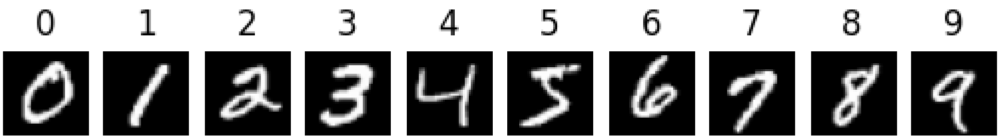
```python
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
from tensorflow.keras.optimizers import RMSprop
from tensorflow.keras.datasets import mnist


# Load the MNIST dataset
(x_train, y_train), (x_test, y_test) = mnist.load_data()


# Loop through each digit (0-9)
for digit in range(10):
    # Find the first occurrence of each digit in the training dataset
    index = np.where(y_train == digit)[0][0]

    # Display the image for this digit
    plt.subplot(1, 10, digit + 1)
    plt.imshow(x_train[index], cmap='gray')
    plt.title(f'{digit}')
    plt.axis('off')  # Hide axis for a cleaner view

# Show the plot with all digits
plt.show()
```




```python
# Normalize the image data to values between 0 and 1
x_train = x_train.reshape(60000, 784).astype('float32') / 255
x_test = x_test.reshape(10000, 784).astype('float32') / 255


# One-hot encoding for labels
y_train = np.eye(10)[y_train]
y_test = np.eye(10)[y_test]


# Define the model architecture
model = Sequential([
    Dense(512, activation='relu', input_shape=(784,)),
    Dropout(0.2),
    Dense(512, activation='relu'),
    Dropout(0.2),
    Dense(10, activation='softmax')
])
```

```
/usr/local/lib/python3.11/dist-packages/keras/src/layers/core/dense.py:87: Us
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

```
# Compile the model
model.compile(loss='categorical_crossentropy', optimizer=RMSprop(), metrics=['acc
```

