

## Train on IBM Cloud

Date	16 November 2022
Team ID	PNT2022TMID26984
Project Name	Project - Classification of Arrhythmia by Using Deep Learning with 2-D ECG Spectral Image Representation
Maximum Marks	4 Marks

## IBM WATSON CREATION

The screenshot shows the IBM Watson Studio web interface. The top navigation bar includes the IBM Watson Studio logo, a search bar, and user account information (Sandhya K's Account, London). The main content area is titled 'ECG' and has tabs for Overview, Assets, Deployments, Jobs, and Manage. The 'Manage' tab is active, showing 'Space Details' for the 'ECG' space. The details include the Name (ECG), Description (No description provided), Space GUID (ef3cd409-5af2-45ad-a9f5-952291d35e2a), Date created (Nov 16, 2022, 9:35 AM by Sandhya K (You)), and Last updated (Nov 16, 2022, 9:35 AM). On the right, there is a 'Cloud Object Storage' section showing 'Storage used' (4.44 MB used) and a 'Machine learning service' section with an 'Associate instance' button.

## DEPLOYMENT

The screenshot shows the IBM Watson Studio web interface with the 'Deployments' tab selected. The page title is 'Online deployments' and it indicates '1 space'. Below this, there is a table of deployments. The table has columns for Name, Asset type, Status, Space, Copies, Last updated, and Created. One deployment is listed: 'Arrhythmia Classification' with Asset type 'Model', Status 'Deployed', Space 'ECG', Copies '1', Last updated 'Nov 16, 2022, 6:28 PM', and Created 'Nov 16, 2022, 6:28 PM'.

Name	Asset type	Status	Space	Copies	Last updated	Created
Arrhythmia Classification	Model	Deployed	ECG	1	Nov 16, 2022, 6:28 PM	Nov 16, 2022, 6:28 PM

