CRUDE OIL PRICE PREDICTION

TEAM ID : PNT2022MID08704

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Dr . MAHALINGAM COLLEGE OF ENGINEERING AND TECHNOLOGY An Autonomous Institution Affiliated to ANNAUNIVERSITY CHENNAI – 600 025

ABSTRACT

In these 2022 transportation plays major role in human’s life especially Road transportation. For that petrol and Diesel are indispensable thing which was produced from crude oil. So many industries and Government yield lot from this crude oil businesses.By this price of crude oil become root source to decide many curve points in industry as well as country economy. But prediction of future crude oil price is considered a significant challenge due to the extremely complex, chaotic, and dynamic nature of the market and stakeholder's perception. The crude oil price changes every minute, and millions of shares ownership's are traded every day. The market price for commodity such as crude oil is influenced by many factors including news, supply-and-demand gap, labour costs, number of remaining resources, as well as stakeholders' perception. Therefore, various indicators for technical analysis have been utilized for the purpose of predicting the future crude oil price. Recently, many researchers have turned to Artificial Intelligence approach to cater to this problem. This study demonstrated the use of RNN with LSTM layered network for predicting the crude oil price based on historical data alongside other technical analysis indicators. This study aims to certify the capability of a prediction model built based on the RNN with LSTM layered network to predict the future price of crude oil. The developed model is trained and evaluated against accuracy matrices to assess the capability of the network to provide an improvement of the accuracy of crude oil price prediction as compared to other strategies. The result obtained from the model shows a promising prediction capability algorithm for predicting crude oil price movement.

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LIST OF ABBREVIATIONS

LSTM	Long Short Term Memory
RNN	Recurrent Neural Network
MAE	Mean Absolute Error
MSE	Mean Squared Error
UAT	User Acceptance Test
UI	User Interface
HTML	HyperText Markup Language
CSS	Cascade Style Sheet
DDOS	Distributed Denial Of Service
XSS	Cross Side Scripting
GDP	Gross Domestic Product
OPEC	Organization of the Petroleum Exporting Countries
ML	Machine Learning
AI	Artificial Intelligence

CHAPTER 1

INTRODUCTION

Prediction of crude oil prices has been a wide topic for ages. People use their intuition and lot of techniques to guess the prices of crude oil. It takes a lot of knowledge about the crude oil to accurately predict it. Predicting the crude oil price is very significant in various economic, political and industrial areas, both for crude oil importer and exporter countries. Since the crude oil is important strategic resource around the globe; it has become the crucial commodity for the world's economy. Thus, prediction of prices of crude oil has always been considered as a very exciting and challenging task which drew the curiosity of professionals, researchers and organizations all over the world. So far, it remains the world's leading fuel, with nearly one-third of global energy consumption. Crude oil price prediction has a scope larger than we can think of, the forecasting used is relevant for big and small industries along with the government benefiting from the predicted prices, but due to the evaporate nature of oil, it becomes very challenging to achieve accuracy. Moreover, crude oil volatility has a critical impact on macroeconomic parameters such as such as inflation, unemployment, exchange rate, economic growth of countries whose economy rely heavily on crude oil export or import. Thus, crude oil price prediction can help governments of countries of the world in economic policy making and make quick and operative economic decisions to hedge against probable risk in these economic parameters.

1.1 PROJECT OVERVIEW

In this, we have used LSTM based recurrent neural networks for the purpose of crude oil price prediction. Recurrent neural networks (RNN) have been proved to be one of the most powerful models for processing time-series based sequential data. LSTM is one of the most successful RNN architectures. LSTM introduces the memory cell, a unit of computation that replaces traditional artificial neurons in the hidden layer of the network. With these memory cells, networks are able to effectively associate memories and input remote in time, hence suit to grasp the structure of data dynamically over time with high prediction capacity.

Recurrent neural network is a type of Neural Network where the output from previous step is fed as input to the current step. In traditional neural networks, all the inputs and outputs are independent of each other, but in cases like when it is required to predict the next word of a sentence, the previous words are required and hence there is a need to remember the previous words. Thus, RNN came into existence, which solved this issue with the help of a Hidden Layer. The main and most important feature of RNN is Hidden state, which remembers some information about a sequence.

LSTM's have chain like structure with the repeating module having a different structure. There are four neural network layers which are interacting to each other in a special way. The key to LSTM's is the cell state, which is the horizontal line running through the top of the diagram. The cell state runs straight down the entire chain, with only some minor linear interactions. The information flows along it unchanged. The LSTM does have the ability to remove or add information to the cell state, carefully regulated by structures called gates. Gates are a way to optionally let information through. They are composed out of a sigmoid neural network layer and a point-wise multiplication operation. An LSTM has three of these gates, to protect and control the cell state.

1.2 PURPOSE

Crude oil price fluctuations have a far-reaching impact on global economies and thus price forecasting can assist in minimizing the risks associated with volatility in oil prices. Price forecasts are very important to various stakeholders;governments, public and private enterprises, policymakers, and investors. According to economic theory, the price of crude oil should be easily predictable from the equilibrium between demand and supply, wherein demand forecasts are usually made from GDP, exchange rates and domestic prices, and supply is predicted from past production data and reserve data. Predicting demand for oil is usually straightforward, however supply is heavily affected by political activity such as cartelisation by OPEC to regulate prices, technological advances leading to the extraction of higher amounts of oil, and wars and other conflicts which can affect supply unpredictably.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEM

Crude oil is one of the major products which includes global measurements. The origin of crude oil prediction errors involves composite supply-demand structures. Scientists have come across unique modes for exploring and forecasting crude oil prices. Studies related to the prediction of prices play an important role in the economic crisis. One of the features of the imperfection of all the methodologies was that the upcoming movement of oil price was derived from the prior data. Machine learning strategies came into existence for oil price prediction. In recent times, many studies have given more focus on the Convolutional neural network which is a neural network based on deep learning concepts.

Crude oil price fluctuations have a far-reaching impact on global economies and thus price forecasting can assist in minimizing the risks associated with volatility in oil prices. Price forecasts are very important to various stakeholders: governments, public and private enterprises, policymakers, and investors. According to economic theory, the price of crude oil should be easily predictable from the equilibrium between demand and supply, wherein demand forecasts are usually made from GDP, exchange rates and domestic prices, and supply is predicted from past production data and reserve data. Predicting demand for oil is usually straightforward, however supply is heavily affected by political activity such as cartelization by OPEC to regulate prices, technological advances leading to the extraction of higher amounts of oil, and wars and other conflicts which can affect supply unpredictably.

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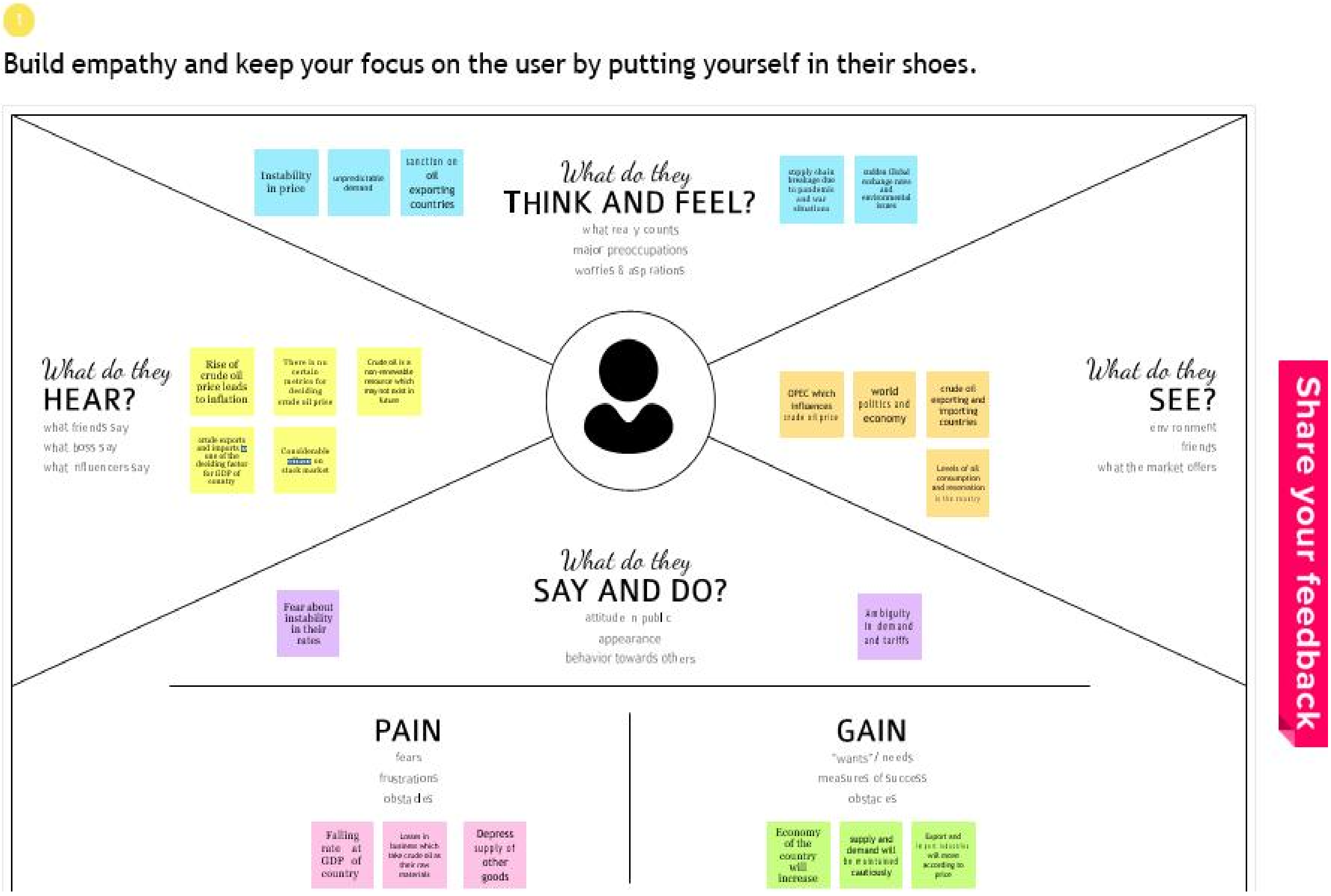
2.3 PROBLEM STATEMENT DEFINITION

Nowadays, the increased oil prices worldwide are having a great impact on all economic activities. Over the years there has been a fluctuation in petroleum prices, and a close consideration of the demand and supply side effects that sparked these price changes shows there is high probability that these changes will continue in the outlook period and beyond. West African Monetary Agency (2008) concluded that increase in world oil prices have been shown to worsen fiscal deficit positions of oil importing countries like Ghana. For this reason, we believe that if the government can see ahead of monthly petroleum prices, our deficit would not be worsened. The ability to forecast these changes in oil prices allows economic participants such as firms to adapt to future market changes and provides decision makers with accurate information with which they can use to select the optimal decision for them. As such, it is vital that we develop a robust model that can forecast the prices of oil and these changes as accurately as possible

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



Build empathy and keep your focus on the user by putting yourself in their shoes.

