Sprint-4

Train The Model On IBM

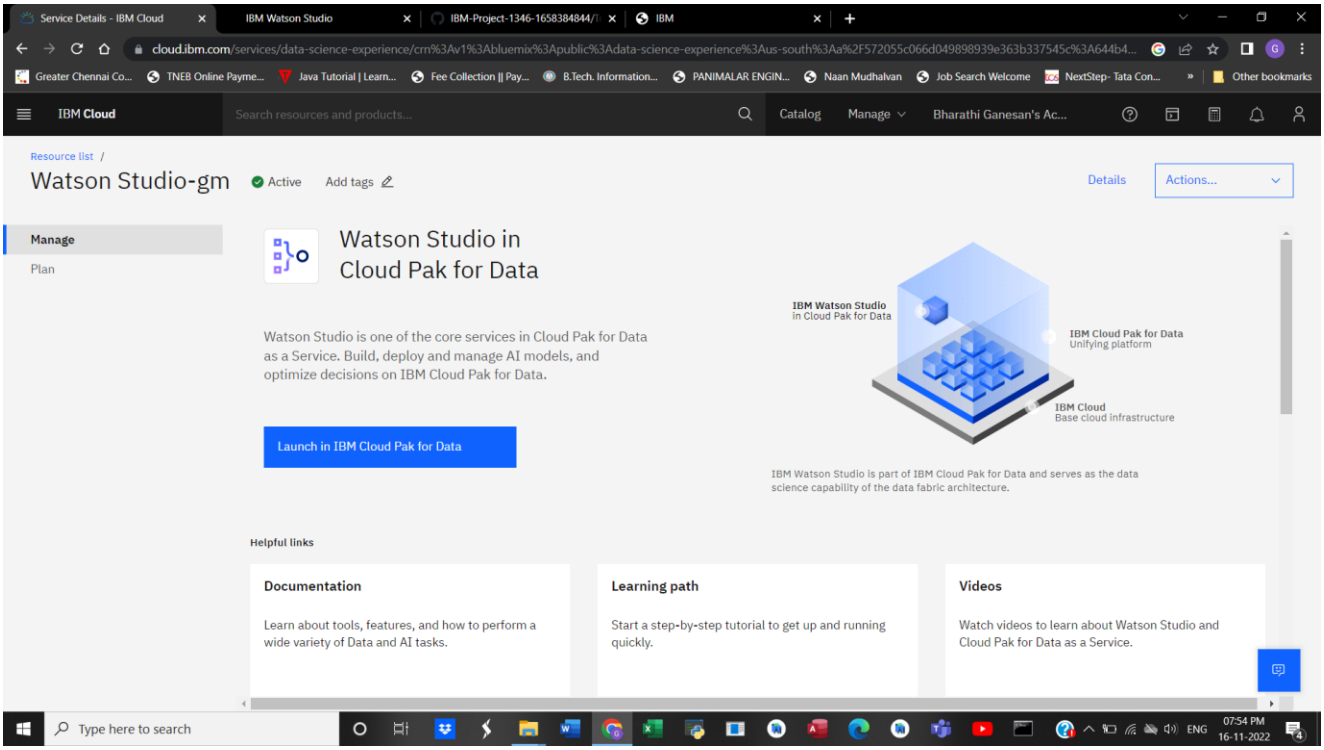
Train The Model on IBM Watson

Date	19 Nov 2022
TeamID	PNT2022TMID01315
ProjectName	Classification of Arrhythmia by Using Deep Learning with 2-D ECG Spectral Image Representation

TASK:

Train The Model on IBM Watson:

GO TO WATSON STUDIO SERVICES AND LAUNCH IT:



