2, degree=3, gamma=0.001, kernel=rbf;;, score=0.417 total time=0.6s
[CV 1/3] END C=0.2, degree=3, gamma=0.001, kernel=linear;;, score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=3, gamma=0.001, kernel=linear;;, score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=3, gamma=0.001, kernel=linear;;, score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=3, gamma=0.001, kernel=poly;;, score=0.076 total time=0.3s
[CV 2/3] END C=0.2, degree=3, gamma=0.001, kernel=poly;;, score=0.076 total time=0.3s
[CV 3/3] END C=0.2, degree=3, gamma=0.001, kernel=poly;;, score=0.076 total time=0.3s
[CV 1/3] END C=0.2, degree=3, gamma=0.001, kernel=sigmoid;;, score=0.142 total time= 0.3s
[CV 2/3] END C=0.2, degree=3, gamma=0.001, kernel=sigmoid;;, score=0.076 total time= 0.3s
[CV 3/3] END C=0.2, degree=3, gamma=0.001, kernel=sigmoid;;, score=0.183 total time= 0.4s
[CV 1/3] END C=0.2, degree=4, gamma=scale, kernel=rbf;;, score=0.613 total time=0.4s
[CV 2/3] END C=0.2, degree=4, gamma=scale, kernel=rbf;;, score=0.612 total time=0.4s
[CV 3/3] END C=0.2, degree=4, gamma=scale, kernel=rbf;;, score=0.614 total time=0.4s
[CV 1/3] END C=0.2, degree=4, gamma=scale, kernel=linear;;, score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=4, gamma=scale, kernel=linear;;, score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=4, gamma=scale, kernel=linear;;, score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=4, gamma=scale, kernel=poly;;, score=0.902 total time=0.2s
[CV 2/3] END C=0.2, degree=4, gamma=scale, kernel=poly;;, score=0.869 total time=0.2s
[CV 3/3] END C=0.2, degree=4, gamma=scale, kernel=poly;;, score=0.823 total time=0.2s
[CV 1/3] END C=0.2, degree=4, gamma=scale, kernel=sigmoid;;, score=0.532 total time= 0.2s
[CV 2/3] END C=0.2, degree=4, gamma=scale, kernel=sigmoid;;, score=0.544 total time= 0.2s
[CV 3/3] END C=0.2, degree=4, gamma=scale, kernel=sigmoid;;, score=0.525 total time= 0.2s
[CV 1/3] END C=0.2, degree=4, gamma=auto, kernel=rbf;;, score=0.219 total time=0.6s
[CV 2/3] END C=0.2, degree=4, gamma=auto, kernel=rbf;;, score=0.128 total time=

0.6s
[CV 3/3] END C=0.2, degree=4, gamma=auto, kernel=rbf;; score=0.192 total time=0.6s
[CV 1/3] END C=0.2, degree=4, gamma=auto, kernel=linear;; score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=4, gamma=auto, kernel=linear;; score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=4, gamma=auto, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=4, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.2, degree=4, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.2, degree=4, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.2, degree=4, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 2/3] END C=0.2, degree=4, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 3/3] END C=0.2, degree=4, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 1/3] END C=0.2, degree=4, gamma=0.1, kernel=rbf;; score=0.408 total time=0.5s
[CV 2/3] END C=0.2, degree=4, gamma=0.1, kernel=rbf;; score=0.433 total time=0.5s
[CV 3/3] END C=0.2, degree=4, gamma=0.1, kernel=rbf;; score=0.383 total time=0.5s
[CV 1/3] END C=0.2, degree=4, gamma=0.1, kernel=linear;; score=0.857 total time=0.1s
[CV 2/3] END C=0.2, degree=4, gamma=0.1, kernel=linear;; score=0.838 total time=0.1s
[CV 3/3] END C=0.2, degree=4, gamma=0.1, kernel=linear;; score=0.793 total time=0.1s
[CV 1/3] END C=0.2, degree=4, gamma=0.1, kernel=poly;; score=0.906 total time=0.2s
[CV 2/3] END C=0.2, degree=4, gamma=0.1, kernel=poly;; score=0.870 total time=0.2s
[CV 3/3] END C=0.2, degree=4, gamma=0.1, kernel=poly;; score=0.850 total time=0.2s
[CV 1/3] END C=0.2, degree=4, gamma=0.1, kernel=sigmoid;; score=0.411 total time= 0.3s
[CV 2/3] END C=0.2, degree=4, gamma=0.1, kernel=sigmoid;; score=0.445 total time= 0.3s
[CV 3/3] END C=0.2, degree=4, gamma=0.1, kernel=sigmoid;; score=0.433 total time= 0.3s
[CV 1/3] END C=0.2, degree=4, gamma=0.01, kernel=rbf;; score=0.563 total time=0.4s
[CV 2/3] END C=0.2, degree=4, gamma=0.01, kernel=rbf;; score=0.553 total time=

0.4s
[CV 3/3] END C=0.2, degree=4, gamma=0.01, kernel=rbf;; score=0.542 total time=0.4s
[CV 1/3] END C=0.2, degree=4, gamma=0.01, kernel=linear;; score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=4, gamma=0.01, kernel=linear;; score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=4, gamma=0.01, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=4, gamma=0.01, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.2, degree=4, gamma=0.01, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.2, degree=4, gamma=0.01, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.2, degree=4, gamma=0.01, kernel=sigmoid;; score=0.520 total time= 0.2s
[CV 2/3] END C=0.2, degree=4, gamma=0.01, kernel=sigmoid;; score=0.520 total time= 0.2s
[CV 3/3] END C=0.2, degree=4, gamma=0.01, kernel=sigmoid;; score=0.503 total time= 0.2s
[CV 1/3] END C=0.2, degree=4, gamma=0.001, kernel=rbf;; score=0.429 total time=0.6s
[CV 2/3] END C=0.2, degree=4, gamma=0.001, kernel=rbf;; score=0.445 total time=0.6s
[CV 3/3] END C=0.2, degree=4, gamma=0.001, kernel=rbf;; score=0.417 total time=0.6s
[CV 1/3] END C=0.2, degree=4, gamma=0.001, kernel=linear;; score=0.857 total time= 0.1s
[CV 2/3] END C=0.2, degree=4, gamma=0.001, kernel=linear;; score=0.838 total time= 0.1s
[CV 3/3] END C=0.2, degree=4, gamma=0.001, kernel=linear;; score=0.793 total time= 0.1s
[CV 1/3] END C=0.2, degree=4, gamma=0.001, kernel=poly;; score=0.076 total time=0.4s
[CV 2/3] END C=0.2, degree=4, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.2, degree=4, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.2, degree=4, gamma=0.001, kernel=sigmoid;; score=0.142 total time= 0.4s
[CV 2/3] END C=0.2, degree=4, gamma=0.001, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 3/3] END C=0.2, degree=4, gamma=0.001, kernel=sigmoid;; score=0.183 total time= 0.4s
[CV 1/3] END C=0.3, degree=2, gamma=scale, kernel=rbf;; score=0.720 total time=0.4s
[CV 2/3] END C=0.3, degree=2, gamma=scale, kernel=rbf;; score=0.743 total time=

