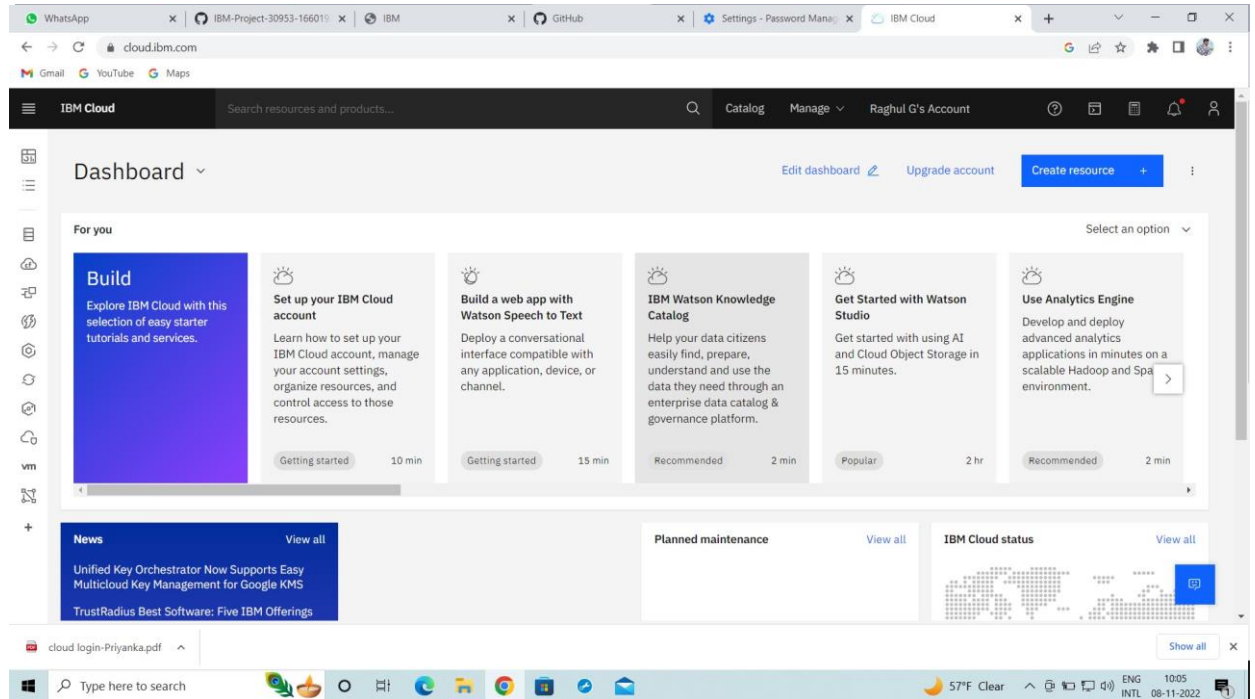


## Delivery of Sprint-4

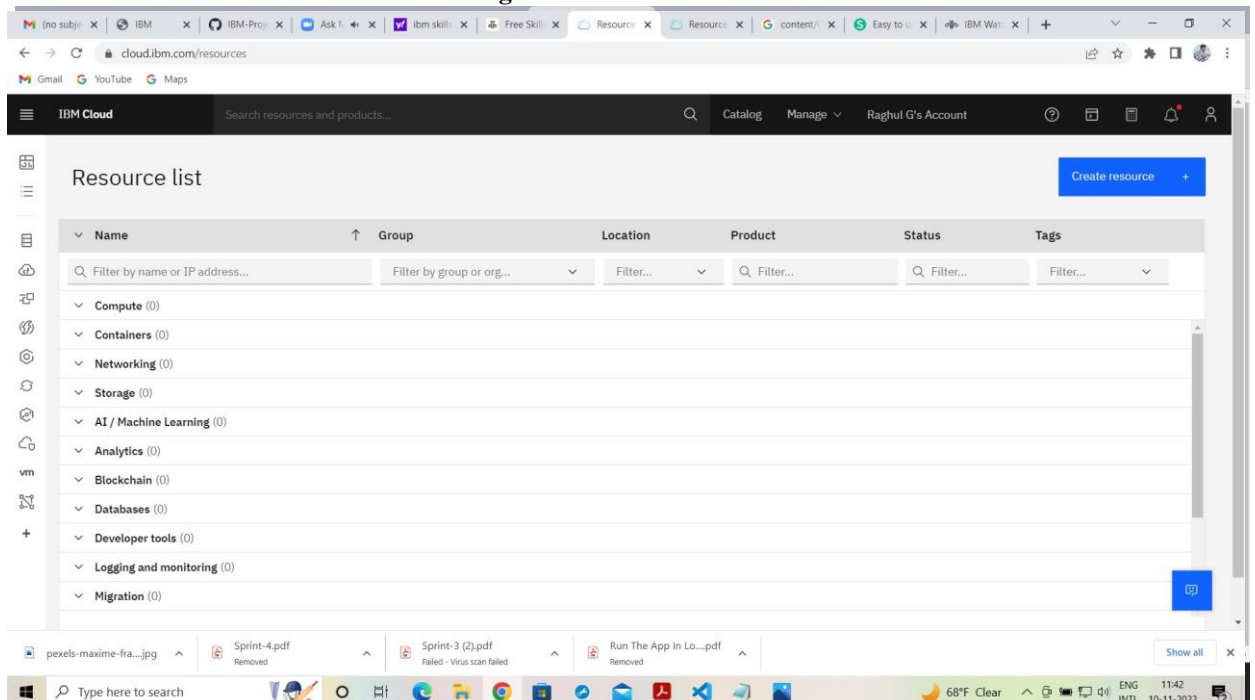
Date	14 November 2022
Team ID	PNT2022TMID48733
Project Name	Crude Oil Price Prediction

