

```
pip install tensorflow keras numpy matplotlib
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➡ Requirement already satisfied: tensorflow in /usr/local/lib/python3.11/dist-packages (2.18.0)
Requirement already satisfied: keras in /usr/local/lib/python3.11/dist-packages (3.8.0)
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages (1.26.4)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.11/dist-packages (3.10.0)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: flatbuffers>=24.3.25 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
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Requirement already satisfied: packaging in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<4.21.6 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
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Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: tensorboard<2.19,>=2.18 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: h5py>=3.11.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
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Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib)
Requirement already satisfied: cyclier>=0.10 in /usr/local/lib/python3.11/dist-packages (from matplotlib)
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Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
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Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow)
Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.11/dist-packages (from markdown-it-py)
Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.11/dist-packages (from werkzeug)
```

```
import tensorflow as tf
from tensorflow import keras
import numpy as np
import matplotlib.pyplot as plt

# Load MNIST dataset (handwritten digits)
(X_train, y_train), (X_test, y_test) = keras.datasets.mnist.load_data()

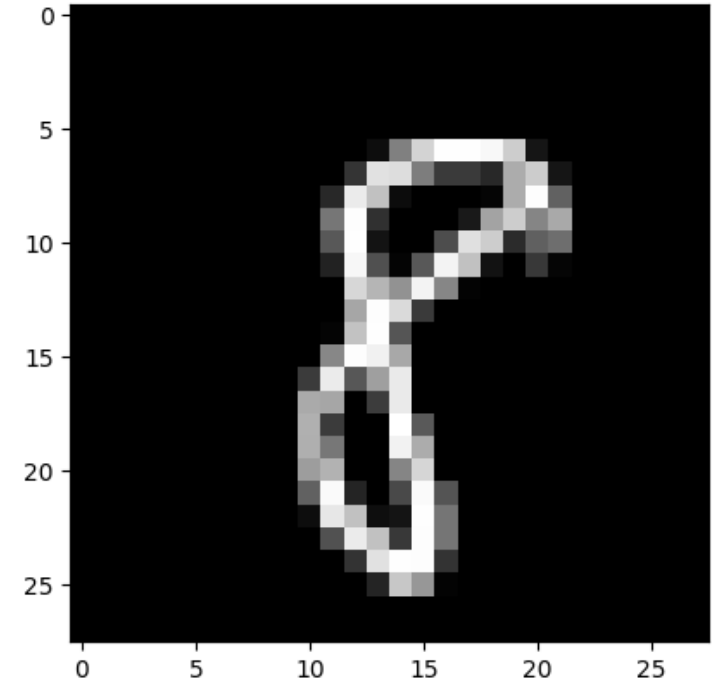
# Normalize images
X_train, X_test = X_train / 255.0, X_test / 255.0

# Build a simple CNN model
model = keras.Sequential([
    keras.layers.Conv2D(32, (3,3), activation='relu', input_shape=(28, 28, 1)),
    keras.layers.MaxPooling2D((2,2)),
    keras.layers.Flatten(),
    keras.layers.Dense(128, activation='relu'),
    keras.layers.Dense(10, activation='softmax') # 10 digits (0-9)
])

# Compile and train
model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])
model.fit(X_train[... , np.newaxis], y_train, epochs=5, validation_data=(X_test[... , np.newaxis], y_test))

# Test on a random image
index = np.random.randint(0, len(X_test))
plt.imshow(X_test[index], cmap='gray')
plt.show()
prediction = model.predict(X_test[index][np.newaxis, ..., np.newaxis])
print("Predicted Digit:", np.argmax(prediction))
```

```
➡ 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:   
    super().__init__(activity_regularizer=activity_regularizer, **kwargs)  
Epoch 1/5  
1875/1875 ————— 46s 24ms/step - accuracy: 0.9107 - loss: 0.3029 - val_accura  
Epoch 2/5  
1875/1875 ————— 83s 24ms/step - accuracy: 0.9850 - loss: 0.0497 - val_accura  
Epoch 3/5  
1875/1875 ————— 83s 25ms/step - accuracy: 0.9901 - loss: 0.0306 - val_accura  
Epoch 4/5  
1875/1875 ————— 80s 24ms/step - accuracy: 0.9939 - loss: 0.0196 - val_accura  
Epoch 5/5  
1875/1875 ————— 82s 24ms/step - accuracy: 0.9956 - loss: 0.0141 - val_accura
```



1/1 ————— 0s 101ms/step
Predicted Digit: 8