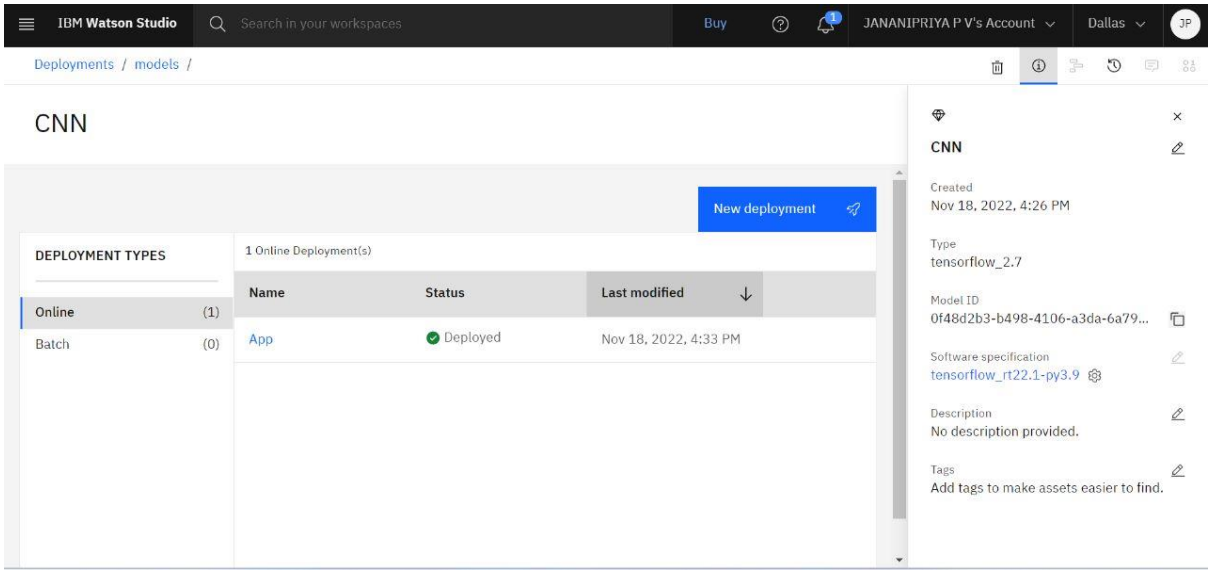
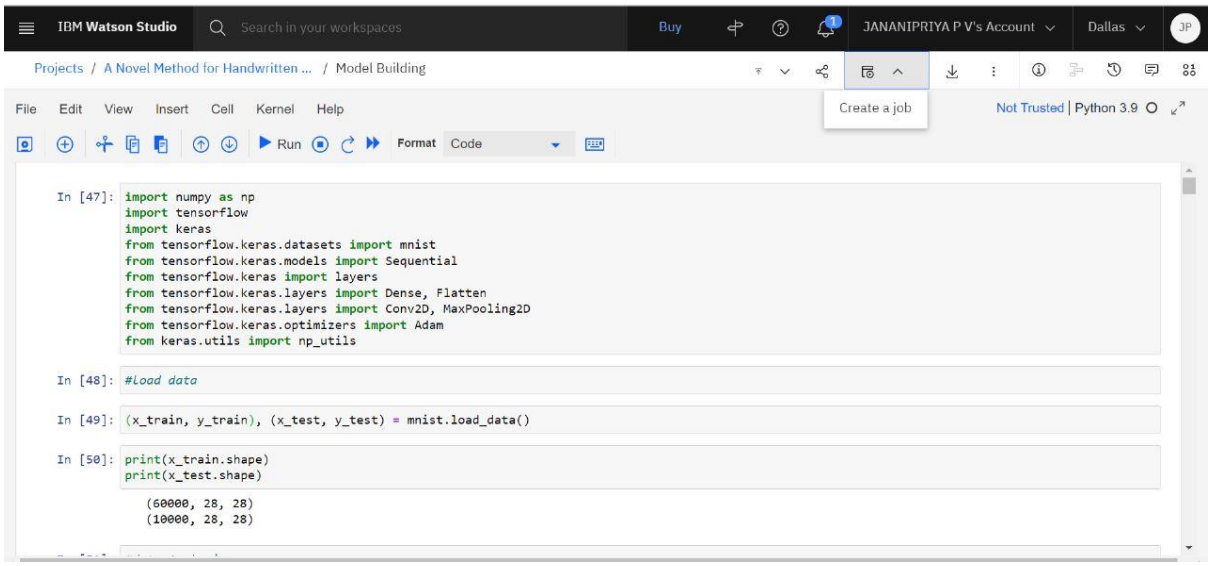
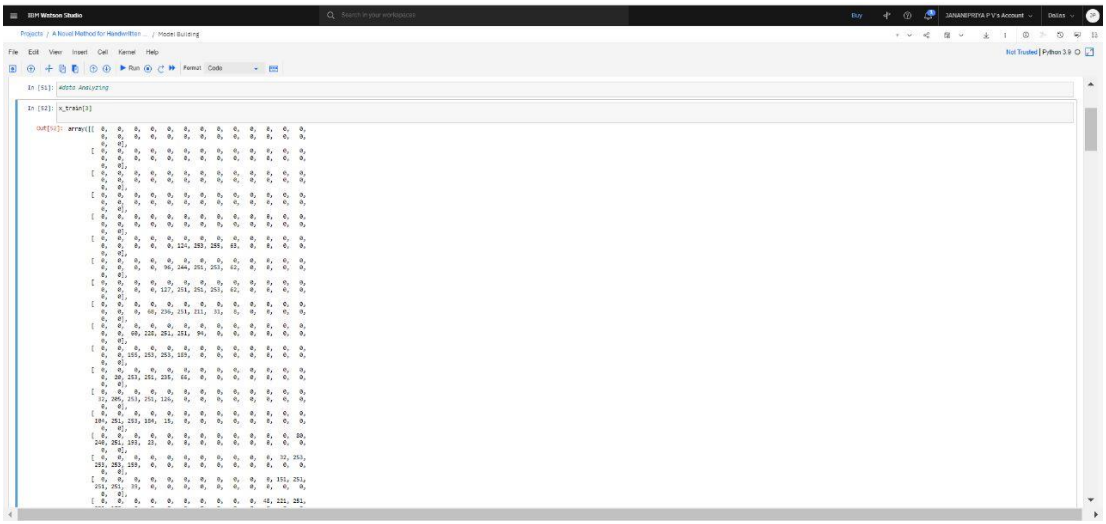
TESTING THE MODEL

TEAM ID	PNT2022TMID16152
PROJECT NAME	A NOVEL METHOD FOR HANDWRITTEN DIGITAL RECOGNITION SYSTEM
TEAM MEMBERS	BOOMIKA P - 927619BIT4010 DHARANI S - 927619BIT4015 JANANIPRIYA P V - 927619BIT4040 KARTHIKA K - 927619BIT4044

SCREENSHOT



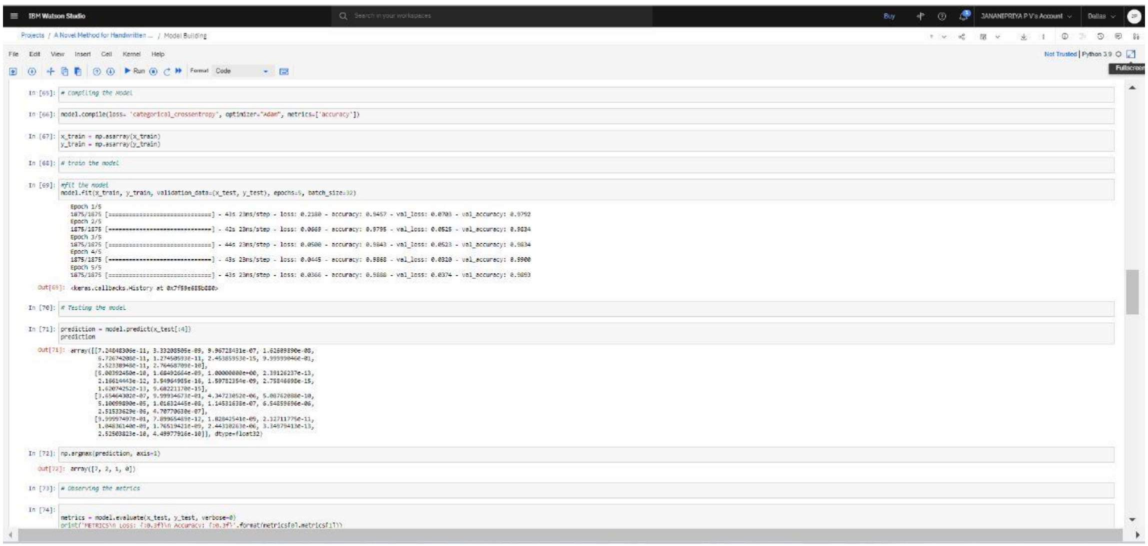




```
In [51]: #data Analyzing

In [52]: x_train[3]

Out[52]: 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, 124, 253, 255,  63,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0,   0,   0,  96, 244, 251, 253,  62,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0,   0,   0, 127, 251, 251, 253,  62,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0,   0,  68, 236, 251, 211,  31,   8,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0,  60, 228, 251, 251,  94,   0,   0,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0, 155, 253, 253, 189,   0,   0,   0,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,  20, 253, 251, 235,  66,   0,   0,   0,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                 32, 205, 253, 251, 126,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                104, 251, 253, 184,  15,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  80,
                240, 251, 193,  23,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  32, 253,
                253, 253, 159,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 151, 251,
                251, 251,  39,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