- Register for IBM Cloud:

### Created account on IBM



### Activated Watson machine learning and Watson Studio:



- **Train the model on IBM:**

#### ‡ Model building in IBM Watson studio:

Team ID : PNT2022TMID04569 Project Name: Crude Oil Price Prediction

## DATA PREPROCESSING

### Importing the libraries

```
In [20]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf

In [21]: 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',
    aws_access_key_id='2Nw_ja3n8DvGoYKQ1gWMPKzE531ZQyUK6xc0zuEq6Qz',
    aws_secret_access_key='...',
    config=Config(signature_version='oauth')),
endpoint_url='https://s3.private.us.cloud-object-storage.appdomain.cloud')

bucket = 'crudeoilpriceprediction-donotdelete-pr-f4tllio5xhghca'
object_key = 'Crude Oil Prices Daily.csv'

body = cos_client.get_object(Bucket=bucket, Key=object_key)['Body']
```

## MODEL BUILDING

### Importing the model building libraries

```
In [41]: from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import LSTM
```

### Initializing the model

```
In [42]: model=Sequential()
```

### Adding LSTM Layers

```
In [43]: model.add(LSTM(50,return_sequences=True,input_shape=(10,1)))
model.add(LSTM(50,return_sequences=True))
model.add(LSTM(50))
```

### Adding Output Layers

```
In [44]: model.add(Dense(1))
model.summary()

Model: "sequential"
```

Layer (type)	Output Shape	Param #
--------------	--------------	---------

IBM Watson Studio interface showing a Jupyter Notebook titled "Crude Oil Price Prediction / Model building". The notebook contains three cells:

```
In [61]: !pip install ibm_watson_machine_learning

Requirement already satisfied: ibm_watson_machine_learning in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (1.0.255)
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: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (0.3.3)
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: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (1.26.7)
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: packaging in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (21.3)
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: 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: 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) (0.10.0)
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==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_learning) (2.11.0)
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.*->ibm_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 [62]: from ibm_watson_machine_learning import APIClient

wml_credentials = {
    "url": "https://us-south.ml.cloud.ibm.com",
    "apikey": "r6Ezjpm1g7n63CHqRbp_rY3E6xV0_Wm3IYDUh0AFtWdH"
}
client = APIClient(wml_credentials)

In [63]: 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'])
```

The bottom status bar shows "31°C Partly sunny" and the time "11:19 PM 09-11-2022".

IBM Watson Studio interface showing the same Jupyter Notebook. The notebook contains three cells:

```
In [64]: space_uid = guid_from_space_name(client, 'models')
print("Space UID = " + space_uid)

Space UID = 0fc5e179-3342-4216-a402-f74fa4d20809

In [65]: client.set_default_space(space_uid)

Out[65]: 'SUCCESS'

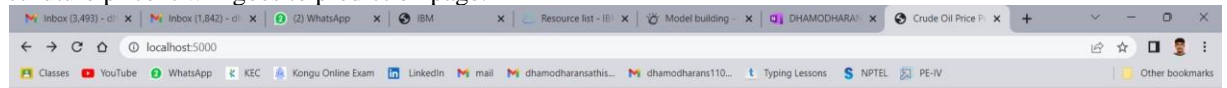
In [66]: client.software_specifications.list()

-----
NAME                ASSET_ID                TYPE
default_py3.6       0062b8c9-8b7d-44a0-a9b9-46c416adcbd9 base
kernel-spark3.2-scala2.12 020d69ce-7ac1-5e08-ac1a-31198867356a base
pytorch-onnx_1.3-py3.7-edt 069ea114-3346-5748-b513-49120e15d288 base
scikit-learn_0.20-py3.6 09c5a1d0-9c1e-4473-a344-e87b6655ff687 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 0cdeb0f1e-5376-4f4d-92dd-da3b69aa9bda base
shiny-r3.6 0e6e79df-875e-4f24-8ae9-62dcc2148306 base
tensorflow_2.4-py3.7-horovod 1092590a-307d-563d-9b62-4ab7064b3f22 base
pytorch_1.1-py3.6 10ac12d6-6b30-4cdd-8392-3e922e096a92 base
tensorflow_1.15-py3.6-ddl 111e41b3-de2d-5422-a4d6-bf776828c4b7 base
runtime-22.1-py3.9 12b83a17-24d8-5082-900f-0ab31fbfd3cb base
scikit-learn_0.22-py3.6 154010fa-5b3b-4ac1-82af-4d5ee5abb85 base
default_r3.6 1b70a6c3-ab34-4b87-8aa0-a4a3c8296a36 base
pytorch-onnx_1.3-py3.6 1bc6029a-c937-56da-b8e0-39c3880dbbe7 base
kernel-spark3.3-r3.6 1c9e5454-f216-59dd-a20e-474a5c-df5988 base
pytorch-onnx_rt22.1-py3.9-edt 1d362186-7ad5-5b59-8b6c-9d0880bde37f base
tensorflow_2.1-py3.6 1eb25b84-d6ed-5d5e-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-da66306ce58 base
do_py3.8 295addb5-9ef9-547e-9b74-92ae3563e720 base
autoai-ts_3.8-py3.8 2aa8c932-798f-5ae9-abd6-15e0c2402fb5 base
-----
```

