**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 (2.7.2)

Collecting tensorflow

Downloading tensorflow-2.10.0-cp39-cp39-manylinux\_2\_17\_x86\_64.manylinux2014\_x86\_64.whl (578.1 MB)

|578.1 MB 40 kB/s /s eta 0:00:01B 15.2 MB/s eta 0:00:34 | | 84.6 MB 15.2 MB/s eta 0:00:33 | | 90.0 MB 15.2 MB/s eta 0:00:33 | | 177.6 MB 103.6 MB/s eta 0:00:04| 280.1 MB 104.4 MB/s eta 0:00:03/s eta 0:00:03

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: 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: 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: 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)

Collecting absl-py>=1.0.0

Downloading absl\_py-1.3.0-py3-none-any.whl (124 kB)

124 kB 83.1 MB/s eta 0:00:01

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

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)

Collecting keras<2.11,>=2.10.0

Downloading keras-2.10.0-py2.py3-none-any.whl (1.7 MB)

1.7 MB 88.2 MB/s eta 0:00:01

Collecting libclang>=13.0.0

Downloading libclang-14.0.6-py2.py3-none-manylinux2010\_x86\_64.whl (14.1 MB)

14.1 MB 78.8 MB/s eta 0:00:01

Collecting tensorboard<2.11,>=2.10

Downloading tensorboard-2.10.1-py3-none-any.whl (5.9 MB)

5.9 MB 69.7 MB/s eta 0:00:01

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

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

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

Collecting tensorflow-estimator<2.11,>=2.10.0

Downloading tensorflow\_estimator-2.10.0-py2.py3-none-any.whl (438 kB)

438 kB 83.2 MB/s eta 0:00:01

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: 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<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: 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: 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: 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: 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: 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: 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: 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: 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: 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: 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: 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: 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: 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)

Installing collected packages: absl-py, tensorflow-estimator, tensorboard, libclang, keras, tensorflow

Attempting uninstall: absl-py

Found existing installation: absl-py 0.12.0

Uninstalling absl-py-0.12.0:

Successfully uninstalled absl-py-0.12.0

Attempting uninstall: tensorflow-estimator

Found existing installation: tensorflow-estimator 2.7.0

Uninstalling tensorflow-estimator-2.7.0:

Successfully uninstalled tensorflow-estimator-2.7.0

Attempting uninstall: tensorboard

Found existing installation: tensorboard 2.7.0

Uninstalling tensorboard-2.7.0:

Successfully uninstalled tensorboard-2.7.0

Attempting uninstall: keras

Found existing installation: Keras 2.2.4

Uninstalling Keras-2.2.4:

Successfully uninstalled Keras-2.2.4

Attempting uninstall: tensorflow

Found existing installation: tensorflow 2.7.2

Uninstalling tensorflow-2.7.2:

Successfully uninstalled tensorflow-2.7.2

Successfully installed absl-py-1.3.0 keras-2.10.0 libclang-14.0.6 tensorboard-2.10.1 tensorflow-2.10.0 tensorflow-estimator-2.10.0

import numpy as np

import tensorflow #open source used for both ML and DL for computation

from tensorflow.keras.datasets import mnist #mnist dataset

from tensorflow.keras.models import Sequential #it is a plain stack of layers

from tensorflow.keras import layers #A Layer consists of a tensor- in tensor-out computat ion funct ion

from tensorflow.keras.layers import Dense, Flatten #Dense-Dense Layer is the regular deeply connected r

#faltten -used fot flattening the input or change the dimension

from tensorflow.keras.layers import Conv2D #convolutional Layer

from keras.utils import np\_utils #used for one-hot encoding

import matplotlib.pyplot as plt #used for data visualization

**Load data**

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

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

11493376/11490434 [==============================] - 0s 0us/step

11501568/11490434 [==============================] - 0s 0us/step

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],

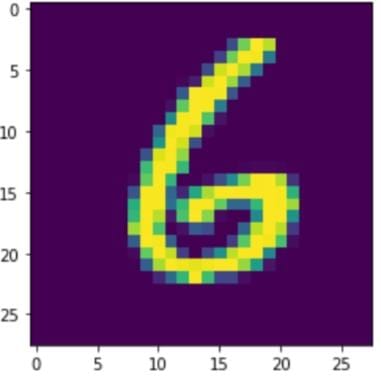
[ 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,

