lab5.2

January 20, 2025

[1]:
```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score, confusion_matrix,␣
 ↪classification_report,roc_auc_score,precision_score,recall_score,f1_score
import matplotlib.pyplot as plt
import seaborn as sns

%matplotlib inline
```

[ ]:
```
df = pd.read_csv("./letter-recognition.csv")
```

[3]:
```
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
scaler = StandardScaler()
```

[4]:
```
encoding = {chr(i): i - 64 for i in range(65, 91)}
df['encoded_alphabet']= df['letter'].map(encoding)
```

[ ]:
```
df.columns = df.columns.str.strip()
```

[96]:
```
X =␣
 ↪df[['xbox','ybox','width','height','onpix','xbar','ybar','x2bar','y2bar','xybar','x2ybar',
 'xy2bar','xedge','xedgey','yedge','yedgex']]
y= df[['encoded_alphabet']].to_numpy()
```

[97]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y,␣
 ↪random_state=22053747, test_size=0.2)
```

[98]:
```
y_test = y_test.ravel()
y_train = y_train.ravel()
```

[100]:
```
scaler_X = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
```

[103]:
```
svm_clf = SVC(kernel='rbf', C=1.0, gamma='scale', random_state=42)
```

```
[104]: svm_clf.fit(X_train_scaled, y_train)
```

```
[104]: SVC(random_state=42)
```

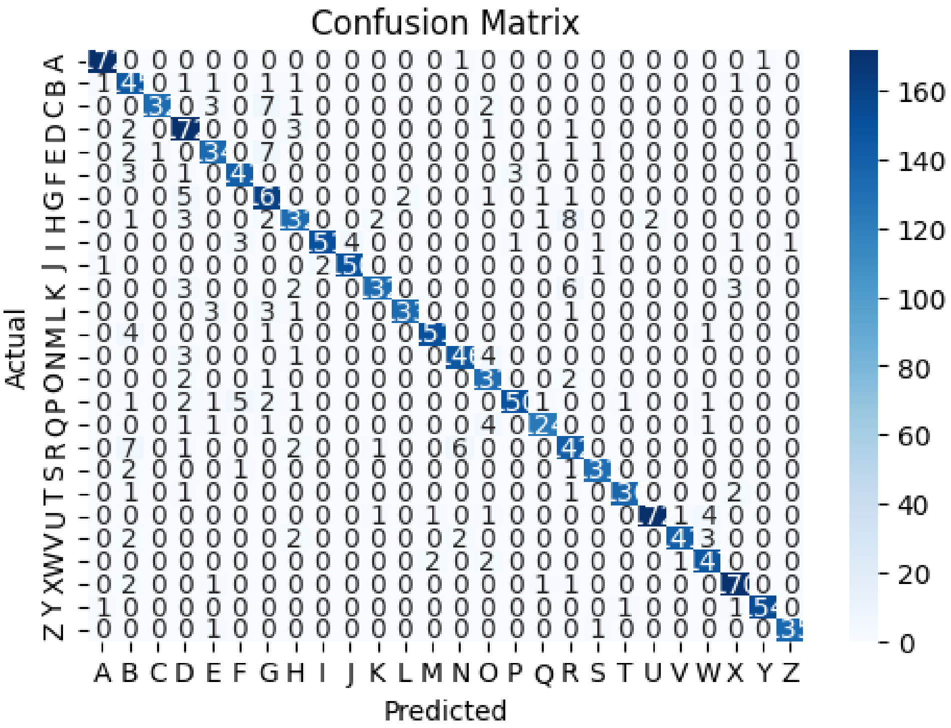
```
[106]: X_test_scaled = scaler.transform(X_test)
```

```
[107]: y_pred = svm_clf.predict(X_test_scaled)
```

```
[108]: accuracy_score(y_pred=y_pred, y_true=y_test)
```

```
[108]: 0.94625
```

```
[112]: class_names = list(encoding.keys())
       cm = confusion_matrix(y_test, y_pred)
       plt.figure(figsize=(6, 4))
       sns.heatmap(cm, annot=True, fmt="d", cmap="Blues",
                   xticklabels=class_names, yticklabels=class_names)
       plt.xlabel("Predicted")
       plt.ylabel("Actual")
       plt.title("Confusion Matrix")
       plt.show()
```



[114]:

