```
#@title Import Libraries

!pip install opencv-python
!pip install tensorflow
import numpy as np
import matplotlib.pyplot as plt
import tensorflow
from tensorflow.keras.datasets import mnist
from tensorflow.keras.layers import Dense,Flatten
from keras.layers.convolutional import Conv2D
from tensorflow.keras.models import Sequential
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.optimizers import Adam
from keras. utils import np_utils
```

```
Requirement already satisfied: opencv-python in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (4.6.0.66)
Requirement already satisfied: numpy>=1.17.3 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from opencv-
python) (1.20.3)
Requirement already satisfied: tensorflow in /opt/conda/envs/Python-
3.9/lib/python3.9/site-packages (2.7.2)
Requirement already satisfied: tensorflow-estimator<2.8,~=2.7.0 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (2.7.0)
Requirement already satisfied: flatbuffers<3.0,>=1.12 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (2.0)
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: 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: gast<0.5.0,>=0.2.1 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (0.4.0)
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: wheel<1.0,>=0.32.0 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (0.37.0)
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: tensorboard~=2.7 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (2.7.0)
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: 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: protobuf>=3.9.2 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (3.19.1)
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: tensorflow-io-gcs-filesystem>=0.21.0 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (0.23.1)
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: keras<2.8,>=2.7.0 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (2.7.0)
Requirement already satisfied: absl-py>=0.4.0 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (0.12.0)
Requirement already satisfied: numpy>=1.14.5 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (1.20.3)
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: wrapt>=1.11.0 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorflow) (1.12.1)
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~=2.7->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~=2.7->tensorflow) (2.26.0)
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~=2.7->tensorflow) (0.4.4)
Requirement already satisfied: google-auth<3,>=1.6.3 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorboard~=2.7->tensorflow) (1.23.0)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorboard~=2.7->tensorflow) (1.6.0)
Requirement already satisfied: setuptools>=41.0.0 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorboard~=2.7->tensorflow) (58.0.4)
Requirement already satisfied: markdown>=2.6.8 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
```

```
tensorboard~=2.7->tensorflow) (3.3.3)
Requirement already satisfied: werkzeug>=0.11.15 in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from
tensorboard~=2.7->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~=2.7->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~=2.7->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~=2.7->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~=2.7->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~=2.7->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~=2.7->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~=2.7->tensorflow) (1.26.7)
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~=2.7->tensorflow) (3.3)
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~=2.7->tensorflow) (2.0.4)
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~=2.7-
>tensorflow) (3.2.1)
```

```
#@title Loading Data


(X_train,y_train),(X_test,y_test)=mnist.load_data()
```

