```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from keras.utils import np utils
from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, Dense, Flatten
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.models import load model
from PIL import Image, ImageOps
import numpy
(X train, y train), (X test, y test) = mnist.load data()
Downloading data from https://storage.googleapis.com/tensorflow/tf-
keras-datasets/mnist.npz
print(X train.shape)
print(X test.shape)
(60000, 28, 28)
(10000, 28, 28)
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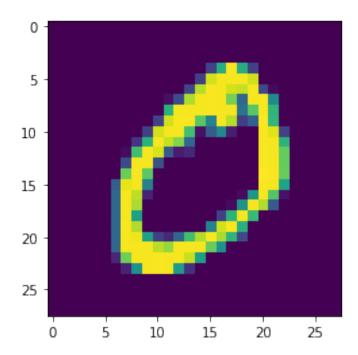
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y_train[0]

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plt.imshow(X_train[1])

<matplotlib.image.AxesImage at 0x7f7679f22b90>



```
X_train = X_train.reshape(60000, 28, 28, 1).astype('float32')
X_test = X_test.reshape(10000, 28, 28, 1).astype('float32')
```

number_of_classes = 10
Y_train = np_utils.to_categorical(y_train, number_of_classes)
Y_test = np_utils.to_categorical(y_test, number_of_classes)

```
Y train[0]
array([0., 0., 0., 0., 0., 1., 0., 0., 0., 0.], dtype=float32)
model = Sequential()
model.add(Conv2D(64, (3, 3), input_shape=(28, 28, 1),
activation="relu"))
model.add(Conv2D(32, (3, 3), activation="relu"))
model.add(Flatten())
model.add(Dense(number of classes, activation="softmax"))
model.compile(loss='categorical_crossentropy', optimizer="Adam",
metrics=["accuracy"])
model.fit(X_train, Y_train, batch_size=32, epochs=5,
validation data=(X test,Y test))
Epoch 1/5
0.1927 - accuracy: 0.9542 - val loss: 0.0764 - val accuracy: 0.9769
Epoch 2/5
0.0631 - accuracy: 0.9805 - val loss: 0.0838 - val accuracy: 0.9752
Epoch 3/5
0.0421 - accuracy: 0.9862 - val loss: 0.0839 - val accuracy: 0.9783
Epoch 4/5
0.0361 - accuracy: 0.9889 - val loss: 0.0956 - val accuracy: 0.9770
Epoch 5/5
0.0261 - accuracy: 0.9917 - val loss: 0.0900 - val accuracy: 0.9807
<keras.callbacks.History at 0x7f767a4f4190>
metrics = model.evaluate(X test, Y test, verbose=0)
print("Metrics (Test Loss & Test Accuracy): ")
print(metrics)
Metrics (Test Loss & Test Accuracy):
[0.0900242030620575, 0.9807000160217285]
prediction = model.predict(X test[:4])
print(prediction)
1/1 [=======] - 0s 103ms/step
[[2.1198963e-12 2.5143053e-16 2.9080804e-08 2.6923164e-08 1.0787076e-
 1.0072105e-12 3.8033966e-17 1.0000000e+00 2.4907893e-11 1.4726306e-
08]
 [1.6187166e-09 3.0472007e-12 9.9999833e-01 5.8330483e-09 6.1154418e-
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 [3.7463948e-07 9.8546553e-01 1.8378964e-03 2.5092066e-09 1.2474166e-
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  1.3331343e-07 9.2518391e-08 3.8755319e-05 1.8302012e-04 1.7161810e-
 [9.9964738e-01 6.1215101e-13 6.1620986e-10 4.1869831e-11 2.5735805e-
10
  2.0356998e-09 3.5265239e-04 1.3145517e-10 9.6421496e-11 3.6439904e-
08]]
print(numpy.argmax(prediction, axis=1))
print(Y_test[:4])
[7 2 1 0]
[[0. 0. 0. 0. 0. 0. 0. 1. 0. 0.]
 [0. 0. 1. 0. 0. 0. 0. 0. 0. 0.]
 [0. 1. 0. 0. 0. 0. 0. 0. 0. 0.]
 [1. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
model.save("model.h5")
model=load model("model.h5")
from keras.datasets import mnist
from matplotlib import pyplot
(X_train,y_train),(X_test,y_test)=mnist.load_data()
print('X train:' +str(X train.shape))
print('y_train:' +str(y_train.shape))
print('X_test:' +str(X_test.shape))
print('y_test:' +str(y_test.shape))
from matplotlib import pyplot
for i in range(9):
  pyplot.subplot(330+1+i)
  pyplot.imshow(X train[i],cmap=pyplot.get cmap('gray'))
  pyplot.show()
X train: (60000, 28, 28)
y train:(60000,)
X_test:(10000, 28, 28)
y_test:(10000,)
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```