What do they THINK AND FEEL?

what really counts

major preoccupations

worries & aspirations

Instability in price

unpredictable demand

sanction on oil exporting countries

supply chain breakage due to pandemic and war situations

sudden Global exchange rates and environmental issues

What do they HEAR?

what friends say

what boss say

what influencers say

Rise of crude oil price leads to inflation

There is no certain metrics for deciding crude oil price

Crude oil is a non-renewable resource which may not exist in future

crude exports and imports is one of the deciding factor for GDP of country

Considerable [illegible] on stack market

What do they SEE?

environment

friends

what the market offers

OPEC which influences crude oil price

world politics and economy

crude oil exporting and importing countries

Levels of oil consumption and reservation in the country

What do they SAY AND DO?

attitude in public

appearance

behavior towards others

Fear about instability in their rates

Ambiguity in demand and tariffs

PAIN

fears

frustrations

obstacles

Falling rate of GDP of country

Losses in business which take crude oil as their raw materials

Depress supply of other goods

GAIN

"wants" / needs

measures of success

obstacles

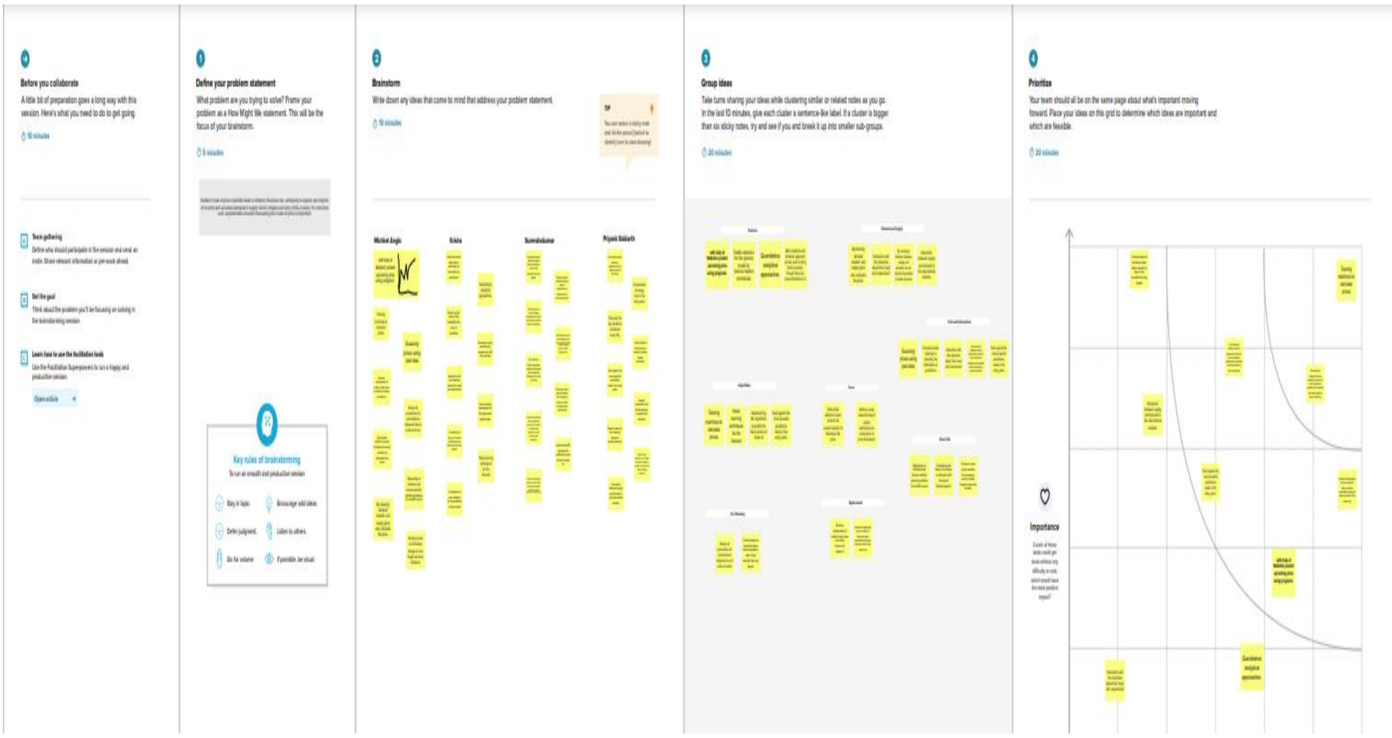
Economy of the country will increase

supply and demand will be maintained cautiously

Export and import industries will move according to price

Figure 1.1. Empathy map canvas

3.2 IDEATION & BRAINSTORMING



Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

A Team gathering

Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

B Set the goal

Think about the problem you'll be focusing on solving in the brainstorming session.

C Learn how to use the facilitation tools

Use the Facilitation Superpowers to run a happy and productive session.

1 Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

2 Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

3 Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

4 Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

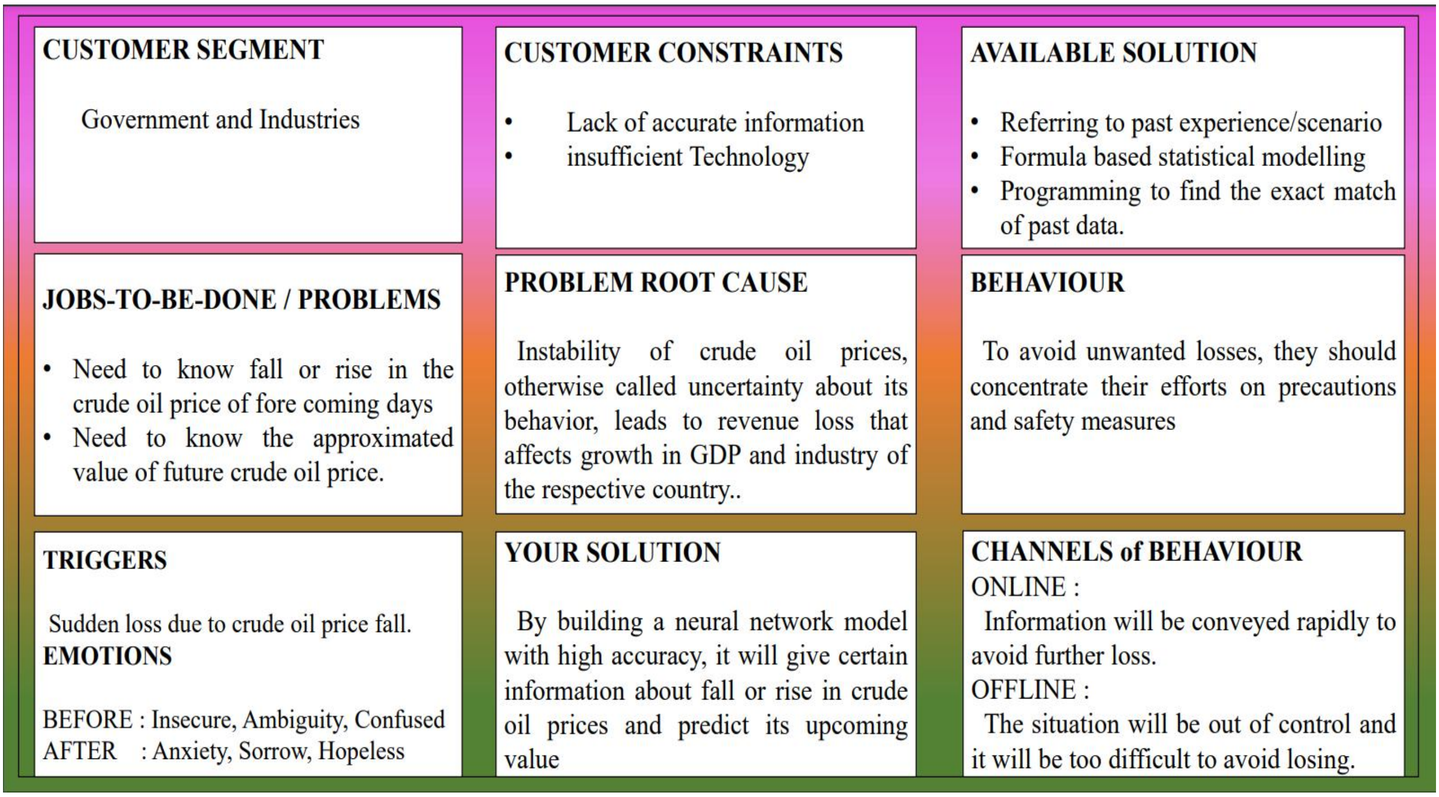
20 minutes

Figure 1.2. Brainstorming & Ideation

3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problemto be solved)	Uncertainty in crude oil prices rises orfalls, and ambiguity in this growth leads to serious effects in companies and the economy, which in turn affect the nation’s GDP.
2.	Idea / Solution description	A model will be built by the combination of machine learning with deep learning techniques. It will function with an artificial neutralnetwork like how the human brain functions.
3.	Novelty / Uniqueness	Nowadays, the world is moving more into a digital world, like automating everything. This deep learning approach will be revolutionary, giving solutions with the highest accuracy ever achieved.
4.	Social Impact / Customer Satisfaction	It prevents companies from losses intheir revenue. The GDP of that nation will gradually increase.
5.	Business Model (RevenueModel)	Crude oil is one of the most traded oils, which contributes to export companies' marketing revenue and the country’s GDP. So, this model will become an undeniable product or source for almost all companies to retain their positions.
6.	Scalability of the Solution	Deep learning is a widely developed technique that comes with new innovations frequently. Due to its fast-growing nature, the model created by this will be used for many year.

3.4 PROBLEM SOLUTION FIT



CUSTOMER SEGMENT

Government and Industries

CUSTOMER CONSTRAINTS

- Lack of accurate information
- insufficient Technology

AVAILABLE SOLUTION

- Referring to past experience/scenario
- Formula based statistical modelling
- Programming to find the exact match of past data.

JOBS-TO-BE-DONE / PROBLEMS

- Need to know fall or rise in the crude oil price of fore coming days
- Need to know the approximated value of future crude oil price.

PROBLEM ROOT CAUSE

Instability of crude oil prices, otherwise called uncertainty about its behavior, leads to revenue loss that affects growth in GDP and industry of the respective country..

BEHAVIOUR

To avoid unwanted losses, they should concentrate their efforts on precautions and safety measures

TRIGGERS

Sudden loss due to crude oil price fall.

EMOTIONS

BEFORE : Insecure, Ambiguity, Confused
AFTER : Anxiety, Sorrow, Hopeless

YOUR SOLUTION

By building a neural network model with high accuracy, it will give certain information about fall or rise in crude oil prices and predict its upcoming value

CHANNELS of BEHAVIOUR

ONLINE :

Information will be conveyed rapidly to avoid further loss.

