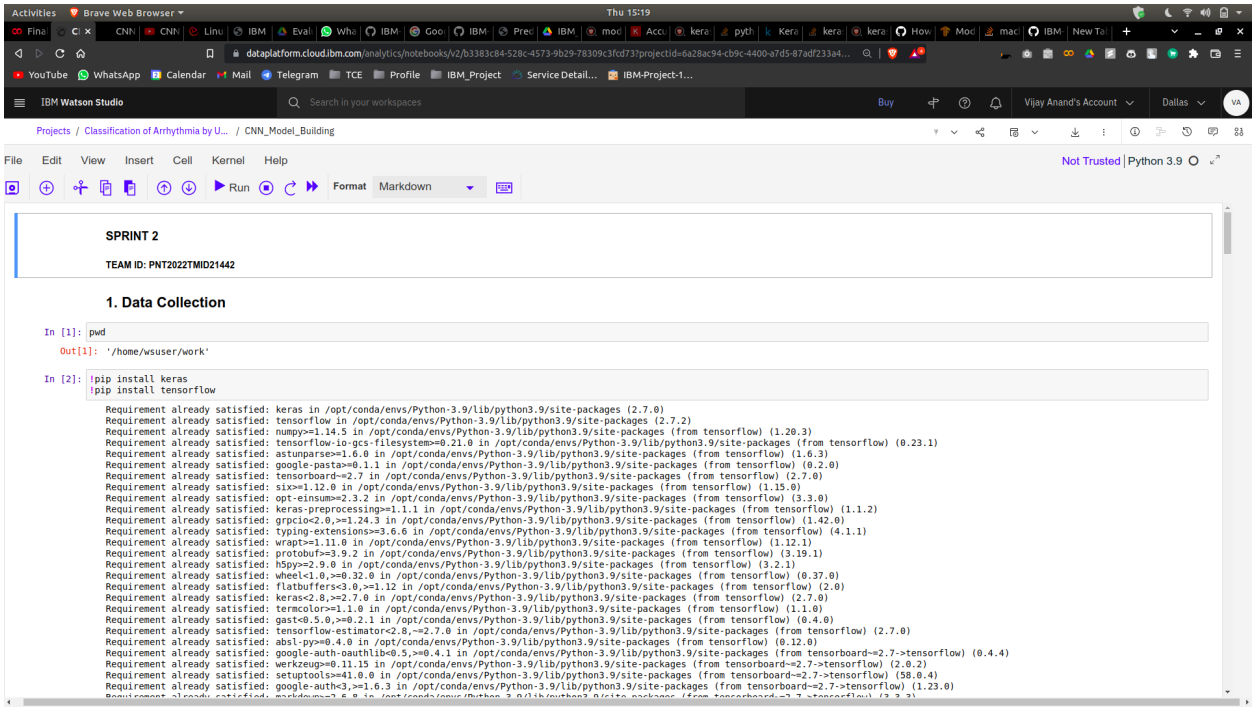
SPRINT 4
TASK: TRAIN ON IBM CLOUD
TEAM ID: PNT2022TMID21442



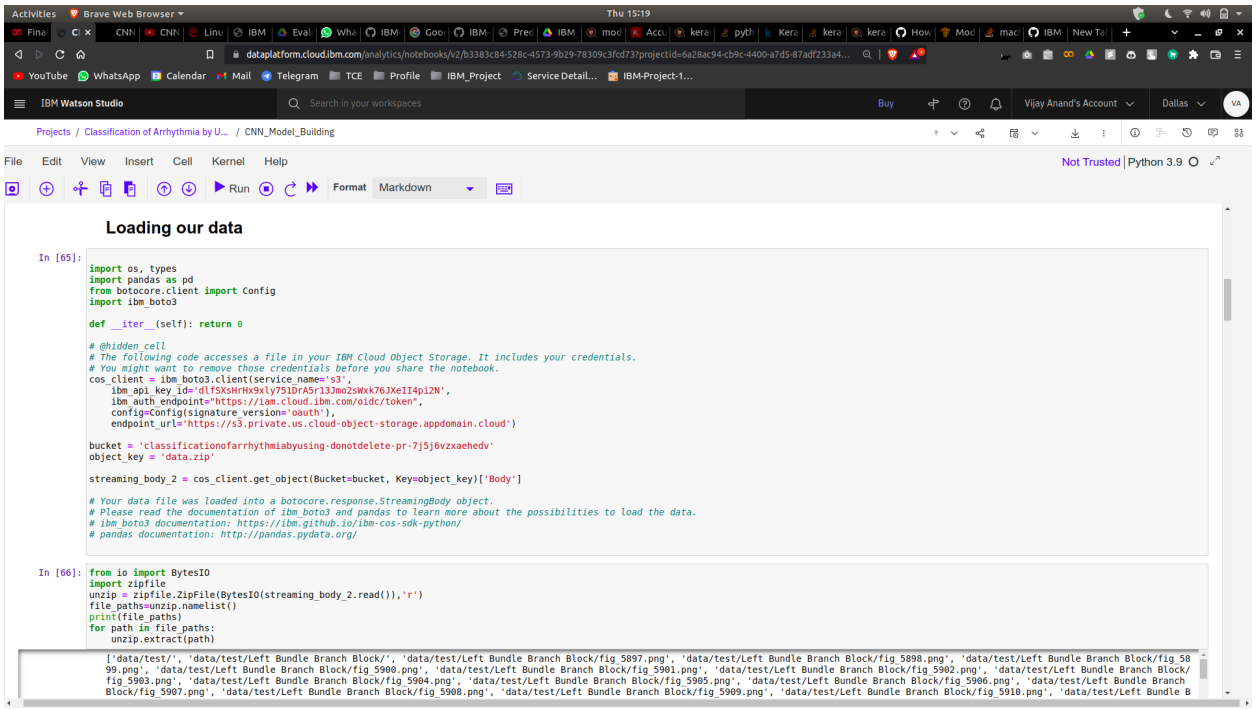
SPRINT 2

TEAM ID: PNT2022TMID21442

1. Data Collection

In [1]:
```
pwd
```
Out[1]: '/home/wsuser/work'

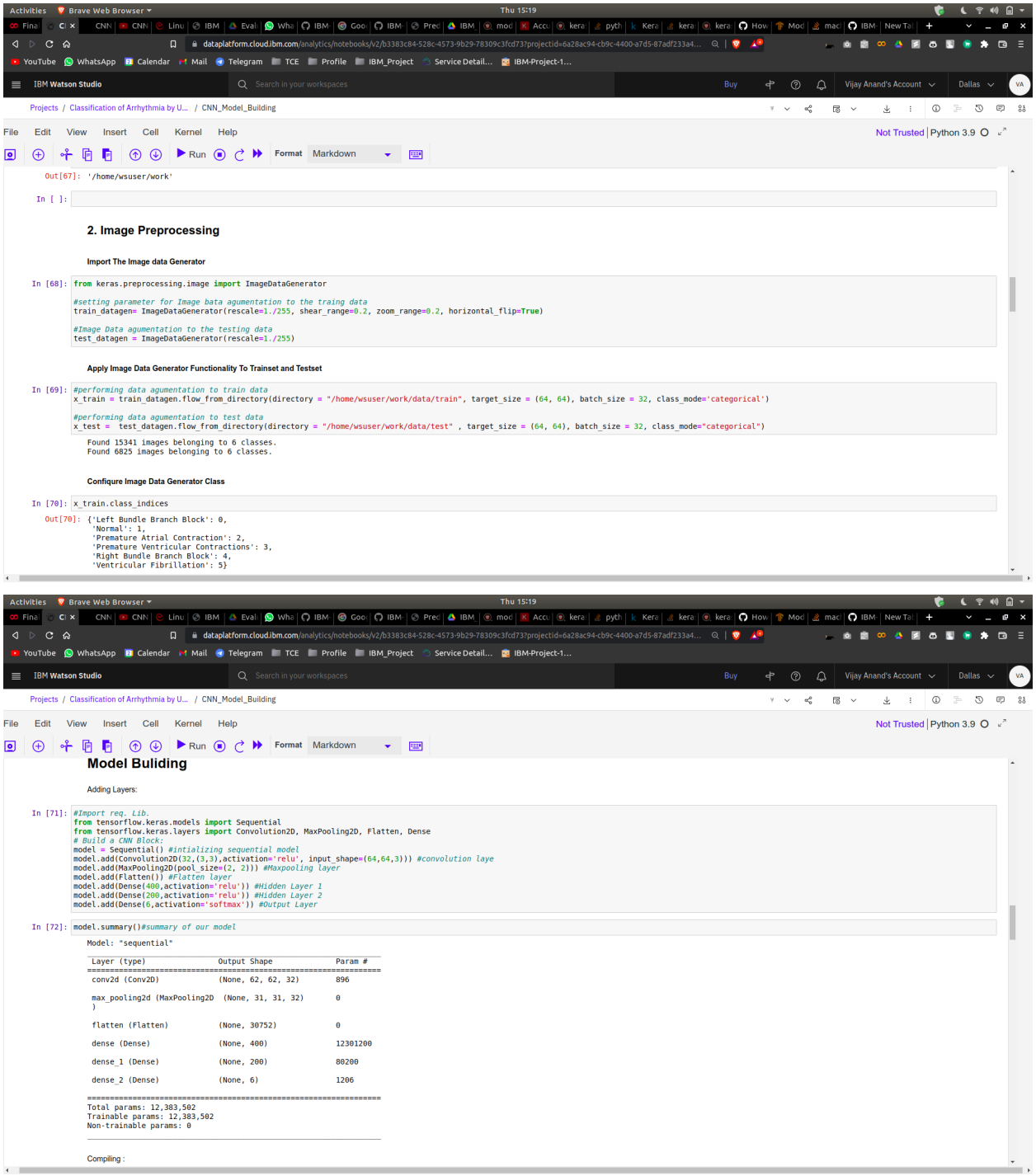
In [2]:
```
!pip install keras
!pip install tensorflow
```
```
Requirement already satisfied: keras in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (2.7.0)
Requirement already satisfied: tensorflow in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (2.7.2)
Requirement already satisfied: numpy>=1.14.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.20.3)
Requirement already satisfied: 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: astunparse>=1.6.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.6.3)
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: tensorboard~=2.7 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (2.7.0)
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: 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-preprocessing>=1.1.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.1.2)
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: 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: wrapt>=1.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.12.1)
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: h5py>=2.9.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (3.2.1)
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: flatbuffers<3.0,>=1.12 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (2.0)
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: termcolor>=1.1.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow) (1.1.0)
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: 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: 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: 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: 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: 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: 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)
```



