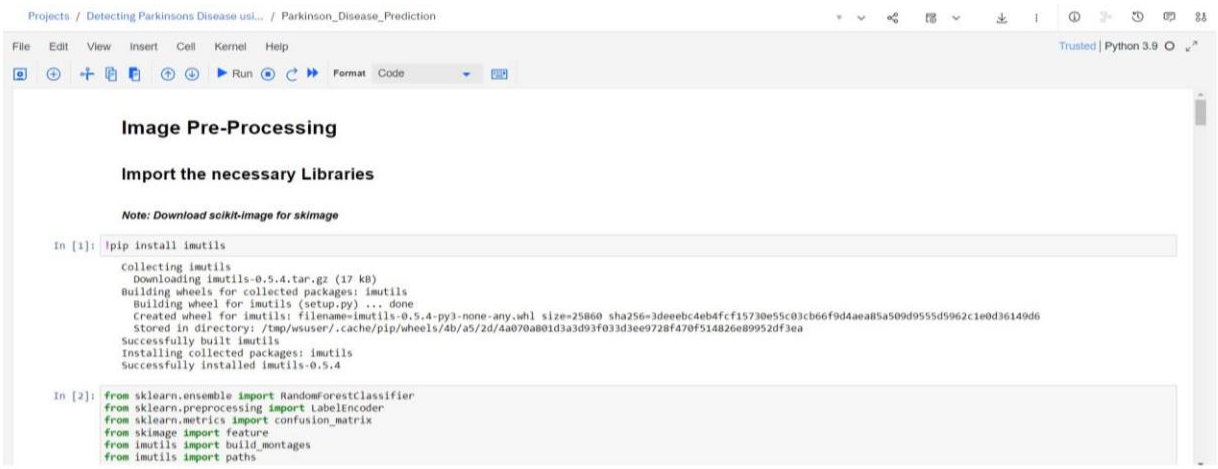
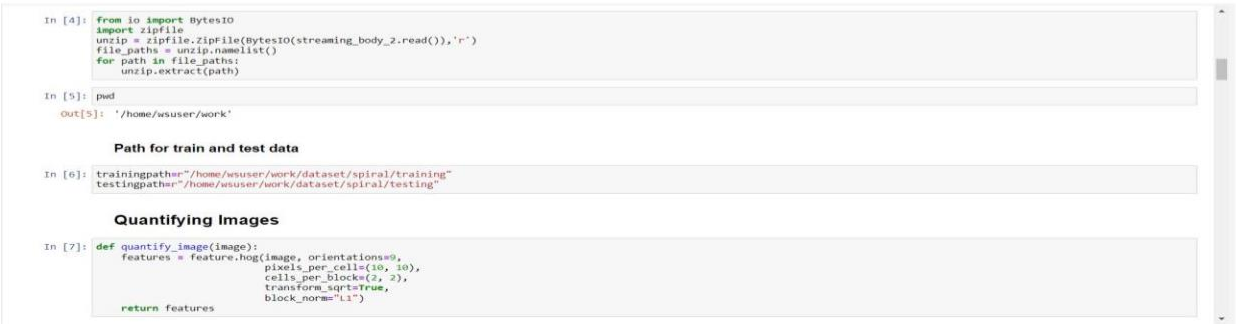
Project Development Phase
(Sprint4)

Date	17 November 2022
Team ID	PNT2022TMID23224
Project Name	Project - Detecting Parkinson's Disease using Machine Learning.

Sprint 4 Task:

- *Deployment of ML Model using IBM cloud.*





Loading Train Data and Test Data

In [8]:
```
def load_split(path):
    imagePaths = list(paths.list_images(path))
    data = []
    labels = []

    for imagePath in imagePaths:
        label = imagePath.split(os.path.sep)[-2]

        image = cv2.imread(imagePath)
        image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
        image = cv2.resize(image, (200, 200))

        image=cv2.threshold(image,0,255,cv2.THRESH_BINARY_INV | cv2.THRESH_OTSU)[1]

        features = quantify_image(image)

        data.append(features)
        labels.append(label)

    return (np.array(data), np.array(labels))
```

Load the train and test data

In [9]:
```
print("[INFO] loading data...")
(X_train, y_train) = load_split(trainingpath)
(X_test, y_test) = load_split(testingpath)
```

```
[INFO] loading data...
```

