```
import tensorflow as tf
from tensorflow.keras import layers, models
import numpy as np

# 1. Load MNIST dataset (provided by Keras, no CSV needed)
(X_train, y_train), (X_test, y_test) = tf.keras.datasets.mnist.load_data()

# 2. Preprocess data
# Reshape to add channel dimension (batch, height, width, channels)
X_train = X_train.reshape(-1, 28, 28, 1).astype("float32") / 255.0
X_test = X_test.reshape(-1, 28, 28, 1).astype("float32") / 255.0

# 3. Build a simple CNN model
model = models.Sequential([
    layers.Conv2D(32, (3,3), activation='relu', input_shape=(28,28,1)),
    layers.MaxPooling2D((2,2)),
    layers.Conv2D(64, (3,3), activation='relu'),
    layers.MaxPooling2D((2,2)),
    layers.Flatten(),
    layers.Dense(64, activation='relu'),
    layers.Dense(10, activation='softmax')
])

# 4. Compile the model
model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])

# 5. Train the model
model.fit(X_train, y_train, epochs=5, batch_size=64, validation_split=0.1)

# 6. Evaluate the model
test_loss, test_acc = model.evaluate(X_test, y_test)
print(f"\nTest accuracy: {test_acc:.4f}")
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz
11490434/11490434 ━━━━━━━━━━━━━━━━━━━━ 0s 0us/step
/usr/local/lib/python3.11/dist-packages/keras/src/layers/convolutional/base_conv.py:107: UserWarning: Do not pass an `input_shape`/`input_dim` argument to
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
Epoch 1/5
844/844 ━━━━━━━━━━━━━━━━━━━━ 29s 33ms/step - accuracy: 0.8561 - loss: 0.4462 - val_accuracy: 0.9812 - val_loss: 0.0618
Epoch 2/5
844/844 ━━━━━━━━━━━━━━━━━━━━ 41s 34ms/step - accuracy: 0.9808 - loss: 0.0603 - val_accuracy: 0.9890 - val_loss: 0.0393
Epoch 3/5
844/844 ━━━━━━━━━━━━━━━━━━━━ 38s 30ms/step - accuracy: 0.9877 - loss: 0.0387 - val_accuracy: 0.9888 - val_loss: 0.0390
Epoch 4/5
844/844 ━━━━━━━━━━━━━━━━━━━━ 43s 33ms/step - accuracy: 0.9908 - loss: 0.0288 - val_accuracy: 0.9900 - val_loss: 0.0347
Epoch 5/5
844/844 ━━━━━━━━━━━━━━━━━━━━ 25s 30ms/step - accuracy: 0.9924 - loss: 0.0232 - val_accuracy: 0.9915 - val_loss: 0.0291
313/313 ━━━━━━━━━━━━━━━━━━━━ 3s 8ms/step - accuracy: 0.9868 - loss: 0.0385

Test accuracy: 0.9905
```