Loading our data

In [65]:
```
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='dlfSXsHrHx9xly75lDrA5r1JJmo2sWxk76JXeII4pi2N',
    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 = 'classificationofarrhythmiabyusing-donotdelete-pr-7j5j6vzxaehedv'
object_key = 'data.zip'

streaming_body_2 = 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 [66]:
```
from io import BytesIO
import zipfile
unzip = zipfile.ZipFile(BytesIO(streaming_body_2.read()),'r')
file_paths=unzip.namelist()
print(file_paths)
for path in file_paths:
    unzip.extract(path)
```
```
['data/test/', 'data/test/Left Bundle Branch Block/', 'data/test/Left Bundle Branch Block/fig_5897.png', 'data/test/Left Bundle Branch Block/fig_5898.png', 'data/test/Left Bundle Branch Block/fig_5899.png', 'data/test/Left Bundle Branch Block/fig_5900.png', 'data/test/Left Bundle Branch Block/fig_5901.png', 'data/test/Left Bundle Branch Block/fig_5902.png', 'data/test/Left Bundle Branch Block/fig_5903.png', 'data/test/Left Bundle Branch Block/fig_5904.png', 'data/test/Left Bundle Branch Block/fig_5905.png', 'data/test/Left Bundle Branch Block/fig_5906.png', 'data/test/Left Bundle Branch Block/fig_5907.png', 'data/test/Left Bundle Branch Block/fig_5908.png', 'data/test/Left Bundle Branch Block/fig_5909.png', 'data/test/Left Bundle Branch Block/fig_5910.png', 'data/test/Left Bundle B
```



Out[67]: '/home/wsuser/work'

In [ ]:

2. Image Preprocessing

Import The Image data Generator

In [68]:
```
from keras.preprocessing.image import ImageDataGenerator

#setting parameter for Image bata agumentation to the traing data
train_datagen= ImageDataGenerator(rescale=1./255, shear_range=0.2, zoom_range=0.2, horizontal_flip=True)

