Project Development Phase

Sprint 1

MNIST Dataset Pre-processing

Date	2 November 2022
Team ID	PNT2022TMID41032
Project Name	A Novel Method For Handwritten Digit Recognition System
Maximum Marks	4 Marks

Understanding the Data

Importing the required libraries

```
import numpy as np
import tensorflow
from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.layers import Conv2D
from keras.optimizers import Adam
from keras.utils import np_utils
Import matplotlib.pyplot as plt
```

loading data

Input:

```
(X_train,y_train) ,( X_test,y_test)=mnist.load_data()
```

Output:

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

Input:

```
Print)x_train.shape)
Print)x_test.shape)
```

Output:

```
(60000, 28, 28)
(10000, 28, 28)
```

Analyzing the data

Input:

X_train[0]

Output:

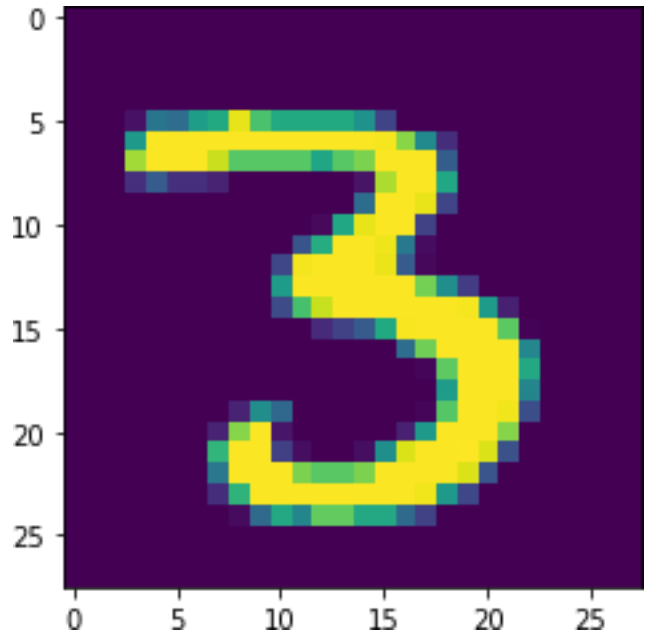
```
array([[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   3,
         18,  18,  18, 126, 136, 175,  26, 166, 255, 247, 127,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,  30,  36,  94, 154, 170,
        253, 253, 253, 253, 253, 225, 172, 253, 242, 195,  64,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,  49, 238, 253, 253, 253, 253,
        253, 253, 253, 253, 251,  93,  82,  82,  56,  39,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,  18, 219, 253, 253, 253, 253,
        253, 198, 182, 247, 241,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,  80, 156, 107, 253, 253,
        205,  11,   0,  43, 154,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,  14,   1, 154, 253,
         90,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 139, 253,
        190,   2,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  11, 190,
        253,  70,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  35,
        241, 225, 160, 108,   1,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
         81, 240, 253, 253, 119,  25,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
```

```
    0,  45, 186, 253, 253, 150,  27,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,  16,  93, 252, 253, 187,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0, 249, 253, 249,  64,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,  46, 130, 183, 253, 253, 207,   2,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  39,
   148, 229, 253, 253, 253, 250, 182,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  24, 114, 221,
   253, 253, 253, 253, 201,  78,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,   0,   0,  23,  66, 213, 253, 253,
   253, 253, 198,  81,   2,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,  18, 171, 219, 253, 253, 253, 253,
   195,  80,   9,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,  55, 172, 226, 253, 253, 253, 253, 244, 133,
    11,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0, 136, 253, 253, 253, 212, 135, 132,  16,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
  [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0]], dtype=uint8)
```

Input:

```
plt.imshow(X_train[500000
])
```

Output:



Input:

```
np.argmax(y_train[5000])
```

Output:

```
0
```

Reshaping the data

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

Apply one-Hot Encoding

```
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)
```