                  0,   0],
                [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  48, 221, 251,
```

```
In [53]: y_train[36]

Out[53]: 6

In [54]: import matplotlib.pyplot as plt

In [55]: plt.imshow(x_train[36])

Out[55]: <matplotlib.image.AxesImage at 0x7f59e7a73ee0>

In [20]: #shaping the data

In [21]: x_train = x_train.reshape(60000, 28, 28, 1).astype('float32')
         x_test = x_test.reshape(10000, 28, 28, 1).astype('float32')
         x_train[0]

Out[21]: array([[[  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],
                 [  0.],

In [22]: # One hot encoding
```

```
In [22]: # One hot encoding

In [56]: no_of_classes=10
         y_train = np_utils.to_categorical(y_train,no_of_classes)
         y_test = np_utils.to_categorical(y_test,no_of_classes)

In [57]: y_train[36]

Out[57]: array([0., 0., 0., 0., 0., 0., 1., 0., 0., 0.], dtype=float32)

In [58]: #model building and adding cnn layers

In [59]: model = Sequential()

In [60]: model.add(Conv2D(32, (3,3),input_shape=(28, 28, 1), activation = 'relu'))
         model.add(MaxPooling2D(pool_size=(2, 2)))

In [61]: model.add(Conv2D(64,(3,3), activation = 'relu'))
         model.add(Conv2D(64,(3,3), activation = 'relu'))

In [62]: model.add(Conv2D(32,(3,3), activation = 'relu'))
         model.add(MaxPooling2D(pool_size=(2, 2)))

In [63]: model.add(Flatten())
         model.add(Dense(10, activation = 'softmax'))

In [64]: model.summary()

Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_4 (Conv2D)           (None, 26, 26, 32)        320

