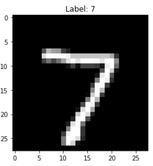
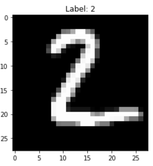
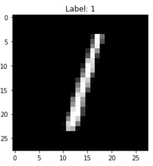
In [1]:

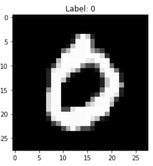
```
import tensorflow as tfb
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Flatten
from tensorflow.keras.layers import Conv2D, MaxPooling2D
import matplotlib.pyplot as plt

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

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

# Reshape data
x_train = x_train.reshape(-1, 28, 28, 1)
x_test = x_test.reshape(-1, 28, 28, 1)

# Display 10 test images and labels
for i in range(10):
    plt.imshow(x_test[i].reshape(28, 28), cmap='gray')
    plt.title(f'Label: {y_test[i]}')
    plt.show()
```

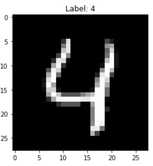
```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz
11490434/11490434 [==============================] - 3s 0us/step
```

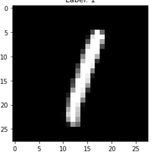


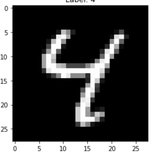


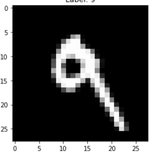


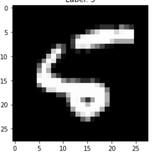


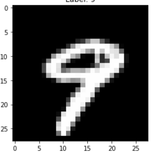












In [2]:

```
model = Sequential()
model.add(Conv2D(32, kernel_size=(3, 3),
                 activation='relu',
                 input_shape=(28, 28, 1)))
model.add(Conv2D(64, (3, 3), activation='relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Flatten())
model.add(Dense(128, activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))

# Compile model
model.compile(loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
              optimizer=tf.keras.optimizers.Adam(),
              metrics=['accuracy'])

# Train model
history = model.fit(x_train, y_train, epochs=10,
                    validation_data=(x_test, y_test))

# Test model
test_loss, test_acc = model.evaluate(x_test, y_test, verbose=2)
print("\nTest accuracy:", test_acc)
```

```
Epoch 1/10
D:\Anaconda\lib\site-packages\tensorflow\python\util\dispatch.py:1082: UserWarning: "`sparse_categorical_crossentropy` received `from_logits=True`, but the `output` argument was produced by a sigmoid or softmax activation and thus does not represent logits. Was this intended?"
  return dispatch_target(*args, **kwargs)
1875/1875 [==============================] - 172s 90ms/step - loss: 0.1837 - accuracy: 0.9448 - val_loss: 0.0494 - val_accuracy: 0.9821
Epoch 2/10
1875/1875 [==============================] - 163s 87ms/step - loss: 0.0785 - accuracy: 0.9762 - val_loss: 0.0345 - val_accuracy: 0.9881
Epoch 3/10
1875/1875 [==============================] - 198s 106ms/step - loss: 0.0602 - accuracy: 0.9813 - val_loss: 0.0290 - val_accuracy: 0.9897
Epoch 4/10
1875/1875 [==============================] - 196s 104ms/step - loss: 0.0490 - accuracy: 0.9850 - val_loss: 0.0288 - val_accuracy: 0.9906
Epoch 5/10
1875/1875 [==============================] - 209s 112ms/step - loss: 0.0418 - accuracy: 0.9870 - val_loss: 0.0272 - val_accuracy: 0.9916
Epoch 6/10
1875/1875 [==============================] - 211s 113ms/step - loss: 0.0364 - accuracy: 0.9887 - val_loss: 0.0261 - val_accuracy: 0.9918
Epoch 7/10
1875/1875 [==============================] - 201s 107ms/step - loss: 0.0324 - accuracy: 0.9899 - val_loss: 0.0304 - val_accuracy: 0.9916
Epoch 8/10
1875/1875 [==============================] - 118s 63ms/step - loss: 0.0292 - accuracy: 0.9908 - val_loss: 0.0276 - val_accuracy: 0.9923
Epoch 9/10
1875/1875 [==============================] - 94s 50ms/step - loss: 0.0242 - accuracy: 0.9919 - val_loss: 0.0291 - val_accuracy: 0.9927
Epoch 10/10
1875/1875 [==============================] - 94s 50ms/step - loss: 0.0236 - accuracy: 0.9927 - val_loss: 0.0303 - val_accuracy: 0.9910
313/313 - 3s - loss: 0.0303 - accuracy: 0.9910 - 3s/epoch - 11ms/step

Test accuracy: 0.9909999966621399
```