Label Encoding

In [10]:
```
le = LabelEncoder()
y_train = le.fit_transform(y_train)
y_test = le.transform(y_test)
print(X_train.shape,y_train.shape)
```

```
(72, 12996) (72,)
```

Model Building

Training The Model

In [11]:
```
print("[INFO] training model")
model = RandomForestClassifier(n_estimators=100)
model.fit(X_train, y_train)
```

```
[INFO] training model
```

Out[11]:
```
RandomForestClassifier()
```

Testing The Model

In [12]:
```
testingpath=list(paths.list_images(testingpath))
idxs=np.arange(0,len(testingpath))
idxs=np.random.choice(idxs,size=(25,),replace=False)
images=[]
```

In [13]:
```
for i in idxs:
    image=cv2.imread(testingpath[i])
    output=image.copy()

    # load the input image,convert to grayscale and resize
```

In [13]:
```
for i in idxs:
    image=cv2.imread(testingpath[i])
    output=image.copy()

    # load the input image,convert to grayscale and resize

    output=cv2.resize(output,(128,128))
    image=cv2.cvtColor(image,cv2.COLOR_BGR2GRAY)
    image=cv2.resize(image,(200,200))
    image=cv2.threshold(image,0,255,cv2.THRESH_BINARY_INV | cv2.THRESH_OTSU)[1]

    #quantify the image and make predictions based on the  extracted feature using last trained random forest
    features=quantify_image(image)
    preds=model.predict([features])
    label=le.inverse_transform(preds)[0]
    #the set of output images
    if label=="healthy":
        color=(0,255,0)
    else:
        color=(0,0,255)

    cv2.putText(output,label,(3,20),cv2.FONT_HERSHEY_SIMPLEX,0.5,color,2)
    images.append(output)

#creating a montage
montage=build_montages(images,(128,128),(5,5))[0]
cv2.imshow("Output",montage)
cv2.waitKey(0)
```

Model Evaluation

In [34]:
```
predictions = model.predict(X_test)

cm = confusion_matrix(y_test, predictions).flatten()
print(cm)
(tn, fp, fn, tp) = cm
accuracy = (tp + tn) / float(cm.sum())
print(accuracy)
```

```
[14  1  3 12]
0.8666666666666667
```

Save The Model

In [15]:
```
pickle.dump(model,open('parkinson.pkl','wb'))
```

Deployment

In [16]:
```
!pip install -U ibm-watson-machine-learning
```

```
Requirement already satisfied: ibm-watson-machine-learning in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (1.0.257)
Requirement already satisfied: tabulate in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (0.8.9)
Requirement already satisfied: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (1.26.7)
Requirement already satisfied: packaging in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (21.3)
Requirement already satisfied: importlib-metadata in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (4.8.2)
Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (2.26.0)
Requirement already satisfied: pandas<1.5.0,>=0.24.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (1.3.4)
Requirement already satisfied: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (2022.9.24)
Requirement already satisfied: ibm-cos-sdk==2.11.* in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (2.11.0)
Requirement already satisfied: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (0.3.3)
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==2.11.*->ibm-watson-machine-learning)
(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==2.11.*->ibm-watson-machine-learni
ng) (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 ibm-cos-sdk==2.11.*->ibm-watson-machine-learning) (0.1
0.0)
Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk-core==2.11.0->ibm-cos-sdk==2.11.*->ib
m-watson-machine-learning) (2.8.2)
Requirement already satisfied: pytz>=2017.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas<1.5.0,>=0.24.2->ibm-watson-machine-learning) (2021.3)
Requirement already satisfied: numpy>=1.17.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas<1.5.0,>=0.24.2->ibm-watson-machine-learning) (1.20.3)
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->ibm-cos-sdk-core==2.11.0->ibm-cos-sdk==
2.11.*->ibm-watson-machine-learning) (1.15.0)
Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->ibm-watson-machine-learning) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->ibm-watson-machine-learning) (3.3)
Requirement already satisfied: zipp>=0.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from importlib-metadata->ibm-watson-machine-learning) (3.6.0)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from packaging->ibm-watson-machine-learning) (3.0.4)
```

In [17]:
```
# Now connect notebook ml service with api key and url

from ibm_watson_machine_learning import APIClient
import json
import numpy as np
```