 max_pooling2d_2 (MaxPooling  (None, 13, 13, 32)       0
 2D)

 conv2d_5 (Conv2D)           (None, 11, 11, 64)        18496

 conv2d_6 (Conv2D)           (None, 9, 9, 64)          36928

 conv2d_7 (Conv2D)           (None, 7, 7, 32)          18464

 max_pooling2d_3 (MaxPooling  (None, 3, 3, 32)         0
 2D)

 flatten_1 (Flatten)         (None, 288)               0

 dense_1 (Dense)             (None, 10)                2890

=================================================================
Total params: 77,098
```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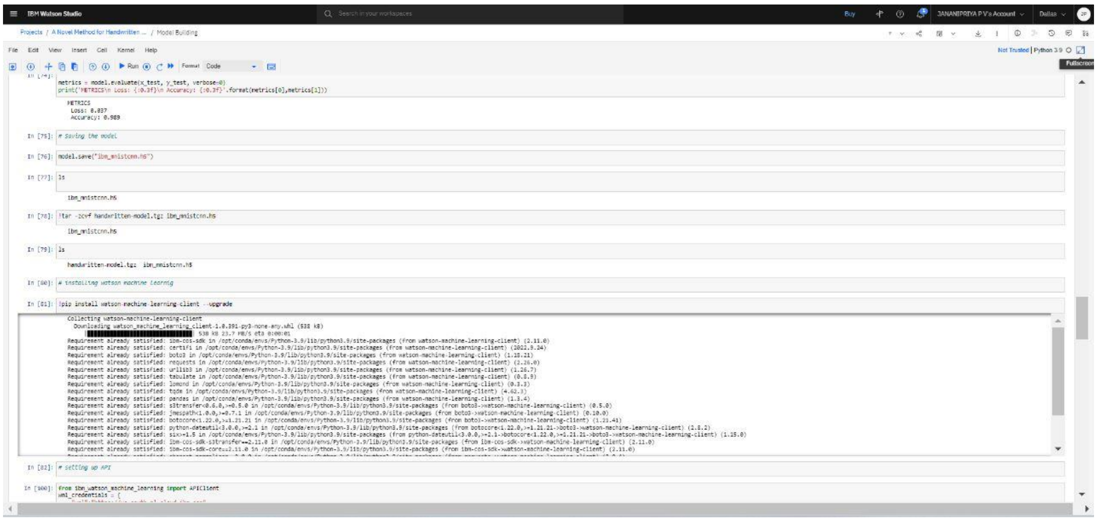
In [65]: # compiling the model
In [66]: model.compile(loss= 'categorical_crossentropy', optimizer="Adam", metrics=['accuracy'])
In [67]: x_train = np.asarray(x_train)
y_train = np.asarray(y_train)
In [68]: # train the model
In [69]: #fit the model
model.fit(x_train, y_train, validation_data=(x_test, y_test), epochs=5, batch_size=32)
Epoch 1/5
1875/1875 [==============================] - 43s 23ms/step - loss: 0.2180 - accuracy: 0.9457 - val_loss: 0.0703 - val_accuracy: 0.9792
Epoch 2/5
1875/1875 [==============================] - 42s 23ms/step - loss: 0.0669 - accuracy: 0.9795 - val_loss: 0.0525 - val_accuracy: 0.9834
Epoch 3/5
1875/1875 [==============================] - 44s 23ms/step - loss: 0.0500 - accuracy: 0.9843 - val_loss: 0.0523 - val_accuracy: 0.9834
Epoch 4/5
1875/1875 [==============================] - 43s 23ms/step - loss: 0.0445 - accuracy: 0.9868 - val_loss: 0.0320 - val_accuracy: 0.9900
Epoch 5/5
1875/1875 [==============================] - 43s 23ms/step - loss: 0.0366 - accuracy: 0.9888 - val_loss: 0.0374 - val_accuracy: 0.9893