```
print("Classification Report:\n", classification_report(y_test, y_pred,␣
 ↪target_names=class_names))
```

```
Classification Report:
               precision    recall  f1-score   support

           A       0.98      0.99      0.99       174
           B       0.84      0.96      0.90       151
           C       0.99      0.91      0.95       145
           D       0.88      0.96      0.92       179
           E       0.92      0.91      0.91       148
           F       0.94      0.95      0.95       148
           G       0.87      0.94      0.90       171
           H       0.90      0.87      0.89       151
           I       0.99      0.93      0.96       162
           J       0.97      0.97      0.97       154
           K       0.97      0.90      0.94       146
           L       0.99      0.94      0.96       141
           M       0.98      0.96      0.97       157
           N       0.94      0.95      0.94       154
           O       0.90      0.96      0.93       136
           P       0.97      0.91      0.94       165
           Q       0.96      0.94      0.95       132
           R       0.86      0.89      0.88       159
           S       0.97      0.97      0.97       135
           T       0.99      0.96      0.97       141
           U       0.99      0.96      0.97       180
           V       0.99      0.94      0.96       150
           W       0.94      0.97      0.95       152
           X       0.96      0.97      0.96       175
           Y       0.99      0.98      0.99       157
           Z       0.99      0.99      0.99       137

    accuracy                           0.95      4000
   macro avg       0.95      0.95      0.95      4000
weighted avg       0.95      0.95      0.95      4000
```

[115]:

```
from sklearn.model_selection import GridSearchCV

param_grid = {
    'C': [0.1, 1, 10],
    'gamma': ['scale', 1e-2, 1e-3],
    'kernel': ['rbf', 'poly']
}

grid_search = GridSearchCV(
```

```python
    estimator=SVC(random_state=42),
    param_grid=param_grid,
    scoring='accuracy',
    cv=5,
    n_jobs=-1
)

grid_search.fit(X_train_scaled, y_train)
print("Best params:", grid_search.best_params_)
print("Best CV score:", grid_search.best_score_)
```

```
Best params: {'C': 10, 'gamma': 'scale', 'kernel': 'rbf'}
Best CV score: 0.9669375
```

[140]:

```python
print(precision)
print(f1)
print(recall)
```

```
0.9481826224448482
0.9466014788213704
0.94625
```

[135]:

```python
print(classification_report(y_test, y_pred))
classification_report
```

```
              precision    recall  f1-score   support

           1       0.98      0.99      0.99       174
           2       0.84      0.96      0.90       151
           3       0.99      0.91      0.95       145
           4       0.88      0.96      0.92       179
           5       0.92      0.91      0.91       148
           6       0.94      0.95      0.95       148
           7       0.87      0.94      0.90       171
           8       0.90      0.87      0.89       151
           9       0.99      0.93      0.96       162
          10       0.97      0.97      0.97       154
          11       0.97      0.90      0.94       146
          12       0.99      0.94      0.96       141
          13       0.98      0.96      0.97       157
          14       0.94      0.95      0.94       154
          15       0.90      0.96      0.93       136
          16       0.97      0.91      0.94       165
          17       0.96      0.94      0.95       132
          18       0.86      0.89      0.88       159
          19       0.97      0.97      0.97       135
          20       0.99      0.96      0.97       141
          21       0.99      0.96      0.97       180
          22       0.99      0.94      0.96       150
          23       0.94      0.97      0.95       152
          24       0.96      0.97      0.96       175
          25       0.99      0.98      0.99       157
          26       0.99      0.99      0.99       137

    accuracy                           0.95      4000
   macro avg       0.95      0.95      0.95      4000
weighted avg       0.95      0.95      0.95      4000
```

```
[135]: <function sklearn.metrics._classification.classification_report(y_true, y_pred,
       *, labels=None, target_names=None, sample_weight=None, digits=2,
       output_dict=False, zero_division='warn')>
```