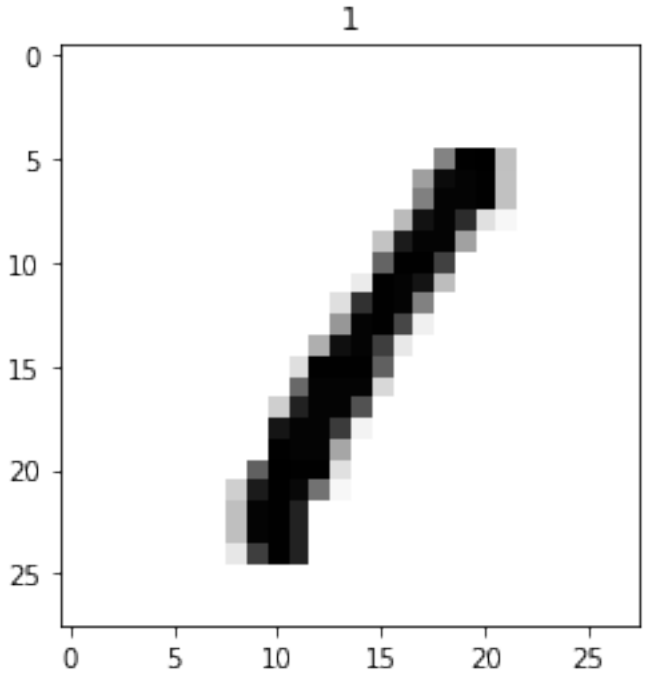
```
Downloading data from https://storage.googleapis.com/tensorflow/tf-
keras-datasets/mnist.npz
11493376/11490434 [==============================] - 0s 0us/step
11501568/11490434 [==============================] - 0s 0us/step
```

```
#@title Shape of images in the dataset

X_train.shape,y_train.shape,X_test.shape,y_test.shape
```

```
((60000, 28, 28), (60000,), (10000, 28, 28), (10000,))
```

```
#@title Show an image from the dataset with label
```

```
def plot_input_img(i):
  plt.imshow(X_train[i],cmap='binary')
  plt.title(y_train[i])
  plt.show
plot_input_img(3)
```




```
#@title Reshaping the images in dataset
```

```
X_train=X_train.reshape(60000,28,28,1).astype('float32')
X_test=X_test.reshape(10000,28,28,1).astype('float32')
X_train.shape,y_train.shape,X_test.shape,y_test.shape
```

```
((60000, 28, 28, 1), (60000,), (10000, 28, 28, 1), (10000,))
```

```
#@title One Hot Encoding
```

```
classes_no=10
y_train=np_utils.to_categorical(y_train,classes_no)
y_test=np_utils.to_categorical(y_test,classes_no)
```

```
#@title Building model.
```

```
#create model
model=Sequential()

#adding modeL Layer
layer1=Conv2D(64,kernel_size=3,activation='relu',input_shape=(28,28,1)
)
layer2=Conv2D(32,kernel_size=3,activation='relu')

#flatten the dimension of the image
layer3=Flatten()

#output layer with 10 neurons
layer4=Dense(10,activation='softmax')

#@title Adding layers to the model.


model.add(layer1)
model.add(layer2)
model.add(layer3)
model.add(layer4)

#@title Compile the Model.


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

#@title Train Model


model.fit(X_train,y_train,validation_data=(X_test,y_test),epochs=10,ba
tch_size=32)
```

```
Epoch 1/10
1875/1875 [==============================] - 166s 88ms/step - loss:
0.2602 - accuracy: 0.9505 - val_loss: 0.1014 - val_accuracy: 0.9668
Epoch 2/10
1875/1875 [==============================] - 166s 88ms/step - loss:
0.0742 - accuracy: 0.9783 - val_loss: 0.0708 - val_accuracy: 0.9796
Epoch 3/10
1875/1875 [==============================] - 164s 87ms/step - loss:
0.0518 - accuracy: 0.9841 - val_loss: 0.0956 - val_accuracy: 0.9739
Epoch 4/10
1875/1875 [==============================] - 163s 87ms/step - loss:
0.0383 - accuracy: 0.9875 - val_loss: 0.1215 - val_accuracy: 0.9658
Epoch 5/10
1875/1875 [==============================] - 164s 88ms/step - loss:
0.0320 - accuracy: 0.9898 - val_loss: 0.1043 - val_accuracy: 0.9741
```