Out[69]: <keras.callbacks.History at 0x7f59e685b880>
In [70]: # Testing the model
In [71]: prediction = model.predict(x_test[:4])
prediction
Out[71]: array([[7.24848306e-11, 3.33208505e-09, 9.96728431e-07, 1.62689890e-08,
6.72674208e-11, 1.27450593e-11, 2.45385953e-15, 9.99999046e-01,
2.52338948e-11, 2.76468709e-10],
[5.00392450e-10, 1.68492664e-05, 1.00000000e+00, 2.39126237e-13,
2.16614443e-12, 3.54964985e-16, 1.59782354e-09, 2.75846698e-15,
1.62074252e-13, 9.68221170e-15],
[3.65464302e-07, 9.99934673e-01, 4.34723052e-06, 5.00762008e-10,
5.10099890e-05, 1.01632445e-08, 1.14531638e-07, 6.54859696e-06,
2.51533629e-06, 4.70770630e-07],
[9.99997497e-01, 7.89965489e-12, 1.02042541e-09, 2.12711775e-11,
1.04836140e-09, 1.76519421e-09, 2.44310263e-06, 3.34979413e-13,
2.52503823e-10, 4.49977916e-10]], dtype=float32)
In [72]: np.argmax(prediction, axis=1)
Out[72]: array([7, 2, 1, 0])
In [73]: # Observing the metrics
In [74]: metrics = model.evaluate(x_test, y_test, verbose=0)
print('METRICS\n Loss: {:0.3f}\n Accuracy: {:0.3f}'.format(metrics[0],metrics[1]))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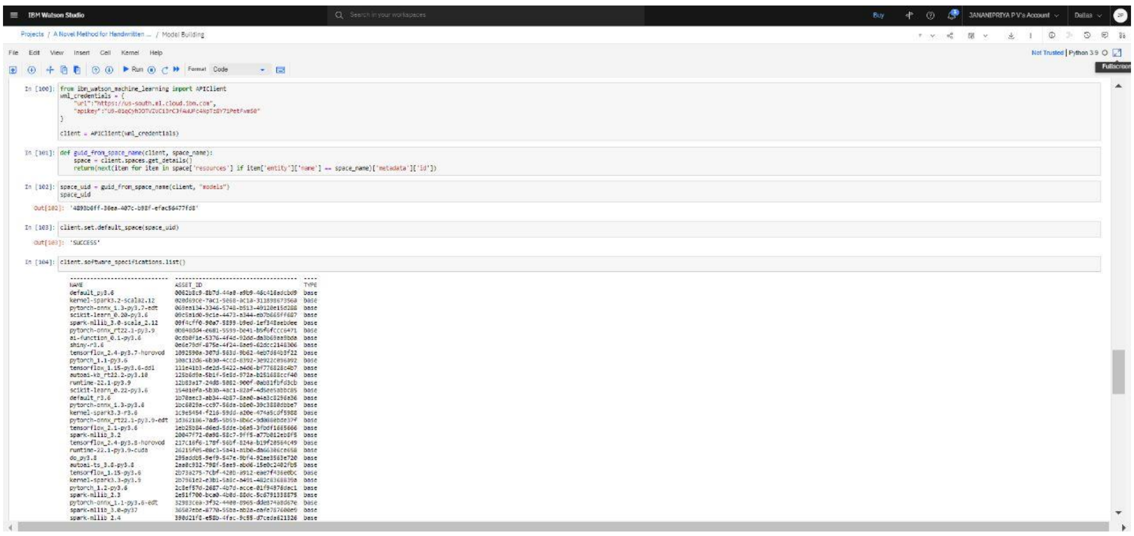
metrics = model.evaluate(x_test, y_test, verbose=0)
print('METRICS\n Loss: {:0.3f}\n Accuracy: {:0.3f}'.format(metrics[0],metrics[1]))
METRICS
Loss: 0.037
Accuracy: 0.989
In [75]: # Saving the model
In [76]: model.save("ibm_mnistcnn.h5")
In [77]: ls
ibm_mnistcnn.h5
In [78]: !tar -zcvf handwritten-model.tgz ibm_mnistcnn.h5
ibm_mnistcnn.h5
In [79]: ls
handwritten-model.tgz ibm_mnistcnn.h5
