

# Understanding the Data

```
In [1]: pwd
```

```
Out[1]: '/home/wsuser/work'
```

```
In [2]: #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_v2
from keras.utils import np_utils
```

```
In [3]: #Loading data
(X_train,y_train) , (X_test,y_test)=mnist.load_data()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz
11493376/11490434 [=====] - 0s 0us/step
11501568/11490434 [=====] - 0s 0us/step
```

```
In [4]: print(X_train.shape)
print(X_test.shape)
```

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

## Analyzing the data

## Understanding the Data

```
In [5]: X_train[0]
```

```
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,
        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, 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, 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, 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, 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,
 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, 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, 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,
 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, 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, 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, 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]], dtype=uint8)

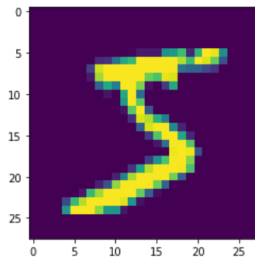
```

```
In [6]: y_train[0]
```

```
Out[6]: 5
```

```
In [7]: import matplotlib.pyplot as plt
plt.imshow(X_train[0])
```

```
Out[7]:
```



## Reshaping the data

```
In [8]: 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

```
In [9]: 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)
```

```
In [10]: y_train[0]
```

```
Out[10]: array([0., 0., 0., 0., 0., 1., 0., 0., 0., 0.], dtype=float32)
```