**Team ID:PNT2022TMID43906**

**Importing the required libraries**

!pip install tensorflow --upgrade

Requirement already satisfied: tensorflow in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (2.10.0)

Requirement already satisfied: setuptools in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (58.0.4)

Requirement already satisfied: gast<=0.4.0,>=0.2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (0.4.0)

Requirement already satisfied: h5py>=2.9.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (3.2.1)

Requirement already satisfied: absl-py>=1.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.3.0)

Requirement already satisfied: opt-einsum>=2.3.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (3.3.0)

Requirement already satisfied: astunparse>=1.6.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.6.3)

Requirement already satisfied: packaging in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (21.3)

Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (0.23.1)

Requirement already satisfied: typing-extensions>=3.6.6 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (4.1.1)

Requirement already satisfied: protobuf<3.20,>=3.9.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (3.19.1)

Requirement already satisfied: libclang>=13.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (14.0.6)

Requirement already satisfied: numpy>=1.20 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.20.3)

Requirement already satisfied: grpcio<2.0,>=1.24.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.42.0)

Requirement already satisfied: tensorflow-estimator<2.11,>=2.10.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (2.10.0)

Requirement already satisfied: wrapt>=1.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.12.1)

Requirement already satisfied: six>=1.12.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.15.0)

Requirement already satisfied: keras-preprocessing>=1.1.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.1.2)

Requirement already satisfied: termcolor>=1.1.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.1.0)

Requirement already satisfied: flatbuffers>=2.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (2.0)

Requirement already satisfied: keras<2.11,>=2.10.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (2.10.0)

Requirement already satisfied: tensorboard<2.11,>=2.10 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (2.10.1)

Requirement already satisfied: google-pasta>=0.1.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (0.2.0)

Requirement already satisfied: wheel<1.0,>=0.23.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from astunparse>=1.6.0->tensorflow) (0.37.0)

Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorboard<2.11,>=2.10->tensorflow) (0.4.4)

Requirement already satisfied: requests<3,>=2.21.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorboard<2.11,>=2.10->tensorflow) (2.26.0)

Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorboard<2.11,>=2.10->tensorflow) (1.6.0)

Requirement already satisfied: google-auth<3,>=1.6.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorboard<2.11,>=2.10->tensorflow) (1.23.0)

Requirement already satisfied: werkzeug>=1.0.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorboard<2.11,>=2.10->tensorflow) (2.0.2)

Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorboard<2.11,>=2.10->tensorflow) (0.6.1)

Requirement already satisfied: markdown>=2.6.8 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorboard<2.11,>=2.10->tensorflow) (3.3.3)

Requirement already satisfied: cachetools<5.0,>=2.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.11,>=2.10->tensorflow) (4.2.2)

Requirement already satisfied: pyasn1-modules>=0.2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.11,>=2.10->tensorflow) (0.2.8)

Requirement already satisfied: rsa<5,>=3.1.4 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.11,>=2.10->tensorflow) (4.7.2)

Requirement already satisfied: requests-oauthlib>=0.7.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.11,>=2.10->tensorflow) (1.3.0)

Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.11,>=2.10->tensorflow) (0.4.8)

Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests<3,>=2.21.0->tensorboard<2.11,>=2.10->tensorflow) (2.0.4)

Requirement already satisfied: idna<4,>=2.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests<3,>=2.21.0->tensorboard<2.11,>=2.10->tensorflow) (3.3)

Requirement already satisfied: certifi>=2017.4.17 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests<3,>=2.21.0->tensorboard<2.11,>=2.10->tensorflow) (2022.9.24)

Requirement already satisfied: urllib3<1.27,>=1.21.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests<3,>=2.21.0->tensorboard<2.11,>=2.10->tensorflow) (1.26.7)

Requirement already satisfied: oauthlib>=3.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.11,>=2.10->tensorflow) (3.2.1)

Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from packaging->tensorflow) (3.0.4)

import numpy as np

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 keras.optimizers import Adam

from keras. utils import np\_utils

import matplotlib.pyplot as plt

**Load data**

(x\_train, y\_train), (x\_test, y\_test)=mnist.load\_data () #splitting the mnist data into train and test

print (x\_train.shape) #shape is used for give the dimens ion values #60000-rows 28x28-pixels

print (x\_test.shape)

(60000, 28, 28)

(10000, 28, 28)

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, 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,