In [80]: # installing watson machine learnig
In [81]: !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 23.7 MB/s eta 0:00:01
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: boto3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.18.21)
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: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.26.7)
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: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.3.3)
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: 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)
In [82]: # setting up API
In [100]: from ibm_watson_machine_learning import APIClient
wml_credentials = {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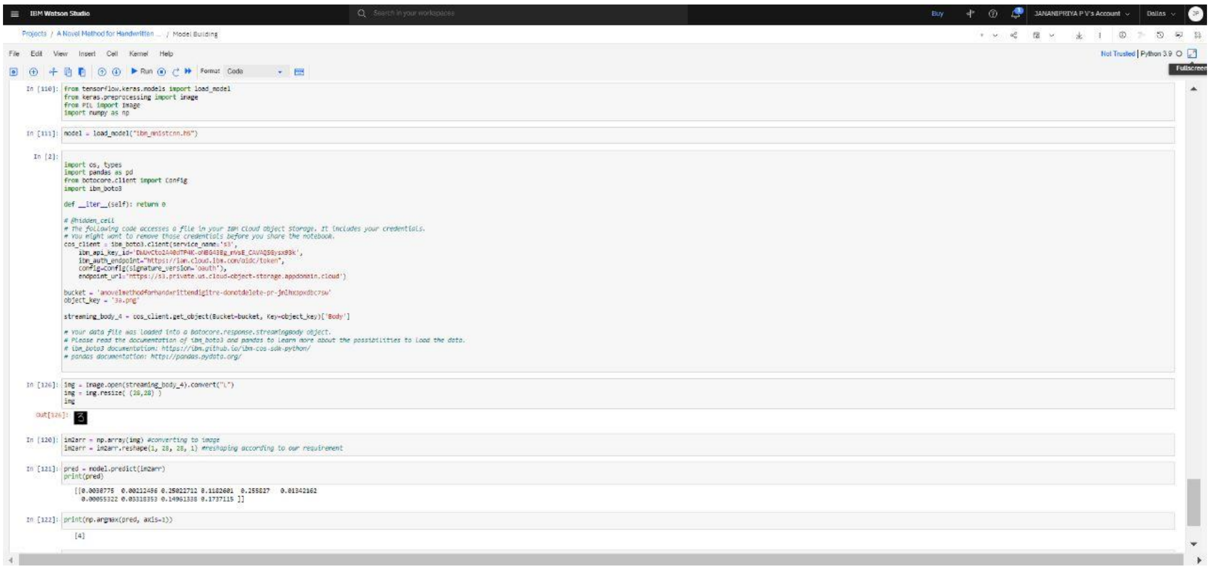
In [100]: from ibm_watson_machine_learning import APIClient
wml_credentials = {
"url":"https://us-south.ml.cloud.ibm.com",
"apikey":"U9-01qCyhJOTVZUC13rCJfAWJFc4NpTz8Y71PetFwm50"
}
client = APIClient(wml_credentials)
In [101]: def guid_from_space_name(client, space_name):
space = client.spaces.get_details()
return(next(item for item in space['resources'] if item['entity']['name'] == space_name)['metadata']['id'])
In [102]: space_uid = guid_from_space_name(client, "models")
space_uid
Out[102]: '4893b6ff-36ea-407c-b98f-efac56477fd8'
In [103]: client.set.default_space(space_uid)
Out[103]: 'SUCCESS'
In [104]: client.software_specifications.list()
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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Search in your workspaces
