#Understanding the Data (Sprint-1)

TEAM ID:PNT2022TMID43734

```python
#Import all Necessary Libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.datasets import mnist

(x_train,y_train),(x_test,y_test)=mnist.load_data()

x_train
```

```
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, 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)
```

```python
x_train.shape
```

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

```python
one_img = x_train[0]
```

```python
one_img.shape
```

```
(28, 28)
```

```python
one_img
```

```
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,
```
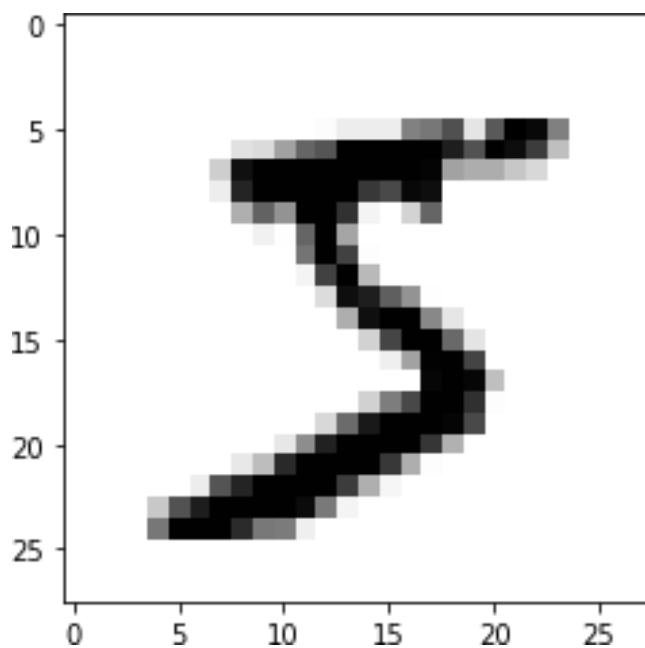
```
3,
          18,  18,  18, 126, 136, 175,  26, 166, 255, 247, 127,   0,
  0,
           0,   0],
        [  0,   0,   0,   0,   0,   0,   0,   0,  30,  36,  94, 154,
170,
         253, 253, 253, 253, 253, 225, 172, 253, 242, 195,  64,   0,
  0,
           0,   0],
        [  0,   0,   0,   0,   0,   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)
```

```python
#plot the single image
plt.imshow(one_img,cmap='binary')
```

```
<matplotlib.image.AxesImage at 0x7f36882992d0>
```



```python
y_train
```

```
array([5, 0, 4, ..., 5, 6, 8], dtype=uint8)
```

```python
#categories the data
from tensorflow.keras.utils import to_categorical
```

```python
y_train.shape
```

```
(60000,)
```

```python
y_example = to_categorical(y_train)
print(y_example,y_example.shape)
```

```
[[0. 0. 0. ... 0. 0. 0.]
 [1. 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. 1. 0.]] (60000, 10)
```

```python
y_example[0]
```

```
array([0., 0., 0., 0., 0., 1., 0., 0., 0., 0.], dtype=float32)
```

```python
y_cat_test = to_categorical(y_test,num_classes=10)
```

```python
y_cat_train = to_categorical(y_train,10)
```

```python
one_img.max(),one_img.min()
```

```
(255, 0)
```

```python
x_train = x_train/255
x_test = x_test/255
```

```python
scaled_img = x_train[0]
scaled_img
```

```
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.        , 0.01176471, 0.07058824, 0.07058824,
  0.07058824, 0.49411765, 0.53333333, 0.68627451, 0.10196078,
  0.65098039, 1.        , 0.96862745, 0.49803922, 0.        ,
  0.        , 0.        , 0.        ],
 [0.        , 0.        , 0.        , 0.        , 0.        ,
  0.        , 0.        , 0.        , 0.11764706, 0.14117647,
  0.36862745, 0.60392157, 0.66666667, 0.99215686, 0.99215686,
  0.99215686, 0.99215686, 0.99215686, 0.88235294, 0.6745098 ,
  0.99215686, 0.94901961, 0.76470588, 0.25098039, 0.        ,
  0.        , 0.        , 0.        ],
 [0.        , 0.        , 0.        , 0.        , 0.        ,
  0.        , 0.        , 0.19215686, 0.93333333, 0.99215686,
  0.99215686, 0.99215686, 0.99215686, 0.99215686, 0.99215686,
  0.99215686, 0.99215686, 0.98431373, 0.36470588, 0.32156863,
  0.32156863, 0.21960784, 0.15294118, 0.        , 0.        ,
  0.        , 0.        , 0.        ],
 [0.        , 0.        , 0.        , 0.        , 0.        ,
  0.        , 0.        , 0.07058824, 0.85882353, 0.99215686,
  0.99215686, 0.99215686, 0.99215686, 0.99215686, 0.77647059,
  0.71372549, 0.96862745, 0.94509804, 0.        , 0.        ,
  0.        , 0.        , 0.        , 0.        , 0.        ,
  0.        , 0.        , 0.        ],
 [0.        , 0.        , 0.        , 0.        , 0.        ,
  0.        , 0.        , 0.        , 0.31372549, 0.61176471,
  0.41960784, 0.99215686, 0.99215686, 0.80392157, 0.04313725,
  0.        , 0.16862745, 0.60392157, 0.        , 0.        ,