OFFLINE :

The situation will be out of control and it will be too difficult to avoid losing.

Figure 1.3. Problem solution fit canvas

CHAPTER 4

REQUIRMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

Solution Requirements (Functional & Non-functional)

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Solution	Model creation using python with necessary libraries needed
FR-4	User Acknowledgement	Sending and receiving data will be made using flask library
FR-5	User Understanding	For better UI experience Angular, HTML and CSS
FR-6	User Storage	Cloud data will be needed
FR-7	User access	To access information a server needed

4.2 NON-FUNCTIONAL REQUIREMENTS

Non-functional Requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Available in all Phone and laptop/computer systems.
NFR-2	**Security**	High Level Technology supporting for Two level authentication and Cryptography used.
NFR-3	**Reliability**	Stable Internet connection
NFR-4	**Performance**	High resolution screen for pictorial representation available without lagging in view.
NFR-5	**Availability**	Power needed for 24x7
NFR-6	**Scalability**	Online data will be feed into model for effective prediction

CHAPTER 5

PROJECT DESIGN

5.1 Data Flow Diagram

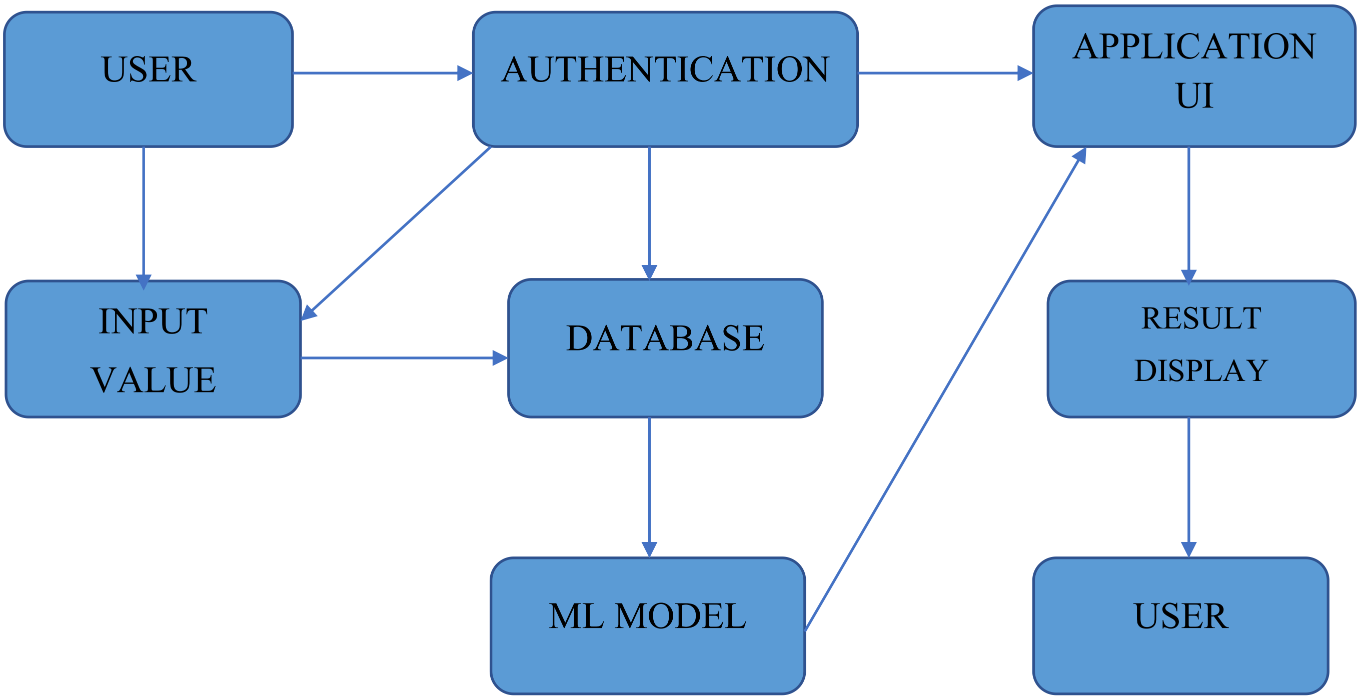


Figure 1.4 Data flow map

USER STORIES

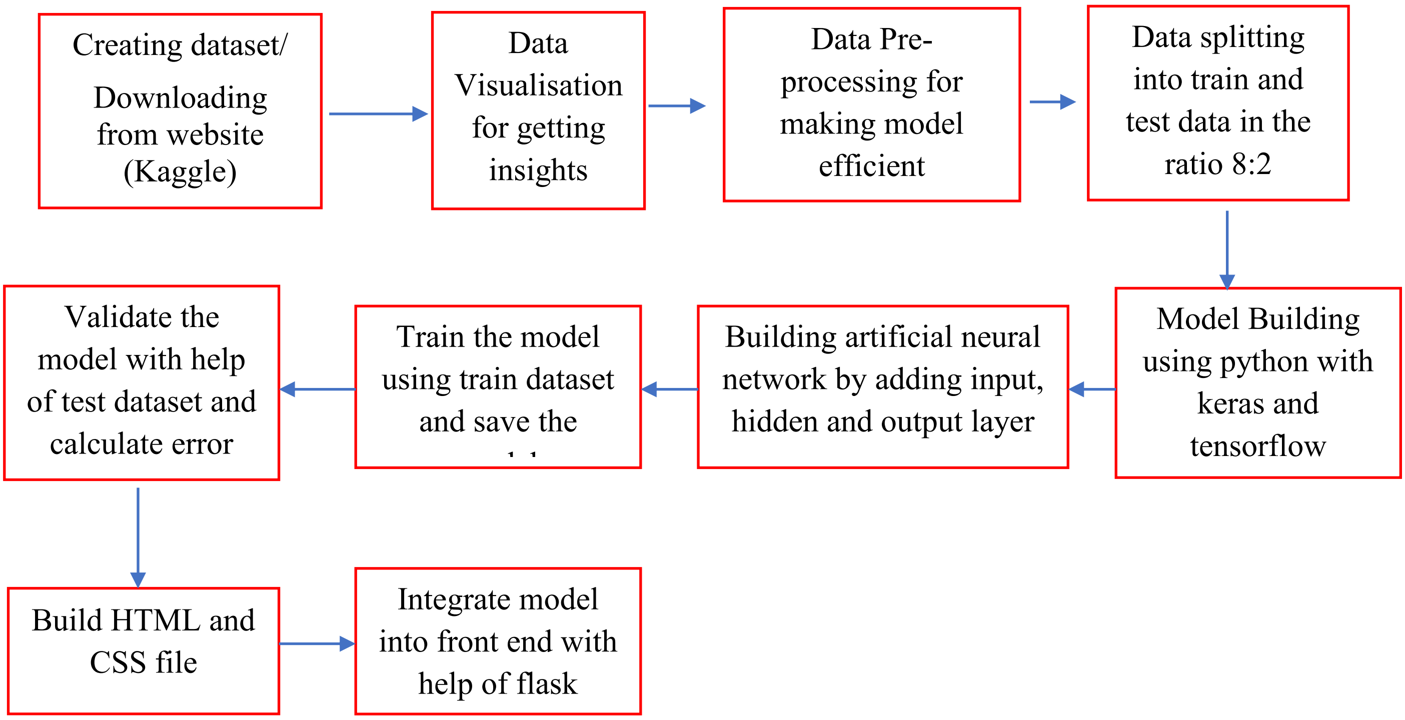
User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Web user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my database with this	High	Sprint-1
Customer (Cloud user)	Access	USN-2	As a user, I can access the model database	I can receive confirmation email & click confirm	High	Sprint-1
Customer (People)	Linked-in registration	USN-3	As a user, I can register for the application through Linked-in	I can register & access the database model with Linked- in Login	Low	Sprint-2
Customer Care Executive	Gmail account	USN-4	As a user, I can register for the application through Gmail	I can register and access the model	Medium	Sprint-1
Administrator	Login	USN-5	As a Admin, I can log into the application by entering email & password	I can access the model database directly	High	Sprint-1
Customer (User)	Internet Facilit	USN-6	As a user I can give input to the model through the website	I can get crude oil price	High	Sprint-3
Customer (User)	Laptop or Computer or Mobile	USN-7	As a user I can view the pictorial or graphical representation of crude price	I can insights on crude oil price	High	Sprint-4

5.2 SOLUTION ARCHITECTURE

SOLUTION ARCHITECTURE

Crude oil price can be predicted using AI model. AI model will be built with help of deep learning technique.

The Technique used for deep learning is RNN (recurrent neutral network). Python Programming will be used for building. In python, NumPy, pandas, TensorFlow and keras libraries will be used



Creating dataset/ Downloading from website (Kaggle)
Data Visualisation for getting insights
Data Pre-processing for making model efficient
Data splitting into train and test data in the ratio 8:2
Model Building using python with keras and tensorflow
Building artificial neural network by adding input, hidden and output layer
Train the model using train dataset and save the
Validate the model with help of test dataset and calculate error
Build HTML and CSS file
Integrate model into front end with help of flask

Figure 1.5 Solution map

TECHNICAL ARCHITECTURE

Project Design Phase-II
Technology Stack (Architecture & Stack)

Technical Architecture:

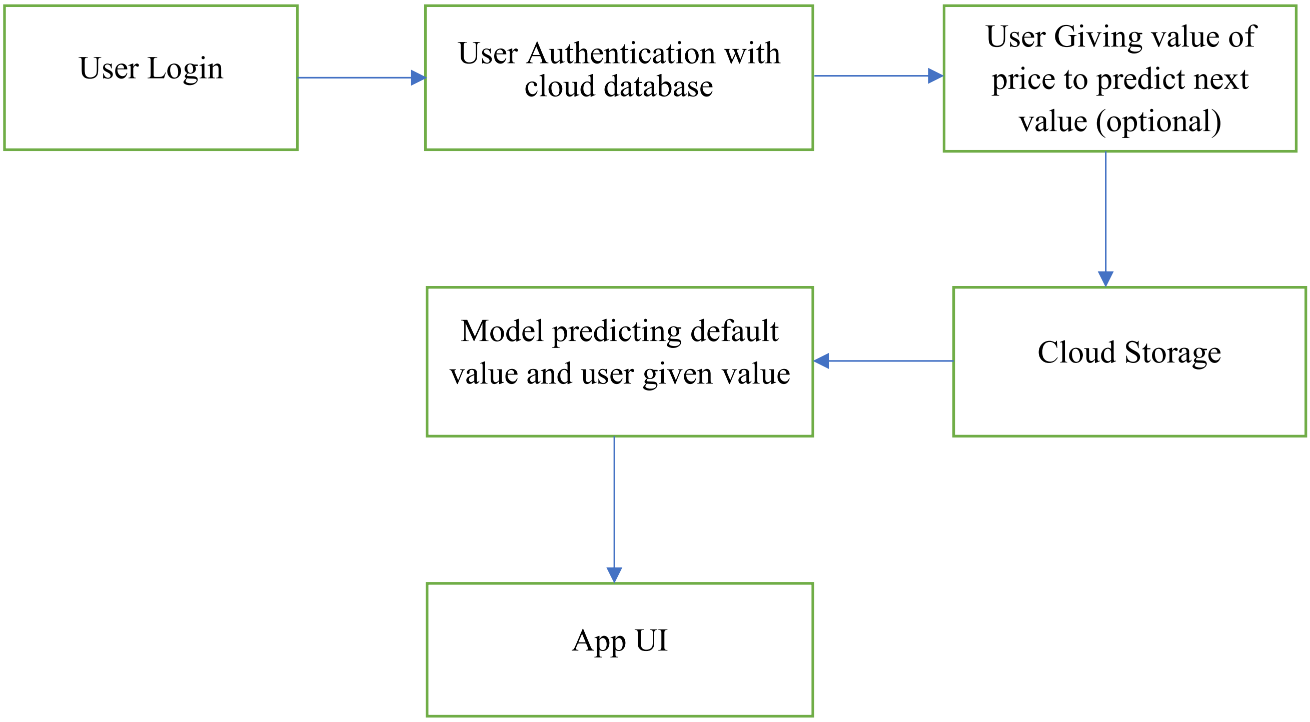

User Login
User Authentication with cloud database
User Giving value of price to predict next value (optional)
Cloud Storage
Model predicting default value and user given value
App UI

