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,

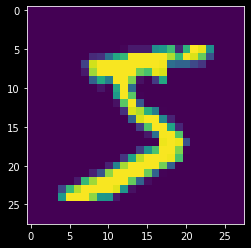
0, 0],

[ 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