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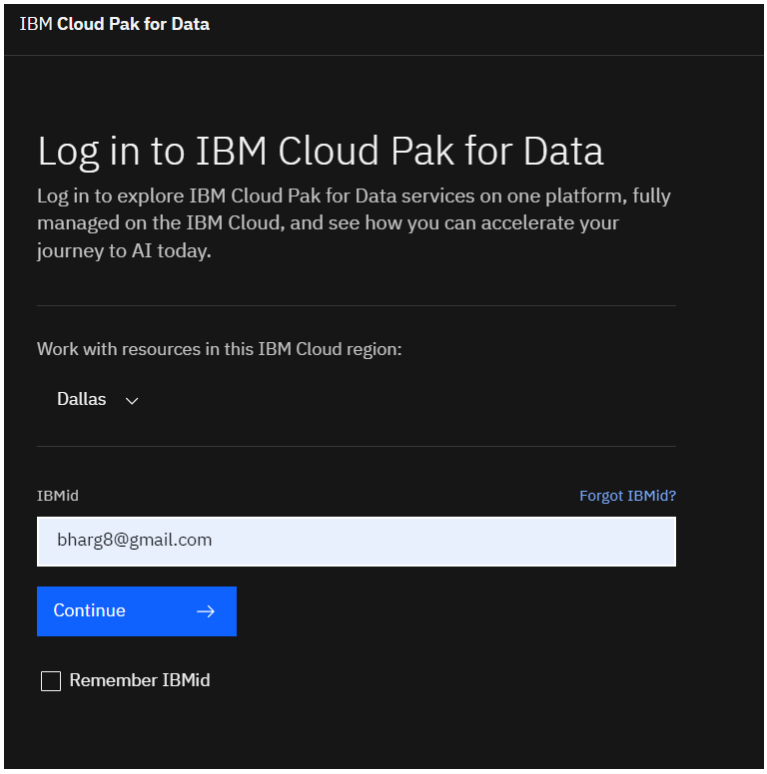
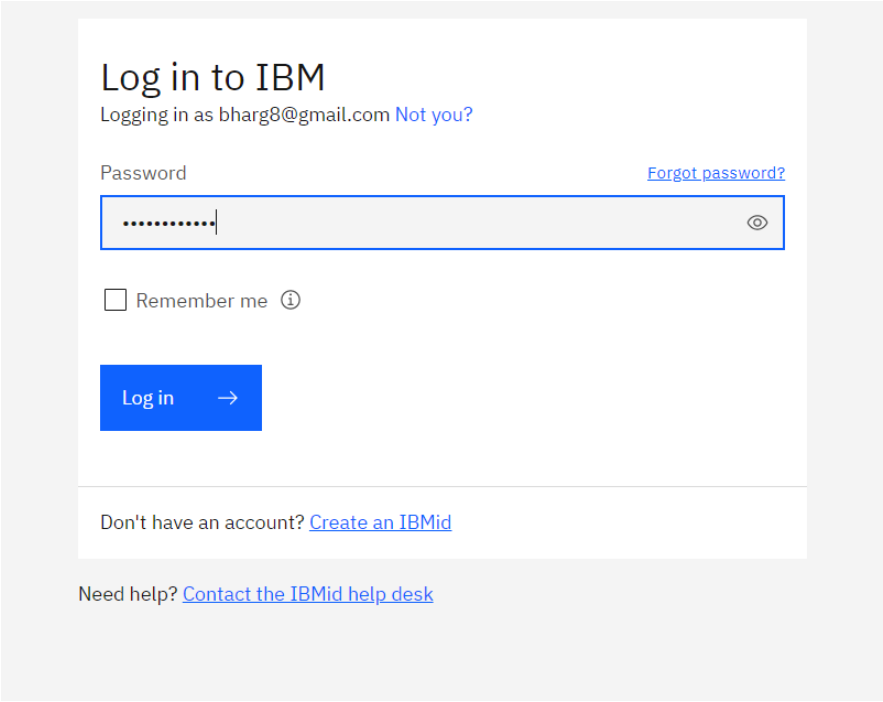
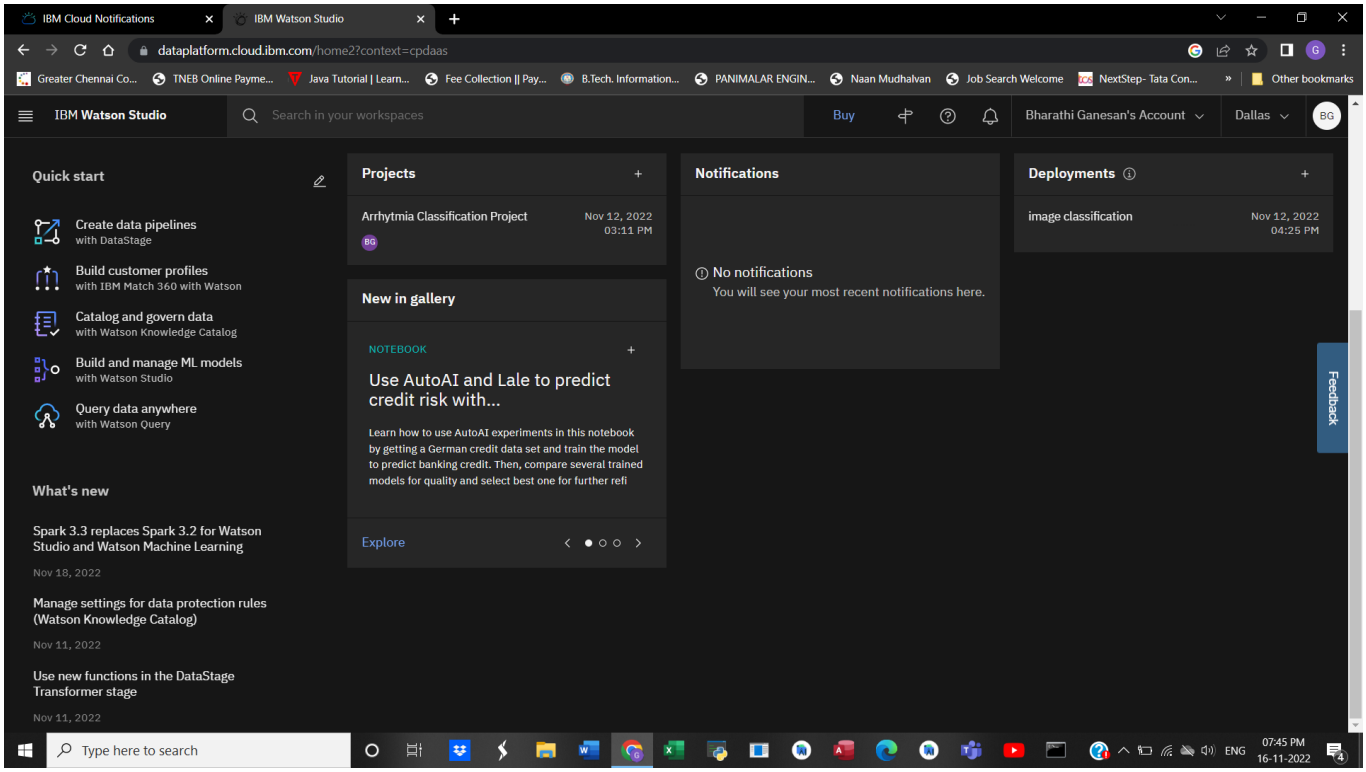
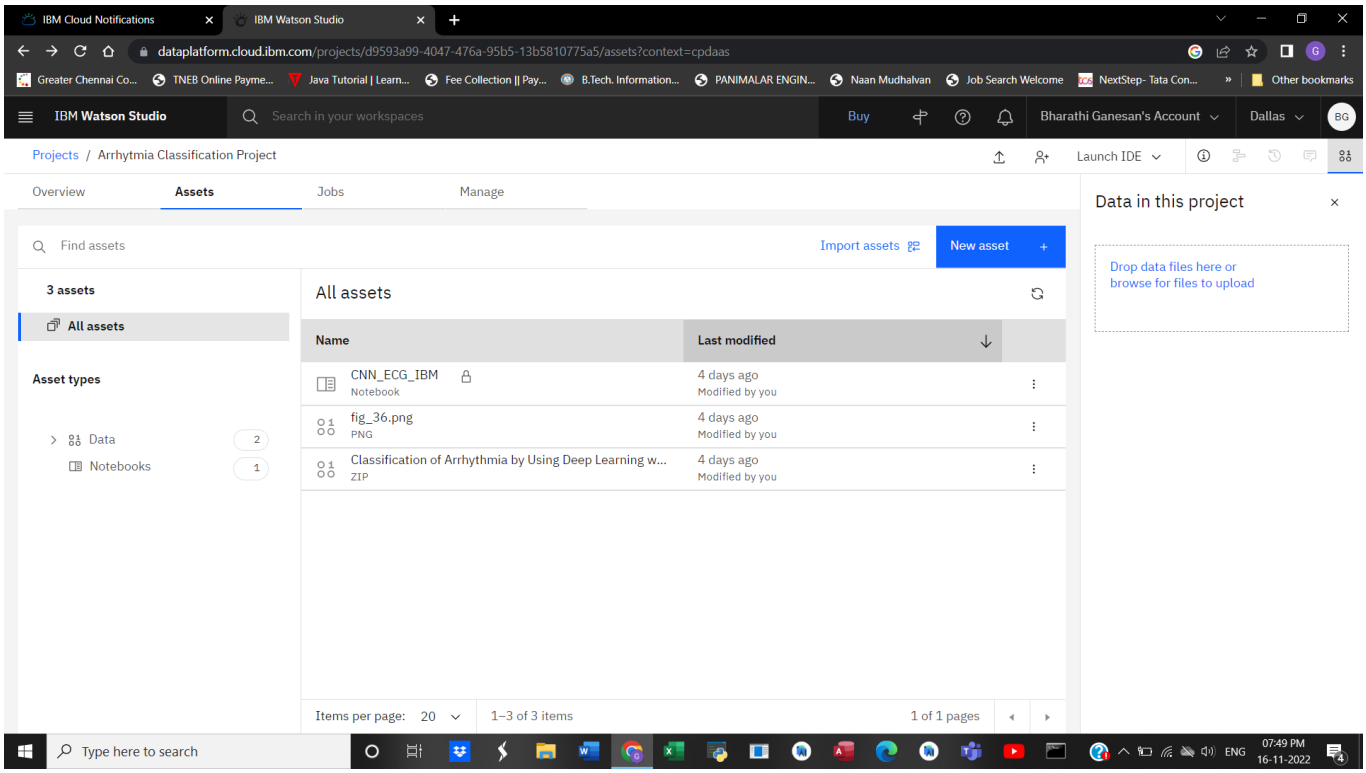


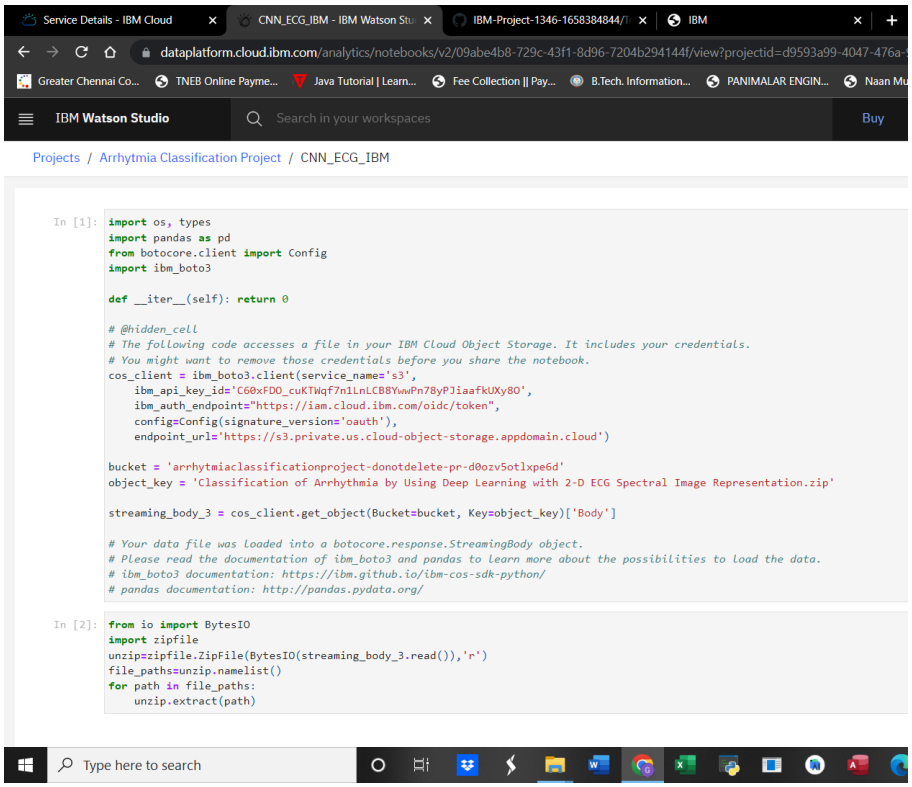


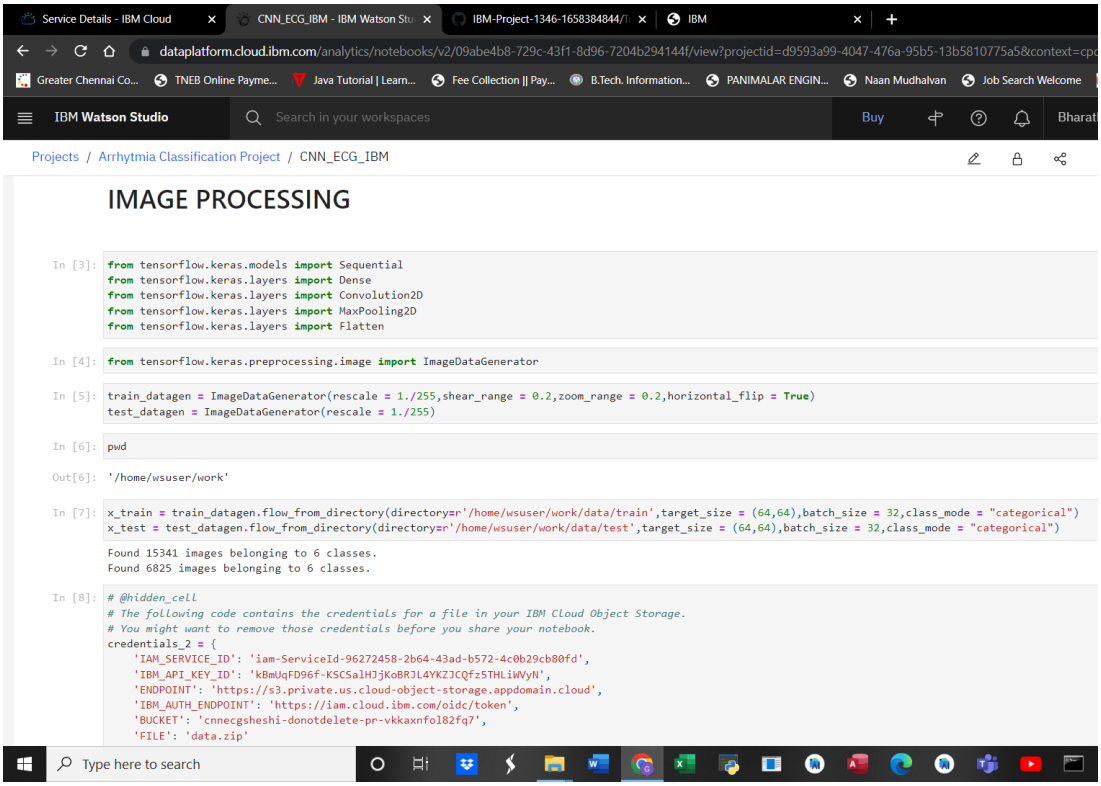