Figure 1.6 Technical flow map

S.No	Component	Description	Technology
1	User Interface	How user access solution. Webapplication	HTML,CSS
2	Application Logic-1	Logic for a process in theapplication	Python (flask)
3	Database	Data Type access, Configurations	MySQL
4	Cloud Database	Database Service on Cloud	IBM Cloud
5	File Storage	File storage requirements	IBM Block Storage & Local Filesystem
6	External API-1	For standalone server	Firebase
7	Machine LearningModel	To predict upcoming price ofcrude oil	Recurrent neural network &LSTM
8	Infrastructure	Application Deployment on Local Server and local host address	Local, Firebase.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Framework -1	Python	Pandas, flask, NumPy, TensorFlow
2.	Open-Source Framework -2	Angular js	App module, component module
3.	Open-Source Framework -3	HTML & CSS	<div> and flex model
4.	Security Implementations	User data will be stored according to CIA model	End to end encryption (SHA-256)
5.	Scalable Architecture	IBM cloud and firebase both used for better performance instorage and authentication	IBM Watson, Firebase, MySQL
6.	Availability	Handle huge requests, avoid DDOS and XSS attack	Effective coding and restrictive user access based on need
7.	Performance	Handle 100 to 10000 users to use server at a time	Flask

CHAPTER 6

PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

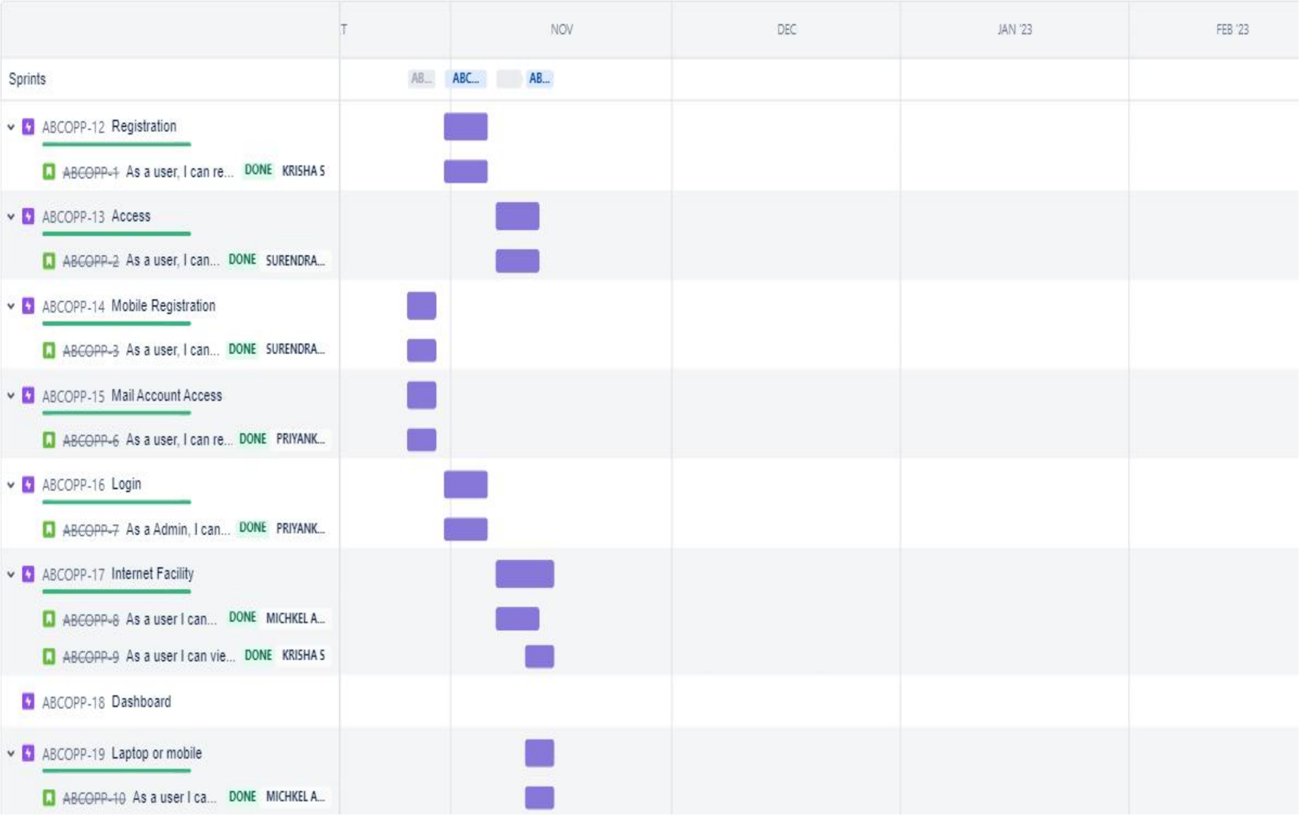
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	10	High	Krisha S
Sprint-3	Access	USN-2	As a user, I can access the model database	5	High	Michkel Anglo J, Surendrakumar B.
Sprint-1	Mobile registration	USN-3	As a user, I can register for the application Through mobile number	10	Low	Surendrakumar B
Sprint-1	Mail Account Access	USN-4	As a user, I can register for the application through mail	10	Low	Priyank siddarth M J
Sprint-2	Login	USN-5	As a Admin, I can log into the application by entering email & password	10	High	Krisha S, Priyank siddarth M J
Sprint - 3	Internet Facility	USN--6	As a user I can give input to the model through	15	High	Michkel Anglo J

			the website			
Sprint-4	Dashboard	USN--7	As a user I can view the pictorial or graphical representation of crude price	10	Medium	Krisha s, Surendrakumar B
Sprint-4	Laptop or computer or mobile	USN-8	As a user I can access Application using Interactive UI	10	Medium	Michkel Anglo J

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	29 Oct 2022	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	05 Nov 2022	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	12 Nov 2022	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	19 Nov 2022	19 Nov 2022

6.3 REPORTS FROM JIRA



Sprints

ABCOPP-12 Registration

~~ABCOPP-1~~ As a user, I can re... DONE KRISHA S

ABCOPP-13 Access

~~ABCOPP-2~~ As a user, I can... DONE SURENDRA...

ABCOPP-14 Mobile Registration

~~ABCOPP-3~~ As a user, I can... DONE SURENDRA...

ABCOPP-15 Mail Account Access

~~ABCOPP-6~~ As a user, I can re... DONE PRIYANK...

ABCOPP-16 Login

~~ABCOPP-7~~ As a Admin, I can... DONE PRIYANK...

ABCOPP-17 Internet Facility

~~ABCOPP-8~~ As a user I can... DONE MICHKEL A...

~~ABCOPP-9~~ As a user I can vie... DONE KRISHA S

ABCOPP-18 Dashboard

ABCOPP-19 Laptop or mobile

~~ABCOPP-10~~ As a user I ca... DONE MICHKEL A...

Figure 1.7 Jira Milestone

CHAPTER 7

CODING & SOLUTIONING

MODEL BUILDING

Python code used for model development in IBM

Pandas was used to control dataframe.Numpy was used for array manipulations.Matplotlip and seaborn are used for visualization. Tensorflow used for deep learning where scikit learn used for

```
import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import tensorflow
from sklearn.preprocessing import MinMaxScaler
from tensorflow.keras.models import Sequential,load_model,Model
from tensorflow.keras.layers import LSTM,Dense,Input

data = pd.read_excel(body.read()) # used to read the file
Batch = 64
epochs = 120
timesteps = 30
```

Dataset was split into 64 batch with 30 step size.

```
#test set will be 20% of entire data set
length = length - int(length *0.20)
print (length)
def get_train_length(dataset, batch_size, test_percent):
    # substract test_percent to be excluded from training, reserved for testset
    length = len(dataset)
    length = length - int(length *test_percent)
    train_length_values = []
    for x in range(int(length) - 100,int(length)):
        modulo=x%batch_size
        if (modulo == 0):
            train_length_values.append(x)
    return (max(train_length_values))
length = get_train_length(data, batch_size, 0.20)
#Adding timesteps * 2
upper_train = length + timesteps*2
data_train = data[0:upper_train]
training_set = data_train.iloc[:,1:2].values
scale = MinMaxScaler(feature_range = (0, 1)) #scaling the dataset
training_set_scaled = scale.fit_transform(np.float64(training_set))
X_train = []
y_train = []
# Creating a data structure with n timesteps

print (length + timesteps)
for i in range(timesteps, length + timesteps):
    X_train.append(training_set_scaled[i-timesteps:i,0])
    y_train.append(training_set_scaled[i:i+timesteps,0])
```

Model Creation

```
inputs_1_mae = Input(batch_shape=(batch_size,timesteps,1))
lstm_1_mae = LSTM(10, stateful=True, return_sequences=True)(inputs_1_mae)
lstm_2_mae = LSTM(10, stateful=True, return_sequences=True)(lstm_1_mae)
output_1_mae = Dense(units = 1)(lstm_2_mae)
regressor_mae = Model(inputs=inputs_1_mae, outputs = output_1_mae)
regressor_mae.compile(optimizer='adam', loss = 'mae')
regressor_mae.summary()
for i in range(epochs):
    print("Epoch: " + str(i))
    regressor_mae.fit(X_train, y_train, shuffle=False, epochs = 1, batch_size = batch_size)
    regressor_mae.reset_states()
```