0.4s
[CV 3/3] END C=0.3, degree=2, gamma=scale, kernel=rbf;;, score=0.678 total time=0.4s
[CV 1/3] END C=0.3, degree=2, gamma=scale, kernel=linear;;, score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=2, gamma=scale, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=2, gamma=scale, kernel=linear;;, score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=2, gamma=scale, kernel=poly;;, score=0.872 total time=0.1s
[CV 2/3] END C=0.3, degree=2, gamma=scale, kernel=poly;;, score=0.835 total time=0.1s
[CV 3/3] END C=0.3, degree=2, gamma=scale, kernel=poly;;, score=0.781 total time=0.1s
[CV 1/3] END C=0.3, degree=2, gamma=scale, kernel=sigmoid;;, score=0.568 total time= 0.2s
[CV 2/3] END C=0.3, degree=2, gamma=scale, kernel=sigmoid;;, score=0.614 total time= 0.2s
[CV 3/3] END C=0.3, degree=2, gamma=scale, kernel=sigmoid;;, score=0.590 total time= 0.2s
[CV 1/3] END C=0.3, degree=2, gamma=auto, kernel=rbf;;, score=0.401 total time=0.6s
[CV 2/3] END C=0.3, degree=2, gamma=auto, kernel=rbf;;, score=0.412 total time=0.6s
[CV 3/3] END C=0.3, degree=2, gamma=auto, kernel=rbf;;, score=0.380 total time=0.6s
[CV 1/3] END C=0.3, degree=2, gamma=auto, kernel=linear;;, score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=2, gamma=auto, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=2, gamma=auto, kernel=linear;;, score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=2, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 2/3] END C=0.3, degree=2, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 3/3] END C=0.3, degree=2, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 1/3] END C=0.3, degree=2, gamma=auto, kernel=sigmoid;;, score=0.076 total time= 0.4s
[CV 2/3] END C=0.3, degree=2, gamma=auto, kernel=sigmoid;;, score=0.076 total time= 0.4s
[CV 3/3] END C=0.3, degree=2, gamma=auto, kernel=sigmoid;;, score=0.076 total time= 0.3s
[CV 1/3] END C=0.3, degree=2, gamma=0.1, kernel=rbf;;, score=0.451 total time=0.5s
[CV 2/3] END C=0.3, degree=2, gamma=0.1, kernel=rbf;;, score=0.493 total time=

0.5s
[CV 3/3] END C=0.3, degree=2, gamma=0.1, kernel=rbf;; score=0.425 total time=0.5s
[CV 1/3] END C=0.3, degree=2, gamma=0.1, kernel=linear;; score=0.848 total time=0.1s
[CV 2/3] END C=0.3, degree=2, gamma=0.1, kernel=linear;; score=0.833 total time=0.1s
[CV 3/3] END C=0.3, degree=2, gamma=0.1, kernel=linear;; score=0.798 total time=0.1s
[CV 1/3] END C=0.3, degree=2, gamma=0.1, kernel=poly;; score=0.900 total time=0.1s
[CV 2/3] END C=0.3, degree=2, gamma=0.1, kernel=poly;; score=0.874 total time=0.1s
[CV 3/3] END C=0.3, degree=2, gamma=0.1, kernel=poly;; score=0.818 total time=0.1s
[CV 1/3] END C=0.3, degree=2, gamma=0.1, kernel=sigmoid;; score=0.411 total time= 0.3s
[CV 2/3] END C=0.3, degree=2, gamma=0.1, kernel=sigmoid;; score=0.448 total time= 0.3s
[CV 3/3] END C=0.3, degree=2, gamma=0.1, kernel=sigmoid;; score=0.450 total time= 0.3s
[CV 1/3] END C=0.3, degree=2, gamma=0.01, kernel=rbf;; score=0.601 total time=0.3s
[CV 2/3] END C=0.3, degree=2, gamma=0.01, kernel=rbf;; score=0.617 total time=0.4s
[CV 3/3] END C=0.3, degree=2, gamma=0.01, kernel=rbf;; score=0.601 total time=0.4s
[CV 1/3] END C=0.3, degree=2, gamma=0.01, kernel=linear;; score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=2, gamma=0.01, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=2, gamma=0.01, kernel=linear;; score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=2, gamma=0.01, kernel=poly;; score=0.534 total time=0.2s
[CV 2/3] END C=0.3, degree=2, gamma=0.01, kernel=poly;; score=0.533 total time=0.2s
[CV 3/3] END C=0.3, degree=2, gamma=0.01, kernel=poly;; score=0.504 total time=0.2s
[CV 1/3] END C=0.3, degree=2, gamma=0.01, kernel=sigmoid;; score=0.547 total time= 0.2s
[CV 2/3] END C=0.3, degree=2, gamma=0.01, kernel=sigmoid;; score=0.542 total time= 0.2s
[CV 3/3] END C=0.3, degree=2, gamma=0.01, kernel=sigmoid;; score=0.528 total time= 0.2s
[CV 1/3] END C=0.3, degree=2, gamma=0.001, kernel=rbf;; score=0.435 total time=0.5s
[CV 2/3] END C=0.3, degree=2, gamma=0.001, kernel=rbf;; score=0.461 total time=

0.5s
[CV 3/3] END C=0.3, degree=2, gamma=0.001, kernel=rbf;;, score=0.416 total time=0.5s
[CV 1/3] END C=0.3, degree=2, gamma=0.001, kernel=linear;;, score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=2, gamma=0.001, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=2, gamma=0.001, kernel=linear;;, score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=2, gamma=0.001, kernel=poly;;, score=0.076 total time=0.4s
[CV 2/3] END C=0.3, degree=2, gamma=0.001, kernel=poly;;, score=0.076 total time=0.3s
[CV 3/3] END C=0.3, degree=2, gamma=0.001, kernel=poly;;, score=0.076 total time=0.3s
[CV 1/3] END C=0.3, degree=2, gamma=0.001, kernel=sigmoid;;, score=0.390 total time= 0.3s
[CV 2/3] END C=0.3, degree=2, gamma=0.001, kernel=sigmoid;;, score=0.402 total time= 0.3s
[CV 3/3] END C=0.3, degree=2, gamma=0.001, kernel=sigmoid;;, score=0.364 total time= 0.4s
[CV 1/3] END C=0.3, degree=3, gamma=scale, kernel=rbf;;, score=0.720 total time=0.4s
[CV 2/3] END C=0.3, degree=3, gamma=scale, kernel=rbf;;, score=0.743 total time=0.4s
[CV 3/3] END C=0.3, degree=3, gamma=scale, kernel=rbf;;, score=0.678 total time=0.4s
[CV 1/3] END C=0.3, degree=3, gamma=scale, kernel=linear;;, score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=3, gamma=scale, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=3, gamma=scale, kernel=linear;;, score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=3, gamma=scale, kernel=poly;;, score=0.906 total time=0.2s
[CV 2/3] END C=0.3, degree=3, gamma=scale, kernel=poly;;, score=0.866 total time=0.2s
[CV 3/3] END C=0.3, degree=3, gamma=scale, kernel=poly;;, score=0.822 total time=0.2s
[CV 1/3] END C=0.3, degree=3, gamma=scale, kernel=sigmoid;;, score=0.568 total time= 0.2s
[CV 2/3] END C=0.3, degree=3, gamma=scale, kernel=sigmoid;;, score=0.614 total time= 0.2s
[CV 3/3] END C=0.3, degree=3, gamma=scale, kernel=sigmoid;;, score=0.590 total time= 0.2s
[CV 1/3] END C=0.3, degree=3, gamma=auto, kernel=rbf;;, score=0.401 total time=0.5s
[CV 2/3] END C=0.3, degree=3, gamma=auto, kernel=rbf;;, score=0.412 total time=