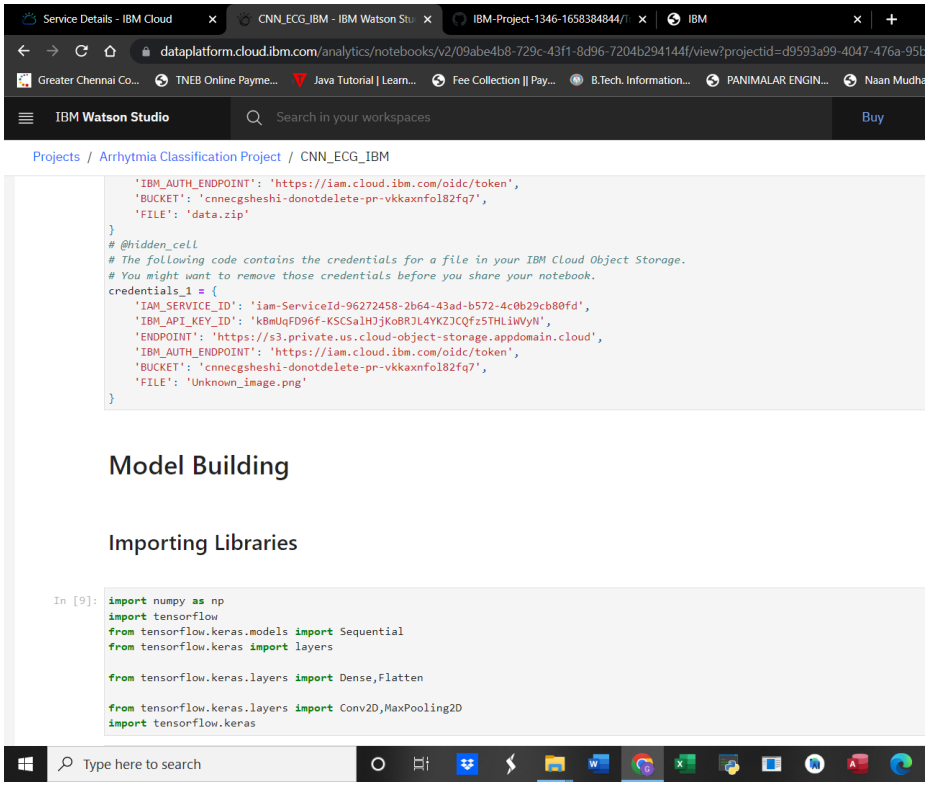
OPEN PROJECTS:



OPEN CNN-ECG-IBM PROJECT:



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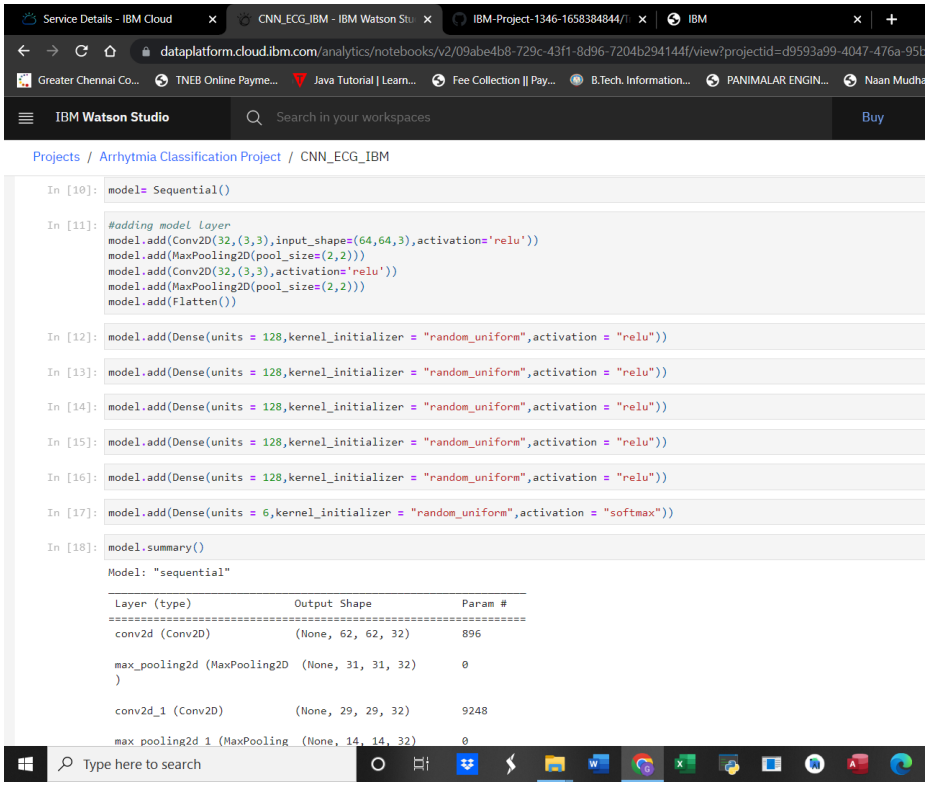
'IBM_AUTH_ENDPOINT': 'https://iam.cloud.ibm.com/oidc/token',
'BUCKET': 'cnnecgsheshi-donotdelete-pr-vkkaxnfol82fq7',
'FILE': 'data.zip'