#Image Data agumentation to the testing data
test_datagen = ImageDataGenerator(rescale=1./255)
```

Apply Image Data Generator Functionality To Trainset and Testset

In [69]:
```
#performing data agumentation to train data
x_train = train_datagen.flow_from_directory(directory = "/home/wsuser/work/data/train", target_size = (64, 64), batch_size = 32, class_mode='categorical')

#performing data agumentation to test data
x_test =  test_datagen.flow_from_directory(directory = "/home/wsuser/work/data/test" , target_size = (64, 64), batch_size = 32, class_mode="categorical")
```

```
Found 15341 images belonging to 6 classes.
Found 6825 images belonging to 6 classes.
```

Configure Image Data Generator Class

In [70]:
```
x_train.class_indices
```

Out[70]:
```
{'Left Bundle Branch Block': 0,
 'Normal': 1,
 'Premature Atrial Contraction': 2,
 'Premature Ventricular Contractions': 3,
 'Right Bundle Branch Block': 4,
 'Ventricular Fibrillation': 5}
```


Model Buliding

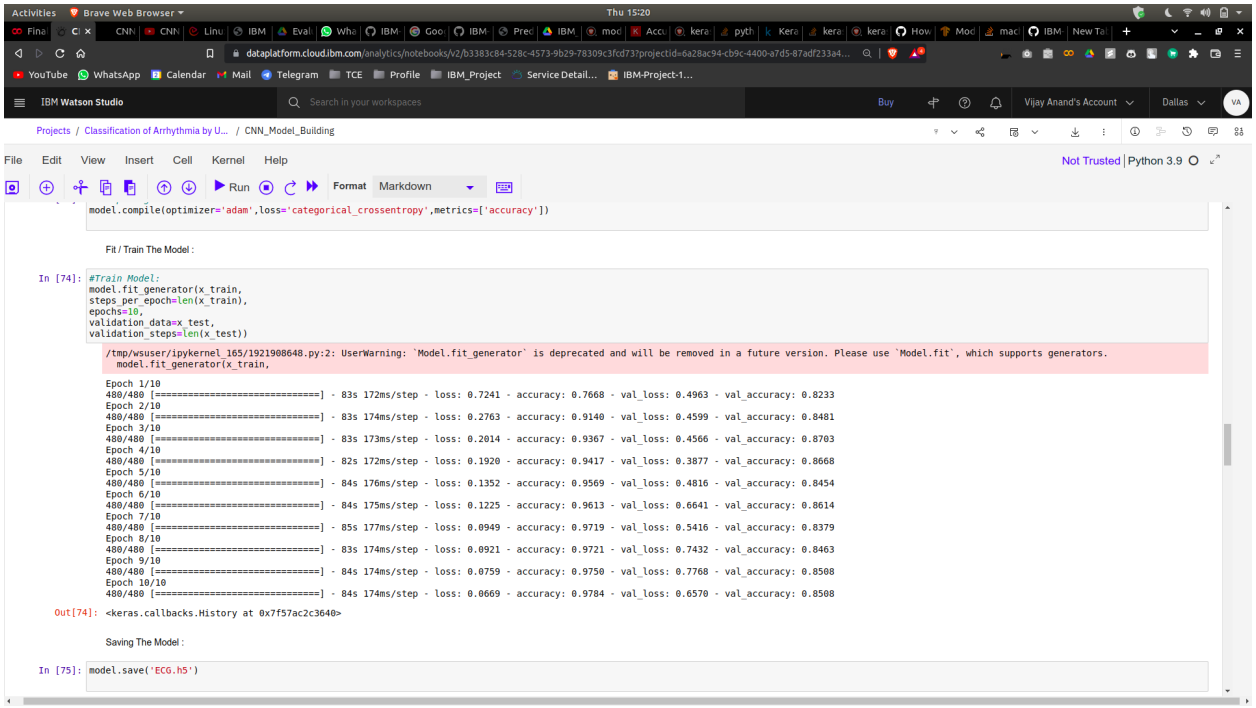
Adding Layers:

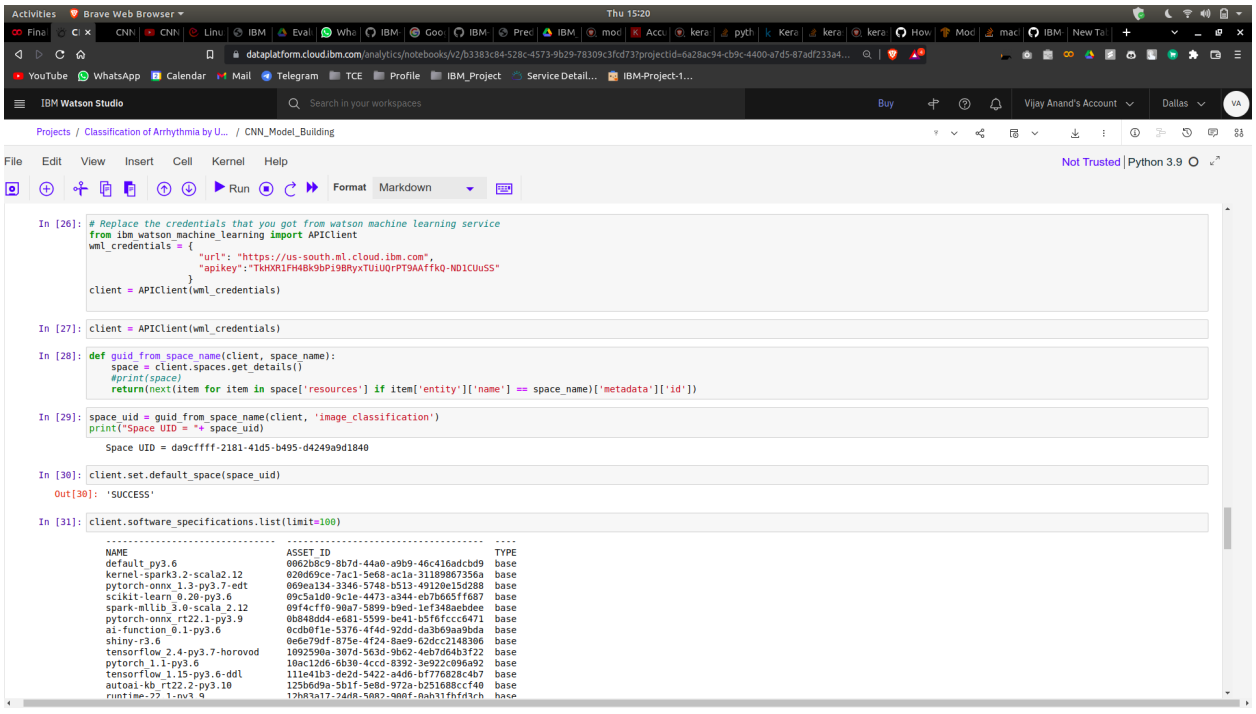
In [71]:
```
#Import req. Lib.
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D, MaxPooling2D, Flatten, Dense
# Build a CNN Block:
model = Sequential() #intializing sequential model