0.6s
[CV 3/3] END C=0.3, degree=3, gamma=auto, kernel=rbf;; score=0.380 total time=0.6s
[CV 1/3] END C=0.3, degree=3, gamma=auto, kernel=linear;; score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=3, gamma=auto, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=3, gamma=auto, kernel=linear;; score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=3, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.3, degree=3, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.3, degree=3, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.3, degree=3, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 2/3] END C=0.3, degree=3, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.3s
[CV 3/3] END C=0.3, degree=3, gamma=auto, kernel=sigmoid;; score=0.076 total time= 0.4s
[CV 1/3] END C=0.3, degree=3, gamma=0.1, kernel=rbf;; score=0.451 total time=0.5s
[CV 2/3] END C=0.3, degree=3, gamma=0.1, kernel=rbf;; score=0.493 total time=0.6s
[CV 3/3] END C=0.3, degree=3, gamma=0.1, kernel=rbf;; score=0.425 total time=0.5s
[CV 1/3] END C=0.3, degree=3, gamma=0.1, kernel=linear;; score=0.848 total time=0.1s
[CV 2/3] END C=0.3, degree=3, gamma=0.1, kernel=linear;; score=0.833 total time=0.1s
[CV 3/3] END C=0.3, degree=3, gamma=0.1, kernel=linear;; score=0.798 total time=0.1s
[CV 1/3] END C=0.3, degree=3, gamma=0.1, kernel=poly;; score=0.913 total time=0.2s
[CV 2/3] END C=0.3, degree=3, gamma=0.1, kernel=poly;; score=0.873 total time=0.2s
[CV 3/3] END C=0.3, degree=3, gamma=0.1, kernel=poly;; score=0.836 total time=0.2s
[CV 1/3] END C=0.3, degree=3, gamma=0.1, kernel=sigmoid;; score=0.411 total time= 0.3s
[CV 2/3] END C=0.3, degree=3, gamma=0.1, kernel=sigmoid;; score=0.448 total time= 0.3s
[CV 3/3] END C=0.3, degree=3, gamma=0.1, kernel=sigmoid;; score=0.450 total time= 0.3s
[CV 1/3] END C=0.3, degree=3, gamma=0.01, kernel=rbf;; score=0.601 total time=0.4s
[CV 2/3] END C=0.3, degree=3, gamma=0.01, kernel=rbf;; score=0.617 total time=

0.4s
[CV 3/3] END C=0.3, degree=3, gamma=0.01, kernel=rbf;; score=0.601 total time=0.4s
[CV 1/3] END C=0.3, degree=3, gamma=0.01, kernel=linear;; score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=3, gamma=0.01, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=3, gamma=0.01, kernel=linear;; score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=3, gamma=0.01, kernel=poly;; score=0.435 total time=0.4s
[CV 2/3] END C=0.3, degree=3, gamma=0.01, kernel=poly;; score=0.465 total time=0.5s
[CV 3/3] END C=0.3, degree=3, gamma=0.01, kernel=poly;; score=0.399 total time=0.3s
[CV 1/3] END C=0.3, degree=3, gamma=0.01, kernel=sigmoid;; score=0.547 total time= 0.3s
[CV 2/3] END C=0.3, degree=3, gamma=0.01, kernel=sigmoid;; score=0.542 total time= 0.2s
[CV 3/3] END C=0.3, degree=3, gamma=0.01, kernel=sigmoid;; score=0.528 total time= 0.2s
[CV 1/3] END C=0.3, degree=3, gamma=0.001, kernel=rbf;; score=0.435 total time=0.6s
[CV 2/3] END C=0.3, degree=3, gamma=0.001, kernel=rbf;; score=0.461 total time=0.5s
[CV 3/3] END C=0.3, degree=3, gamma=0.001, kernel=rbf;; score=0.416 total time=0.5s
[CV 1/3] END C=0.3, degree=3, gamma=0.001, kernel=linear;; score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=3, gamma=0.001, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=3, gamma=0.001, kernel=linear;; score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=3, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.3, degree=3, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.3, degree=3, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.3, degree=3, gamma=0.001, kernel=sigmoid;; score=0.390 total time= 0.3s
[CV 2/3] END C=0.3, degree=3, gamma=0.001, kernel=sigmoid;; score=0.402 total time= 0.4s
[CV 3/3] END C=0.3, degree=3, gamma=0.001, kernel=sigmoid;; score=0.364 total time= 0.3s
[CV 1/3] END C=0.3, degree=4, gamma=scale, kernel=rbf;; score=0.720 total time=0.4s
[CV 2/3] END C=0.3, degree=4, gamma=scale, kernel=rbf;; score=0.743 total time=