0, 0]], dtype=uint8)

plt.imshow(x\_train[6000]) #ploting the index=image

np.argmax(y\_train[6000])



**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 [==============================] - 126s 67ms/step - loss: 0.2690 - accuracy: 0.9514 - val\_loss: 0.0884 - val\_accuracy: 0.9728

Epoch 2/5

1875/1875 [==============================] - 125s 66ms/step - loss: 0.0676 - accuracy: 0.9789 - val\_loss: 0.0803 - val\_accuracy: 0.9788

Epoch 3/5

1875/1875 [==============================] - 125s 67ms/step - loss: 0.0458 - accuracy: 0.9852 - val\_loss: 0.0791 - val\_accuracy: 0.9788

Epoch 4/5

1875/1875 [==============================] - 125s 67ms/step - loss: 0.0387 - accuracy: 0.9883 - val\_loss: 0.1079 - val\_accuracy: 0.9759

Epoch 5/5

1875/1875 [==============================] - 125s 67ms/step - loss: 0.0280 - accuracy: 0.9909 - val\_loss: 0.0991 - val\_accuracy: 0.9774

**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) :

[0.09910603612661362, 0.977400004863739]

**Test The Model**

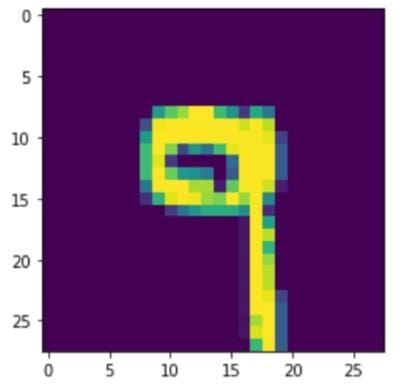
prediction=model.predict(x\_test[6000:6001])

print(prediction)

[[9.1516389e-13 8.1778777e-19 2.4542002e-14 1.7823329e-07 5.2257418e-04

5.8763407e-09 6.2800168e-17 3.1880148e-07 6.3142506e-03 9.9316275e-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

!tar -zcvf handwritten-digit-recognition-model\_new.tgz mnistCNN.h5

mnistCNN.h5

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

Collecting watson-machine-learning-client

Downloading watson\_machine\_learning\_client-1.0.391-py3-none-any.whl (538 kB)

538 kB 21.5 MB/s eta 0:00:01

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

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

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: 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: 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-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: 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: 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)

Installing collected packages: watson-machine-learning-client

Successfully installed watson-machine-learning-client-1.0.391

**Cloud deploy**

from ibm\_watson\_machine\_learning import APIClient

credentials ={

"url":"https://jp-tok.ml.cloud.ibm.com",

"apikey":"BHyalu2c7JN6n9cnvAVULvSKRYFVLMQ\_m51toZ9Yk0nS"

}

client = APIClient(credentials)

client

client.spaces.get\_details()

{'resources': [{'entity': {'compute': [{'crn': 'crn:v1:bluemix:public:pm-20:jp-tok:a/53f9f6400d0d44889534e8abcd2dfe39:0f4376b6-c944-4b27-b23e-48b54d8f4bbd::',

'guid': '0f4376b6-c944-4b27-b23e-48b54d8f4bbd',

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

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

'description': '',

'name': 'digitrecognition',

'scope': {'bss\_account\_id': '53f9f6400d0d44889534e8abcd2dfe39'},

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

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

'storage': {'properties': {'bucket\_name': '63888f6f-d1ef-475c-a8d8-a2e4957bb673',