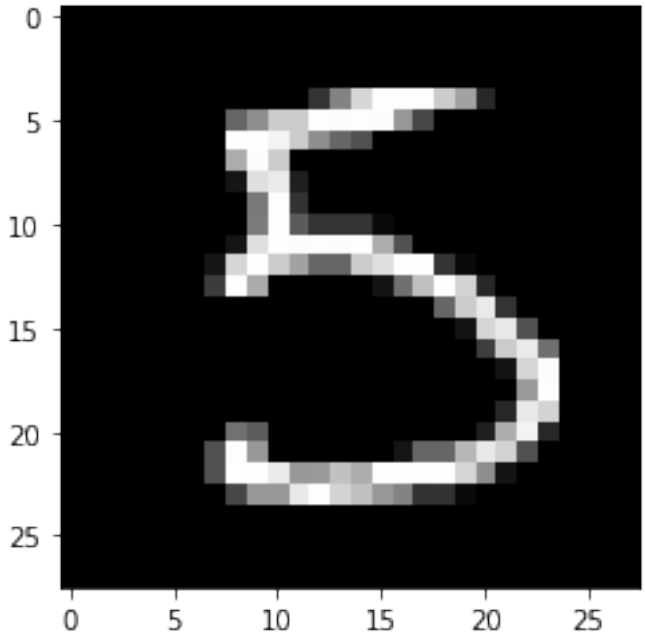
```
Epoch 6/10
1875/1875 [==============================] - 165s 88ms/step - loss:
0.0256 - accuracy: 0.9921 - val_loss: 0.1168 - val_accuracy: 0.9766
Epoch 7/10
1875/1875 [==============================] - 165s 88ms/step - loss:
0.0242 - accuracy: 0.9932 - val_loss: 0.1296 - val_accuracy: 0.9786
Epoch 8/10
1875/1875 [==============================] - 164s 87ms/step - loss:
0.0207 - accuracy: 0.9942 - val_loss: 0.1849 - val_accuracy: 0.9723
Epoch 9/10
1875/1875 [==============================] - 163s 87ms/step - loss:
0.0174 - accuracy: 0.9946 - val_loss: 0.1497 - val_accuracy: 0.9793
Epoch 10/10
1875/1875 [==============================] - 164s 87ms/step - loss:
0.0174 - accuracy: 0.9952 - val_loss: 0.2393 - val_accuracy: 0.9726

<keras.callbacks.History at 0x7fe9dd541dc0>
```

```
#@title Evaluate the Model


metrics = model.evaluate(X_test, y_test, verbose=0)
print("Metrics (Test Loss & Test Accuracy): ")
print(metrics)
```

```
Metrics (Test Loss & Test Accuracy):
[0.2392578423023224, 0.972599983215332]
```

```
#@title Test the model


test_img=X_test[15]
prediction=model.predict(test_img.reshape(1,28,28,1))
#first output
print("softmax{}".format(prediction))
hard_maxed_prediction=np.zeros(prediction.shape)
hard_maxed_prediction[0][np.argmax(prediction)]=1
#second output
print("hardmax{}".format(hard_maxed_prediction))
#third output
plt.imshow(test_img.reshape(28,28),cmap="gray")
plt.show()
print("final{}".format(np.argmax(prediction)))
```

```
softmax[[7.5888513e-37 0.0000000e+00 5.4936177e-29 1.3545132e-11
1.9612329e-36
  1.0000000e+00 8.3028593e-30 1.9509480e-31 1.3362523e-27 3.8361595e-
36]]
hardmax[[0. 0. 0. 0. 0. 1. 0. 0. 0. 0.]]
```




```
final5
```

```
# Save the model


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

```
cd models
```

```
/home/wsuser/work/models/models
```

```
!tar -zcvf handwritten-digit-recognition-model_new.tgz mnistCNN.h5
```

```
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: requests in /opt/conda/envs/Python-
3.9/lib/python3.9/site-packages (from watson-machine-learning-client)
(2.26.0)
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: 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: 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: tabulate in /opt/conda/envs/Python-
3.9/lib/python3.9/site-packages (from watson-machine-learning-client)
(0.8.9)
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: tqdm in
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-
machine-learning-client) (4.62.3)
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-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: 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: 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: 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 DEPLOYING


from ibm_watson_machine_learning import APIClient
credentials ={
    "url":"https://us-south.ml.cloud.ibm.com",
    "apikey":"YCNrcr1eWHYXWHzhvmtlteWHhIlc6DHNK85tPxzemyHx"
}
client = APIClient(credentials)
client
```

```
<ibm_watson_machine_learning.client.APIClient at 0x7fe9b947d520>
```

```
client.spaces.get_details()
```

```
{'resources': [{'entity': {'compute': [{'crn':
'crn:v1:bluemix:public:pm-20:us-south:a/adaba45aaf084629a2dbe4cbfced35
0a:c66ab4bb-c234-4648-978b-315ff94cc251::',
      'guid': 'c66ab4bb-c234-4648-978b-315ff94cc251',
      'name': 'Watson Machine Learning-nf',
      'type': 'machine_learning'}],
    'description': '',
    'name': 'HDR_deployment',
    'scope': {'bss_account_id': 'adaba45aaf084629a2dbe4cbfced350a'},
    'stage': {'production': False},
    'status': {'state': 'active'},
    'storage': {'properties': {'bucket_name': '0d81d996-e9e5-4d71-
ab6a-47835d5a4b08',
      'bucket_region': 'us-south',
      'credentials': {'admin': {'access_key_id':
'7909bbb2372e43969d133b4a83eab2af',
        'api_key': 'wGuTmmqtKL6HjL42axKN_qDsFMqPQm7yzrC284b6mg-l',
        'secret_access_key':
'69389d5326400b0496238cf9817218f0dc71eb2caaf7ac31',
        'service_id': 'ServiceId-142ebdae-a857-4698-8f81-
fb1af30777ab'},
       'editor': {'access_key_id': '689707ca3fe14219b5f4e58e41f9cc00',
        'api_key': 'mLCT7qr0AR5nSWmuyvzN0AwH8J2EjzfEJvRuynIuXy8O',
        'resource_key_crn': 'crn:v1:bluemix:public:cloud-object-
storage:global:a/adaba45aaf084629a2dbe4cbfced350a:7157bd50-a8ca-4d53-
9fd9-757b9af2cfac::',
        'secret_access_key':
'815f3e73111d98554d7843172b91e222db0e86429f25643d',
        'service_id': 'ServiceId-f0feba9b-c515-4353-844b-
89f9b450c2ca'},
       'viewer': {'access_key_id': '72b92950976e4e1c85676413aa31ca4d',
        'api_key': 'AFJIqjqWcjTAH-G2KUB4vpQVStQR2zbPPyehP5Sjc1Tr',
        'resource_key_crn': 'crn:v1:bluemix:public:cloud-object-
storage:global:a/adaba45aaf084629a2dbe4cbfced350a:7157bd50-a8ca-4d53-
9fd9-757b9af2cfac::',
        'secret_access_key':
```