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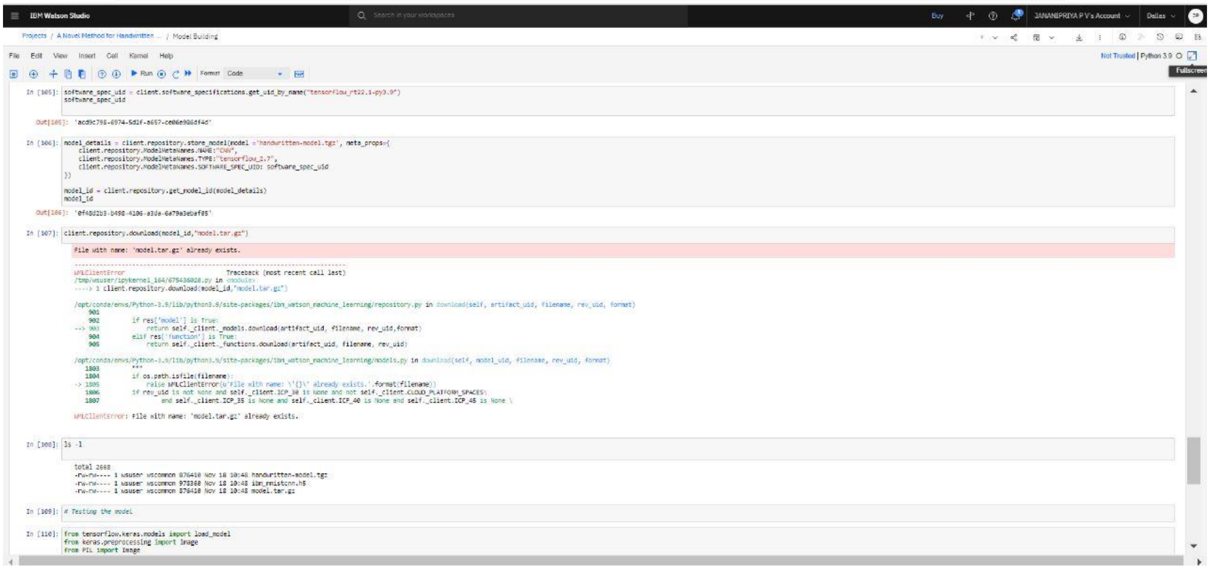
File Edit View Insert Cell Kernel Help
Run Format Code
In [110]: from tensorflow.keras.models import load_model
from keras.preprocessing import image
from PIL import Image
import numpy as np
In [111]: model = load_model("ibm_mnistcnn.h5")
In [2]: import os, types
import pandas as pd
from botocore.client 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='DWUvCto2A40dTP4K-oNBG43Bg_mVsE_CAVAQ5Gysx93k',
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 = 'anovelmethodforhandwrittendigitre-donotdelete-pr-jnlhx3pxdbc7sw'
object_key = '3a.png'
streaming_body_4 = 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/
In [126]: img = Image.open(streaming_body_4).convert("L")
img = img.resize((28,28))
img
Out[126]:
In [120]: im2arr = np.array(img) #converting to image
im2arr = im2arr.reshape(1, 28, 28, 1) #reshaping according to our requirement
In [121]: pred = model.predict(im2arr)
print(pred)
In [122]: print(np.argmax(pred, axis=1))
[4]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File Edit View Insert Cell Kernel Help
Run Format Code
In [105]: software_spec_uid = client.software_specifications.get_uid_by_name("tensorflow_rt22.1-py3.9")
software_spec_uid
Out[105]: 'acd9c798-6974-5d2f-a657-ce06e986df4d'
In [106]: model_details = client.repository.store_model(model ='handwritten-model.tgz', meta_props={
client.repository.ModelMetaNames.NAME:"CNN",
client.repository.ModelMetaNames.TYPE:"tensorflow_2.7",
client.repository.ModelMetaNames.SOFTWARE_SPEC_UID: software_spec_uid
})
model_id = client.repository.get_model_id(model_details)