0.4s
[CV 3/3] END C=0.3, degree=4, gamma=scale, kernel=rbf;;, score=0.678 total time=0.4s
[CV 1/3] END C=0.3, degree=4, gamma=scale, kernel=linear;;, score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=4, gamma=scale, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=4, gamma=scale, kernel=linear;;, score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=4, gamma=scale, kernel=poly;;, score=0.904 total time=0.2s
[CV 2/3] END C=0.3, degree=4, gamma=scale, kernel=poly;;, score=0.871 total time=0.2s
[CV 3/3] END C=0.3, degree=4, gamma=scale, kernel=poly;;, score=0.834 total time=0.2s
[CV 1/3] END C=0.3, degree=4, gamma=scale, kernel=sigmoid;;, score=0.568 total time= 0.2s
[CV 2/3] END C=0.3, degree=4, gamma=scale, kernel=sigmoid;;, score=0.614 total time= 0.2s
[CV 3/3] END C=0.3, degree=4, gamma=scale, kernel=sigmoid;;, score=0.590 total time= 0.2s
[CV 1/3] END C=0.3, degree=4, gamma=auto, kernel=rbf;;, score=0.401 total time=0.6s
[CV 2/3] END C=0.3, degree=4, gamma=auto, kernel=rbf;;, score=0.412 total time=0.6s
[CV 3/3] END C=0.3, degree=4, gamma=auto, kernel=rbf;;, score=0.380 total time=0.6s
[CV 1/3] END C=0.3, degree=4, gamma=auto, kernel=linear;;, score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=4, gamma=auto, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=4, gamma=auto, kernel=linear;;, score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=4, gamma=auto, kernel=poly;;, score=0.076 total time=0.4s
[CV 2/3] END C=0.3, degree=4, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 3/3] END C=0.3, degree=4, gamma=auto, kernel=poly;;, score=0.076 total time=0.4s
[CV 1/3] END C=0.3, degree=4, gamma=auto, kernel=sigmoid;;, score=0.076 total time= 0.4s
[CV 2/3] END C=0.3, degree=4, gamma=auto, kernel=sigmoid;;, score=0.076 total time= 0.4s
[CV 3/3] END C=0.3, degree=4, gamma=auto, kernel=sigmoid;;, score=0.076 total time= 0.4s
[CV 1/3] END C=0.3, degree=4, gamma=0.1, kernel=rbf;;, score=0.451 total time=0.5s
[CV 2/3] END C=0.3, degree=4, gamma=0.1, kernel=rbf;;, score=0.493 total time=

0.6s
[CV 3/3] END C=0.3, degree=4, gamma=0.1, kernel=rbf;; score=0.425 total time=0.6s
0.6s
[CV 1/3] END C=0.3, degree=4, gamma=0.1, kernel=linear;; score=0.848 total time=0.1s
[CV 2/3] END C=0.3, degree=4, gamma=0.1, kernel=linear;; score=0.833 total time=0.1s
[CV 3/3] END C=0.3, degree=4, gamma=0.1, kernel=linear;; score=0.798 total time=0.1s
[CV 1/3] END C=0.3, degree=4, gamma=0.1, kernel=poly;; score=0.906 total time=0.2s
[CV 2/3] END C=0.3, degree=4, gamma=0.1, kernel=poly;; score=0.870 total time=0.2s
[CV 3/3] END C=0.3, degree=4, gamma=0.1, kernel=poly;; score=0.850 total time=0.2s
[CV 1/3] END C=0.3, degree=4, gamma=0.1, kernel=sigmoid;; score=0.411 total time= 0.3s
[CV 2/3] END C=0.3, degree=4, gamma=0.1, kernel=sigmoid;; score=0.448 total time= 0.3s
[CV 3/3] END C=0.3, degree=4, gamma=0.1, kernel=sigmoid;; score=0.450 total time= 0.3s
[CV 1/3] END C=0.3, degree=4, gamma=0.01, kernel=rbf;; score=0.601 total time=0.4s
[CV 2/3] END C=0.3, degree=4, gamma=0.01, kernel=rbf;; score=0.617 total time=0.4s
[CV 3/3] END C=0.3, degree=4, gamma=0.01, kernel=rbf;; score=0.601 total time=0.4s
[CV 1/3] END C=0.3, degree=4, gamma=0.01, kernel=linear;; score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=4, gamma=0.01, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=4, gamma=0.01, kernel=linear;; score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=4, gamma=0.01, kernel=poly;; score=0.298 total time=0.4s
[CV 2/3] END C=0.3, degree=4, gamma=0.01, kernel=poly;; score=0.109 total time=0.4s
[CV 3/3] END C=0.3, degree=4, gamma=0.01, kernel=poly;; score=0.213 total time=0.3s
[CV 1/3] END C=0.3, degree=4, gamma=0.01, kernel=sigmoid;; score=0.547 total time= 0.2s
[CV 2/3] END C=0.3, degree=4, gamma=0.01, kernel=sigmoid;; score=0.542 total time= 0.2s
[CV 3/3] END C=0.3, degree=4, gamma=0.01, kernel=sigmoid;; score=0.528 total time= 0.2s
[CV 1/3] END C=0.3, degree=4, gamma=0.001, kernel=rbf;; score=0.435 total time=0.5s
[CV 2/3] END C=0.3, degree=4, gamma=0.001, kernel=rbf;; score=0.461 total time=

0.6s
[CV 3/3] END C=0.3, degree=4, gamma=0.001, kernel=rbf;;, score=0.416 total time=0.5s
[CV 1/3] END C=0.3, degree=4, gamma=0.001, kernel=linear;;, score=0.848 total time= 0.1s
[CV 2/3] END C=0.3, degree=4, gamma=0.001, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.3, degree=4, gamma=0.001, kernel=linear;;, score=0.798 total time= 0.1s
[CV 1/3] END C=0.3, degree=4, gamma=0.001, kernel=poly;;, score=0.076 total time=0.4s
[CV 2/3] END C=0.3, degree=4, gamma=0.001, kernel=poly;;, score=0.076 total time=0.4s
[CV 3/3] END C=0.3, degree=4, gamma=0.001, kernel=poly;;, score=0.076 total time=0.3s
[CV 1/3] END C=0.3, degree=4, gamma=0.001, kernel=sigmoid;;, score=0.390 total time= 0.4s
[CV 2/3] END C=0.3, degree=4, gamma=0.001, kernel=sigmoid;;, score=0.402 total time= 0.4s
[CV 3/3] END C=0.3, degree=4, gamma=0.001, kernel=sigmoid;;, score=0.364 total time= 0.4s
[CV 1/3] END C=0.4, degree=2, gamma=scale, kernel=rbf;;, score=0.788 total time=0.4s
[CV 2/3] END C=0.4, degree=2, gamma=scale, kernel=rbf;;, score=0.763 total time=0.4s
[CV 3/3] END C=0.4, degree=2, gamma=scale, kernel=rbf;;, score=0.727 total time=0.4s
[CV 1/3] END C=0.4, degree=2, gamma=scale, kernel=linear;;, score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=2, gamma=scale, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=2, gamma=scale, kernel=linear;;, score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=2, gamma=scale, kernel=poly;;, score=0.889 total time=0.1s
[CV 2/3] END C=0.4, degree=2, gamma=scale, kernel=poly;;, score=0.849 total time=0.1s
[CV 3/3] END C=0.4, degree=2, gamma=scale, kernel=poly;;, score=0.801 total time=0.1s
[CV 1/3] END C=0.4, degree=2, gamma=scale, kernel=sigmoid;;, score=0.640 total time= 0.2s
[CV 2/3] END C=0.4, degree=2, gamma=scale, kernel=sigmoid;;, score=0.668 total time= 0.2s
[CV 3/3] END C=0.4, degree=2, gamma=scale, kernel=sigmoid;;, score=0.619 total time= 0.2s
[CV 1/3] END C=0.4, degree=2, gamma=auto, kernel=rbf;;, score=0.433 total time=0.6s
[CV 2/3] END C=0.4, degree=2, gamma=auto, kernel=rbf;;, score=0.452 total time=