model.add(Convolution2D(32,(3,3),activation='relu', input_shape=(64,64,3))) #convolution laye
model.add(MaxPooling2D(pool_size=(2, 2))) #Maxpooling layer
model.add(Flatten()) #flatten layer
model.add(Dense(400,activation='relu')) #Hidden Layer 1
model.add(Dense(200,activation='relu')) #Hidden Layer 2
model.add(Dense(6,activation='softmax')) #Output Layer
```

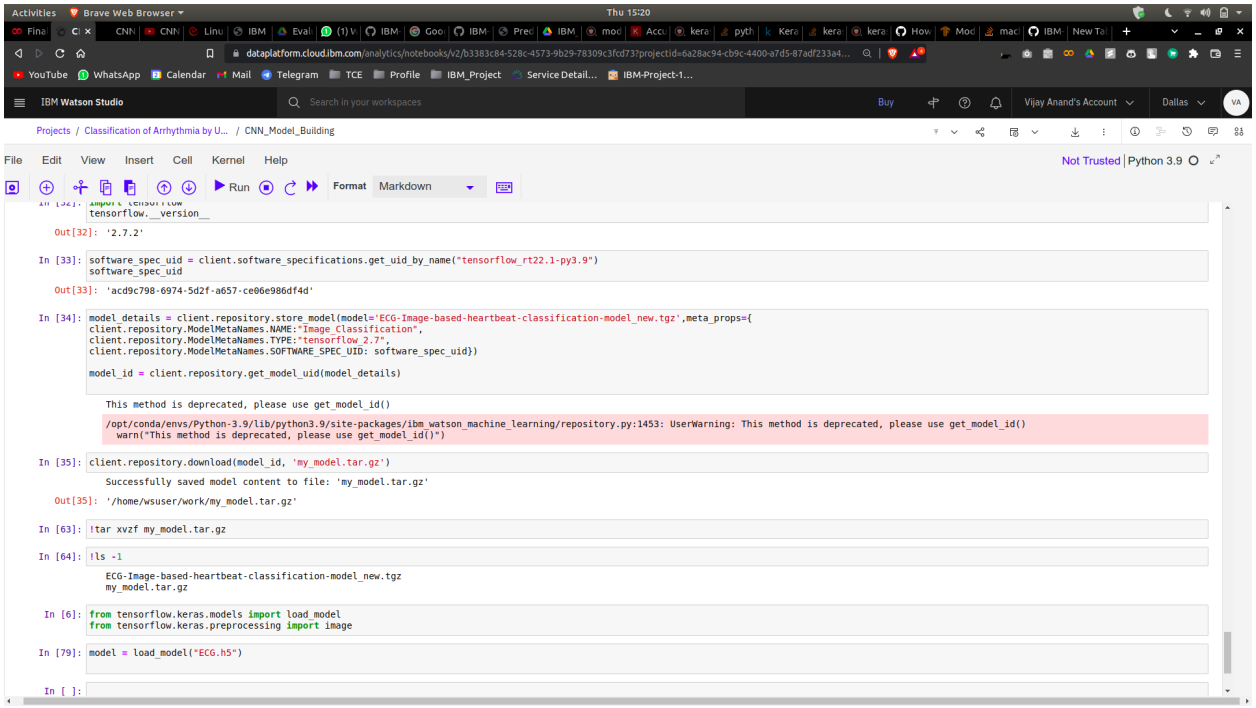
In [72]:
```
model.summary()#summary of our model
```

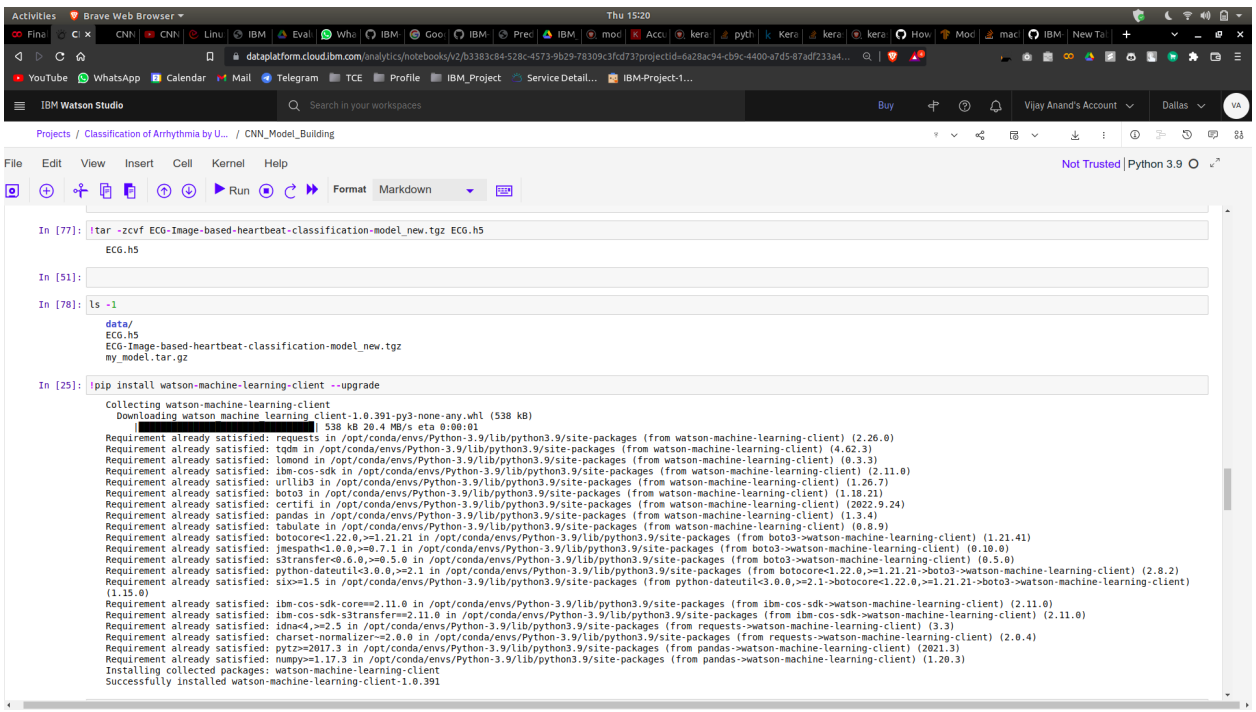
```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 62, 62, 32)        896