'bucket\_region': 'jp-tok-standard',

'credentials': {'admin': {'access\_key\_id': '834b3358ebb945fb9ebbb4020cd2bf0e',

'api\_key': '2JONUuuPfYzZzPGzTp1J7dwwjNTpkOsyxdW5gx\_vml3m',

'secret\_access\_key': '1ed5b29fdd6c65b48ca72963b6177133ce51a7b23acdcaa5',

'service\_id': 'ServiceId-a2495f73-f36b-4fa1-9991-976f110c1a4f'},

'editor': {'access\_key\_id': 'b56d445c54794369b2a4e0115e166605',

'api\_key': 'wcwCBLp8z4xpgnsEDeUCOZquAovrWhXu2wcF9Kz5Vhpe',

'resource\_key\_crn': 'crn:v1:bluemix:public:cloud-object-storage:global:a/53f9f6400d0d44889534e8abcd2dfe39:d8fa8aee-cd61-4757-9543-a61f55971074::',

'secret\_access\_key': '84b0b128f52e57c025e6517604a06212b8d19f0b349eeea3',

'service\_id': 'ServiceId-4e1f87ab-27bc-4654-b6ea-667a8640c7e0'},

'viewer': {'access\_key\_id': '558109e942fb4b1eb020c881f04d8588',

'api\_key': 'zWS-VZ\_d9GfkDt1XnCmWoOA6liYXNnGtrPwJt2fI0UI5',

'resource\_key\_crn': 'crn:v1:bluemix:public:cloud-object-storage:global:a/53f9f6400d0d44889534e8abcd2dfe39:d8fa8aee-cd61-4757-9543-a61f55971074::',

'secret\_access\_key': '3e2d27ab9d4041707cfa721daa638d1ad57f42ab8df94c09',

'service\_id': 'ServiceId-93177c88-86e2-470d-b5bf-3aed99d093a8'}},

'endpoint\_url': 'https://s3.jp-tok.cloud-object-storage.appdomain.cloud',

'guid': 'd8fa8aee-cd61-4757-9543-a61f55971074',

'resource\_crn': 'crn:v1:bluemix:public:cloud-object-storage:global:a/53f9f6400d0d44889534e8abcd2dfe39:d8fa8aee-cd61-4757-9543-a61f55971074::'},

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

'metadata': {'created\_at': '2022-10-31T10:33:07.575Z',

'creator\_id': 'IBMid-667000CZ2Y',

'id': 'aa24227a-9f01-493f-90e6-1b6132057fc6',

'updated\_at': '2022-10-31T10:33:25.148Z',

'url': '/v2/spaces/aa24227a-9f01-493f-90e6-1b6132057fc6'}}]}

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,'digitrecognition')