Input layer was selected with 10 and consequences layer also selected with 10 input.At last it wil yield one output. For correcting it erroe itself, ‘adam’ was used

After test data was cleaned and predicted using model, it will undergo error evaluation between original and predicted value.

```
print(np.any(np.isnan(test_set)))

print(np.any(np.isnan(y_test)))

np.nan_to_num(test_set,copy=False)

np.nan_to_num(y_test,copy=False)

from sklearn.metrics import mean_absolute_error

mae = float(mean_absolute_error(test_set[timesteps:len(y_test)], y_test[0:len(y_test) - timesteps]))

print(mae)

import math

from sklearn.metrics import mean_squared_error

rmse = math.sqrt(mean_squared_error(test_set[timesteps:len(y_test)], y_test[0:len(y_test) -
timesteps]))

print(rmse)

regressor_mae.save("Crude_oil_LSTM_prediction.h5")

# compress the file

!tar -zcvf crudeoil_prediction_model.tgz Crude_oil_LSTM_prediction.h5
```

Flask File Integration with model and html

app.py file code

```
import bcrypt

import numpy as np

from flask import Flask, redirect, render_template, request, session, url_for

from pymongo import MongoClient

from sklearn.preprocessing import MinMaxScaler

from tensorflow.keras.models import load_model


model = load_model('prediction_model.h5')

#set app as a Flask instance

app = Flask(__name__)

#encryption relies on secret keys so they could be run

app.secret_key = "GReece@2"


# #connect to your Mongo DB database
```

```
def MongoDB():
    con_string ="mongodb+srv://micky:power0!6@cluster0.ziiirqp.mongodb.net/?retryWrites=true&w=majority"
    client = MongoClient(con_string )
    db = client['Predict_app'] ## database anme
    user_collection = db['userdata'] ## table name
    return user_collection
records = MongoDB()
#assign URLs to have a particular route
@app.route("/", methods=['post', 'get'])
def index():
    message = ''
    #if method post in index
    if "email" in session:
        return redirect(url_for("logged_in"))
    if request.method == "POST":
        user = request.form.get("fullname")
        email = request.form.get("email")
        password1 = request.form.get("password1")
        password2 = request.form.get("password2")
        #if found in database showcase that it's found
        user_found = records.find_one({"name": user})
        email_found = records.find_one({"email": email})
        if user_found:
            message = 'There already is a user by that name'
            return render_template('index.html', message=message)
        if email_found:
            message = 'This email already exists in database'
            return render_template('index.html', message=message)
        if password1 != password2:
            message = 'Passwords should match!'
            return render_template('index.html', message=message)
        else:
            #hash the password and encode it
            hashed = bcrypt.hashpw(password2.encode('utf-8'), bcrypt.gensalt())
            #assing them in a dictionary in key value pairs
            user_input = {'name': user, 'email': email, 'password': hashed}
            #insert it in the record collection
            records.insert_one(user_input)
           #find the new created account and its email
            user_data = records.find_one({"email": email})
            new_email = user_data['email']
            #if registered redirect to logged in as the registered user
            return render_template('logged_in.html', email=new_email)
    return render_template('index.html')
@app.route("/login", methods=["POST", "GET"])
def login():
    message = 'Please login to your account'
    if "email" in session:
        return redirect(url_for("logged_in"))
    if request.method == "POST":
        email = request.form.get("email")
        password = request.form.get("password")
        #check if email exists in database
        email_found = records.find_one({"email": email})
        if email_found:
            email_val = email_found['email']
            passwordcheck = email_found['password']
            #encode the password and check if it matches
            if bcrypt.checkpw(password.encode('utf-8'), passwordcheck):
                session["email"] = email_val
                return redirect(url_for('logged_in'))
            else:
                if "email" in session:
                    return redirect(url_for("logged_in"))
                message = 'Wrong password'
                return render_template('login.html', message=message)
        else:
            message = 'Email not found'
            return render_template('login.html', message=message)
    return render_template('login.html', message=message)
    @app.route('/logged_in')
def logged_in():
    if "email" in session:
        email = session["email"]
        return render_template('logged_in.html', email=email)
    else:
        return redirect(url_for("login"))
@app.route('/prediction',methods=["POST", "GET"])
def predict():
    if request.method == 'POST':
        value=request.form.get('list') ## get the value that come with list name
        b=value.split(",") ## split the data using comma
        values = list(map(float, b))  ## create a list from string
        List= np.array([values]) ## convert it to array
        List=np.reshape(List,(-1,1))
        scale = MinMaxScaler(feature_range = (0, 1))
        List=scale.fit_transform(np.float64(List))
        val= model.predict(List) ## predict the value for give data
        val=np.reshape(val,(30,1))
        val=scale.inverse_transform(val)
        answer= float(val[29])
        answer=round(answer, 2)
    return render_template('prediction.html', result=answer)
@app.route("/logout", methods=["POST", "GET"])
def logout():
    if "email" in session:
        session.pop("email", None)
        return render_template("signout.html")
    else:
     return render_template('index.html')
if __name__ == "__main__":
  app.run(debug=True, host='0.0.0.0', port=5000) ## run in local host 5000 port and any change in code
will reflected immediately.
```

CHAPTER 8

TESTING

8.1 TEST CASES

Test case ID	Feature Type	Component	Test Scenario	Steps To Execute	Test Data
RegisterPage_TC_OO1	UI	Home Page	Verify the UI elements working properly	1.Enter URL and click go 2.Click on registration dropdown button, if not in register page 3.Verify register page	https://120.0.0.1:5000/register
RegisterPage_TC_OO2	Functional	Register Page	Verify user is able to give valid details then only allowing them to register successfully with notification	1.Enter URL and click go 2.Verify Register page popup with below UI elements: a.email text box b.password text box c.Username d.register button	https://120.0.0.1:5000/register
RegisterPage_TC_OO3	Functional	Home page	Verify user data successfully added into DB	1.Enter and click go 2.Enter Valid username/email in Email text box 3.Enter valid password in password text box and click register button 5.Check whether data successfully added into MongoDB	name:Michkel Anglo J email: anglo1199038@gmail.com password: 123456
LoginPage_TC_O O1	Functional	Login page	Verify the UI elements working properly	1.Enter URL and click go 2.Click on email id text box	https://120.0.0.1:5000/login

				3.click on password text box 5.Click on login button and check	
Login Page_ TC_O O2	Functi onal	Login page	Verify user is not able to log into application with InValid credentials	1.Enter URL(https://shopenzer.com/) and click go 2.Enter Valid username/email in Email text box 3.Enter Invalid password in password text box 4.Click on login button	email: rajkumar@gmail.com password: 453245
Login Page_ TC_O O3	Functi onal	Login page	Verify user is able to log into application with Valid credentials	1.Enter URL(https://shopenzer.com/) and click go 2.Enter Valid username/email in Email text box 3.Enter valid password in password text box 4.Click on login button	email: anglo1199038@gmail.com password: 123456
Login Page_ TC_O O4	Functi onal	Login page	After giving valid credentials it must redirect to home page	1.Enter URL and click go 2.Enter Valid username/email in Email text box 3.Enter valid password in password text box 4.Click on login button and check whether it redirect to home page	https://120.0.0.1:5000/login

Home Page_TC_001	UI	Home Page	Verify the UI elements working properly	1.Enter URL and click go 2.click Input data(text box) field for model 3.Enter predict button 4.check whether it redirect to result page	https://120.0.0.1:5000/home
Home Page_TC_002	Functional	Home Page	Check whether input for crude oil price model passed properly	1.Enter URL and click go 2.click Input data(text box) field for model 3.Enter predict button 4.check whether it redirect to result page	23.34,34.67,65,78,98,95,93,98.7,98.6,98
Home Page_TC_003	Functional	Home Page	Check total number of input got as much as needed	1.Enter URL and click go 2.click Input data(text box) field for model 3.Enter predict button 4.check whether it redirect to result page	23.34,34.67,65,78,98,95,93,98.7,98.6,98
Result_TC_001	UI	Result Page	Verify the UI elements working properly	1.Enter URL and click go 2.check whether page loaded properly	https://120.0.0.1:5000/prediction
Result_TC_002	Functional	Result Page	check model result displayed properly from api	1.Enter URL and click go 2.check whether it display price prediction properly	https://120.0.0.1:5000/prediction

Test case ID	Expected Result	Actual Result	Status	BUG ID	Executed By
RegisterPage_TC_OO1	Register popup want to display properly	Working as expected	Pass	No Bug	Michkel Anglo J
RegisterPage_TC_OO2	Application should show below UI elements: a.email text box b.password text box c.Name text box d.Register button with blue color	Working as expected	Pass	No Bug	Michkel Anglo J
RegisterPage_TC_OO3	check Mongo DB compass with data passed are stored properly	Working as expected	Pass	No Bug	Priyank Siddarth
LoginPage_TC_OO1	Login/Signup popup should display	Working as expected	Pass	No Bug	Krisha S
LoginPage_TC_OO2	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass	No Bug	Krisha S
LoginPage_TC_OO3	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass	No Bug	Surendrakumar B

LoginPage_ TC_OO4	User should navigate to user account homepage	Working as expected	Pass	No Bug	Surendrakumar B
HomePage_ TC_001	Application should show below UI elements: a.Description about crude oil b.input text box c.Predict button with blue color	Working as expected	Pass	No Bug	Priyank Siddarth
HomePage_ TC_002	User should navigate to Result page	Working as expected	Pass	No Bug	Michkel Anglo J
HomePage_ TC_003	User should navigate to Result page	Working as expected	Pass	No Bug	Michkel Anglo J
Result_TC_ 001	User should able to see the prediction result price	Working as expected	Pass	No Bug	Surendrakumar B
Result_TC_ 002	User should able to see the prediction result price	Working as expected	Pass	No Bug	Krisha S

8.2 USER ACCEPTANCE TESTING

Sprint	Functional Requirement (Epic)	UAT Task	User Story Numb	User Story / Task	Story Points	Priority	Team Members

			er				
Sprint-1	Mobile registration, Mail Account Access,login	UAT Design	US01,US02,US03	Preparing UAT test cases for stories planned for current sprint	10	Medium	Surendrakumar B Priyank siddarth M J
Sprint-2	Mobile registration, Mail Account Access,login	UAT Execution	US01,US02,US03	Executing UAT test cases against the UAT Environment	15	Medium	Michkel Anglo J Priyank siddarth M J
Sprint-3	Model development& Access	UAT Design	US04,US05,US06	Preparing UAT test cases for stories planned for current sprint	20	High	Krisha S Surendrakumar B
Sprint-4	Model development& Access	UAT Execution	US04,US06,US05	Executing UAT test cases against the UAT Environment	20	High	Michkel Anglo J, Surendrakumar B, Krisha S
Sprint-5	Prediction Dashboard	UAT Design	US08,US07	Preparing UAT test cases for	15	High	Michkel Anglo J, Surendrakum

				stories planned for current sprint I			ar B, Krisha S
Sprint-6	Prediction Dashboard	UAT Execution	US08,US07	Executing UAT test cases against the UAT Environment	20	High	Michkel Anglo J, Surendrakumar B, Krisha S

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	1 day	10 Nov 2022	10 Nov 2022	20	10 Nov 2022
Sprint-2	15	1 day	11 Nov 2022	11 Nov 2022	15	11 Nov 2022
Sprint-3	20	2 days	12 Nov 2022	13 Nov 2022	20	13 Nov 2022
Sprint-4	20	1 day	14 Nov 2022	14 Nov 2022	20	14 Nov 2022
Sprint-5	15	2 day	15 Nov 2022	16 Nov 2022	15	16 Nov 2022
Sprint-6	20	1 days	17 Nov 2022	17 Nov 2022	20	17 Nov 2022

UAT Execution & Report Submission

Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [Crude oil Price Prediction] project at the time of the release to User Acceptance Testing (UAT).

Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	7	2	1	4	14
Duplicate	1	0	0	0	1
External	0	1	0	1	2
Fixed	8	1	1	2	10
Not Reproduced	0	0	0	0	0
Skipped	1	0	0	1	1
Won't Fix	0	1	0	2	3
Totals	16	5	2	10	33

Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	3	0	0	3
UI	7	0	0	7
Security	5	0	0	5
Outsource Shipping	1	0	0	1
Exception Reporting	6	0	0	6
Final Report Output	2	0	0	2
Version Control	1	0	0	1

CHAPTER 9

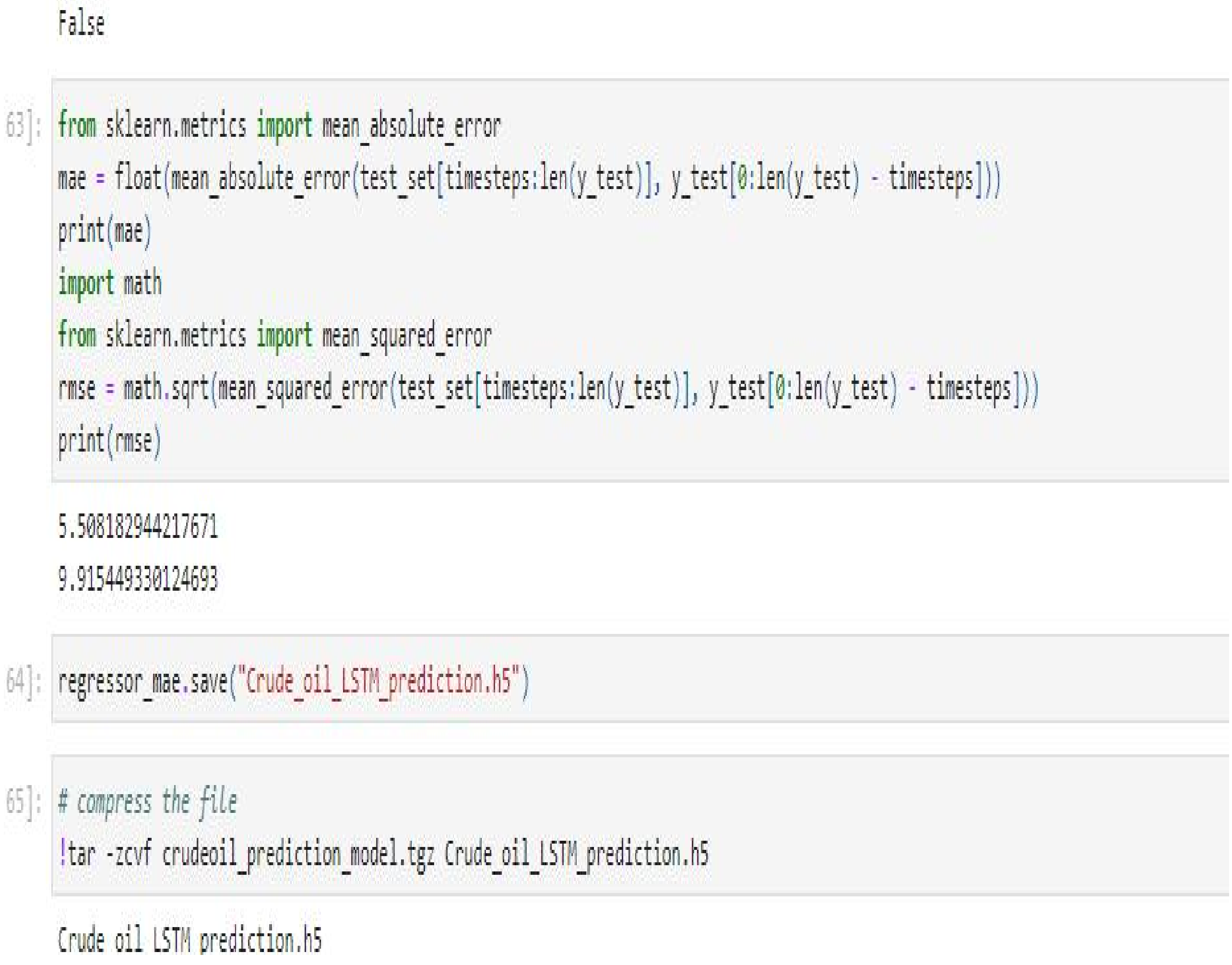
RESULTS

Parameter: Metrics

Values:

RNN with LSTM Model

1. MAE -5.56
2. MSE - 9.92



```
False
```

```
63]: from sklearn.metrics import mean_absolute_error
     mae = float(mean_absolute_error(test_set[timesteps:len(y_test)], y_test[0:len(y_test) - timesteps]))
     print(mae)
     import math
     from sklearn.metrics import mean_squared_error
     rmse = math.sqrt(mean_squared_error(test_set[timesteps:len(y_test)], y_test[0:len(y_test) - timesteps]))
     print(rmse)
```

```
5.508182944217671
9.915449330124693
```

```
64]: regressor_mae.save("Crude_oil_LSTM_prediction.h5")
```

```
65]: # compress the file
     !tar -zcvf crudeoil_prediction_model.tgz Crude_oil_LSTM_prediction.h5
```

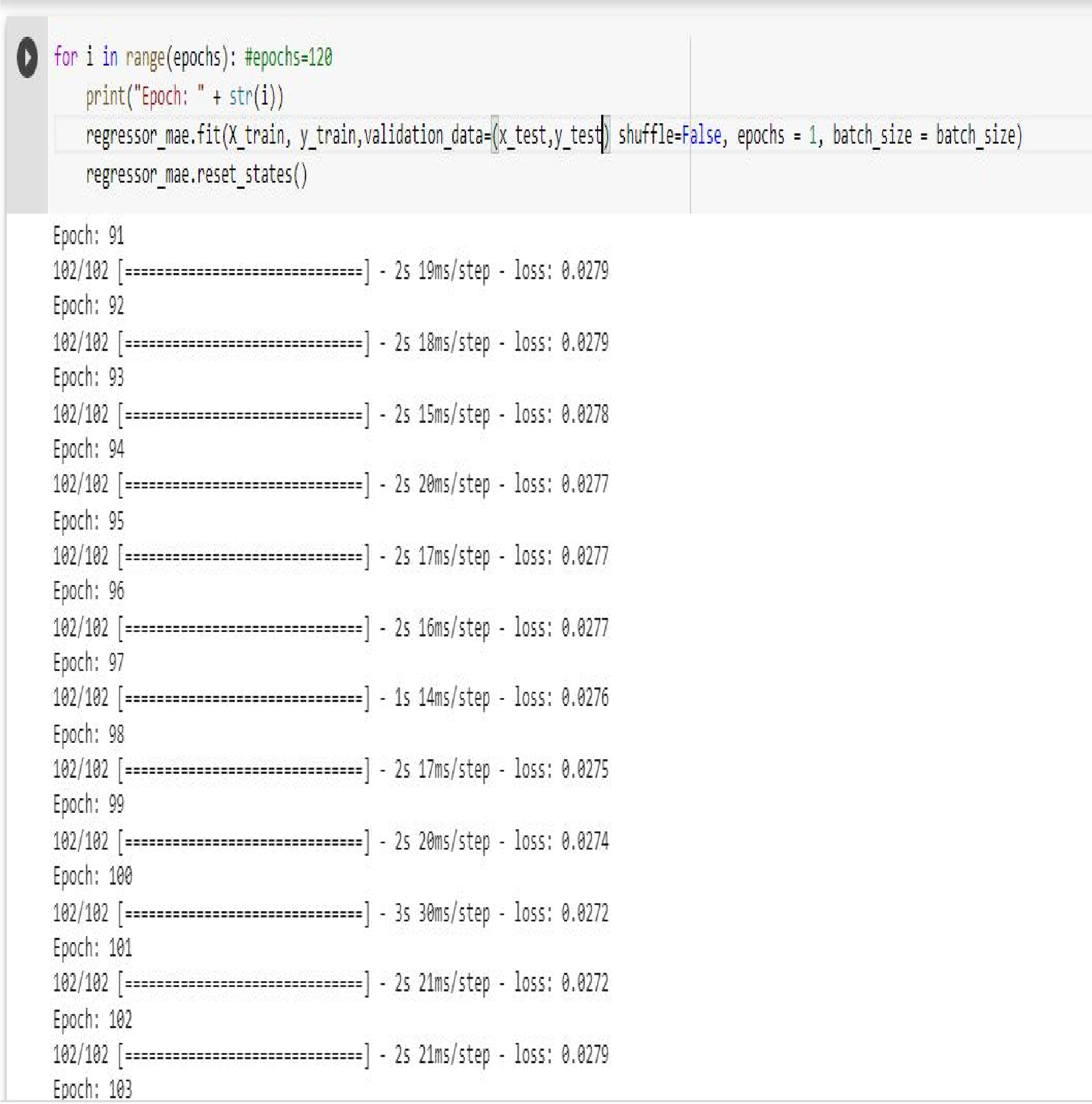
```
Crude oil LSTM prediction.h5
```

Figure 1.8 Metrics

Parameter: Tune the model

Values:

Hyper parameter Tuning - 120 epochs
Validation Method - Testing data



```
for i in range(epochs): #epochs=120
    print("Epoch: " + str(i))
    regressor_mae.fit(X_train, y_train,validation_data=(x_test,y_test) shuffle=False, epochs = 1, batch_size = batch_size)
    regressor_mae.reset_states()
```

```
Epoch: 91
102/102 [==============================] - 2s 19ms/step - loss: 0.0279
Epoch: 92
102/102 [==============================] - 2s 18ms/step - loss: 0.0279
Epoch: 93
102/102 [==============================] - 2s 15ms/step - loss: 0.0278
Epoch: 94
102/102 [==============================] - 2s 20ms/step - loss: 0.0277
Epoch: 95
102/102 [==============================] - 2s 17ms/step - loss: 0.0277
Epoch: 96
102/102 [==============================] - 2s 16ms/step - loss: 0.0277
Epoch: 97
102/102 [==============================] - 1s 14ms/step - loss: 0.0276
Epoch: 98
102/102 [==============================] - 2s 17ms/step - loss: 0.0275
Epoch: 99
102/102 [==============================] - 2s 20ms/step - loss: 0.0274
Epoch: 100
102/102 [==============================] - 3s 30ms/step - loss: 0.0272
Epoch: 101
102/102 [==============================] - 2s 21ms/step - loss: 0.0272
Epoch: 102
102/102 [==============================] - 2s 21ms/step - loss: 0.0279
Epoch: 103
```

Figure 1.9 Tuning

CHAPTER 10

ADVANTAGES AND DISADVANTAGES

Advantages

- It will Provide stability for industries to make decisions with respect to crude oil
- Imports and exports of crude oil are made easier
- Due to its intelligence,predicting accuracy of crude oil price is high

Disadvantages

- Even though it trained with past prices datasets, time series will change for each period without restriction, so making model to be continuously learning was lacking.
- In time series, not all the time it follows seasonality or usual scenarios. So,predicting outlier data will be become challenging

CHAPTER 11
CONCLUSION

With help of RNN with LSTM layered network, future crude oil price was forecasted. Even though exact price of crude oil was unknown ,it will give intuition for industries to determine whether there is increment or decrement with high accuracy rate.