}
# @hidden_cell
# The following code contains the credentials for a file in your IBM Cloud Object Storage.
# You might want to remove those credentials before you share your notebook.
credentials_1 = {
'IAM_SERVICE_ID': 'iam-ServiceId-96272458-2b64-43ad-b572-4c0b29cb80fd',
'IBM_API_KEY_ID': 'kBmUqFD96f-KSCSalHJjKoBRJL4YKZJCQfz5THLiWVyN',
'ENDPOINT': 'https://s3.private.us.cloud-object-storage.appdomain.cloud',
'IBM_AUTH_ENDPOINT': 'https://iam.cloud.ibm.com/oidc/token',
'BUCKET': 'cnnecgsheshi-donotdelete-pr-vkkaxnfol82fq7',
'FILE': 'Unknown_image.png'
}
Model Building
Importing Libraries
In [9]:
import numpy as np
import tensorflow
from tensorflow.keras.models import Sequential
from tensorflow.keras import layers
from tensorflow.keras.layers import Dense,Flatten
from tensorflow.keras.layers import Conv2D,MaxPooling2D
import tensorflow.keras
Type here to search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In [10]:
model= Sequential()
In [11]:
#adding model layer
model.add(Conv2D(32,(3,3),input_shape=(64,64,3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Conv2D(32,(3,3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())
In [12]:
model.add(Dense(units = 128,kernel_initializer = "random_uniform",activation = "relu"))
In [13]:
model.add(Dense(units = 128,kernel_initializer = "random_uniform",activation = "relu"))
In [14]:
model.add(Dense(units = 128,kernel_initializer = "random_uniform",activation = "relu"))
In [15]:
model.add(Dense(units = 128,kernel_initializer = "random_uniform",activation = "relu"))
In [16]:
model.add(Dense(units = 128,kernel_initializer = "random_uniform",activation = "relu"))
In [17]:
model.add(Dense(units = 6,kernel_initializer = "random_uniform",activation = "softmax"))
In [18]:
model.summary()
Model: "sequential"
Layer (type) Output Shape Param #
conv2d (Conv2D) (None, 62, 62, 32) 896
max_pooling2d (MaxPooling2D (None, 31, 31, 32) 0
)
conv2d_1 (Conv2D) (None, 29, 29, 32) 9248
max_pooling2d_1 (MaxPooling (None, 14, 14, 32) 0
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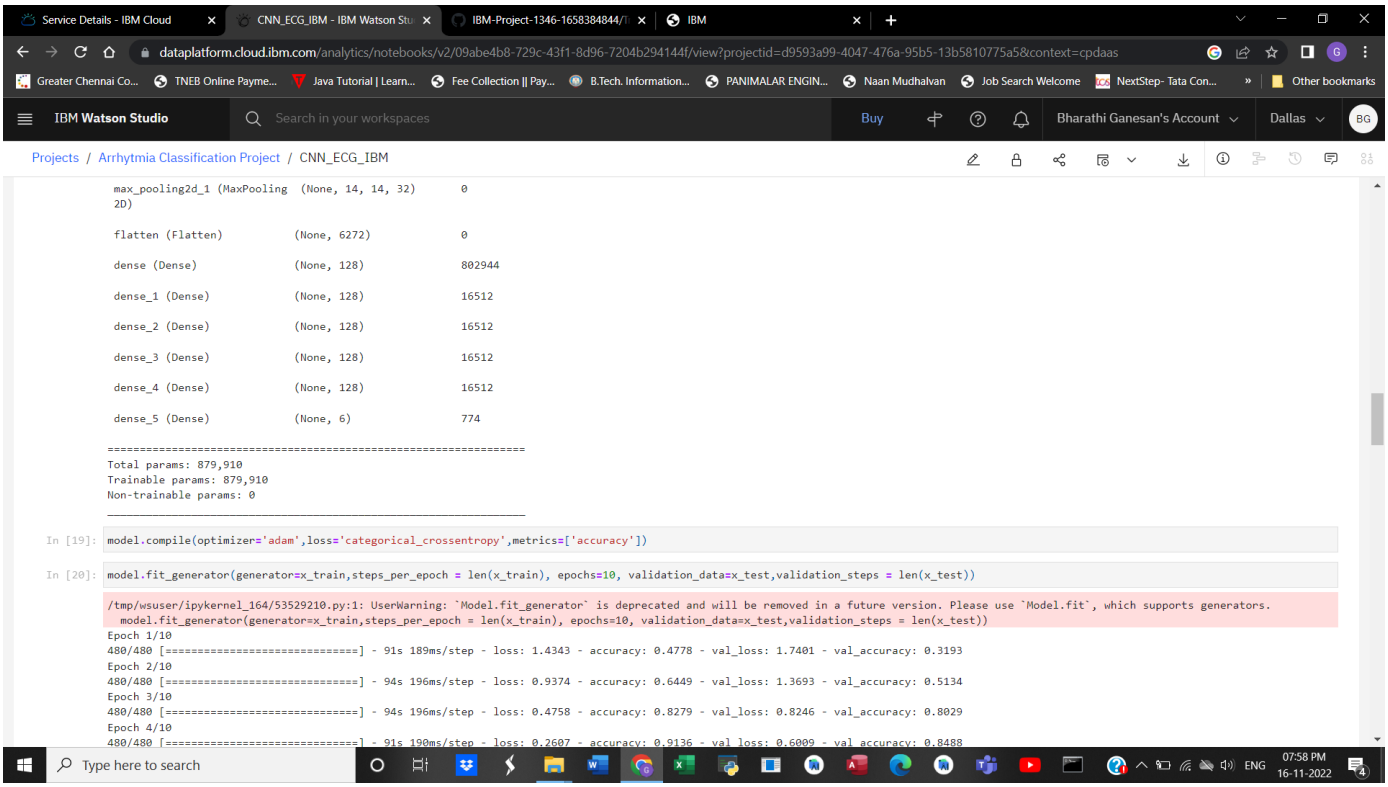
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max_pooling2d_1 (MaxPooling2D) (None, 14, 14, 32) 0
flatten (Flatten) (None, 6272) 0
dense (Dense) (None, 128) 802944
dense_1 (Dense) (None, 128) 16512
dense_2 (Dense) (None, 128) 16512
dense_3 (Dense) (None, 128) 16512
dense_4 (Dense) (None, 128) 16512
dense_5 (Dense) (None, 6) 774
Total params: 879,910
Trainable params: 879,910
Non-trainable params: 0
In [19]: model.compile(optimizer='adam',loss='categorical_crossentropy',metrics=['accuracy'])
In [20]: model.fit_generator(generator=x_train,steps_per_epoch = len(x_train), epochs=10, validation_data=x_test,validation_steps = len(x_test))
/tmp/wsuser/ipykernel_164/53529210.py:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which supports generators.
