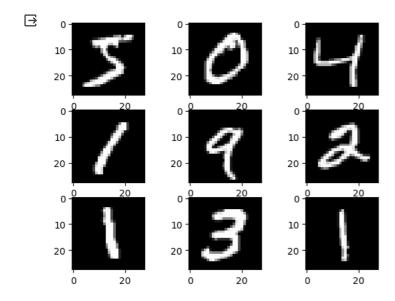
```
import numpy as np
import os

from tensorflow.keras.datasets import mnist
from matplotlib import pyplot as plt
(trainX, trainy), (testX, testy) = mnist.load_data()
print('Train: X=%s, y=%s' % (trainX.shape, trainy.shape))
print('Test: X=%s, y=%s' % (testX.shape, testy.shape))

Train: X=(60000, 28, 28), y=(60000,)
   Test: X=(10000, 28, 28), y=(10000,)

for i in range(9):
   plt.subplot(330 + 1 + i)
   plt.imshow(trainX[i], cmap=plt.get_cmap('gray'))
data = ...
```



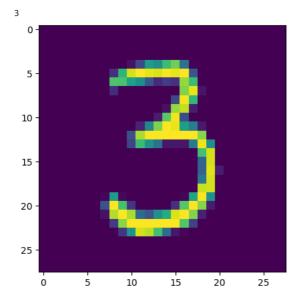
```
import matplotlib.pyplot as plt
import seaborn as sns
#import cv2
from PIL import Image
import tensorflow as tf
tf.random.set_seed(3)
from tensorflow import keras
from keras.datasets import mnist
from tensorflow.math import confusion_matrix
import random
(X_{train}, Y_{train}), (X_{test}, Y_{test}) = mnist.load_data()
type(X_train)
     numpy.ndarray
print(X_train.shape,Y_train.shape,X_test.shape,Y_test.shape)
     (60000, 28, 28) (60000,) (10000, 28, 28) (10000,)
print(X_train[9])
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print(X_train[9].shape)

(28, 28)

plt.imshow(X_train[50])
plt.show
print(Y_train[50])



print(Y_train.shape,Y_test.shape)

(60000,) (10000,)

```
# print unique value in Y_train
print(np.unique(Y_train))
# print unique value in Y_test
print(np.unique(Y_test))
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     [0 1 2 3 4 5 6 7 8 9]
X_{train} = X_{train}/255
X_{\text{test}} = X_{\text{test}}/255
print(X_train[9])
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model = keras.Sequential([
    keras.layers.Flatten(input_shape = (28,28)),
    keras.layers.Dense(50, activation = 'relu'),
    keras.layers.Dense(50, activation = 'relu'),
    keras.layers.Dense(10, activation = 'sigmoid')
])
model.compile(optimizer = 'adam',
              loss = 'sparse_categorical_crossentropy',
              metrics = ['accuracy'])
```

model.fit(X_train, Y_train,epochs = 10)

```
Epoch 1/10
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     Epoch 2/10
Enoch 3/10
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     Epoch 4/10
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        Epoch 5/10
1875/1875 [
          =========] - 4s 2ms/step - loss: 0.0678 - accuracy: 0.9790
Epoch 6/10
1875/1875 [
          =========] - 4s 2ms/step - loss: 0.0594 - accuracy: 0.9812
Epoch 7/10
1875/1875 [============ ] - 5s 3ms/step - loss: 0.0510 - accuracy: 0.9836
Epoch 8/10
Epoch 9/10
Epoch 10/10
<keras.src.callbacks.History at 0x7deb6d454340>
```

```
INDEX = random.randint(0,Y_test.shape[0])
actual = Y_test[INDEX]
pred = np.argmax(model.predict(np.array([X_test[INDEX]]))[0])
pred,actual
plt.imshow(X_test[INDEX])
plt.title(f'actual label : {actual}, predict label : {pred}')
plt.show()
```

1/1 [======] - 0s 96ms/step