CHAPTER 12

FUTURE SCOPE

It can be developed to predict values very accurately by creating ensemble algorithms with this neutral network algorithm. But machine specifications needed to achieve this model is not yet easily available. Even though it is used it will consume more time or more cores to be processed at a time. Datasets used for this model will have plenty of features, to achieve that much multi dimensional is still difficult task.

APPENDIX

SOURCE CODE

Python code used for model development in IBM

```
import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import tensorflow
from sklearn.preprocessing import MinMaxScaler
from tensorflow.keras.models import Sequential,load_model,Model
from tensorflow.keras.layers import LSTM,Dense,Input

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='CksY-92OBcPex5E-MwaGfkfoTkQW6wen5HVtZ1LXGMOK',
    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 = 'crudeoilpriceprediction-donotdelete-pr-vtg7hvlasgnhuz'
object_key = 'Crude Oil Prices Daily.xlsx'

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

data = pd.read_excel(body.read())

# @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.
metadata_1 = {
    'IAM_SERVICE_ID': 'iam-ServiceId-5d623ebb-fdda-4e0c-baa0-104a5991e97f',
    'IBM_API_KEY_ID': 'CksY-92OBcPex5E-MwaGfkfoTkQW6wen5HVtZ1LXGMOK',
    'ENDPOINT': 'https://s3.private.us.cloud-object-storage.appdomain.cloud',
    'IBM_AUTH_ENDPOINT': 'https://iam.cloud.ibm.com/oidc/token',
    'BUCKET': 'crudeoilpriceprediction-donotdelete-pr-vtg7hvlasgnhuz',
    'FILE': 'Crude Oil Prices Daily.xlsx'
}
batch_size = 64
epochs = 120
timesteps = 30
length = len(data)
print (length)

#test set will be 20% of entire data set
length = length - int(length *0.20)
print (length)
def get_train_length(dataset, batch_size, test_percent):
    # substract test_percent to be excluded from training, reserved for
testset
    length = len(dataset)
    length = length - int(length *test_percent)
    train_length_values = []
    for x in range(int(length) - 100,int(length)):
        modulo=x%batch_size
        if (modulo == 0):
            train_length_values.append(x)
    return (max(train_length_values))
length = get_train_length(data, batch_size, 0.20)
#Adding timesteps * 2
upper_train = length + timesteps*2
data_train = data[0:upper_train]
training_set = data_train.iloc[:,1:2].values
scale = MinMaxScaler(feature_range = (0, 1)) #scaling the dataset
training_set_scaled = scale.fit_transform(np.float64(training_set))
X_train = []
y_train = []
# Creating a data structure with n timesteps

print (length + timesteps)
for i in range(timesteps, length + timesteps):
    X_train.append(training_set_scaled[i-timesteps:i,0])
    y_train.append(training_set_scaled[i:i+timesteps,0])

print (len(X_train))
print (len (y_train))
print (np.array(X_train).shape)
print (np.array(y_train).shape)
# Creating a data structure with n timestep
for i in range(timesteps, length + timesteps):
    X_train.append(training_set_scaled[i-timesteps:i,0])
    y_train.append(training_set_scaled[i:i+timesteps,0])
# Reshaping
X_train, y_train = np.array(X_train), np.array(y_train)
X_train = np.reshape(X_train, (X_train.shape[0], X_train.shape[1], 1))
y_train = np.reshape(y_train, (y_train.shape[0], y_train.shape[1], 1))
```

Model Creation

```
inputs_1_mae = Input(batch_shape=(batch_size,timesteps,1))
lstm_1_mae = LSTM(10, stateful=True, return_sequences=True)(inputs_1_mae)
lstm_2_mae = LSTM(10, stateful=True, return_sequences=True)(lstm_1_mae)

output_1_mae = Dense(units = 1)(lstm_2_mae)

regressor_mae = Model(inputs=inputs_1_mae, outputs = output_1_mae)

regressor_mae.compile(optimizer='adam', loss = 'mae')
regressor_mae.summary()
for i in range(epochs):
    print("Epoch: " + str(i))
    regressor_mae.fit(X_train, y_train, shuffle=False, epochs = 1, batch_size
= batch_size)
    regressor_mae.reset_states()
```

Testing

```
def get_test_length(dataset, batch_size):

    test_length_values = []
    for x in range(len(dataset) - 200, len(dataset) - timesteps*2):
        modulo=(x-upper_train)%batch_size
        if (modulo == 0):
            test_length_values.append(x)
            print (x)
    return (max(test_length_values))
test_length = get_test_length(data, batch_size)
print(test_length)
upper_test = test_length + timesteps*2
testset_length = test_length - upper_train
print (testset_length)
# construct test set

#subsetting
df_data_1_test = data[upper_train:upper_test]
test_set = df_data_1_test.iloc[:,1:2].values

#scaling
scaled_real_bcg_values_test = scale.fit_transform(np.float64(test_set))

#creating input data
X_test = []
for i in range(timesteps, testset_length + timesteps):
    X_test.append(scaled_real_bcg_values_test[i-timesteps:i, 0])
X_test = np.array(X_test)
```

```
#reshaping
X_test = np.reshape(X_test, (X_test.shape[0], X_test.shape[1], 1))
#prediction
predicted_bcg_values_test_mae = regressor_mae.predict(X_test,
batch_size=batch_size)
regressor_mae.reset_states()

print (predicted_bcg_values_test_mae.shape)

#reshaping
predicted_bcg_values_test_mae = np.reshape(predicted_bcg_values_test_mae,
                                       (predicted_bcg_values_test_mae.shape[0],
                                        predicted_bcg_values_test_mae.shape[1])
)

print (predicted_bcg_values_test_mae.shape)
#inverse transform
predicted_bcg_values_test_mae =
scale.inverse_transform(predicted_bcg_values_test_mae)


#creating y_test data
y_test = []
for j in range(0, testset_length - timesteps):
    y_test = np.append(y_test, predicted_bcg_values_test_mae[j, timesteps-1])

# reshaping
y_test = np.reshape(y_test, (y_test.shape[0], 1))

print (y_test.shape)
plt.plot(test_set[timesteps:len(y_test)], color = 'red', label = 'Real Crude
Oil Prices')
plt.plot(y_test[0:len(y_test) - timesteps], color = 'blue', label = 'Predicted
Crude Oil Prices')
plt.title('Crude Oil Prices Prediction - MAE')
plt.xlabel('Time')
plt.ylabel('Crude Oil Prices')
plt.legend()
plt.show()


print(np.any(np.isnan(test_set)))
print(np.any(np.isnan(y_test)))
np.nan_to_num(test_set,copy=False)
np.nan_to_num(y_test,copy=False)
from sklearn.metrics import mean_absolute_error
mae = float(mean_absolute_error(test_set[timesteps:len(y_test)],
y_test[0:len(y_test) - timesteps]))
print(mae)
import math
```

```
from sklearn.metrics import mean_squared_error
rmse = math.sqrt(mean_squared_error(test_set[timesteps:len(y_test)],
y_test[0:len(y_test) - timesteps]))
print(rmse)
regressor_mae.save("Crude_oil_LSTM_prediction.h5")
# compress the file
!tar -zcvf crudeoil_prediction_model.tgz Crude_oil_LSTM_prediction.h5
```

IBM Deployment

```
pip install ibm_watson_machine_learning
from ibm_watson_machine_learning import APIClient
wmi_credentials={
    "url":"https://us-south.ml.cloud.ibm.com",
    "apikey":"9RsKJwBgAvBgaBdJb5NY4pFp2hP-z_rV3jEVTEkRNdmm"
}
client = APIClient(wmi_credentials)
space_id="90c5aed6-96c9-4761-b1d2-eab8fbdd04db"
client.set.default_space(space_id)
software_space_uid=client.software_specifications.get_id_by_name("tensorflow_r
t22.1-py3.9")
model_details=client.repository.store_model(model='crudeoil_prediction_model.t
gz',meta_props={
    client.repository.ModelMetaNames.NAME:"LSTM Model",
    client.repository.ModelMetaNames.TYPE:"tensorflow_2.7",
    client.repository.ModelMetaNames.SOFTWARE_SPEC_UID:software_space_uid
})
```