 max_pooling2d (MaxPooling2D  (None, 31, 31, 32)       0
 )

 flatten (Flatten)           (None, 30752)             0

 dense (Dense)               (None, 400)               12301200

 dense_1 (Dense)             (None, 200)               80200

 dense_2 (Dense)             (None, 6)                 1206

=================================================================
Total params: 12,383,502
Trainable params: 12,383,502
Non-trainable params: 0
_________________________________________________________________
```

Compiling :


Activities
Brave Web Browser
Thu 15:20
dataplatform.cloud.ibm.com/analytics/notebooks/v2/b3383c84-528c-4573-9b29-78309c3fcd73?projectid=6a28ac94-cb9c-4400-a7d5-87adf233a4...
YouTube
WhatsApp
Calendar
Mail
Telegram
TCE
Profile
IBM_Project
Service Detail...
IBM-Project-1...
IBM Watson Studio
Search in your workspaces
Buy
Vijay Anand's Account
Dallas
Projects / Classification of Arrhythmia by U... / CNN_Model_Building
File Edit View Insert Cell Kernel Help
Not Trusted | Python 3.9
Run
Format Markdown
model.compile(optimizer='adam',loss='categorical_crossentropy',metrics=['accuracy'])
Fit / Train The Model :
In [74]:
#Train Model:
model.fit_generator(x_train,
steps_per_epoch=len(x_train),
epochs=10,
validation_data=x_test,
validation_steps=len(x_test))
/tmp/wsuser/ipykernel_165/1921908648.py:2: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which supports generators.
model.fit_generator(x_train,
Epoch 1/10
480/480 [==============================] - 83s 172ms/step - loss: 0.7241 - accuracy: 0.7668 - val_loss: 0.4963 - val_accuracy: 0.8233
Epoch 2/10
480/480 [==============================] - 83s 174ms/step - loss: 0.2763 - accuracy: 0.9140 - val_loss: 0.4599 - val_accuracy: 0.8481
Epoch 3/10
480/480 [==============================] - 83s 173ms/step - loss: 0.2014 - accuracy: 0.9367 - val_loss: 0.4566 - val_accuracy: 0.8703
Epoch 4/10
480/480 [==============================] - 82s 172ms/step - loss: 0.1920 - accuracy: 0.9417 - val_loss: 0.3877 - val_accuracy: 0.8668
Epoch 5/10
480/480 [==============================] - 84s 176ms/step - loss: 0.1352 - accuracy: 0.9569 - val_loss: 0.4816 - val_accuracy: 0.8454
Epoch 6/10
480/480 [==============================] - 84s 175ms/step - loss: 0.1225 - accuracy: 0.9613 - val_loss: 0.6641 - val_accuracy: 0.8614
Epoch 7/10
480/480 [==============================] - 85s 177ms/step - loss: 0.0949 - accuracy: 0.9719 - val_loss: 0.5416 - val_accuracy: 0.8379
Epoch 8/10
480/480 [==============================] - 83s 174ms/step - loss: 0.0921 - accuracy: 0.9721 - val_loss: 0.7432 - val_accuracy: 0.8463
Epoch 9/10
480/480 [==============================] - 84s 174ms/step - loss: 0.0759 - accuracy: 0.9750 - val_loss: 0.7768 - val_accuracy: 0.8508
Epoch 10/10
480/480 [==============================] - 84s 174ms/step - loss: 0.0669 - accuracy: 0.9784 - val_loss: 0.6570 - val_accuracy: 0.8508
Out[74]:
<keras.callbacks.History at 0x7f57ac2c3640>
Saving The Model :
In [75]:
model.save('ECG.h5')


Activities
Brave Web Browser
Thu 15:20
dataplatform.cloud.ibm.com/analytics/notebooks/v2/b3383c84-528c-4573-9b29-78309c3fcd73?projectid=6a28ac94-cb9c-4400-a7d5-87adf233a4...
YouTube
WhatsApp
Calendar
Mail
Telegram
TCE
Profile
IBM_Project
Service Detail...
IBM-Project-1...
IBM Watson Studio
Search in your workspaces
Buy
Vijay Anand's Account
Dallas
Projects / Classification of Arrhythmia by U... / CNN_Model_Building
File Edit View Insert Cell Kernel Help
Not Trusted | Python 3.9
Run
Format Markdown
In [26]:
# Replace the credentials that you got from watson machine learning service
from ibm_watson_machine_learning import APIClient