0.6s
[CV 3/3] END C=0.4, degree=2, gamma=auto, kernel=rbf;; score=0.415 total time=0.6s
[CV 1/3] END C=0.4, degree=2, gamma=auto, kernel=linear;; score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=2, gamma=auto, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=2, gamma=auto, kernel=linear;; score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=2, gamma=auto, kernel=poly;; score=0.076 total time=0.4s
[CV 2/3] END C=0.4, degree=2, gamma=auto, kernel=poly;; score=0.076 total time=0.4s
[CV 3/3] END C=0.4, degree=2, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.4, degree=2, gamma=auto, kernel=sigmoid;; score=0.242 total time= 0.3s
[CV 2/3] END C=0.4, degree=2, gamma=auto, kernel=sigmoid;; score=0.190 total time= 0.3s
[CV 3/3] END C=0.4, degree=2, gamma=auto, kernel=sigmoid;; score=0.192 total time= 0.4s
[CV 1/3] END C=0.4, degree=2, gamma=0.1, kernel=rbf;; score=0.583 total time=0.5s
[CV 2/3] END C=0.4, degree=2, gamma=0.1, kernel=rbf;; score=0.588 total time=0.5s
[CV 3/3] END C=0.4, degree=2, gamma=0.1, kernel=rbf;; score=0.550 total time=0.5s
[CV 1/3] END C=0.4, degree=2, gamma=0.1, kernel=linear;; score=0.846 total time=0.1s
[CV 2/3] END C=0.4, degree=2, gamma=0.1, kernel=linear;; score=0.833 total time=0.1s
[CV 3/3] END C=0.4, degree=2, gamma=0.1, kernel=linear;; score=0.794 total time=0.1s
[CV 1/3] END C=0.4, degree=2, gamma=0.1, kernel=poly;; score=0.900 total time=0.1s
[CV 2/3] END C=0.4, degree=2, gamma=0.1, kernel=poly;; score=0.874 total time=0.1s
[CV 3/3] END C=0.4, degree=2, gamma=0.1, kernel=poly;; score=0.818 total time=0.1s
[CV 1/3] END C=0.4, degree=2, gamma=0.1, kernel=sigmoid;; score=0.412 total time= 0.3s
[CV 2/3] END C=0.4, degree=2, gamma=0.1, kernel=sigmoid;; score=0.453 total time= 0.3s
[CV 3/3] END C=0.4, degree=2, gamma=0.1, kernel=sigmoid;; score=0.463 total time= 0.3s
[CV 1/3] END C=0.4, degree=2, gamma=0.01, kernel=rbf;; score=0.684 total time=0.3s
[CV 2/3] END C=0.4, degree=2, gamma=0.01, kernel=rbf;; score=0.698 total time=

0.3s
[CV 3/3] END C=0.4, degree=2, gamma=0.01, kernel=rbf;; score=0.663 total time=0.3s
[CV 1/3] END C=0.4, degree=2, gamma=0.01, kernel=linear;; score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=2, gamma=0.01, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=2, gamma=0.01, kernel=linear;; score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=2, gamma=0.01, kernel=poly;; score=0.563 total time=0.2s
[CV 2/3] END C=0.4, degree=2, gamma=0.01, kernel=poly;; score=0.554 total time=0.2s
[CV 3/3] END C=0.4, degree=2, gamma=0.01, kernel=poly;; score=0.525 total time=0.2s
[CV 1/3] END C=0.4, degree=2, gamma=0.01, kernel=sigmoid;; score=0.566 total time= 0.2s
[CV 2/3] END C=0.4, degree=2, gamma=0.01, kernel=sigmoid;; score=0.570 total time= 0.2s
[CV 3/3] END C=0.4, degree=2, gamma=0.01, kernel=sigmoid;; score=0.572 total time= 0.2s
[CV 1/3] END C=0.4, degree=2, gamma=0.001, kernel=rbf;; score=0.440 total time=0.5s
[CV 2/3] END C=0.4, degree=2, gamma=0.001, kernel=rbf;; score=0.463 total time=0.5s
[CV 3/3] END C=0.4, degree=2, gamma=0.001, kernel=rbf;; score=0.418 total time=0.5s
[CV 1/3] END C=0.4, degree=2, gamma=0.001, kernel=linear;; score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=2, gamma=0.001, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=2, gamma=0.001, kernel=linear;; score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=2, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.4, degree=2, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.4, degree=2, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.4, degree=2, gamma=0.001, kernel=sigmoid;; score=0.434 total time= 0.3s
[CV 2/3] END C=0.4, degree=2, gamma=0.001, kernel=sigmoid;; score=0.447 total time= 0.3s
[CV 3/3] END C=0.4, degree=2, gamma=0.001, kernel=sigmoid;; score=0.416 total time= 0.3s
[CV 1/3] END C=0.4, degree=3, gamma=scale, kernel=rbf;; score=0.788 total time=0.4s
[CV 2/3] END C=0.4, degree=3, gamma=scale, kernel=rbf;; score=0.763 total time=

0.4s
[CV 3/3] END C=0.4, degree=3, gamma=scale, kernel=rbf;;, score=0.727 total time=0.4s
[CV 1/3] END C=0.4, degree=3, gamma=scale, kernel=linear;;, score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=3, gamma=scale, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=3, gamma=scale, kernel=linear;;, score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=3, gamma=scale, kernel=poly;;, score=0.913 total time=0.2s
[CV 2/3] END C=0.4, degree=3, gamma=scale, kernel=poly;;, score=0.869 total time=0.2s
[CV 3/3] END C=0.4, degree=3, gamma=scale, kernel=poly;;, score=0.825 total time=0.2s
[CV 1/3] END C=0.4, degree=3, gamma=scale, kernel=sigmoid;;, score=0.640 total time= 0.2s
[CV 2/3] END C=0.4, degree=3, gamma=scale, kernel=sigmoid;;, score=0.668 total time= 0.2s
[CV 3/3] END C=0.4, degree=3, gamma=scale, kernel=sigmoid;;, score=0.619 total time= 0.2s
[CV 1/3] END C=0.4, degree=3, gamma=auto, kernel=rbf;;, score=0.433 total time=0.6s
[CV 2/3] END C=0.4, degree=3, gamma=auto, kernel=rbf;;, score=0.452 total time=0.6s
[CV 3/3] END C=0.4, degree=3, gamma=auto, kernel=rbf;;, score=0.415 total time=0.5s
[CV 1/3] END C=0.4, degree=3, gamma=auto, kernel=linear;;, score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=3, gamma=auto, kernel=linear;;, score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=3, gamma=auto, kernel=linear;;, score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=3, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 2/3] END C=0.4, degree=3, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 3/3] END C=0.4, degree=3, gamma=auto, kernel=poly;;, score=0.076 total time=0.3s
[CV 1/3] END C=0.4, degree=3, gamma=auto, kernel=sigmoid;;, score=0.242 total time= 0.3s
[CV 2/3] END C=0.4, degree=3, gamma=auto, kernel=sigmoid;;, score=0.190 total time= 0.3s
[CV 3/3] END C=0.4, degree=3, gamma=auto, kernel=sigmoid;;, score=0.192 total time= 0.3s
[CV 1/3] END C=0.4, degree=3, gamma=0.1, kernel=rbf;;, score=0.583 total time=0.5s
[CV 2/3] END C=0.4, degree=3, gamma=0.1, kernel=rbf;;, score=0.588 total time=