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

Space UID = aa24227a-9f01-493f-90e6-1b6132057fc6

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

runtime-22.1-py3.9 12b83a17-24d8-5082-900f-0ab31fbfd3cb base

scikit-learn\_0.22-py3.6 154010fa-5b3b-4ac1-82af-4d5ee5abbc85 base

default\_r3.6 1b70aec3-ab34-4b87-8aa0-a4a3c8296a36 base

pytorch-onnx\_1.3-py3.6 1bc6029a-cc97-56da-b8e0-39c3880dbbe7 base

kernel-spark3.3-r3.6 1c9e5454-f216-59dd-a20e-474a5cdf5988 base

pytorch-onnx\_rt22.1-py3.9-edt 1d362186-7ad5-5b59-8b6c-9d0880bde37f base

tensorflow\_2.1-py3.6 1eb25b84-d6ed-5dde-b6a5-3fbdf1665666 base

spark-mllib\_3.2 20047f72-0a98-58c7-9ff5-a77b012eb8f5 base

tensorflow\_2.4-py3.8-horovod 217c16f6-178f-56bf-824a-b19f20564c49 base

runtime-22.1-py3.9-cuda 26215f05-08c3-5a41-a1b0-da66306ce658 base

do\_py3.8 295addb5-9ef9-547e-9bf4-92ae3563e720 base

autoai-ts\_3.8-py3.8 2aa0c932-798f-5ae9-abd6-15e0c2402fb5 base

tensorflow\_1.15-py3.6 2b73a275-7cbf-420b-a912-eae7f436e0bc base

kernel-spark3.3-py3.9 2b7961e2-e3b1-5a8c-a491-482c8368839a base

pytorch\_1.2-py3.6 2c8ef57d-2687-4b7d-acce-01f94976dac1 base

spark-mllib\_2.3 2e51f700-bca0-4b0d-88dc-5c6791338875 base

pytorch-onnx\_1.1-py3.6-edt 32983cea-3f32-4400-8965-dde874a8d67e base

spark-mllib\_3.0-py37 36507ebe-8770-55ba-ab2a-eafe787600e9 base

spark-mllib\_2.4 390d21f8-e58b-4fac-9c55-d7ceda621326 base

xgboost\_0.82-py3.6 39e31acd-5f30-41dc-ae44-60233c80306e base

pytorch-onnx\_1.2-py3.6-edt 40589d0e-7019-4e28-8daa-fb03b6f4fe12 base

default\_r36py38 41c247d3-45f8-5a71-b065-8580229facf0 base

autoai-ts\_rt22.1-py3.9 4269d26e-07ba-5d40-8f66-2d495b0c71f7 base

autoai-obm\_3.0 42b92e18-d9ab-567f-988a-4240ba1ed5f7 base

pmml-3.0\_4.3 493bcb95-16f1-5bc5-bee8-81b8af80e9c7 base

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

xgboost\_0.90-py3.6 4ff8d6c2-1343-4c18-85e1-689c965304d3 base

pytorch-onnx\_1.1-py3.6 50f95b2a-bc16-43bb-bc94-b0bed208c60b base

autoai-ts\_3.9-py3.8 52c57136-80fa-572e-8728-a5e7cbb42cde base

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

spark-mllib\_3.0 5c1b0ca2-4977-5c2e-9439-ffd44ea8ffe9 base

autoai-obm\_2.0 5c2e37fa-80b8-5e77-840f-d912469614ee base

spss-modeler\_18.1 5c3cad7e-507f-4b2a-a9a3-ab53a21dee8b base

cuda-py3.8 5d3232bf-c86b-5df4-a2cd-7bb870a1cd4e base

autoai-kb\_3.1-py3.7 632d4b22-10aa-5180-88f0-f52dfb6444d7 base

pytorch-onnx\_1.7-py3.8 634d3cdc-b562-5bf9-a2d4-ea90a478456b base

spark-mllib\_2.3-r\_3.6 6586b9e3-ccd6-4f92-900f-0f8cb2bd6f0c base

tensorflow\_2.4-py3.7 65e171d7-72d1-55d9-8ebb-f813d620c9bb base

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

pytorch-onnx\_1.2-py3.6 692a6a4d-2c4d-45ff-a1ed-b167ee55469a base

spark-mllib\_2.3-scala\_2.11 7963efe5-bbec-417e-92cf-0574e21b4e8d base

spark-mllib\_2.4-py37 7abc992b-b685-532b-a122-a396a3cdbaab base

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

pytorch-onnx\_1.7-py3.7 812c6631-42b7-5613-982b-02098e6c909c base

cuda-py3.6 82c79ece-4d12-40e6-8787-a7b9e0f62770 base

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

hybrid\_0.1 8c1a58c6-62b5-4dc4-987a-df751c2756b6 base

pytorch-onnx\_1.3-py3.7 8d5d8a87-a912-54cf-81ec-3914adaa988d base

caffe-ibm\_1.0-py3.6 8d863266-7927-4d1e-97d7-56a7f4c0a19b base

spss-modeler\_17.1 902d0051-84bd-4af6-ab6b-8f6aa6fdeabb base

do\_12.10 9100fd72-8159-4eb9-8a0b-a87e12eefa36 base

do\_py3.7 9447fa8b-2051-4d24-9eef-5acb0e3c59f8 base

spark-mllib\_3.0-r\_3.6 94bb6052-c837-589d-83f1-f4142f219e32 base

cuda-py3.7-opence 94e9652b-7f2d-59d5-ba5a-23a414ea488f base

nlp-py3.8 96e60351-99d4-5a1c-9cc0-473ac1b5a864 base

