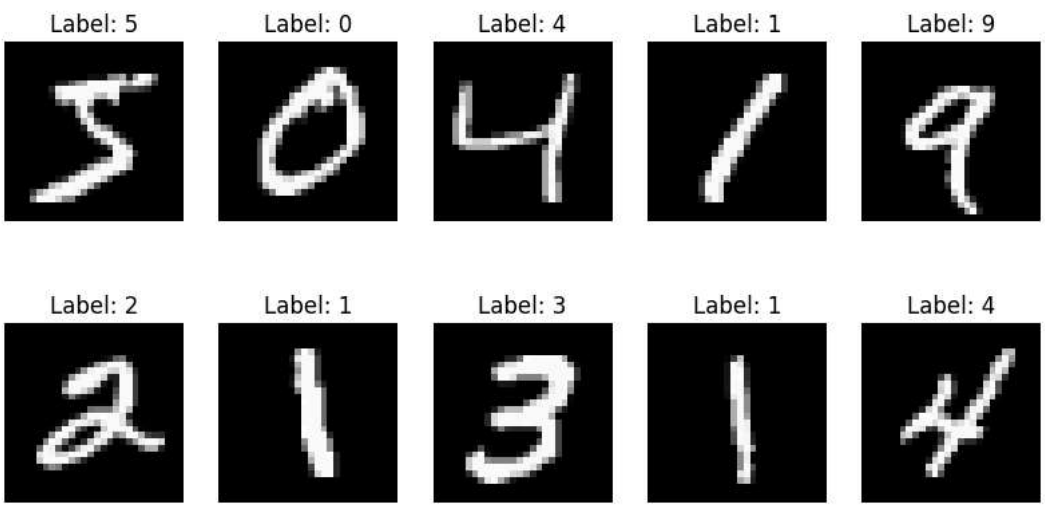
```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)


import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))



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.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix
import tensorflow as tf
from tensorflow.keras.datasets import mnist

(X_train, y_train), (X_test, y_test) = mnist.load_data()

print(f'Training data shape: {X_train.shape}')
print(f'Test data shape: {X_test.shape}')
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz
11490434/11490434 ━━━━━━━━━━━━━━━━━━━━ 0s 0us/step
Training data shape: (60000, 28, 28)
Test data shape: (10000, 28, 28)
```

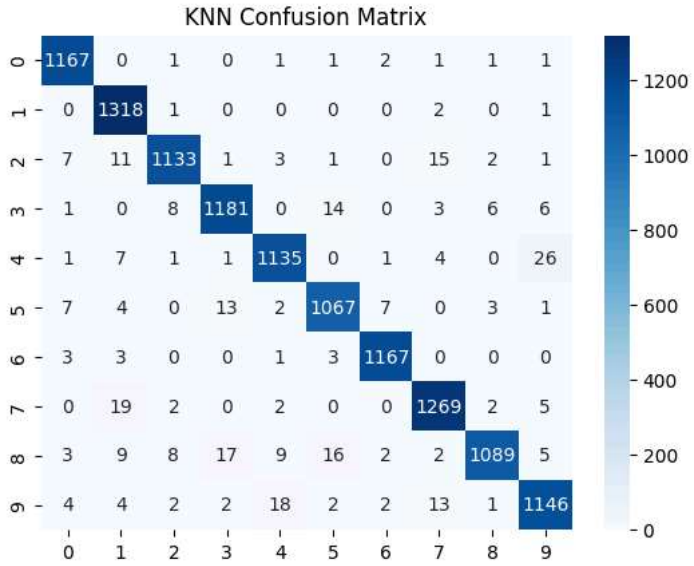
```
plt.figure(figsize=(10, 5))
for i in range(10):
    plt.subplot(2, 5, i + 1)
    plt.imshow(X_train[i], cmap='gray')
    plt.title(f"Label: {y_train[i]}")
    plt.axis('off')
plt.show()

X_train_flat = X_train.reshape(X_train.shape[0], -1) / 255.0
X_test_flat = X_test.reshape(X_test.shape[0], -1) / 255.0

print(f'Flattened training data shape: {X_train_flat.shape}')
print(f'Flattened test data shape: {X_test_flat.shape}')

X_train_split, X_val, y_train_split, y_val = train_test_split(X_train_flat, y_train, test_size=0.2, random_state=42)

print(f'Training set shape: {X_train_split.shape}')
print(f'Validation set shape: {X_val.shape}')
```




```
Flattened training data shape: (60000, 784)
Flattened test data shape: (10000, 784)
Training set shape: (48000, 784)
```

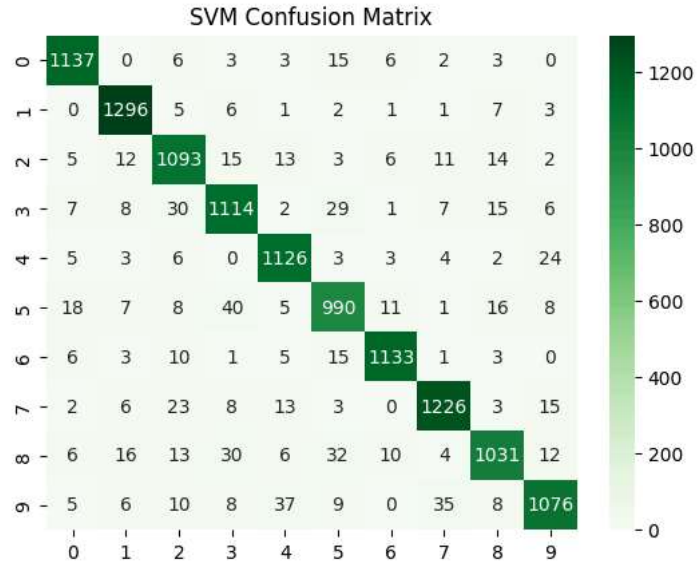
```
knn_model = KNeighborsClassifier(n_neighbors=3)
knn_model.fit(X_train_split, y_train_split)

y_val_pred_knn = knn_model.predict(X_val)

knn_acc = accuracy_score(y_val, y_val_pred_knn)
print(f'KNN Validation Accuracy: {knn_acc:.4f}')

print(classification_report(y_val, y_val_pred_knn))
sns.heatmap(confusion_matrix(y_val, y_val_pred_knn), annot=True, fmt='d', cmap='Blues')
plt.title("KNN Confusion Matrix")
plt.show()
```

```
KNN Validation Accuracy: 0.9727
              precision    recall  f1-score   support

           0       0.98      0.99      0.99      1175