Flask File Integration with model and html

app.py file code

```
import bcrypt
import numpy as np
from flask import Flask, redirect, render_template, request, session, url_for
from pymongo import MongoClient
from sklearn.preprocessing import MinMaxScaler
from tensorflow.keras.models import load_model

model = load_model('prediction_model.h5')
#set app as a Flask instance
app = Flask(__name__)
#encryption relies on secret keys so they could be run
app.secret_key = "GReece@2"

# #connect to your Mongo DB database
```

```
def MongoDB():
    con_string
="mongodb+srv://micky:power0!6@cluster0.ziiirqp.mongodb.net/?retryWrites=true&
w=majority"
    client = MongoClient(con_string )
    db = client['Predict_app']
    user_collection = db['userdata']
    return user_collection
records = MongoDB()


##Connect with Docker Image###


#assign URLs to have a particular route
@app.route("/", methods=['post', 'get'])
def index():
    message = ''
    #if method post in index
    if "email" in session:
        return redirect(url_for("logged_in"))
    if request.method == "POST":
        user = request.form.get("fullname")
        email = request.form.get("email")
        password1 = request.form.get("password1")
        password2 = request.form.get("password2")
        #if found in database showcase that it's found
        user_found = records.find_one({"name": user})
        email_found = records.find_one({"email": email})
        if user_found:
            message = 'There already is a user by that name'
            return render_template('index.html', message=message)
        if email_found:
            message = 'This email already exists in database'
            return render_template('index.html', message=message)
        if password1 != password2:
            message = 'Passwords should match!'
            return render_template('index.html', message=message)
        else:
            #hash the password and encode it
            hashed = bcrypt.hashpw(password2.encode('utf-8'), bcrypt.gensalt())
            #assing them in a dictionary in key value pairs
            user_input = {'name': user, 'email': email, 'password': hashed}
            #insert it in the record collection
            records.insert_one(user_input)

            #find the new created account and its email
            user_data = records.find_one({"email": email})
            new_email = user_data['email']
            #if registered redirect to logged in as the registered user
            return render_template('logged_in.html', email=new_email)
    return render_template('index.html')

@app.route("/login", methods=["POST", "GET"])
def login():
    message = 'Please login to your account'
    if "email" in session:
        return redirect(url_for("logged_in"))

    if request.method == "POST":
        email = request.form.get("email")
        password = request.form.get("password")

        #check if email exists in database
        email_found = records.find_one({"email": email})
        if email_found:
            email_val = email_found['email']
            passwordcheck = email_found['password']
            #encode the password and check if it matches
            if bcrypt.checkpw(password.encode('utf-8'), passwordcheck):
                session["email"] = email_val
                return redirect(url_for('logged_in'))
            else:
                if "email" in session:
                    return redirect(url_for("logged_in"))
                message = 'Wrong password'
                return render_template('login.html', message=message)
        else:
            message = 'Email not found'
            return render_template('login.html', message=message)
    return render_template('login.html', message=message)

@app.route('/logged_in')
def logged_in():
    if "email" in session:
        email = session["email"]
        return render_template('logged_in.html', email=email)
    else:
        return redirect(url_for("login"))
@app.route('/prediction',methods=["POST", "GET"])
def predict():
    if request.method == 'POST':
        value=request.form.get('list')
        #print(type(value))
        b=value.split(",")
        values = list(map(float, b))
        List= np.array([values])
        List=np.reshape(List,(-1,1))
        scale = MinMaxScaler(feature_range = (0, 1))
        List=scale.fit_transform(np.float64(List))
        val= model.predict(List)
        val=np.reshape(val,(30,1))
        val=scale.inverse_transform(val)
        answer= float(val[29])
        answer=round(answer, 2)
    return render_template('prediction.html', result=answer)

@app.route("/logout", methods=["POST", "GET"])
def logout():
    if "email" in session:
        session.pop("email", None)
        return render_template("signout.html")
    else:
        return render_template('index.html')



if __name__ == "__main__":
  app.run(debug=True, host='0.0.0.0', port=5000)
```

HTML files

Base.html file

```
<!doctype html>
<html lang="en">
<head><meta charset="utf-8">


  <title>{% block title %}{%endblock %}</title>

  <link rel="stylesheet"
href="https://stackpath.bootstrapcdn.com/bootstrap/4.5.0/css/bootstrap.min.css
" integrity="sha384-
9aIt2nRpC12Uk9gS9baDl411NQApFmC26EwAOH8WgZl5MYYxFfc+NcPb1dKGj7Sk"
crossorigin="anonymous">

</head>
<body>

<nav class="navbar navbar-light" style="background-color: #7dafd3;">
  <a class="navbar-brand" href="#">Registration Form</a>
  <button class="navbar-toggler" type="button" data-toggle="collapse" data-
target="#navbarNavAltMarkup" aria-controls="navbarNavAltMarkup" aria-
expanded="false" aria-label="Toggle navigation">
    <span class="navbar-toggler-icon"></span>
  </button>
  <div class="collapse navbar-collapse" id="navbarNavAltMarkup">
    <div class="navbar-nav">
      <a class="nav-item nav-link active" href="/">Register <span class="sr-
only">(current)</span></a>
      <a class="nav-item nav-link" href="/login">Login</a>
      <a class="nav-item nav-link" href="/logout">Logout</a>
    </div>
  </div>
</nav>


<script src="https://code.jquery.com/jquery-3.5.1.slim.min.js"
integrity="sha384-
DfXdz2htPH0lsSSs5nCTpuj/zy4C+OGpamoFVy38MVBnE+IbbVYUew+OrCXaRkfj"
crossorigin="anonymous"></script>
    <script
src="https://cdn.jsdelivr.net/npm/popper.js@1.16.0/dist/umd/popper.min.js"
integrity="sha384-
Q6E9RHvbIyZFJoft+2mJbHaEWldlvI9IOYy5n3zV9zzTtmI3UksdQRVvoxMfooAo"
crossorigin="anonymous"></script>
    <script
src="https://stackpath.bootstrapcdn.com/bootstrap/4.5.0/js/bootstrap.min.js"
integrity="sha384-
OgVRvuATP1z7JjHLkuOU7Xw704+h835Lr+6QL9UvYjZE3Ipu6Tp75j7Bh/kR0JKI"
crossorigin="anonymous"></script>
    <script
src="https://stackpath.bootstrapcdn.com/bootstrap/4.5.0/js/bootstrap.min.js"
integrity="sha384-
OgVRvuATP1z7JjHLkuOU7Xw704+h835Lr+6QL9UvYjZE3Ipu6Tp75j7Bh/kR0JKI"
crossorigin="anonymous"></script>

{% block content %}{% endblock %}
</body>
</html>
```

Index.html file

```
{% extends "base.html" %}
{% block title %}Register System{% endblock %}

{% block content %}

{% if message  %}
    <div class="alert alert-secondary" role="alert">
        <p>{{ message }}</p>
    </div>
{% endif %}
<span class="test">
<form action="" method="post">
    <div class="form-group">
        <label for="Fullname"  class="fonts">Full name</label>
        <input name="fullname" class="form-control" id="inputFullName" aria-
describedby="emailHelp" placeholder="Enter full name">
        <small id="fullName" class="form-text text-muted">Please enter your
full name(First name and Last name)</small>
  </div>
  <div class="form-group">
        <label for="InputEmail"  class="fonts">Email address</label>
        <input name="email" class="form-control"
id="InputEmail"  placeholder="Enter email">
        <small id="emailHelp" class="form-text text-muted">We'll never share
your email with anyone else.</small>
  </div>
  <div class="form-group">
    <label for="InputPassword"  class="fonts">Password</label>
    <input type="password" name="password1" class="form-control"
id="InputPassword" placeholder="Password">
  </div>

    <div class="form-group">
    <label for="InputPassword2"  class="fonts">Repeat Password</label>
    <input type="password" name="password2" class="form-control"
id="InputPassword2" placeholder="Repeat Password">

    </div>
  <button type="submit" class="btn btn-primary">Submit</button>


</form>
</span>
<style>
    html {
   height: 100%;
}

.test{
/* Remember to use the other versions for IE 10 and older browsers! */
display: flex;
justify-content: center;
align-items: center;
min-height: 100%;
font-family: 'lato', sans-serif;
color: rgb(47, 206, 198);
 /* W3C, IE 10+/ Edge, Firefox 16+, Chrome 26+, Opera 12+, Safari 7+ */
}
.fonts{
color: black;
}

</style>



{% endblock %}
```

Logged_in.html file

```
{% extends "base.html" %}
{% block title %}Youv'e logged in {% endblock %}

{% block content %}
<p class="second">Crude oil is mainly used as a fuel and combustible, but is
also indispensable as a chemical raw material. It is the foundation of modern
life and in virtually every product around us – from smartphones and vehicle
parts to wind turbines.<br>
</p>
<p class="second">Crude oil is one of the world's most important commodities
and its price can have ripple effects through the broader economy. Rising oil
prices mean higher gasoline prices at the pump, higher shipping costs, and
increased input costs for producers.
</p>
<p class="second"><b>Here you can know about forecasting of crude oil
price</b></p>
<form  class="todo" action="prediction" method="post">
    <div>
        Type last 30 days crude oil price<br>
        <input class="todo" type="text" name="list">
    </div>
<br>
<input type="submit" name="submit" value= "To predict click here!!!"
href="/prediction" >
</form>
<style>
    .todo{
        padding-left: 10%;
        padding-right: 10%;
        align-items: center;
        justify-content: center;
    }
    .design{
        color: brown;
        font-size: medium;
        font-family: Cambria, Cochin, Georgia, Times, 'Times New Roman', serif;
        font-display: solid;
    }
    .second{
        color: rgb(104, 26, 39);
        font-size: large;
        padding-top: 4%;
        padding-left: 2%;
        padding-right: 2%;
        font-family: Cambria, Cochin, Georgia, Times, 'Times New Roman', serif;
        font-display: solid;
        align-items: center;
        justify-content: center;
    }
</style>

{% endblock %}
```

Login.html file

```
{% extends "base.html" %}

<span class="test">
    {% block title %}Login System{% endblock %}
{% block content %}</span>

{% if message  %}
    <div class="alert alert-secondary" role="alert">
        <p>{{ message }}</p>
    </div>
{% endif %}
<style>
    html {
   height: 100%;
}

.test{
/* Remember to use the other versions for IE 10 and older browsers! */
display: flex;
justify-content: center;
align-items: center;
min-height: 100%;
font-family: 'lato', sans-serif;
color: #fff;
 /* W3C, IE 10+/ Edge, Firefox 16+, Chrome 26+, Opera 12+, Safari 7+ */
}
.fonts{
color: black;
}
```

```
</style>
<span class="test">
<form action="" method="post">
  <div class="form-group">
      <label for="InputEmail" class="fonts">Email address</label>
      <input  name="email" class="form-control"
id="InputEmail"  placeholder="Enter email/number">
      <small id="emailHelp" class="form-text text-muted">We'll never share
your email with anyone else.</small>
  </div>
    <div class="form-group">
      <label for="InputPassword" class="fonts">Password</label>
      <input type="password" name="password" class="form-control"
id="InputPassword" placeholder="Password">
  </div>
  <button type="submit" class="btn btn-primary">Submit</button>
</form> </span>
{% endblock %}
```

Prediction.html file

```
<body class="todo">
    <b>
<p> From given input this is the crude oil price of next day</p>

<p>The future price of crude oil will be Rs.{{result}}.</p></b>
</body>
<style>
    .todo{
        background-color: rgb(101, 221, 221);
        padding-left: 34%;
        padding-right: 30%;
        padding-top: 18%;
        padding-bottom: 18%;
        font-size: xx-large;
    }
</style>
```

Signout.html file

```
{% extends "base.html" %}
{% block title %}Register System{% endblock %}

{% block content %}
<h1 class="design">You are signed out!</h1>
```

```
<style>
    .design{
        color: brown;
        font-size: x-large;
        font-family: Cambria, Cochin, Georgia, Times, 'Times New Roman', serif;
        font-display: solid;}
        </style>
{% endblock %}
```

GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project-7228-1658850306

PROJECT DEMO LINK

https://youtu.be/vh4QDrpWHjc

--------------------- Thank you --------------------