TEAM ID:PNT2022TMID10729

#understanding the data (sprint 1)

```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)
```

x_train.shape (60000, 28, 28) one_img =

x_train[0] one_img.shape (28, 28) 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')
```
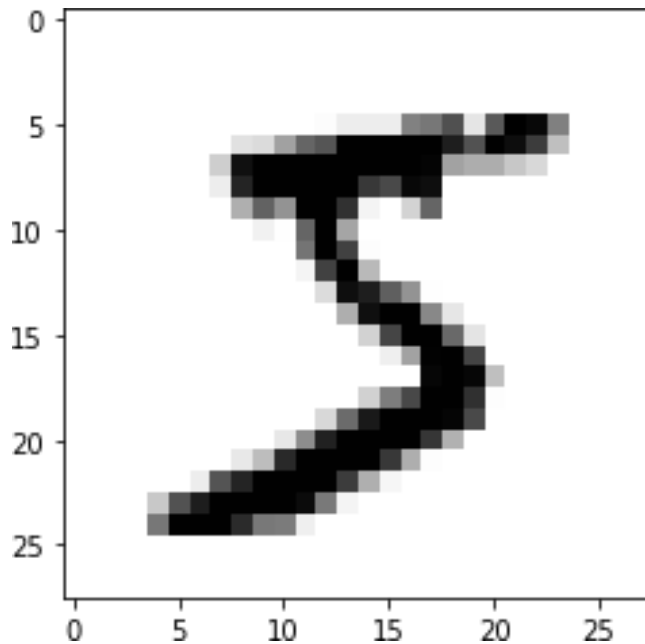
```
<matplotlib.image.AxesImage at 0x7f36882992d0>
```



```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) y_cat_train

= to_categorical(y_train,10) one_img.max(),one_img.min()
```

```
(255, 0)
```

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

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.        , 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.        ]])
```

```python
#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))
```