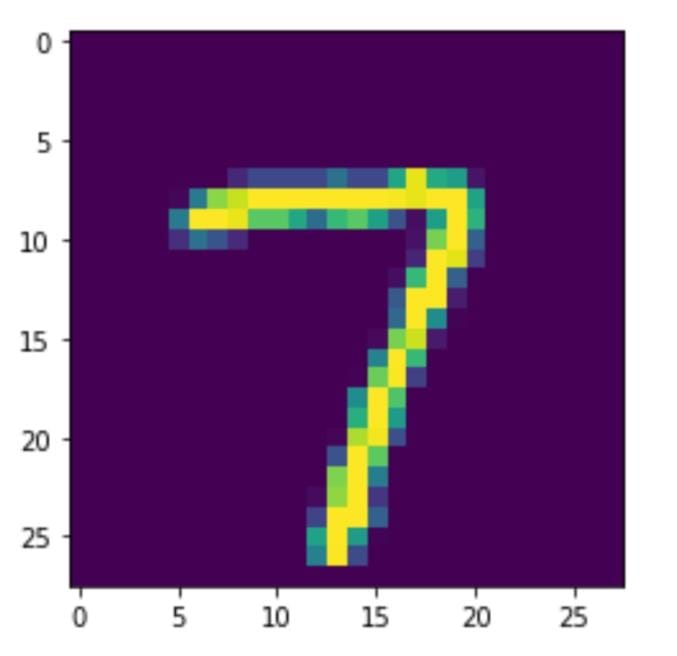
0, 0],

[ 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(x\_train[5100]) #ploting the index=image



np.argmax(y\_train[5100])

0

**Reshaping Dataset**

#Reshaping to format which CNN expects (batch, height, width, channels)

x\_train=x\_train.reshape (60000, 28, 28, 1).astype('float32')

x\_test=x\_test.reshape (10000, 28, 28, 1).astype ('float32')

**Applying One Hot Encoding**

number\_of\_classes = 10 #storing the no of classes in a variable

y\_train = np\_utils.to\_categorical (y\_train, number\_of\_classes) #converts the output in binary format

y\_test = np\_utils.to\_categorical (y\_test, number\_of\_classes)

**Add CNN Layers**

#create model

model=Sequential ()

#adding modeL Layer

model.add(Conv2D(64, (3, 3), input\_shape=(28, 28, 1), activation='relu'))

model.add(Conv2D(32, (3, 3), activation = 'relu'))

#flatten the dimension of the image

model.add(Flatten())

#output layer with 10 neurons

model.add(Dense(number\_of\_classes,activation = 'softmax'))

**Compiling the model**

#Compile model

model.compile(loss= 'categorical\_crossentropy', optimizer="Adam", metrics=['accuracy'])

x\_train = np.asarray(x\_train)

y\_train = np.asarray(y\_train)

**Train the model**

#fit the model

model.fit(x\_train, y\_train, validation\_data=(x\_test, y\_test), epochs=5, batch\_size=32)

Epoch 1/5

1875/1875 [==============================] - 216s 115ms/step - loss: 0.2739 - accuracy: 0.9499 - val\_loss: 0.1067 - val\_accuracy: 0.9690

Epoch 2/5

1875/1875 [==============================] - 205s 109ms/step - loss: 0.0724 - accuracy: 0.9779 - val\_loss: 0.0930 - val\_accuracy: 0.9718

Epoch 3/5

1875/1875 [==============================] - 206s 110ms/step - loss: 0.0509 - accuracy: 0.9841 - val\_loss: 0.0899 - val\_accuracy: 0.9749

Epoch 4/5

1875/1875 [==============================] - 201s 107ms/step - loss: 0.0403 - accuracy: 0.9875 - val\_loss: 0.0905 - val\_accuracy: 0.9763

Epoch 5/5

1875/1875 [==============================] - 199s 106ms/step - loss: 0.0289 - accuracy: 0.9906 - val\_loss: 0.0885 - val\_accuracy: 0.9773

**Observing the metrics**

# Final evaluation of the model

metrics = model.evaluate(x\_test, y\_test, verbose=0)

print("Metrics (Test loss &Test Accuracy) : ")

print(metrics)

Metrics (Test loss &Test Accuracy) :

[0.08848220854997635, 0.9772999882698059]