```
'17bbafbb525adcc69b505f6b228de063034585db2c8b3c84',
        'service_id': 'ServiceId-f9a9917c-29e7-43fb-82b6-
02a5cdf101a2'}},
      'endpoint_url': 'https://s3.us-south.cloud-object-
storage.appdomain.cloud',
      'guid': '7157bd50-a8ca-4d53-9fd9-757b9af2cfac',
      'resource_crn': 'crn:v1:bluemix:public:cloud-object-
storage:global:a/adaba45aaf084629a2dbe4cbfced350a:7157bd50-a8ca-4d53-
9fd9-757b9af2cfac::'},
     'type': 'bmcos_object_storage'}},
   'metadata': {'created_at': '2022-11-15T15:34:06.733Z',
    'creator_id': 'IBMid-66400459VQ',
    'id': 'b28f212c-7303-4571-aa33-41ba07e2194f',
    'updated_at': '2022-11-15T15:34:17.782Z',
    'url': '/v2/spaces/b28f212c-7303-4571-aa33-41ba07e2194f'}}]}

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_deployment')
print("Space UID = " + space_uid)

Space UID = b28f212c-7303-4571-aa33-41ba07e2194f

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
autoai-kb_rt22.2-py3.10          125b6d9a-5b1f-5e8d-972a-b251688ccf40
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
autoai-ts_rt22.2-py3.10          396b2e83-0953-5b86-9a55-7ce1628a406f
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
pytorch-onnx_rt22.2-py3.10      40e73f55-783a-5535-b3fa-0c8b94291431
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
tensorflow_rt22.2-py3.10         f65bd165-f057-55de-b5cb-f97cf2c0f393
base
do_20.1                          f686cdd9-7904-5f9d-a732-01b0d6b10dc5
base
pytorch-onnx_rt22.2-py3.10-edt   f8a05d07-e7cd-57bb-a10b-23f1d4b837ac
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': '2022-11-15T17:08:00.893Z',
  'id': 'cafa9910-24e8-4efa-91f8-b44460116c2b',
  'modified_at': '2022-11-15T17:08:03.629Z',
  'name': 'CNN Digit recognition model',
  'owner': 'IBMid-66400459VQ',
  'resource_key': '90f477d7-b66e-4060-a728-57d8a893e090',
  'space_id': 'b28f212c-7303-4571-aa33-41ba07e2194f'},
 'system': {'warnings': []}}
```

```
model_id = client.repository.get_model_id(model_details)
model_id
```

```
'cafa9910-24e8-4efa-91f8-b44460116c2b'
```

```
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                  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='w3KRZcW_Rn1ansSlaQuw1BxXm-2pFaiff9UIs0q0Cdck',
    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 = 'hdrproject-donotdelete-pr-72qrdilphlr02t'
object_key = 'three_hand.png'

streaming_body_3 = 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_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)
```

```
[[0.0000000e+00 3.5023538e-26 1.0260074e-26 1.0000000e+00 1.4276489e-
31
  5.1018649e-19 5.0525308e-28 3.2075054e-29 3.0027430e-21 8.3975897e-
23]]
```

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

```
[3]
```