```
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()

Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz

11490434/11490434 [==============================] - 0s 0us/step

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]],
```

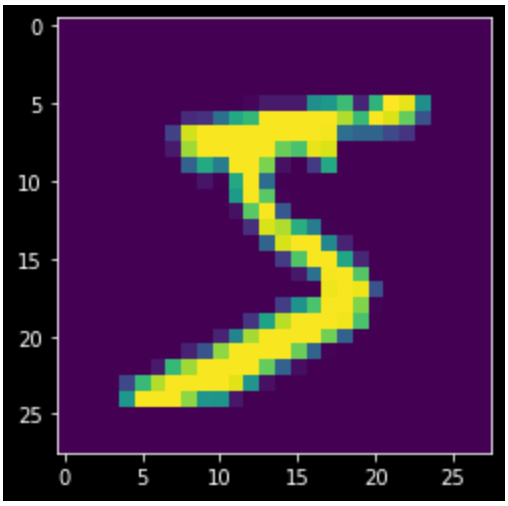
```
[[0, 0, 0, ..., 0, 0, 0],
  [0, 0, 0, ..., 0, 0, 0],
  [0, 0, 0, ..., 0, 0, 0],
  ...,
  [0, 0, 0, ..., 0, 0, 0],
  [0, 0, 0, ..., 0, 0, 0],
  [0, 0, 0, ..., 0, 0, 0]],

...,

[[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)
plt.imshow(one_img,cmap='binary')
```



y_train

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

from tensorflow.keras.utils import to_categorical

y_train.shape

(60000,)

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)

y_example[0]

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

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)

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.        ]])
```

```
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))

from keras.models import Sequential

from keras.layers import Dense, Dropout, Flatten

from keras.layers import Conv2D, MaxPool2D

model = Sequential()

model.add(Conv2D(filters=32, kernel_size=(4,4),activation='relu',input_shape=(28,28,1)))

model.add(MaxPool2D(pool_size=(2,2)))

model.add(Flatten())

model.add(Dense(128,activation='relu'))

model.add(Dense(10,activation='softmax'))

model.compile(loss='categorical_crossentropy',optimizer='Adadelta',metrics=['accuracy'])

from tensorflow.keras.callbacks import EarlyStopping

early_stop = EarlyStopping(monitor='val-loss', patience=1)

model.fit(x_train,y_cat_train,

          epochs=15,

          validation_data=(x_test,y_cat_test),

          callbacks=[early_stop])

Epoch 1/15

1875/1875 [==============================] - ETA: 0s - loss: 2.1605 - accuracy: 0.3975

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 39s 20ms/step - loss: 2.1605 - accuracy: 0.3975 - val_loss: 2.0075 - val_accuracy: 0.6398
```

Epoch 2/15

1875/1875 [==============================] - ETA: 0s - loss: 1.8521 - accuracy: 0.7126

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 39s 21ms/step - loss: 1.8521 - accuracy: 0.7126 - val_loss: 1.6793 - val_accuracy: 0.7678

Epoch 3/15

1874/1875 [==============================>.] - ETA: 0s - loss: 1.5166 - accuracy: 0.7804

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 1.5166 - accuracy: 0.7804 - val_loss: 1.3403 - val_accuracy: 0.8016

Epoch 4/15

1874/1875 [==============================>.] - ETA: 0s - loss: 1.2043 - accuracy: 0.8038

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 46s 24ms/step - loss: 1.2043 - accuracy: 0.8038 - val_loss: 1.0556 - val_accuracy: 0.8203

Epoch 5/15

1875/1875 [==============================] - ETA: 0s - loss: 0.9645 - accuracy: 0.8206

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.9645 - accuracy: 0.8206 - val_loss: 0.8526 - val_accuracy: 0.8351

Epoch 6/15

1874/1875 [==============================>.] - ETA: 0s - loss: 0.7993 - accuracy: 0.8334

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 39s 21ms/step - loss: 0.7993 - accuracy: 0.8334 -

val_loss: 0.7165 - val_accuracy: 0.8497

Epoch 7/15

1874/1875 [==============================>.] - ETA: 0s - loss: 0.6882 - accuracy: 0.8447

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.6881 - accuracy: 0.8447 - val_loss: 0.6242 - val_accuracy: 0.8598

Epoch 8/15

1874/1875 [==============================>.] - ETA: 0s - loss: 0.6110 - accuracy: 0.8548

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.6111 - accuracy: 0.8548 - val_loss: 0.5594 - val_accuracy: 0.8690

Epoch 9/15

1874/1875 [==============================>.] - ETA: 0s - loss: 0.5558 - accuracy: 0.8633

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.5559 - accuracy: 0.8633 - val_loss: 0.5121 - val_accuracy: 0.8772

Epoch 10/15

1874/1875 [==============================>.] - ETA: 0s - loss: 0.5147 - accuracy: 0.8702

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.5146 - accuracy: 0.8702 - val_loss: 0.4766 - val_accuracy: 0.8824

Epoch 11/15

1875/1875 [==============================] - ETA: 0s - loss: 0.4827 - accuracy: 0.8753

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.4827 - accuracy: 0.8753 - val_loss: 0.4484 - val_accuracy: 0.8883

Epoch 12/15

1874/1875 [==============================>.] - ETA: 0s - loss: 0.4575 - accuracy: 0.8796

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.4575 - accuracy: 0.8796 - val_loss: 0.4261 - val_accuracy: 0.8921

Epoch 13/15

1875/1875 [==============================] - ETA: 0s - loss: 0.4369 - accuracy: 0.8838

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.4369 - accuracy: 0.8838 - val_loss: 0.4079 - val_accuracy: 0.8947

Epoch 14/15

1875/1875 [==============================] - ETA: 0s - loss: 0.4198 - accuracy: 0.8870

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.4198 - accuracy: 0.8870 - val_loss: 0.3923 - val_accuracy: 0.8983

Epoch 15/15

1875/1875 [==============================] - ETA: 0s - loss: 0.4054 - accuracy: 0.8904

WARNING:tensorflow:Early stopping conditioned on metric `val-loss` which is not available. Available metrics are: loss,accuracy,val_loss,val_accuracy

1875/1875 [==============================] - 38s 20ms/step - loss: 0.4054 - accuracy: 0.8904 - val_loss: 0.3794 - val_accuracy: 0.9008