**Test The Model**

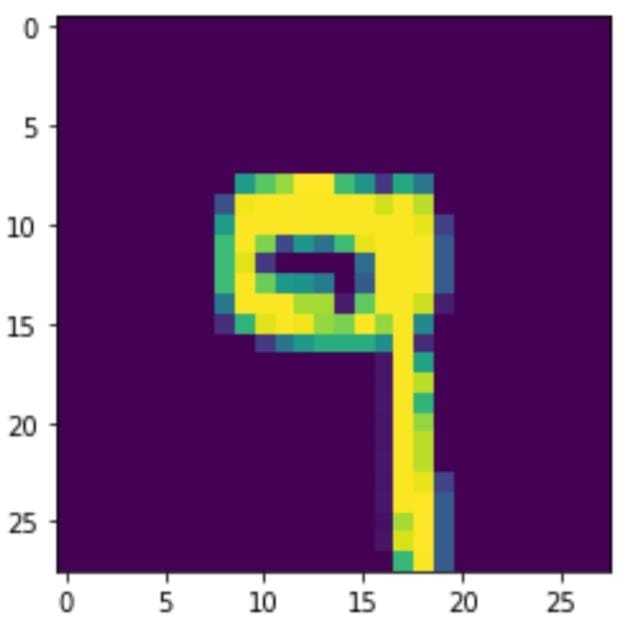
prediction=model.predict(x\_test[6000:6001])

print(prediction)

1/1 [==============================] - 0s 103ms/step

[[5.4288979e-13 6.3697273e-13 8.3372931e-10 6.7059277e-06 1.0848880e-01

1.1161150e-05 2.1058578e-12 4.7689871e-05 6.4801867e-04 8.9079767e-01]]



plt.imshow(x\_test[6000])

import numpy as np

print(np.argmax(prediction, axis=1)) #printing our Labels from first 4 images

[9]

np.argmax(y\_test[6000:6001]) #printing the actual labels

9

**Save The model**

# Save the model

model.save('models/mnistCNN.h5')

cd models

/home/wsuser/work/models/models

!tar -zcvf hdr\_deployment.tgz mnistCNN.h5

mnistCNN.h5

ls -1

hdr\_deployment.tgz

mnistCNN.h5

!pip install watson-machine-learning-client --upgrade

Requirement already satisfied: watson-machine-learning-client in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (1.0.391)

Requirement already satisfied: ibm-cos-sdk in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.11.0)

Requirement already satisfied: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2022.9.24)

Requirement already satisfied: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.26.7)

Requirement already satisfied: pandas in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.3.4)

Requirement already satisfied: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.3.3)

Requirement already satisfied: tabulate in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.8.9)

Requirement already satisfied: boto3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.18.21)

Requirement already satisfied: tqdm in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (4.62.3)

Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.26.0)

Requirement already satisfied: s3transfer<0.6.0,>=0.5.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (0.5.0)

Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (0.10.0)

Requirement already satisfied: botocore<1.22.0,>=1.21.21 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (1.21.41)

Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from botocore<1.22.0,>=1.21.21->boto3->watson-machine-learning-client) (2.8.2)

Requirement already satisfied: six>=1.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from python-dateutil<3.0.0,>=2.1->botocore<1.22.0,>=1.21.21->boto3->watson-machine-learning-client) (1.15.0)

Requirement already satisfied: ibm-cos-sdk-core==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk->watson-machine-learning-client) (2.11.0)

Requirement already satisfied: ibm-cos-sdk-s3transfer==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk->watson-machine-learning-client) (2.11.0)

Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->watson-machine-learning-client) (2.0.4)

Requirement already satisfied: idna<4,>=2.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->watson-machine-learning-client) (3.3)

Requirement already satisfied: pytz>=2017.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas->watson-machine-learning-client) (2021.3)

Requirement already satisfied: numpy>=1.17.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas->watson-machine-learning-client) (1.20.3)

**Cloud deploy**

from ibm\_watson\_machine\_learning import APIClient

credentials ={

"url":"https://us-south.ml.cloud.ibm.com",

"apikey":"Qxwy3byu83al\_Lvmk05S2xcRhHqeQiy\_4BxWzPcxuB9A"

}

client = APIClient(credentials)

client

client.spaces.get\_details()

{'resources': [{'entity': {'compute': [{'crn': 'crn:v1:bluemix:public:pm-20:us-south:a/14d571ceb9ec45fe98e6eac22b1fe65f:a2858581-aa42-498f-8101-3cb5eeb52609::',

'guid': 'a2858581-aa42-498f-8101-3cb5eeb52609',

'name': 'Watson Machine Learning-vu',

'type': 'machine\_learning'}],

'description': '',

'name': 'hdr',

'scope': {'bss\_account\_id': '14d571ceb9ec45fe98e6eac22b1fe65f'},

'stage': {'production': False},

'status': {'state': 'active'},

'storage': {'properties': {'bucket\_name': '98aa0e16-84dc-4ca5-af32-24752ee67208',