Authenticate and Set Space

In [18]:
```
wml_credentials = {
    "apikey" : "RYa2JTvIsfgzBUbvFxnCYVUxLBDntmTwzc9KGStjRtC5",
    "url" : "https://us-south.ml.cloud.ibm.com" #For Dallas region
}
```

In [19]:
```
wml_client =APIClient(wml_credentials)
```

In [20]:
```
# Check the available deployments

wml_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
efa48345-def9-4aa5-b19f-4dd7d5f766ce  ParkinsonDiseaseDetection  2022-11-06T10:09:49.894Z
------------------------------------  ------------------------  -------------------------
```

In [21]:
```
SPACE_ID = "efa48345-def9-4aa5-b19f-4dd7d5f766ce"
```

Show desktop

In [22]:
```
# Space id created default one

wml_client.set.default_space(SPACE_ID)
```

Out[22]: 'SUCCESS'

In [23]:
```
# To check the environment

wml_client.software_specifications.list()
```

```
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-a491-482c83688339  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
```

Save and Deploy the Model

In [24]:
```
import sklearn
sklearn.__version__
```

Out[24]: '1.0.2'

In [25]:
```
MODEL_NAME = "ParkinsonDiseaseDetection_DeployedModel"
DEPLOYMENT_NAME = "ParkinsonDiseaseDetection"
```

In [26]:
```
# Set Python default version

software_spec_uid = wml_client.software_specifications.get_id_by_name('runtime-22.1-py3.9')
```

Create Model Properties to deploy the model

In [27]:
```
# Setup Model Meta

model_props = {
    wml_client.repository.ModelMetaNames.NAME: MODEL_NAME,
    wml_client.repository.ModelMetaNames.TYPE: 'scikit-learn_1.0',
    wml_client.repository.ModelMetaNames.SOFTWARE_SPEC_UID: software_spec_uid
}
```

In [28]:
```
# Save Model

model_details = wml_client.repository.store_model(
    model = model,
    meta_props = model_props,
    training_data = X_train,
    training_target = y_train
)
```

In [29]:
```
model_details
```


```
{'schemas': {'input': [{'fields': [{'name': 'f0', 'type': 'float'},
                {'name': 'f1', 'type': 'float'},
                {'name': 'f2', 'type': 'float'},
                {'name': 'f3', 'type': 'float'},
                {'name': 'f4', 'type': 'float'},
                {'name': 'f5', 'type': 'float'},
                {'name': 'f6', 'type': 'float'},
                {'name': 'f7', 'type': 'float'},
                {'name': 'f8', 'type': 'float'},
                {'name': 'f9', 'type': 'float'},
                {'name': 'f10', 'type': 'float'},
                {'name': 'f11', 'type': 'float'},
                {'name': 'f12', 'type': 'float'},
                {'name': 'f13', 'type': 'float'},
                {'name': 'f14', 'type': 'float'},
                {'name': 'f15', 'type': 'float'},
                {'name': 'f16', 'type': 'float'},
                {'name': 'f17', 'type': 'float'},
                {'name': 'f18', 'type': 'float'},
                {'name': 'f19', 'type': 'float'},
```


In [30]:
```
model_id = wml_client.repository.get_model_id(model_details)
model_id
```

Out[30]: '7d936b97-a55f-403a-9624-5ad06e18e6b0'

Deploy in props

In [31]:
```
# Set meta

deployment_props = {
    wml_client.deployments.ConfigurationMetaNames.NAME : DEPLOYMENT_NAME,
    wml_client.deployments.ConfigurationMetaNames.ONLINE : {}
}
```

In [32]:
```
# Deploy

deployment = wml_client.deployments.create(
    artifact_uid = model_id,
    meta_props = deployment_props
)
```

```
#######################################################################################

Synchronous deployment creation for uid: '7d936b97-a55f-403a-9624-5ad06e18e6b0' started

#######################################################################################


initializing
Note: online_url is deprecated and will be removed in a future release. Use serving_urls instead.

ready


------------------------------------------------------------------------------------------------
Successfully finished deployment creation, deployment_uid='cbe26007-da09-4ca5-919f-3b00aa88f433'
------------------------------------------------------------------------------------------------
```