cuda-py3.7 9a44990c-1aa1-4c7d-baf8-c4099011741c base

hybrid\_0.2 9b3f9040-9cee-4ead-8d7a-780600f542f7 base

spark-mllib\_3.0-py38 9f7a8fc1-4d3c-5e65-ab90-41fa8de2d418 base

autoai-kb\_3.3-py3.7 a545cca3-02df-5c61-9e88-998b09dc79af base

spark-mllib\_3.0-py39 a6082a27-5acc-5163-b02c-6b96916eb5e0 base

runtime-22.1-py3.9-do a7e7dbf1-1d03-5544-994d-e5ec845ce99a base

default\_py3.8 ab9e1b80-f2ce-592c-a7d2-4f2344f77194 base

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

kernel-spark3.2-py3.9 ad7033ee-794e-58cf-812e-a95f4b64b207 base

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

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

tensorflow\_2.1-py3.7 c4032338-2a40-500a-beef-b01ab2667e27 base

do\_py3.7\_opence cc8f8976-b74a-551a-bb66-6377f8d865b4 base

spark-mllib\_3.3 d11f2434-4fc7-58b7-8a62-755da64fdaf8 base

autoai-kb\_3.0-py3.6 d139f196-e04b-5d8b-9140-9a10ca1fa91a base

spark-mllib\_3.0-py36 d82546d5-dd78-5fbb-9131-2ec309bc56ed base

autoai-kb\_3.4-py3.8 da9b39c3-758c-5a4f-9cfd-457dd4d8c395 base

kernel-spark3.2-r3.6 db2fe4d6-d641-5d05-9972-73c654c60e0a base

autoai-kb\_rt22.1-py3.9 db6afe93-665f-5910-b117-d879897404d9 base

tensorflow\_rt22.1-py3.9-horovod dda170cc-ca67-5da7-9b7a-cf84c6987fae base

autoai-ts\_1.0-py3.7 deef04f0-0c42-5147-9711-89f9904299db base

tensorflow\_2.1-py3.7-horovod e384fce5-fdd1-53f8-bc71-11326c9c635f base

default\_py3.7 e4429883-c883-42b6-87a8-f419d64088cd base

do\_22.1 e51999ba-6452-5f1f-8287-17228b88b652 base

autoai-obm\_3.2 eae86aab-da30-5229-a6a6-1d0d4e368983 base

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

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

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='handwritten-digit-recognition-model\_new.tgz',meta\_props={

client.repository.ModelMetaNames.NAME:"CNN Digit recognition model",

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': '2022-11-01T10:15:40.847Z',

'id': '97d463b1-45ee-47f7-b8af-aed338794ce1',

'modified\_at': '2022-11-01T10:15:44.197Z',

'name': 'CNN Digit recognition model',

'owner': 'IBMid-667000CZ2Y',

'resource\_key': '84636ddb-9fa8-47e4-8fa4-3c36731e2fe6',

'space\_id': 'aa24227a-9f01-493f-90e6-1b6132057fc6'},

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

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

model\_id

'97d463b1-45ee-47f7-b8af-aed338794ce1'

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/DigitRecog\_IBM\_model.tar.gz'

ls

DigitRecog\_IBM\_model.tar.gz mnistCNN.h5

handwritten-digit-recognition-model\_new.tgz

**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='is\_QZGPyU8oxZr3W-td-LCHXS3QPMaWArILi18FdSyGT',

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

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

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

bucket = 'handwrittenimagerecognition-donotdelete-pr-8tlrnykut46vpi'

object\_key = 'mnist-dataset-1024x424 (2).png'

streaming\_body\_1 = cos\_client.get\_object(Bucket=bucket, Key=object\_key)['Body']

# Your data file was loaded into a botocore.response.StreamingBody object.

# Please read the documentation of ibm\_boto3 and pandas to learn more about the possibilities to load the data.

# ibm\_boto3 documentation: https://ibm.github.io/ibm-cos-sdk-python/

# pandas documentation: http://pandas.pydata.org/

img = Image.open(streaming\_body\_1).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)

[[1.0000000e+00 5.3912803e-17 3.9648812e-11 2.0051219e-16 5.1053910e-18

2.9315760e-12 7.0849349e-13 2.0999634e-16 2.9204243e-09 7.4729778e-11]]

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

[0]