           1       0.96      1.00      0.98      1322
           2       0.98      0.97      0.97      1174
           3       0.97      0.97      0.97      1219
           4       0.97      0.97      0.97      1176
           5       0.97      0.97      0.97      1104
           6       0.99      0.99      0.99      1177
           7       0.97      0.98      0.97      1299
           8       0.99      0.94      0.96      1160
           9       0.96      0.96      0.96      1194

    accuracy                           0.97     12000
   macro avg       0.97      0.97      0.97     12000
weighted avg       0.97      0.97      0.97     12000
```




```
svm_model = SVC(kernel='linear')
svm_model.fit(X_train_split, y_train_split)

y_val_pred_svm = svm_model.predict(X_val)

svm_acc = accuracy_score(y_val, y_val_pred_svm)
print(f'SVM Validation Accuracy: {svm_acc:.4f}')

print(classification_report(y_val, y_val_pred_svm))
sns.heatmap(confusion_matrix(y_val, y_val_pred_svm), annot=True, fmt='d', cmap='Greens')
plt.title("SVM Confusion Matrix")
plt.show()
```

```
SVM Validation Accuracy: 0.9352
              precision    recall  f1-score   support

           0       0.95      0.97      0.96      1175
           1       0.96      0.98      0.97      1322
           2       0.91      0.93      0.92      1174
           3       0.91      0.91      0.91      1219
           4       0.93      0.96      0.94      1176
           5       0.90      0.90      0.90      1104
           6       0.97      0.96      0.97      1177
           7       0.95      0.94      0.95      1299
           8       0.94      0.89      0.91      1160
           9       0.94      0.90      0.92      1194

    accuracy                           0.94     12000
   macro avg       0.93      0.93      0.93     12000
weighted avg       0.94      0.94      0.94     12000
```




```
y_test_pred_svm = svm_model.predict(X_test_flat)
test_acc_svm = accuracy_score(y_test, y_test_pred_svm)
print(f'SVM Test Accuracy: {test_acc_svm:.4f}')
```

```
SVM Test Accuracy: 0.9351
```