```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report
from sklearn.datasets import load_iris, load_diabetes
import pandas as pd
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report
import seaborn as sns
import matplotlib.pyplot as plt
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
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import LabelBinarizer
from sklearn.metrics import roc_auc_score
from sklearn.preprocessing import LabelBinarizer
from sklearn.metrics import roc_auc_score, roc_curve
import matplotlib.pyplot as plt


from google.colab import files
uploaded = files.upload()
```

Choose Files letter-recognition.csv

- **letter-recognition.csv**(text/csv) - 732680 bytes, last modified: 4/21/2025 - 100% done

Saving letter-recognition.csv to letter-recognition.csv

```
df = pd.read_csv('letter-recognition.csv')
df
```

	letter	xbox	ybox	width	height	onpix	xbar	ybar	x2bar	y2bar	xybar	x2ybar	xy2bar	xedge	xedgey	yedge	yedgex
0	T	2	8	3	5	1	8	13	0	6	6	10	8	0	8	0	8
1	I	5	12	3	7	2	10	5	5	4	13	3	9	2	8	4	10
2	D	4	11	6	8	6	10	6	2	6	10	3	7	3	7	3	9
3	N	7	11	6	6	3	5	9	4	6	4	4	10	6	10	2	8
4	G	2	1	3	1	1	8	6	6	6	6	5	9	1	7	5	10
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19995	D	2	2	3	3	2	7	7	7	6	6	6	4	2	8	3	7
19996	C	7	10	8	8	4	4	8	6	9	12	9	13	2	9	3	7
19997	T	6	9	6	7	5	6	11	3	7	11	9	5	2	12	2	4
19998	S	2	3	4	2	1	8	7	2	6	10	6	8	1	9	5	8
19999	A	4	9	6	6	2	9	5	3	1	8	1	8	2	7	2	8

20000 rows × 17 columns

Next steps: Generate code with df | View recommended plots | New interactive sheet

```
X = df.drop('letter', axis=1)
y = df['letter']


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)


svm_model = SVC(kernel='rbf', probability=True)
svm_model.fit(X_train, y_train)
```

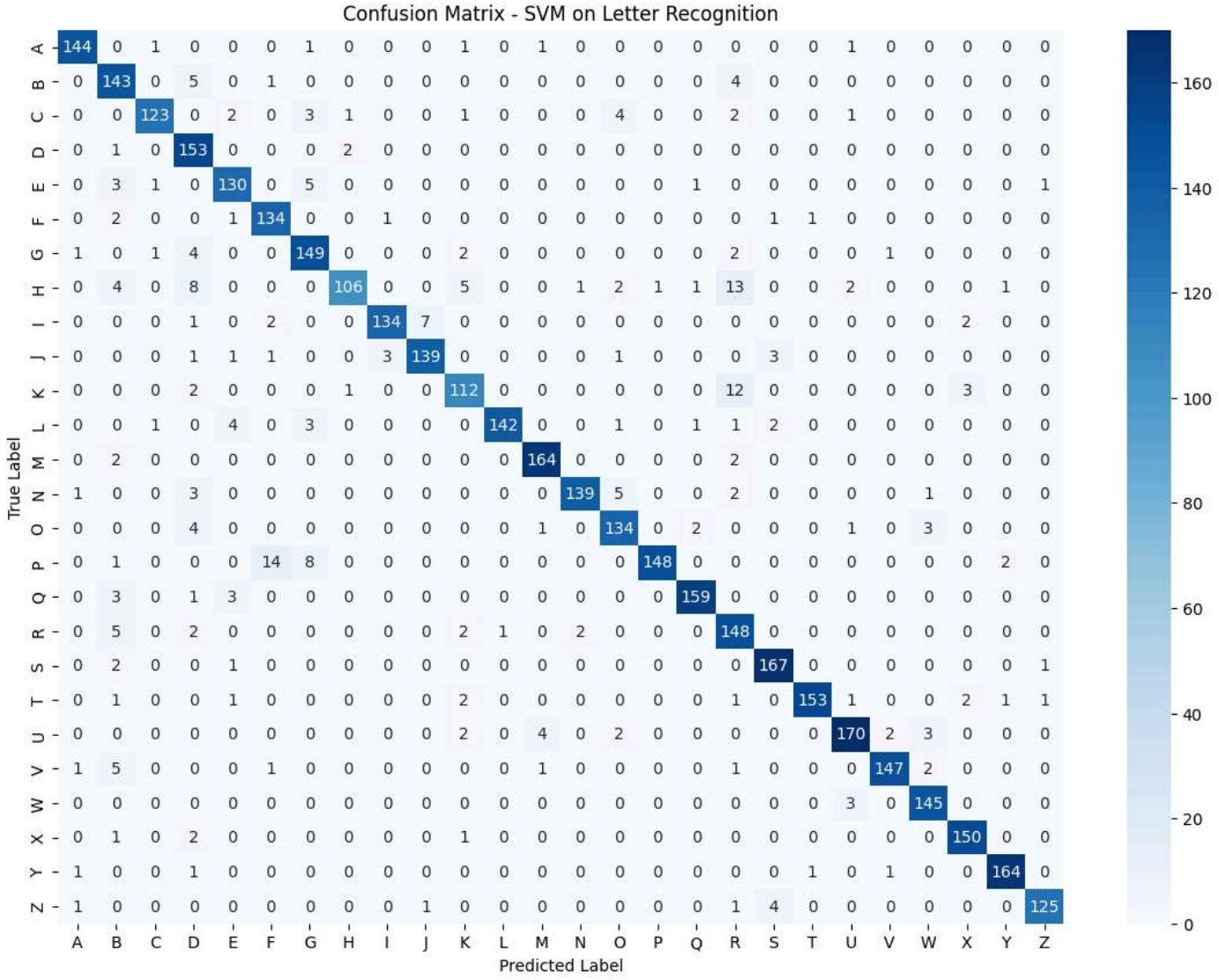
SVC

SVC(probability=True)

```
y_pred = svm_model.predict(X_test)


acc = accuracy_score(y_test, y_pred)
print("Accuracy:", acc)
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(14,10))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
            xticklabels=sorted(df['letter'].unique()),
            yticklabels=sorted(df['letter'].unique()))
plt.title("Confusion Matrix - SVM on Letter Recognition")
plt.xlabel("Predicted Label")
plt.ylabel("True Label")
plt.show()
```

```
Accuracy: 0.9305
```




```
lb = LabelBinarizer()
y_test_bin = lb.fit_transform(y_test)
y_score = svm_model.predict_proba(X_test)

auc = roc_auc_score(y_test_bin, y_score, average="macro", multi_class="ovr")
print("AUC Score (macro-averaged):", auc)
fpr = {}
tpr = {}
plt.figure(figsize=(10, 7))
for i, letter in enumerate(lb.classes_[:5]):
    fpr[i], tpr[i], _ = roc_curve(y_test_bin[:, i], y_score[:, i])
    plt.plot(fpr[i], tpr[i], label=f'ROC curve for {letter}')
plt.plot([0, 1], [0, 1], 'k--')
plt.xlabel('False Positive Rate')
```

```
plt.ylabel('True Positive Rate')
plt.title('ROC Curves (First 5 Letters)')
plt.legend()
plt.grid(True)
plt.show()
```

```
AUC Score (macro-averaged): 0.9985048363617783
```