# TRAINING ON IBM CLOUD

```
MODEL_BUILDING - IBM Watson
eu-gb.dataplatform.cloud.ibm.com/analytic/notebooks/v2/ae7ed986-bae3-4c8b-8b31-3a022354fec?projectId=9f30ef81-50c5-4cd6-9df9-fad3816ac20e&context=cpsdaas

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File Edit View Insert Cell Kernel Help
Python 3.9

In [2]:
import os, types
import pandas as pd
from botocore.client import Config
import 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 = boto3.client(service_name='s3',
    iam_api_key_id='qxMku_pm9RmanR40cui4X9ZvuhKn86zUuzH0HtEEx',
    iam_auth_endpoint='https://iam.cloud.ibm.com/oidc/token',
    config=Config(signature_version='auth'),
    endpoint_url='https://s3.private.eu.cloud-object-storage.appdomain.cloud')

bucket = 'ibmproject-donotdelete-pr-3ekkk631l0a0e'
object_key = 'Classification of Arrhythmia by Using Deep Learning with 2-D ECG Spectral Image Representation.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 boto3 and pandas to learn more about the possibilities to load the data.
# boto3 documentation: https://boto3.amazonaws.com/v1/documentation/api/latest/guide/quickstart.html#python
# pandas documentation: http://pandas.pydata.org/

IMAGE PREPROCESSING

In [3]: from io import BytesIO
import zipfile
unzip = zipfile.ZipFile(BytesIO(streaming_body_2.read()), 'r')
file_paths = unzip.namelist()
for path in file_paths:
    unzip.extract(path)

In [4]: cwd = os.getcwd()
cwd
Out[4]: '/home/user/work'
```

```
MODEL_BUILDING - IBM Watson
eu-gb.dataplatform.cloud.ibm.com/analytic/notebooks/v2/ae7ed986-bae3-4c8b-8b31-3a022354fec?projectId=9f30ef81-50c5-4cd6-9df9-fad3816ac20e&context=cpsdaas

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In [12]: # Adding CNN Layers
model.Sequential()
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 [13]: # Adding Dense Layers
model.add(Dense(32))
model.add(Dense(6,activation='softmax'))
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 (MaxPooling2D) (None, 14, 14, 32) 0
flatten (Flatten) (None, 6272) 0
dense (Dense) (None, 32) 200736
dense_1 (Dense) (None, 6) 198
-----
Total params: 211,078
Trainable params: 211,078
Non-trainable params: 0
```

```
MODEL_BUILDING - IBM Watson
eu-gb.dataplatform.cloud.ibm.com/analytics/notebooks/v2/ae7ed986-bae3-4cfb-8b31-3a022354fec?projectid=930ef81-50c5-4c06-9df9-fad3816ac20e&context=cpdaas
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In [14]: # Configure The Learning Process
model.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])

In [15]: model.fit_generator(generator=x_train, steps_per_epoch=len(x_train), epochs=10, validation_data=(x_test, validation_steps=len(x_test)))

/tmp/ususer/ipykernel_164/745804578.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 [=====] - 55s 113ms/step - loss: 0.8534 - accuracy: 0.7134 - val_loss: 0.4537 - val_accuracy: 0.8280
Epoch 2/10
480/480 [=====] - 54s 112ms/step - loss: 0.2921 - accuracy: 0.9139 - val_loss: 0.3219 - val_accuracy: 0.8979
Epoch 3/10
480/480 [=====] - 54s 111ms/step - loss: 0.2343 - accuracy: 0.9316 - val_loss: 0.3997 - val_accuracy: 0.8722
Epoch 4/10
480/480 [=====] - 54s 113ms/step - loss: 0.2107 - accuracy: 0.9372 - val_loss: 0.3627 - val_accuracy: 0.8727
Epoch 5/10
480/480 [=====] - 54s 111ms/step - loss: 0.1863 - accuracy: 0.9442 - val_loss: 0.3402 - val_accuracy: 0.8837
Epoch 6/10
480/480 [=====] - 56s 117ms/step - loss: 0.1614 - accuracy: 0.9501 - val_loss: 0.3607 - val_accuracy: 0.8816
Epoch 7/10
480/480 [=====] - 54s 113ms/step - loss: 0.1538 - accuracy: 0.9544 - val_loss: 0.2740 - val_accuracy: 0.9190
Epoch 8/10
480/480 [=====] - 54s 112ms/step - loss: 0.1349 - accuracy: 0.9583 - val_loss: 0.2914 - val_accuracy: 0.9127
Epoch 9/10
480/480 [=====] - 54s 113ms/step - loss: 0.1317 - accuracy: 0.9608 - val_loss: 0.2978 - val_accuracy: 0.9086
Epoch 10/10
480/480 [=====] - 54s 112ms/step - loss: 0.1230 - accuracy: 0.9626 - val_loss: 0.3585 - val_accuracy: 0.9141

Out[15]: <keras.callbacks.History at 0x7f493a49f78>

In [16]: # Save The Model
model.save('ECG.h5')

In [17]: !tar -zcvf ECG-classification.tgz ECG.h5
ECG.h5
```

```
MODEL_BUILDING - IBM Watson
eu-gb.dataplatform.cloud.ibm.com/analytics/notebooks/v2/ae7ed986-bae3-4cfb-8b31-3a022354fec?projectid=930ef81-50c5-4c06-9df9-fad3816ac20e&context=cpdaas
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In [24]: client.spaces.list()

Note: 'limit' is not provided. Only first 50 records will be displayed if the number of records exceed 50
-----
ID NAME CREATED
ef3cd409-5af2-45ad-a9f5-952291d35e2a ECG 2022-11-16T04:05:41.652Z
5cf1a711-eeeb-4201-9932-b204806d55a52 Demo 2022-11-08T10:28:13.914Z
-----

In [29]: def guid_from_space_name(client, space_name):
space = client.spaces.get_details(space_name)
return(next(item for item in space['resources'] if item['entity']['name']==space_name)['metadata']['id'])

In [30]: space_id = guid_from_space_name(client, 'ECG')
print("Space UID: " + space_id)

Space UID: ef3cd409-5af2-45ad-a9f5-952291d35e2a

In [31]: client.set_default_space(space_id)
Out[31]: 'SUCCESS'

In [32]: client.software_specifications.list()

-----
NAME ASSET_ID TYPE
default_py3.6 0062b8c9-8b7d-44a0-a0b0-46c416adcb09 base
kernel-spark3.2-scala2.12 020609ce-7ac1-5e08-ac1a-21108067356a base
pytorch-onnx_1.3-py3.7-edt 000ea13d-3346-5748-b513-49120e15d288 base
scikit-learn_0.20-py3.6 09c5a1d0-9c1e-4473-a344-eb7b665f6687 base
spark-mllib_3.0-scala_2.12 09ff4cf8-9ea7-5099-b9ed-1ef348aebd0e base
pytorch-onnx_rt22.1-py3.9 00a480d4-e081-5599-ba41-b5f6f6cc0471 base
ai-function_0.1-py3.6 0cdeb0fe-5376-4f4d-92dd-da3b69aa9bda base
shiny-r3.6 0e6e79df-875e-4f24-8ae9-62dc2114930e base
tensorflow_2.4-py3.7-horovod 1092590a-3076-563d-9062-4eb7664b3f22 base
pytorch_1.1-py3.6 10ac12d6-0b30-4c4d-8392-3e922c09e402 base
tensorflow_1.15-py3.6-ddl 111e41b3-de2d-5422-a4de-bf776828c407 base
autoai-kb_rt22.2-py3.10 125b069a-501f-5e8d-972a-b251088ccf40 base
runtime_v2.1-py3.9 12083a17-2468-508f-9a031fbfd3cb base
scikit-learn_0.22-py3.6 154010fa-5b3b-4ac1-82af-4d5ee5abbc85 base
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```