0.5s
[CV 3/3] END C=0.4, degree=3, gamma=0.1, kernel=rbf;; score=0.550 total time=0.5s
0.1s
[CV 1/3] END C=0.4, degree=3, gamma=0.1, kernel=linear;; score=0.846 total time=0.1s
[CV 2/3] END C=0.4, degree=3, gamma=0.1, kernel=linear;; score=0.833 total time=0.1s
[CV 3/3] END C=0.4, degree=3, gamma=0.1, kernel=linear;; score=0.794 total time=0.1s
[CV 1/3] END C=0.4, degree=3, gamma=0.1, kernel=poly;; score=0.913 total time=0.2s
[CV 2/3] END C=0.4, degree=3, gamma=0.1, kernel=poly;; score=0.873 total time=0.2s
[CV 3/3] END C=0.4, degree=3, gamma=0.1, kernel=poly;; score=0.836 total time=0.2s
[CV 1/3] END C=0.4, degree=3, gamma=0.1, kernel=sigmoid;; score=0.412 total time= 0.3s
[CV 2/3] END C=0.4, degree=3, gamma=0.1, kernel=sigmoid;; score=0.453 total time= 0.3s
[CV 3/3] END C=0.4, degree=3, gamma=0.1, kernel=sigmoid;; score=0.463 total time= 0.3s
[CV 1/3] END C=0.4, degree=3, gamma=0.01, kernel=rbf;; score=0.684 total time=0.3s
[CV 2/3] END C=0.4, degree=3, gamma=0.01, kernel=rbf;; score=0.698 total time=0.3s
[CV 3/3] END C=0.4, degree=3, gamma=0.01, kernel=rbf;; score=0.663 total time=0.3s
[CV 1/3] END C=0.4, degree=3, gamma=0.01, kernel=linear;; score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=3, gamma=0.01, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=3, gamma=0.01, kernel=linear;; score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=3, gamma=0.01, kernel=poly;; score=0.441 total time=0.3s
[CV 2/3] END C=0.4, degree=3, gamma=0.01, kernel=poly;; score=0.463 total time=0.3s
[CV 3/3] END C=0.4, degree=3, gamma=0.01, kernel=poly;; score=0.412 total time=0.3s
[CV 1/3] END C=0.4, degree=3, gamma=0.01, kernel=sigmoid;; score=0.566 total time= 0.2s
[CV 2/3] END C=0.4, degree=3, gamma=0.01, kernel=sigmoid;; score=0.570 total time= 0.2s
[CV 3/3] END C=0.4, degree=3, gamma=0.01, kernel=sigmoid;; score=0.572 total time= 0.2s
[CV 1/3] END C=0.4, degree=3, gamma=0.001, kernel=rbf;; score=0.440 total time=0.5s
[CV 2/3] END C=0.4, degree=3, gamma=0.001, kernel=rbf;; score=0.463 total time=

0.5s
[CV 3/3] END C=0.4, degree=3, gamma=0.001, kernel=rbf;; score=0.418 total time=0.5s
[CV 1/3] END C=0.4, degree=3, gamma=0.001, kernel=linear;; score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=3, gamma=0.001, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=3, gamma=0.001, kernel=linear;; score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=3, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.4, degree=3, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.4, degree=3, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.4, degree=3, gamma=0.001, kernel=sigmoid;; score=0.434 total time= 0.3s
[CV 2/3] END C=0.4, degree=3, gamma=0.001, kernel=sigmoid;; score=0.447 total time= 0.3s
[CV 3/3] END C=0.4, degree=3, gamma=0.001, kernel=sigmoid;; score=0.416 total time= 0.3s
[CV 1/3] END C=0.4, degree=4, gamma=scale, kernel=rbf;; score=0.788 total time=0.4s
[CV 2/3] END C=0.4, degree=4, gamma=scale, kernel=rbf;; score=0.763 total time=0.4s
[CV 3/3] END C=0.4, degree=4, gamma=scale, kernel=rbf;; score=0.727 total time=0.3s
[CV 1/3] END C=0.4, degree=4, gamma=scale, kernel=linear;; score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=4, gamma=scale, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=4, gamma=scale, kernel=linear;; score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=4, gamma=scale, kernel=poly;; score=0.906 total time=0.2s
[CV 2/3] END C=0.4, degree=4, gamma=scale, kernel=poly;; score=0.873 total time=0.2s
[CV 3/3] END C=0.4, degree=4, gamma=scale, kernel=poly;; score=0.845 total time=0.2s
[CV 1/3] END C=0.4, degree=4, gamma=scale, kernel=sigmoid;; score=0.640 total time= 0.2s
[CV 2/3] END C=0.4, degree=4, gamma=scale, kernel=sigmoid;; score=0.668 total time= 0.2s
[CV 3/3] END C=0.4, degree=4, gamma=scale, kernel=sigmoid;; score=0.619 total time= 0.2s
[CV 1/3] END C=0.4, degree=4, gamma=auto, kernel=rbf;; score=0.433 total time=0.6s
[CV 2/3] END C=0.4, degree=4, gamma=auto, kernel=rbf;; score=0.452 total time=