wml_credentials = {
"url": "https://us-south.ml.cloud.ibm.com",
"apikey":"TkHXR1FH4Bk9bPi9BRyxTUiUQrPT9AAffkQ-ND1CUuSS"
}
client = APIClient(wml_credentials)
In [27]:
client = APIClient(wml_credentials)
In [28]:
def guid_from_space_name(client, space_name):
space = client.spaces.get_details()
#print(space)
return(next(item for item in space['resources'] if item['entity']['name'] == space_name)['metadata']['id'])
In [29]:
space_uid = guid_from_space_name(client, 'image_classification')
print("Space UID = "+ space_uid)
Space UID = da9cffff-2181-41d5-b495-d4249a9d1840
In [30]:
client.set.default_space(space_uid)
Out[30]:
'SUCCESS'
In [31]:
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


Activities
Brave Web Browser
Thu 15:20
dataplatform.cloud.ibm.com/analytics/notebooks/v2/b3383c84-528c-4573-9b29-78309c3fcd73?projectid=6a28ac94-cb9c-4400-a7d5-87adf233a4...
YouTube
WhatsApp
Calendar
Mail
Telegram
TCE
Profile
IBM_Project
Service Detail...
IBM-Project-1...
IBM Watson Studio
Search in your workspaces
Buy
Vijay Anand's Account
Dallas
Projects / Classification of Arrhythmia by U... / CNN_Model_Building
File Edit View Insert Cell Kernel Help
Not Trusted | Python 3.9
Run
Format Markdown
tensorflow.__version__
Out[32]: '2.7.2'
In [33]: software_spec_uid = client.software_specifications.get_uid_by_name("tensorflow_rt22.1-py3.9")
software_spec_uid
Out[33]: 'acd9c798-6974-5d2f-a657-ce06e986df4d'
In [34]: model_details = client.repository.store_model(model='ECG-Image-based-heartbeat-classification-model_new.tgz',meta_props={
client.repository.ModelMetaNames.NAME:"Image_Classification",
client.repository.ModelMetaNames.TYPE:"tensorflow_2.7",
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 [35]: client.repository.download(model_id, 'my_model.tar.gz')
Successfully saved model content to file: 'my_model.tar.gz'
Out[35]: '/home/wsuser/work/my_model.tar.gz'
In [63]: !tar xvzf my_model.tar.gz
In [64]: !ls -1
ECG-Image-based-heartbeat-classification-model_new.tgz
my_model.tar.gz
In [6]: from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
In [79]: model = load_model("ECG.h5")
In [ ]:


Activities
Brave Web Browser
Thu 15:20
dataplatform.cloud.ibm.com/analytics/notebooks/v2/b3383c84-528c-4573-9b29-78309c3fcd73?projectid=6a28ac94-cb9c-4400-a7d5-87adf233a4...
YouTube
WhatsApp
Calendar
Mail
Telegram
TCE
Profile
IBM_Project
Service Detail...
IBM-Project-1...
IBM Watson Studio
Search in your workspaces
Buy
Vijay Anand's Account
Dallas
Projects / Classification of Arrhythmia by U... / CNN_Model_Building
File Edit View Insert Cell Kernel Help
Not Trusted | Python 3.9
Run
Format Markdown
In [77]: !tar -zcvf ECG-Image-based-heartbeat-classification-model_new.tgz ECG.h5
ECG.h5
In [51]:
In [78]: ls -1
data/
ECG.h5
ECG-Image-based-heartbeat-classification-model_new.tgz
my_model.tar.gz
In [25]: !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 20.4 MB/s eta 0:00:01
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: tqdm in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (4.62.3)
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: 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: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.26.7)
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: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2022.9.24)
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: 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: 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: 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