```
import numpy
import tensorflow
from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras import layers
from tensorflow.keras.layers import Dense,Flatten
from tensorflow.keras.layers import Conv2D
from tensorflow import keras
from tensorflow.keras.optimizers import Adam
from keras.utils import np_utils
(x_train,y_train),(x_test,y_test)=mnist.load_data()
print(x_train.shape)
print(y_train.shape)
(60000, 28, 28)
(60000,)
print(x_test.shape)
print(y_test.shape)
(10000, 28, 28)
(10000,)
x_train[3]
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, 124, 253, 255, 63, 0, 0, 0, 0,
 0, 0],
[ 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
 0, 0, 0, 0, 96, 244, 251, 253, 62, 0, 0, 0, 0,
 0, 0],
[ 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
 0, 0, 0, 0, 127, 251, 251, 253, 62, 0, 0, 0, 0,
 0, 0],
[ 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
 0, 0, 0, 68, 236, 251, 211, 31, 8, 0, 0, 0, 0,
 0, 0],
[ 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
 0, 0, 60, 228, 251, 251, 94, 0, 0, 0, 0, 0, 0,
```

```
      0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
      0,   0, 155, 253, 253, 189,   0,   0,   0,   0,   0,   0,   0,
      0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
      0,  20, 253, 251, 235,  66,   0,   0,   0,   0,   0,   0,   0,
      0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
     32, 205, 253, 251, 126,   0,   0,   0,   0,   0,   0,   0,   0,
      0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    104, 251, 253, 184,  15,   0,   0,   0,   0,   0,   0,   0,   0,
      0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  80,
    240, 251, 193,  23,   0,   0,   0,   0,   0,   0,   0,   0,   0,
      0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  32, 253,
    253, 253, 159,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
      0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 151, 251,
    251, 251,  39,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
      0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  48, 221, 251,
    251, 172,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
      0,   0],
```

```
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 234, 251, 251,
 196,  12,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 253, 251, 251,
  89,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0, 159, 255, 253, 253,
  31,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  48, 228, 253, 247, 140,
   8,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  64, 251, 253, 220,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  64, 251, 253, 220,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  24, 193, 253, 220,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
```

```
        0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
        0,   0],
    [   0,   0,   0,   0,   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)
```

```
y_train[36]
```

```
6
```

```
import matplotlib.pyplot as plt
plt.imshow(x_train[36])
```

```
import numpy
import tensorflow
from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras import layers
from tensorflow.keras.layers import Dense,Flatten
from tensorflow.keras.layers import Conv2D
from tensorflow import keras
from tensorflow.keras.optimizers import Adam
from keras.utils import np_utils
(x_train,y_train),(x_test,y_test)=mnist.load_data()
print(x_train.shape)
print(y_train.shape)
```

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

```
print(x_test.shape)

print(y_test.shape)

(10000, 28, 28)

(10000,)

x_train[3]

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, 124, 253, 255,   63,    0,    0,    0,    0,
           0,    0],
       [   0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
           0,    0,    0,    0,   96, 244, 251, 253,   62,    0,    0,    0,    0,
```

```
    0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,   0, 127, 251, 251, 253,  62,   0,   0,   0,   0,
    0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,   0,  68, 236, 251, 211,  31,   8,   0,   0,   0,   0,
    0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0,  60, 228, 251, 251,  94,   0,   0,   0,   0,   0,   0,
    0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0, 155, 253, 253, 189,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,  20, 253, 251, 235,  66,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   32, 205, 253, 251, 126,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
  104, 251, 253, 184,  15,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
[   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  80,
  240, 251, 193,  23,   0,   0,   0,   0,   0,   0,   0,   0,   0,
    0,   0],
```

```
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  32, 253,
 253, 253, 159,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 151, 251,
 251, 251,  39,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  48, 221, 251,
 251, 172,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 234, 251, 251,
 196,  12,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 253, 251, 251,
  89,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0, 159, 255, 253, 253,
  31,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  48, 228, 253, 247, 140,
   8,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  64, 251, 253, 220,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  64, 251, 253, 220,   0,
```

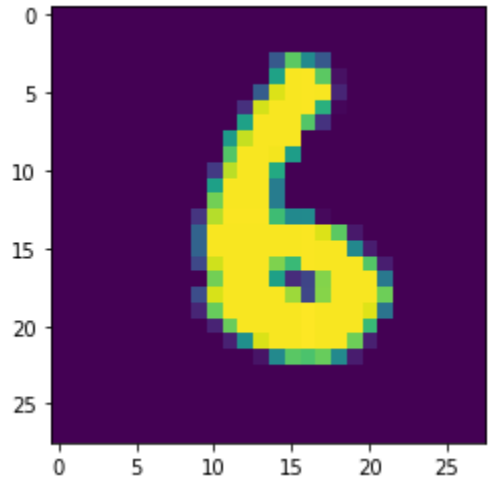
```
        0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
        0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,  24, 193, 253, 220,   0,
        0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
        0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
        0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
        0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
        0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
        0,   0],
       [  0,   0,   0,   0,   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)
```

```
y_train[36]
```

```
6
```

```
import matplotlib.pyplot as plt

plt.imshow(x_train[36])
```



```
x_train=x_train.reshape(60000,28,28,1).astype('float32')

x_test=x_test.reshape(10000,28,28,1).astype('float32')

no_of_classes=10

y_train=np_utils.to_categorical(y_train,no_of_classes)

y_test=np_utils.to_categorical(y_test,no_of_classes)

y_test[3]

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