0.6s
[CV 3/3] END C=0.4, degree=4, gamma=auto, kernel=rbf;; score=0.415 total time=0.6s
[CV 1/3] END C=0.4, degree=4, gamma=auto, kernel=linear;; score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=4, gamma=auto, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=4, gamma=auto, kernel=linear;; score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=4, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.4, degree=4, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.4, degree=4, gamma=auto, kernel=poly;; score=0.076 total time=0.3s
[CV 1/3] END C=0.4, degree=4, gamma=auto, kernel=sigmoid;; score=0.242 total time= 0.3s
[CV 2/3] END C=0.4, degree=4, gamma=auto, kernel=sigmoid;; score=0.190 total time= 0.3s
[CV 3/3] END C=0.4, degree=4, gamma=auto, kernel=sigmoid;; score=0.192 total time= 0.4s
[CV 1/3] END C=0.4, degree=4, gamma=0.1, kernel=rbf;; score=0.583 total time=0.5s
[CV 2/3] END C=0.4, degree=4, gamma=0.1, kernel=rbf;; score=0.588 total time=0.5s
[CV 3/3] END C=0.4, degree=4, gamma=0.1, kernel=rbf;; score=0.550 total time=0.5s
[CV 1/3] END C=0.4, degree=4, gamma=0.1, kernel=linear;; score=0.846 total time=0.1s
[CV 2/3] END C=0.4, degree=4, gamma=0.1, kernel=linear;; score=0.833 total time=0.1s
[CV 3/3] END C=0.4, degree=4, gamma=0.1, kernel=linear;; score=0.794 total time=0.1s
[CV 1/3] END C=0.4, degree=4, gamma=0.1, kernel=poly;; score=0.906 total time=0.2s
[CV 2/3] END C=0.4, degree=4, gamma=0.1, kernel=poly;; score=0.870 total time=0.2s
[CV 3/3] END C=0.4, degree=4, gamma=0.1, kernel=poly;; score=0.850 total time=0.2s
[CV 1/3] END C=0.4, degree=4, gamma=0.1, kernel=sigmoid;; score=0.412 total time= 0.3s
[CV 2/3] END C=0.4, degree=4, gamma=0.1, kernel=sigmoid;; score=0.453 total time= 0.3s
[CV 3/3] END C=0.4, degree=4, gamma=0.1, kernel=sigmoid;; score=0.463 total time= 0.3s
[CV 1/3] END C=0.4, degree=4, gamma=0.01, kernel=rbf;; score=0.684 total time=0.3s
[CV 2/3] END C=0.4, degree=4, gamma=0.01, kernel=rbf;; score=0.698 total time=

0.3s
[CV 3/3] END C=0.4, degree=4, gamma=0.01, kernel=rbf;; score=0.663 total time=0.3s
[CV 1/3] END C=0.4, degree=4, gamma=0.01, kernel=linear;; score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=4, gamma=0.01, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=4, gamma=0.01, kernel=linear;; score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=4, gamma=0.01, kernel=poly;; score=0.397 total time=0.3s
[CV 2/3] END C=0.4, degree=4, gamma=0.01, kernel=poly;; score=0.411 total time=0.3s
[CV 3/3] END C=0.4, degree=4, gamma=0.01, kernel=poly;; score=0.365 total time=0.3s
[CV 1/3] END C=0.4, degree=4, gamma=0.01, kernel=sigmoid;; score=0.566 total time= 0.2s
[CV 2/3] END C=0.4, degree=4, gamma=0.01, kernel=sigmoid;; score=0.570 total time= 0.2s
[CV 3/3] END C=0.4, degree=4, gamma=0.01, kernel=sigmoid;; score=0.572 total time= 0.2s
[CV 1/3] END C=0.4, degree=4, gamma=0.001, kernel=rbf;; score=0.440 total time=0.5s
[CV 2/3] END C=0.4, degree=4, gamma=0.001, kernel=rbf;; score=0.463 total time=0.5s
[CV 3/3] END C=0.4, degree=4, gamma=0.001, kernel=rbf;; score=0.418 total time=0.5s
[CV 1/3] END C=0.4, degree=4, gamma=0.001, kernel=linear;; score=0.846 total time= 0.1s
[CV 2/3] END C=0.4, degree=4, gamma=0.001, kernel=linear;; score=0.833 total time= 0.1s
[CV 3/3] END C=0.4, degree=4, gamma=0.001, kernel=linear;; score=0.794 total time= 0.1s
[CV 1/3] END C=0.4, degree=4, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 2/3] END C=0.4, degree=4, gamma=0.001, kernel=poly;; score=0.076 total time=0.3s
[CV 3/3] END C=0.4, degree=4, gamma=0.001, kernel=poly;; score=0.076 total time=0.4s
[CV 1/3] END C=0.4, degree=4, gamma=0.001, kernel=sigmoid;; score=0.434 total time= 0.3s
[CV 2/3] END C=0.4, degree=4, gamma=0.001, kernel=sigmoid;; score=0.447 total time= 0.3s
[CV 3/3] END C=0.4, degree=4, gamma=0.001, kernel=sigmoid;; score=0.416 total time= 0.4s

```
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)
```

```
best_svm = grid_search_svm.best_estimator_
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': 4, 'gamma': 0.1, 'kernel': 'poly'}

```
['e:\\Documents\\CS231\\project\\Traffic-Sign-Classification-through-
Images\\joblib\\best_svm_model.joblib']
```

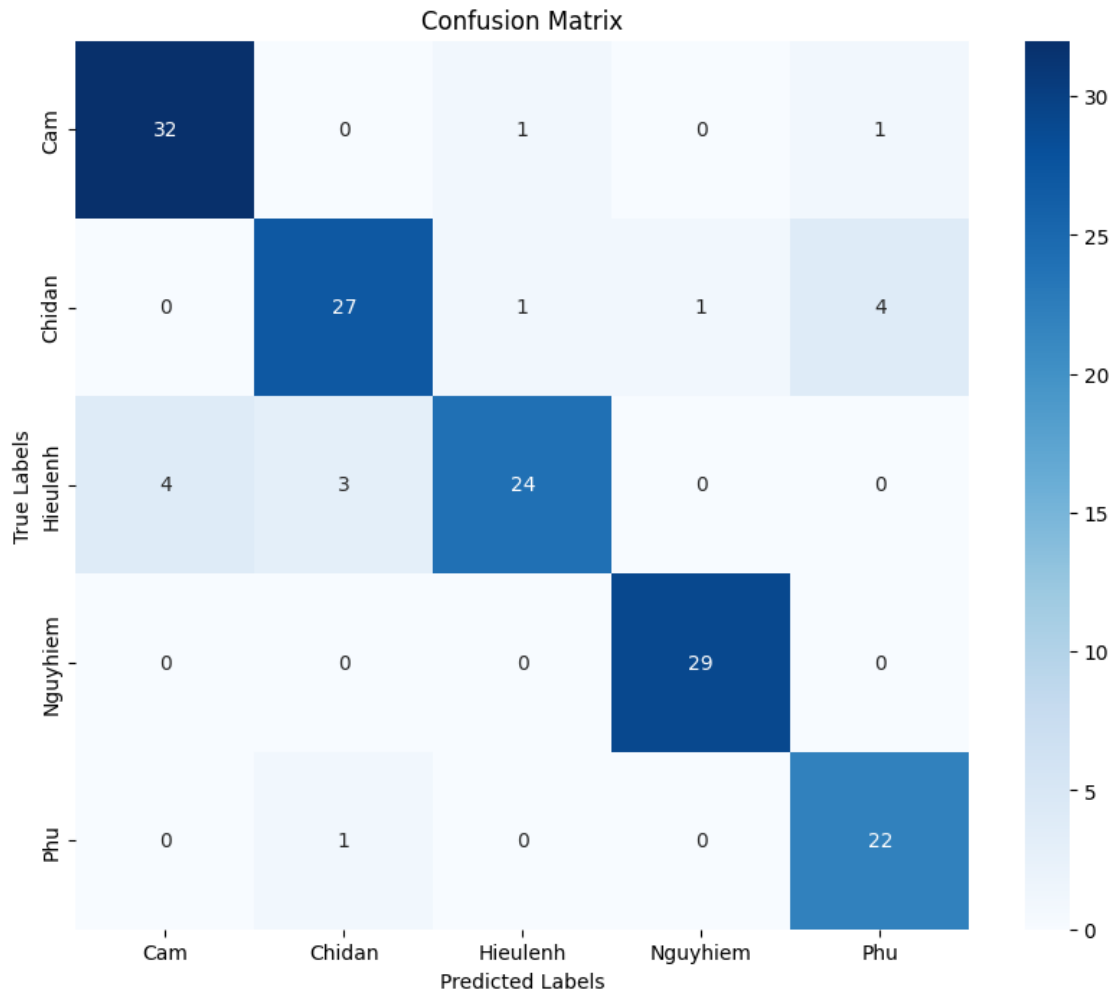
8 Predict on test images for KNN

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

	precision	recall	f1-score	support
Cam	0.89	0.94	0.91	34
Chidan	0.87	0.82	0.84	33
Hieulenh	0.92	0.77	0.84	31
Nguyhiem	0.97	1.00	0.98	29
Phu	0.81	0.96	0.88	23
accuracy			0.89	150
macro avg	0.89	0.90	0.89	150
weighted avg	0.90	0.89	0.89	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()
```



```

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')