model.fit_generator(generator=x_train,steps_per_epoch = len(x_train), epochs=10, validation_data=x_test,validation_steps = len(x_test))
Epoch 1/10
480/480 [==========] - 91s 189ms/step - loss: 1.4343 - accuracy: 0.4778 - val_loss: 1.7401 - val_accuracy: 0.3193
Epoch 2/10
480/480 [==========] - 94s 196ms/step - loss: 0.9374 - accuracy: 0.6449 - val_loss: 1.3693 - val_accuracy: 0.5134
Epoch 3/10
480/480 [==========] - 94s 196ms/step - loss: 0.4758 - accuracy: 0.8279 - val_loss: 0.8246 - val_accuracy: 0.8029
Epoch 4/10
480/480 [==========] - 91s 190ms/step - loss: 0.2607 - accuracy: 0.9136 - val_loss: 0.6009 - val_accuracy: 0.8488
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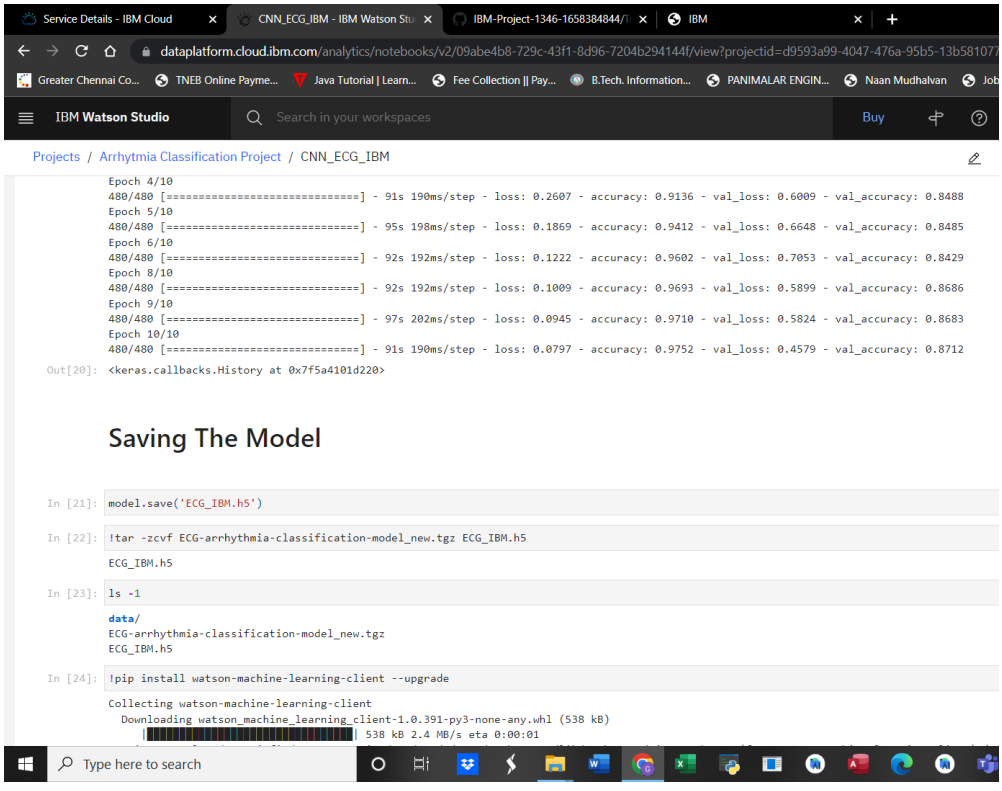
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Epoch 4/10
480/480 [==========] - 91s 190ms/step - loss: 0.2607 - accuracy: 0.9136 - val_loss: 0.6009 - val_accuracy: 0.8488
Epoch 5/10
480/480 [==========] - 95s 198ms/step - loss: 0.1869 - accuracy: 0.9412 - val_loss: 0.6648 - val_accuracy: 0.8485
Epoch 6/10
480/480 [==========] - 92s 192ms/step - loss: 0.1222 - accuracy: 0.9602 - val_loss: 0.7053 - val_accuracy: 0.8429
Epoch 8/10
480/480 [==========] - 92s 192ms/step - loss: 0.1009 - accuracy: 0.9693 - val_loss: 0.5899 - val_accuracy: 0.8686
Epoch 9/10
480/480 [==========] - 97s 202ms/step - loss: 0.0945 - accuracy: 0.9710 - val_loss: 0.5824 - val_accuracy: 0.8683
Epoch 10/10
480/480 [==========] - 91s 190ms/step - loss: 0.0797 - accuracy: 0.9752 - val_loss: 0.4579 - val_accuracy: 0.8712
Out[20]: <keras.callbacks.History at 0x7f5a4101d220>
Saving The Model
In [21]: model.save('ECG_IBM.h5')
In [22]: !tar -zcvf ECG-arrhythmia-classification-model_new.tgz ECG_IBM.h5
ECG_IBM.h5
In [23]: ls -1
data/
ECG-arrhythmia-classification-model_new.tgz
ECG_IBM.h5
In [24]: !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 2.4 MB/s eta 0:00:01
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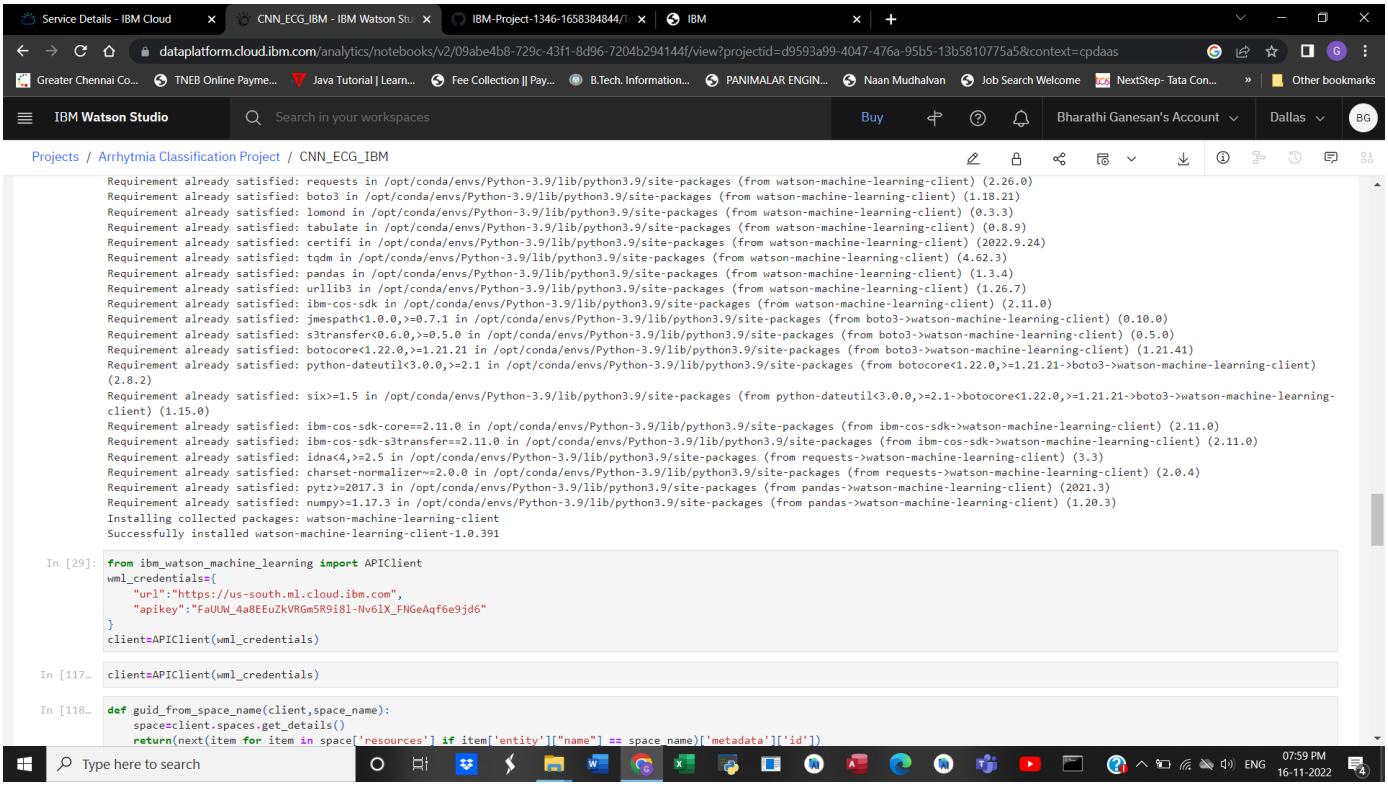
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Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.26.0)