'bucket\_region': 'us-south',

'credentials': {'admin': {'access\_key\_id': '4c745639eeba4adb8d2f56fd2b57f351',

'api\_key': 'T16lCcwdvCpz4BUdQtm0QnMRtUmxyj\_w78zt6doIpCx8',

'secret\_access\_key': 'dde37ce0ae17d50ee939028eda9f9c44d20b54bcc2f9f67c',

'service\_id': 'ServiceId-8758d9a8-8ee7-40b6-a087-94e890958f1f'},

'editor': {'access\_key\_id': '39926bf2c3864cf1812a88a8c661777b',

'api\_key': '6zyoE\_tjcZBkTR8GX8ekxGbIGZ5rExOeK0JnrZxO1gso',

'resource\_key\_crn': 'crn:v1:bluemix:public:cloud-object-storage:global:a/14d571ceb9ec45fe98e6eac22b1fe65f:d2f3728b-5535-4221-8e87-5979bd277451::',

'secret\_access\_key': '4e65a00e9fdf812be05b475c806016fb22a18a5ffff1e862',

'service\_id': 'ServiceId-53c75cd9-6c06-4a62-a454-373adba43e04'},

'viewer': {'access\_key\_id': '0c78e063fbf34169879b4f0254093638',

'api\_key': 'p6DIeD3B\_z3xTlamNASmPo0MCSqH5RivNif\_kdL0YMDe',

'resource\_key\_crn': 'crn:v1:bluemix:public:cloud-object-storage:global:a/14d571ceb9ec45fe98e6eac22b1fe65f:d2f3728b-5535-4221-8e87-5979bd277451::',

'secret\_access\_key': '862b19e2719f5de7d2eacd0a033f18a4019ad4061d988aa9',

'service\_id': 'ServiceId-b8291bea-6e0e-4205-aba5-0e201994562f'}},

'endpoint\_url': 'https://s3.us-south.cloud-object-storage.appdomain.cloud',

'guid': 'd2f3728b-5535-4221-8e87-5979bd277451',

'resource\_crn': 'crn:v1:bluemix:public:cloud-object-storage:global:a/14d571ceb9ec45fe98e6eac22b1fe65f:d2f3728b-5535-4221-8e87-5979bd277451::'},

'type': 'bmcos\_object\_storage'}},

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'creator\_id': 'IBMid-667000BZM2',

'id': 'ad4acd34-c854-43ef-8fa2-0e31b3b4a474',

'updated\_at': '2022-11-07T17:20:30.503Z',

'url': '/v2/spaces/ad4acd34-c854-43ef-8fa2-0e31b3b4a474'}}]}

def guid\_from\_space\_name(client,deploy):

space = client.spaces.get\_details()

return (next(item for item in space['resources'] if item['entity']['name']==deploy)['metadata']['id'])

space\_uid = guid\_from\_space\_name(client,'hdr')

print("Space UID = " + space\_uid)

Space UID = ad4acd34-c854-43ef-8fa2-0e31b3b4a474

client.set.default\_space(space\_uid)

'SUCCESS'

client.software\_specifications.list(limit=100)

------------------------------- ------------------------------------ ----

NAME ASSET\_ID TYPE

default\_py3.6 0062b8c9-8b7d-44a0-a9b9-46c416adcbd9 base

kernel-spark3.2-scala2.12 020d69ce-7ac1-5e68-ac1a-31189867356a base

pytorch-onnx\_1.3-py3.7-edt 069ea134-3346-5748-b513-49120e15d288 base

scikit-learn\_0.20-py3.6 09c5a1d0-9c1e-4473-a344-eb7b665ff687 base

spark-mllib\_3.0-scala\_2.12 09f4cff0-90a7-5899-b9ed-1ef348aebdee base

pytorch-onnx\_rt22.1-py3.9 0b848dd4-e681-5599-be41-b5f6fccc6471 base

ai-function\_0.1-py3.6 0cdb0f1e-5376-4f4d-92dd-da3b69aa9bda base

shiny-r3.6 0e6e79df-875e-4f24-8ae9-62dcc2148306 base

tensorflow\_2.4-py3.7-horovod 1092590a-307d-563d-9b62-4eb7d64b3f22 base

pytorch\_1.1-py3.6 10ac12d6-6b30-4ccd-8392-3e922c096a92 base

tensorflow\_1.15-py3.6-ddl 111e41b3-de2d-5422-a4d6-bf776828c4b7 base

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spark-mllib\_2.4-r\_3.6 49403dff-92e9-4c87-a3d7-a42d0021c095 base

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spark-mllib\_2.4-scala\_2.11 55a70f99-7320-4be5-9fb9-9edb5a443af5 base

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spss-modeler\_18.2 687eddc9-028a-4117-b9dd-e57b36f1efa5 base