model_id
Out[106]: '0f48d2b3-b498-4106-a3da-6a79a3ebaf85'
In [107]: client.repository.download(model_id,"model.tar.gz")
File with name: 'model.tar.gz' already exists.
WMLClientError Traceback (most recent call last)
/tmp/wsuser/ipykernel_164/675436028.py in <module>
----> 1 client.repository.download(model_id,"model.tar.gz")
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages/ibm_watson_machine_learning/repository.py in download(self, artifact_uid, filename, rev_uid, format)
if res['model'] is True:
return self._client._models.download(artifact_uid, filename, rev_uid,format)
elif res['function'] is True:
return self._client._functions.download(artifact_uid, filename, rev_uid)
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages/ibm_watson_machine_learning/models.py in download(self, model_uid, filename, rev_uid, format)
if os.path.isfile(filename):
raise WMLClientError(u'File with name: \'{}\' already exists.'.format(filename))
if rev_uid is not None and self._client.ICP_30 is None and not self._client.CLOUD_PLATFORM_SPACES\
and self._client.ICP_35 is None and self._client.ICP_40 is None and self._client.ICP_45 is None \
WMLClientError: File with name: 'model.tar.gz' already exists.
In [108]: ls -l
total 2668
-rw-rw---- 1 wsuser wscommon 876410 Nov 18 10:48 handwritten-model.tgz
-rw-rw---- 1 wsuser wscommon 978368 Nov 18 10:48 ibm_mnistcnn.h5
-rw-rw---- 1 wsuser wscommon 876410 Nov 18 10:48 model.tar.gz
In [109]: # Testing the model
In [110]: from tensorflow.keras.models import load_model
from keras.preprocessing import image
from PIL import Image