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import tensorflow as tf
from tensorflow.keras import layers, models
import matplotlib.pyplot as plt

# Load MNIST handwritten digits dataset
(x_train, y_train), (x_test, y_test) = tf.keras.datasets.mnist.load_data()

# Normalize pixel values
x_train = x_train / 255.0
x_test = x_test / 255.0

# Reshape for CNN input (batch, height, width, channels)
x_train = x_train.reshape((-1, 28, 28, 1))
x_test = x_test.reshape((-1, 28, 28, 1))

# Define the 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(128, activation='relu'),
    layers.Dropout(0.5),
    layers.Dense(10, activation='softmax') # 10 classes for digits 0-9
])

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

# Train model
model.fit(x_train, y_train, epochs=5, validation_data=(x_test, y_test))

# Evaluate
test_loss, test_acc = model.evaluate(x_test, y_test, verbose=2)
print(f'\nTest accuracy: {test_acc}')

```

 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` to `input\_shape`  
 super().\_\_init\_\_(activity\_regularizer=activity\_regularizer, \*\*kwargs)  
 Epoch 1/5  
 1875/1875 ————— 53s 27ms/step - accuracy: 0.8610 - loss: 0.4278 - val\_accuracy: 0.9819 - val\_loss: 0.0525  
 Epoch 2/5  
 1875/1875 ————— 80s 26ms/step - accuracy: 0.9757 - loss: 0.0803 - val\_accuracy: 0.9887 - val\_loss: 0.0344  
 Epoch 3/5  
 1875/1875 ————— 83s 27ms/step - accuracy: 0.9837 - loss: 0.0563 - val\_accuracy: 0.9897 - val\_loss: 0.0284  
 Epoch 4/5  
 1875/1875 ————— 83s 27ms/step - accuracy: 0.9871 - loss: 0.0413 - val\_accuracy: 0.9921 - val\_loss: 0.0233  
 Epoch 5/5  
 1875/1875 ————— 79s 25ms/step - accuracy: 0.9884 - loss: 0.0369 - val\_accuracy: 0.9903 - val\_loss: 0.0305  
 313/313 - 3s - 9ms/step - accuracy: 0.9903 - loss: 0.0305  
 Test accuracy: 0.9902999997138977