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caffe\_1.0-py3.6 7bb3dbe2-da6e-4145-918d-b6d84aa93b6b base

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tensorflow\_1.15-py3.6-horovod 8964680e-d5e4-5bb8-919b-8342c6c0dfd8 base

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tensorflow\_rt22.1-py3.9 acd9c798-6974-5d2f-a657-ce06e986df4d base

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autoai-obm\_2.0 with Spark 3.0 af10f35f-69fa-5d66-9bf5-acb58434263a base

default\_py3.7\_opence c2057dd4-f42c-5f77-a02f-72bdbd3282c9 base

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do\_20.1 f686cdd9-7904-5f9d-a732-01b0d6b10dc5 base

scikit-learn\_0.19-py3.6 f963fa9d-4bb7-5652-9c5d-8d9289ef6ad9 base

tensorflow\_2.4-py3.8 fe185c44-9a99-5425-986b-59bd1d2eda46 base

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software\_space\_uid = client.software\_specifications.get\_uid\_by\_name('tensorflow\_rt22.1-py3.9')

software\_space\_uid

'acd9c798-6974-5d2f-a657-ce06e986df4d'

model\_details = client.repository.store\_model(model='hdr\_deployment.tgz',meta\_props={

client.repository.ModelMetaNames.NAME:"Digit Recognition System",

client.repository.ModelMetaNames.TYPE:"tensorflow\_2.7",

client.repository.ModelMetaNames.SOFTWARE\_SPEC\_UID:software\_space\_uid

})

model\_details

{'entity': {'hybrid\_pipeline\_software\_specs': [],

'software\_spec': {'id': 'acd9c798-6974-5d2f-a657-ce06e986df4d',

'name': 'tensorflow\_rt22.1-py3.9'},

'type': 'tensorflow\_2.7'},

'metadata': {'created\_at': '2022-11-07T19:37:53.206Z',

'id': '9801d0d9-421d-4f4c-95ed-28adca79fbf6',

'modified\_at': '2022-11-07T19:37:56.212Z',

'name': 'Digit Recognition System',

'owner': 'IBMid-667000BZM2',

'resource\_key': 'a31b3b85-c7c6-487f-9492-28baa551ae08',

'space\_id': 'ad4acd34-c854-43ef-8fa2-0e31b3b4a474'},

'system': {'warnings': []}}

model\_id = client.repository.get\_model\_id(model\_details)

model\_id

'9801d0d9-421d-4f4c-95ed-28adca79fbf6'

client.repository.download(model\_id,'DigitRecog\_IBM\_model.tar.gz')

Successfully saved model content to file: 'DigitRecog\_IBM\_model.tar.gz'

'/home/wsuser/work/models/models/DigitRecog\_IBM\_model.tar.gz'

ls

DigitRecog\_IBM\_model.tar.gz hdr\_deployment.tgz mnistCNN.h5

**Test Model**

from tensorflow.keras.models import load\_model

from keras.preprocessing import image

from PIL import Image

import numpy as np

model = load\_model("mnistCNN.h5")

import os, types

import pandas as pd

from botocore.client import Config

import ibm\_boto3

def \_iter\_(self): return 0

# @hidden\_cell

# The following code accesses a file in your IBM Cloud Object Storage. It includes your credentials.

# You might want to remove those credentials before you share the notebook.

cos\_client = ibm\_boto3.client(service\_name='s3',

ibm\_api\_key\_id='1rEQ4QsDyr45SbIYkkmEXGolFpDjMBjlc1KmxrsH2V1U',

ibm\_auth\_endpoint="https://iam.cloud.ibm.com/oidc/token",

config=Config(signature\_version='oauth'),

endpoint\_url='https://s3.private.us.cloud-object-storage.appdomain.cloud')

bucket = 'digitrecognition-donotdelete-pr-kvpefjqsoxebrc'

object\_key = '4.jpg'

streaming\_body\_3 = cos\_client.get\_object(Bucket=bucket, Key=object\_key)['Body']

img = Image.open(streaming\_body\_3).convert("L") # convert image to monochrome

img = img.resize( (28,28) ) # resizing of input image

img



im2arr = np.array(img) #converting to image

im2arr = im2arr.reshape(1, 28, 28, 1) #reshaping according to our requirement

pred = model.predict(im2arr)

print(pred)

1/1 [==============================] - 0s 112ms/step

[[7.5318508e-14 1.6512175e-07 8.0947671e-10 4.0885627e-08 9.9998868e-01

1.6610469e-08 2.4431620e-12 7.6923061e-07 4.7200156e-06 5.7087254e-06]]

print(np.argmax(pred, axis=1)) #printing our Labels

[4]