Requirement already satisfied: boto3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.18.21)
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: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2022.9.24)
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: 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: 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: 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: 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: 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)
Installing collected packages: watson-machine-learning-client
Successfully installed watson-machine-learning-client-1.0.391
In [29]:
from ibm_watson_machine_learning import APIClient
wml_credentials={
"url":"https://us-south.ml.cloud.ibm.com",
"apikey":"FaUUW_4a8EEuZkVRGm5R9i8l-Nv6lX_FNGeAqf6e9jd6"
}
client=APIClient(wml_credentials)
In [117…
client=APIClient(wml_credentials)
In [118…
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'])
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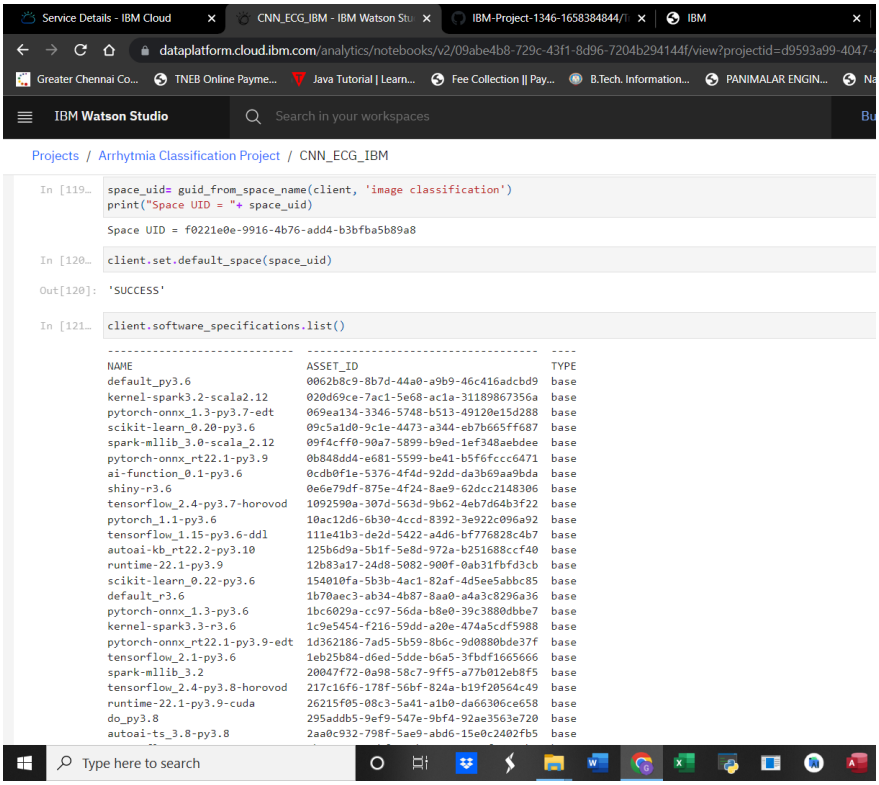
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In [119…
space_uid= guid_from_space_name(client, 'image classification')
print("Space UID = "+ space_uid)
Space UID = f0221e0e-9916-4b76-add4-b3bfba5b89a8
In [120…
client.set.default_space(space_uid)
Out[120]:
'SUCCESS'
In [121…
client.software_specifications.list()
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
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
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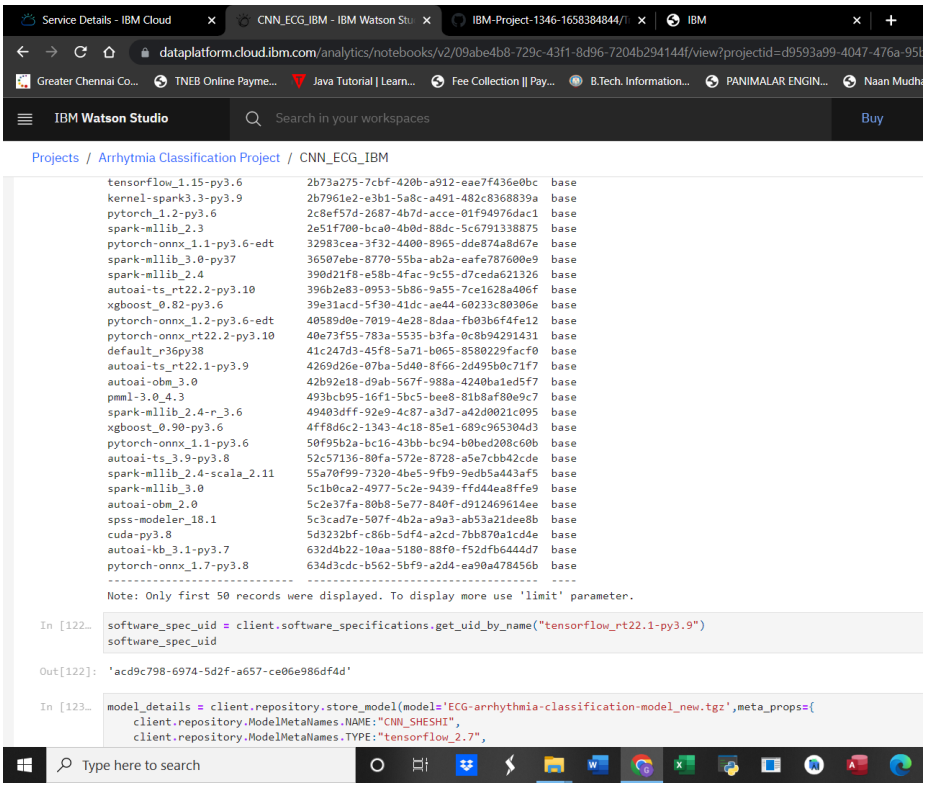
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kernel-spark3.3-py3.9 2b7961e2-e3b1-5a8c-a491-482c8368839a base
pytorch_1.2-py3.6 2c8ef57d-2687-4b7d-acce-01f94976dac1 base
spark-mllib_2.3 2e51f700-bca0-4b0d-88dc-5c6791338875 base
pytorch-onnx_1.1-py3.6-edt 32983cea-3f32-4400-8965-dde874a8d67e base
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
Note: Only first 50 records were displayed. To display more use 'limit' parameter.