The bottom status bar shows "31°C Partly sunny" and the time "11:20 PM 09-11-2022".

- **Integrate Flask with scoring end point:**

**Home page:** This is our home page where we get to know the summary of the project. By clicking on predict future price it will go to prediction page.



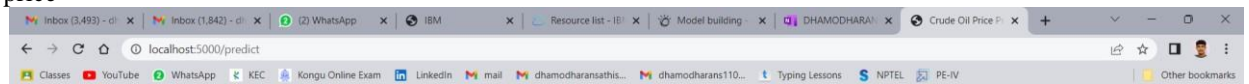
## Crude Oil Price Prediction

Demand for oil is inelastic, therefore the rise in price is good news for producers because they will see an increase in their revenue. Oil importers, however, will experience increased costs of purchasing oil. Because oil is the largest traded commodity, the effects are quite significant. A rising oil price can even shift economic/political power from oil importers to oil exporters. The crude oil price movements are subject to diverse influencing factors.

[Predict Future Price](#)



**Prediction page:** In this page, by entering 10 days price and click the submit button, will give the predicted price



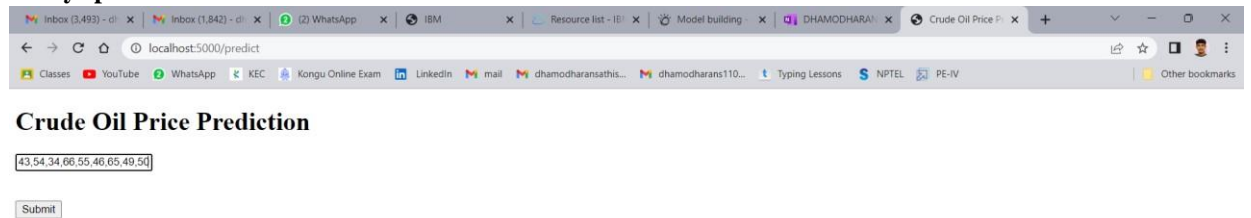
## Crude Oil Price Prediction

Enter the crude oil price for

Submit



10 days price are entered:

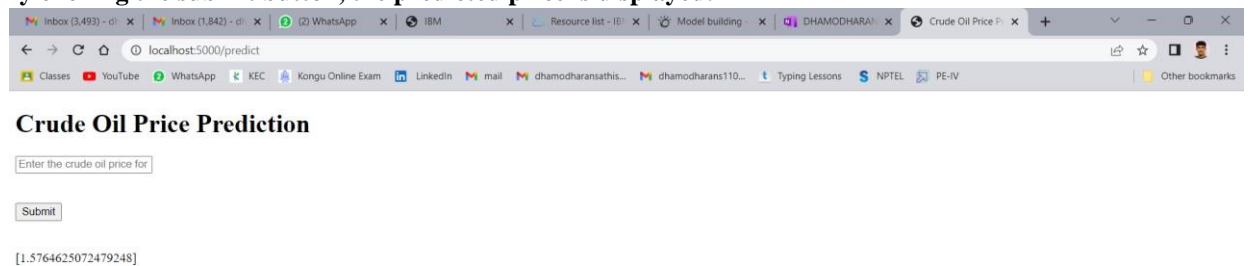


Crude Oil Price Prediction

43.54,34.66,55.46,65.49,50

Submit

By clicking the submit button, the predicted price is displayed:



Crude Oil Price Prediction

Enter the crude oil price for

Submit

[1.5764625072479248]