```

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

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



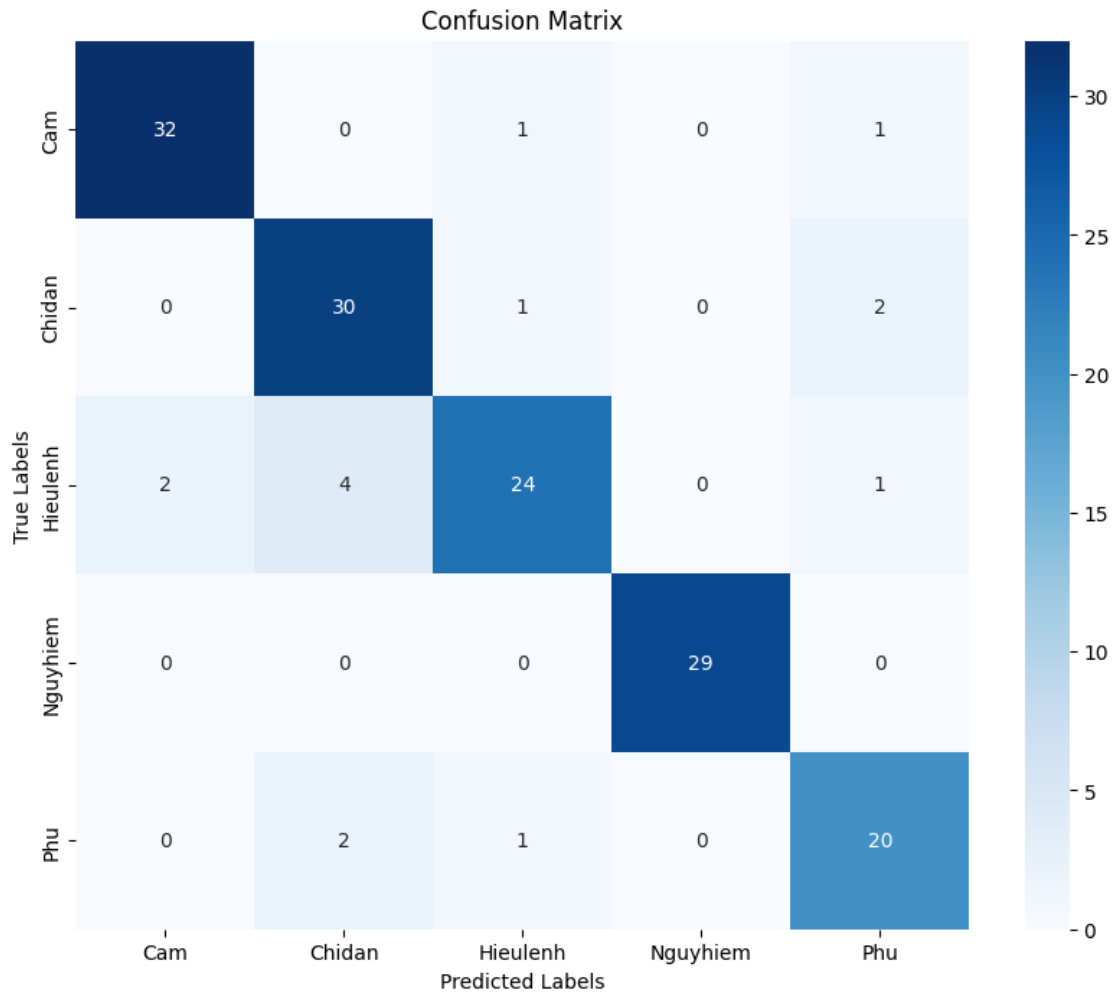
9 Predict on test images for SVM

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

	precision	recall	f1-score	support
Cam	0.94	0.94	0.94	34
Chidan	0.83	0.91	0.87	33
Hieulenh	0.89	0.77	0.83	31
Nguyhiem	1.00	1.00	1.00	29
Phu	0.83	0.87	0.85	23
accuracy			0.90	150
macro avg	0.90	0.90	0.90	150
weighted avg	0.90	0.90	0.90	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()
```



```

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')

```

```

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

plt.tight_layout()
plt.show()

```

10 Save grid search results

```

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

```

```

# 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)

```

Đã xuất file PDF thành công: e:\Documents\CS231\project\Traffic-Sign-Classification-through-

Images\grid_search_results\notebook_export_2024-12-10_09_24_16.pdf

```
'e:\\Documents\\CS231\\project\\Traffic-Sign-Classification-through-  
Images\grid_search_results\notebook_export_2024-12-10_09_24_16.pdf'
```

```
param_grid_KNN = { 'n_neighbors': [3, 4, 5, 6, 7, 10], 'weights': ['uniform', 'distance'],  
'metric': [cityblock, cosine, sqeuclidean, chi_square_distance, bhattacharyya_distance, intersec-  
tion_distance ] }
```

Best Params: {'metric': , 'n_neighbors': 4, 'weights': 'distance'}

```
param_grid_SVC = { '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],  
}
```

Best parameters: {'C': 0.1, 'degree': 4, 'gamma': 0.1, 'kernel': 'poly'}