In [122…
software_spec_uid = client.software_specifications.get_uid_by_name("tensorflow_rt22.1-py3.9")
software_spec_uid
Out[122]:
'acd9c798-6974-5d2f-a657-ce06e986df4d'
In [123…
model_details = client.repository.store_model(model='ECG-arrhythmia-classification-model_new.tgz',meta_props={
client.repository.ModelMetaNames.NAME:"CNN_SHESHI",
client.repository.ModelMetaNames.TYPE:"tensorflow_2.7",
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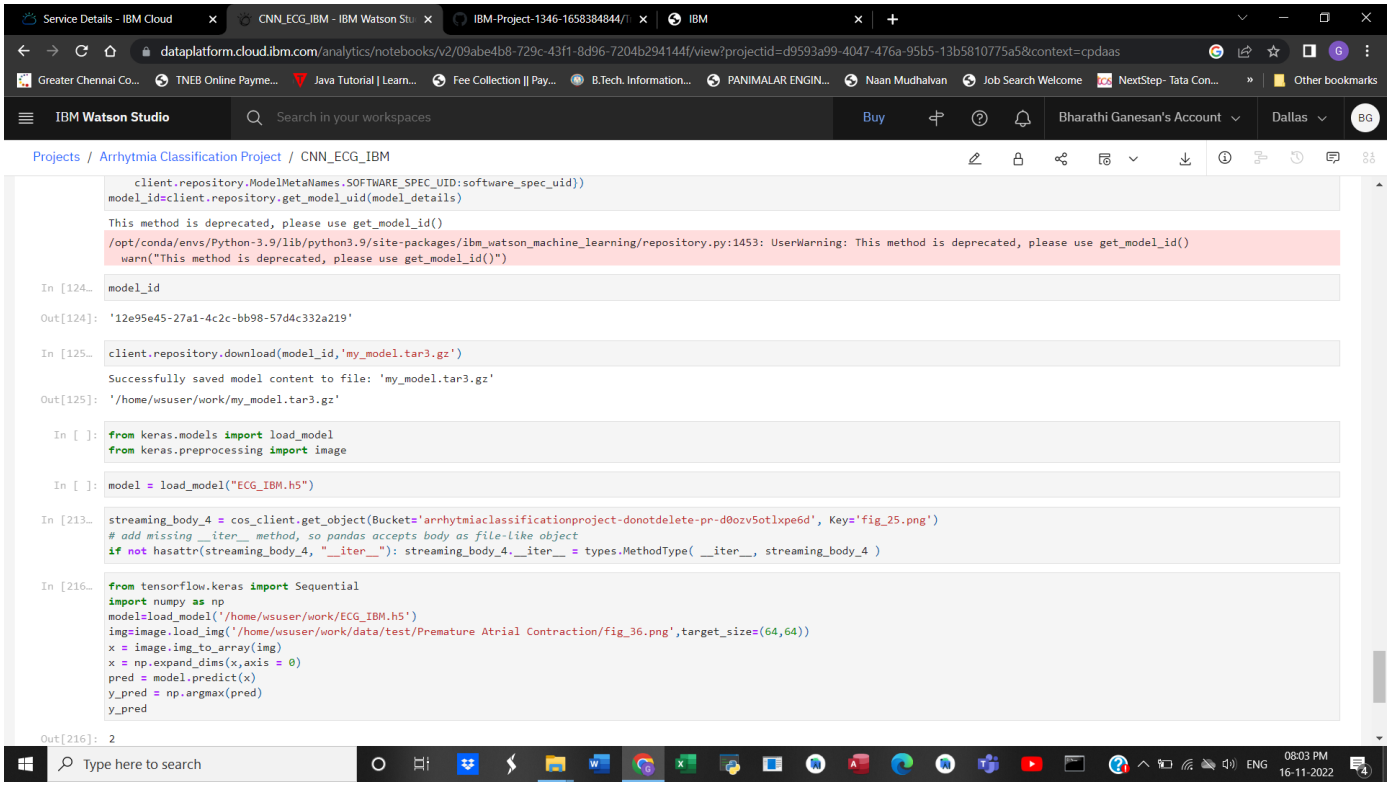
Service Details - IBM Cloud
CNN_ECG_IBM - IBM Watson Stu
IBM-Project-1346-1658384844/T
IBM
dataplatform.cloud.ibm.com/analytics/notebooks/v2/09abe4b8-729c-43f1-8d96-7204b294144f/view?projectid=d9593a99-4047-476a-95b5-13b5810775a5&context=cpdaas
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IBM Watson Studio
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Buy
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Dallas
BG
Projects / Arrhytmia Classification Project / CNN_ECG_IBM
client.repository.ModelMetaNames.SOFTWARE_SPEC_UID:software_spec_uid))
model_id=client.repository.get_model_uid(model_details)
This method is deprecated, please use get_model_id()
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages/ibm_watson_machine_learning/repository.py:1453: UserWarning: This method is deprecated, please use get_model_id()
warn("This method is deprecated, please use get_model_id()")
In [124…
model_id
Out[124]:
'12e95e45-27a1-4c2c-bb98-57d4c332a219'
In [125…
client.repository.download(model_id,'my_model.tar3.gz')