```
Start coding or generate with AI.
```

```
# Train the model
model.fit(x_train, y_train, batch_size=128, epochs=20, validation_data=(x_test, y
```

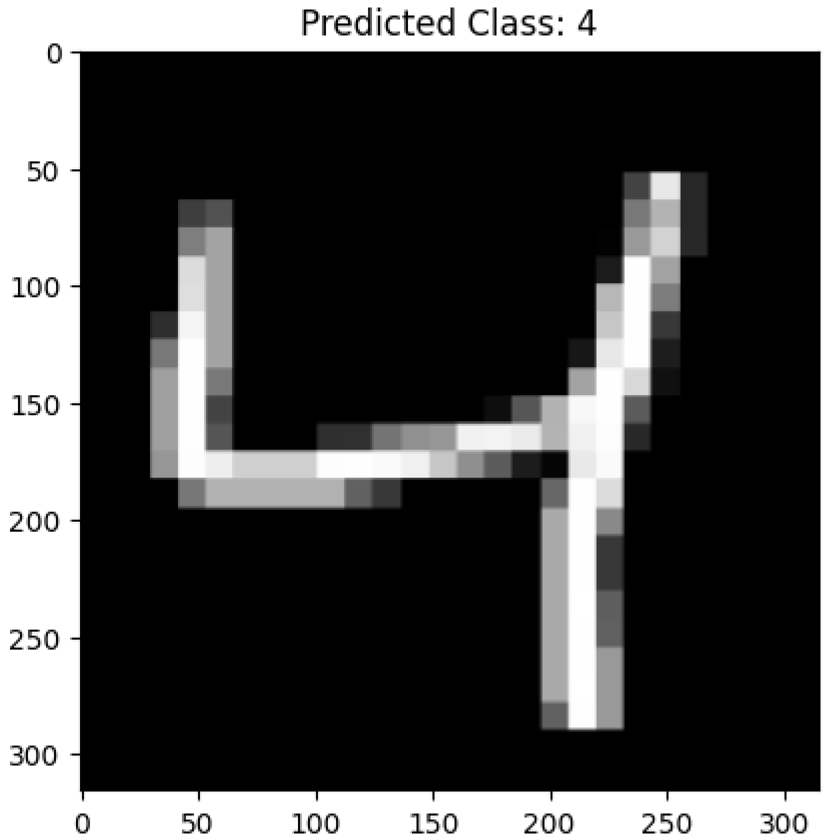
```
Epoch 1/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 13s 22ms/step - accuracy: 0.8591 - loss: 0.4456
Epoch 2/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 8s 18ms/step - accuracy: 0.9671 - loss: 0.1084 -
Epoch 3/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 21ms/step - accuracy: 0.9776 - loss: 0.0722
Epoch 4/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 21ms/step - accuracy: 0.9821 - loss: 0.0575
Epoch 5/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 9s 19ms/step - accuracy: 0.9848 - loss: 0.0458 -
Epoch 6/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 9s 19ms/step - accuracy: 0.9875 - loss: 0.0390 -
Epoch 7/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 21ms/step - accuracy: 0.9885 - loss: 0.0369
Epoch 8/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 20ms/step - accuracy: 0.9910 - loss: 0.0279
Epoch 9/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 8s 18ms/step - accuracy: 0.9919 - loss: 0.0246 -
Epoch 10/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 18ms/step - accuracy: 0.9926 - loss: 0.0225
Epoch 11/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 11s 21ms/step - accuracy: 0.9935 - loss: 0.0196
Epoch 12/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 21ms/step - accuracy: 0.9946 - loss: 0.0165
Epoch 13/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 21ms/step - accuracy: 0.9949 - loss: 0.0154
Epoch 14/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 9s 18ms/step - accuracy: 0.9954 - loss: 0.0156 -
Epoch 15/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 20ms/step - accuracy: 0.9958 - loss: 0.0134
Epoch 16/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 20ms/step - accuracy: 0.9959 - loss: 0.0117
Epoch 17/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 9s 20ms/step - accuracy: 0.9960 - loss: 0.0116 -
Epoch 18/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 9s 18ms/step - accuracy: 0.9962 - loss: 0.0117 -
Epoch 19/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 11s 19ms/step - accuracy: 0.9964 - loss: 0.0100
Epoch 20/20
469/469 ━━━━━━━━━━━━━━━━━━━━ 10s 21ms/step - accuracy: 0.9969 - loss: 0.0092
<keras.src.callbacks.history.History at 0x7aa4e1d617d0>
```

```
# Evaluate the model
score = model.evaluate(x_test, y_test, verbose=0)
print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

```
Test loss: 0.07435020804405212
Test accuracy: 0.9847000241279602
```

```
import numpy as np
import matplotlib.pyplot as plt
from PIL import Image
from tensorflow.keras.models import load_model

# Load the trained model (replace with your actual model)
# model = load_model('your_trained_model.h5')

# Load and preprocess the PNG image
def preprocess_image(image_path):
    # Open the image
    img = Image.open(image_path)

    # Convert to grayscale (if not already in grayscale)
    img = img.convert('L')

    # Resize the image to 28x28 (for MNIST, adjust based on your dataset)
    img = img.resize((28, 28))

    # Convert to a numpy array and normalize the pixel values to [0, 1]
    img_array = np.array(img) / 255.0

    # Reshape the image to match the input shape (1, 784) for MNIST
    img_array = img_array.reshape(1, 784)

    return img_array

# Path to the PNG image
image_path = 'four.png'  # Update this with your actual image path

# Preprocess the image
processed_image = preprocess_image(image_path)

# Predict the class using the trained model
prediction = model.predict(processed_image)

# Get the predicted class (index of the highest probability)
predicted_class = np.argmax(prediction)

# Display the image
img = Image.open(image_path)
plt.imshow(img, cmap='gray')
plt.title(f"Predicted Class: {predicted_class}")
plt.show()

print(f"Predicted Class: {predicted_class}")
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 80ms/step
```




```
Predicted Class: 4
```