  0.        , 0.        , 0.        , 0.        , 0.        ,
  0.        , 0.        , 0.        ],
 [0.        , 0.        , 0.        , 0.        , 0.        ,
  0.        , 0.        , 0.        , 0.        , 0.05490196,
  0.00392157, 0.60392157, 0.99215686, 0.35294118, 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.        , 0.54509804, 0.99215686, 0.74509804, 0.00784314,
  0.        , 0.        , 0.        , 0.        , 0.        ,
  0.        , 0.        , 0.        , 0.        , 0.        ,
  0.        , 0.        , 0.        ],
 [0.        , 0.        , 0.        , 0.        , 0.        ,
```

```
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.04313725, 0.74509804, 0.99215686, 0.2745098 ,
 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.        , 0.1372549 , 0.94509804, 0.88235294,
 0.62745098, 0.42352941, 0.00392157, 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        ],
[0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.31764706, 0.94117647,
 0.99215686, 0.99215686, 0.46666667, 0.09803922, 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        ],
[0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.17647059,
 0.72941176, 0.99215686, 0.99215686, 0.58823529, 0.10588235,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        ],
[0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.0627451 , 0.36470588, 0.98823529, 0.99215686, 0.73333333,
 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.        , 0.97647059, 0.99215686, 0.97647059,
 0.25098039, 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        ],
[0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.18039216,
 0.50980392, 0.71764706, 0.99215686, 0.99215686, 0.81176471,
 0.00784314, 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        ],
[0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.15294118, 0.58039216, 0.89803922,
 0.99215686, 0.99215686, 0.99215686, 0.98039216, 0.71372549,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        ],
[0.        , 0.        , 0.        , 0.        , 0.        ,
 0.        , 0.        , 0.        , 0.        , 0.        ,
 0.09411765, 0.44705882, 0.86666667, 0.99215686, 0.99215686,
```

```
        0.99215686, 0.99215686, 0.78823529, 0.30588235, 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        ],
       [0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.09019608, 0.25882353,
        0.83529412, 0.99215686, 0.99215686, 0.99215686, 0.99215686,
        0.77647059, 0.31764706, 0.00784314, 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        ],
       [0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.07058824, 0.67058824, 0.85882353, 0.99215686,
        0.99215686, 0.99215686, 0.99215686, 0.76470588, 0.31372549,
        0.03529412, 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        ],
       [0.        , 0.        , 0.        , 0.        , 0.21568627,
        0.6745098 , 0.88627451, 0.99215686, 0.99215686, 0.99215686,
        0.99215686, 0.95686275, 0.52156863, 0.04313725, 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        ],
       [0.        , 0.        , 0.        , 0.        , 0.53333333,
        0.99215686, 0.99215686, 0.99215686, 0.83137255, 0.52941176,
        0.51764706, 0.0627451 , 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.        ]])

#reshape the scaled data
x_train = x_train.reshape(60000,28,28,1)
x_test = x_test.reshape(10000,28,28,1)

x_train.shape,x_test.shape
```

```
((60000, 28, 28, 1), (10000, 28, 28, 1))
```