Successfully saved model content to file: 'my_model.tar3.gz'
Out[125]:
'/home/wsuser/work/my_model.tar3.gz'
In [ ]:
from keras.models import load_model
from keras.preprocessing import image
In [ ]:
model = load_model("ECG_IBM.h5")
In [213…
streaming_body_4 = cos_client.get_object(Bucket='arrhytmiaclassificationproject-donotdelete-pr-d0ozv5otlxpe6d', Key='fig_25.png')
# add missing __iter__ method, so pandas accepts body as file-like object
if not hasattr(streaming_body_4, "__iter__"): streaming_body_4.__iter__ = types.MethodType(__iter__, streaming_body_4)
In [216…
from tensorflow.keras import Sequential
import numpy as np
model=load_model('/home/wsuser/work/ECG_IBM.h5')
img=image.load_img('/home/wsuser/work/data/test/Premature Atrial Contraction/fig_36.png',target_size=(64,64))
x = image.img_to_array(img)
x = np.expand_dims(x,axis = 0)
pred = model.predict(x)
y_pred = np.argmax(pred)
y_pred
Out[216]:
2
Type here to search
ENG
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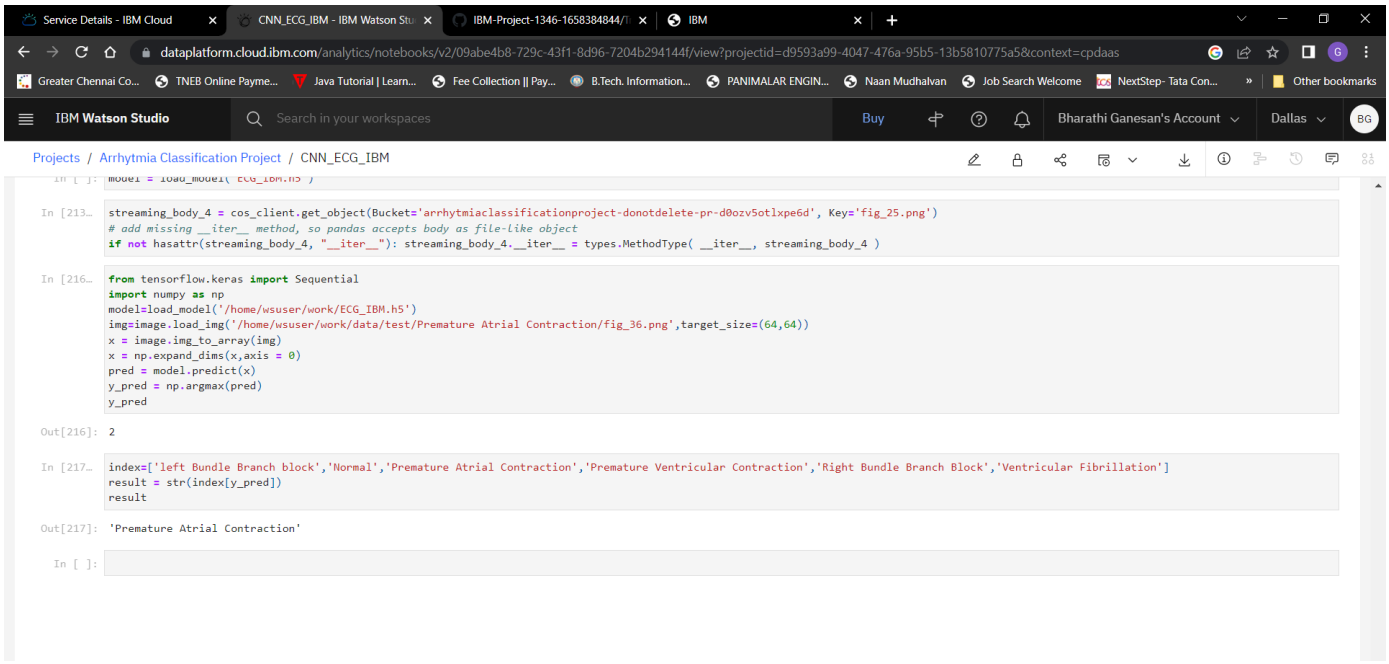
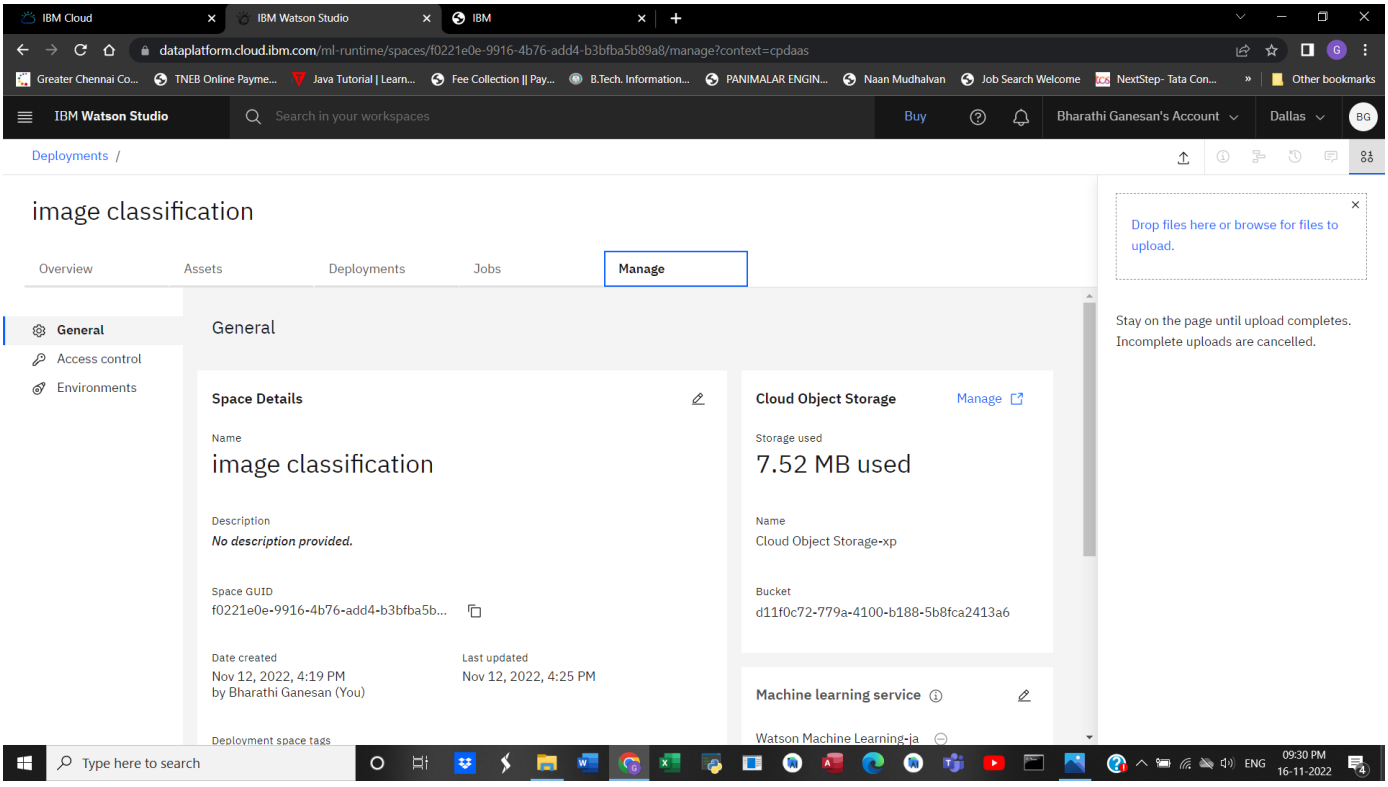
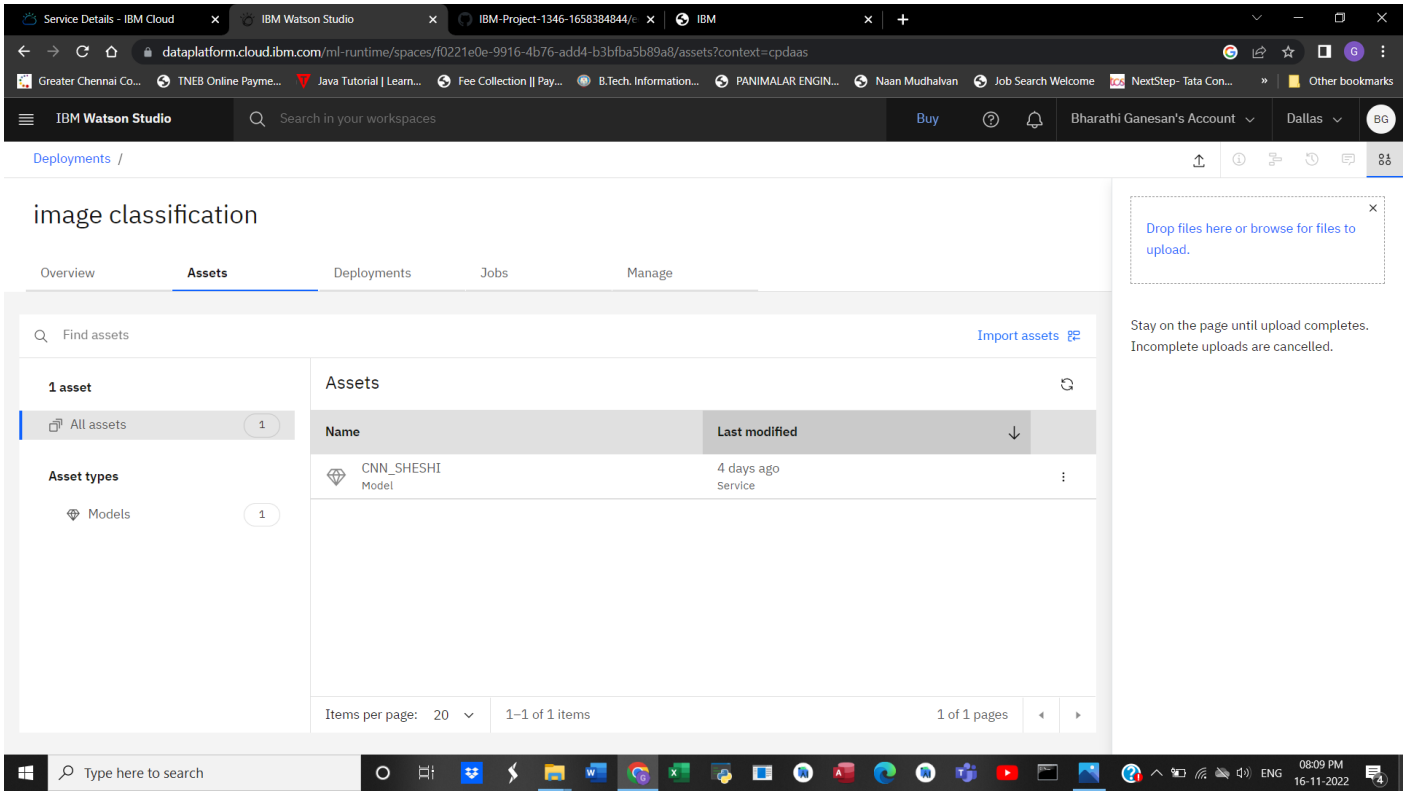


DEPLOYMENTS:




Service Details - IBM Cloud
IBM Watson Studio
IBM-Project-1346-1658384844/e
IBM
dataplatform.cloud.ibm.com/ml-runtime/spaces/f0221e0e-9916-4b76-add4-b3bfba5b89a8/assets?context=cpdaas
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Models 1
Assets
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Model
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1 of 1 pages
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