Project Report

INTRODUCTION

Crude oil is a yellow-black naturally occurring liquid found in geological formations beneath the Earth's surface that can be fractionated into various types of consumer fuels. Crude oil is currently one of the most important energy resources on the planet. So far, it has remained the world's most important fuel, accounting for nearly one-third of global energy consumption. Refined crude oil is also used to make petroleum products. Encouragement of the use of fossil fuels is becoming increasingly unpopular because they are unmistakably responsible for global warming and other severe effects on ecosystems. To address the climate crisis, the world is making a concerted effort to phase out fossil fuels.

1.1 Project Overview

- Crude oil is one of the most crucial resources in today's world since it is the main fuel and because its price directly affects oil exploration, exploitation, and other activities as well as the environment and our economy.
- Predicting oil prices is now essential; it benefits many big and small businesses, people, and the government.
- Due to the volatile nature of crude oil prices, it is highly difficult to estimate its price and it is tough to be precise with the same.
- A modern and cutting-edge approach to forecasting crude oil prices is to use a recurrent neural network (RNN).
- The primary benefit of using RNN in this manner is that it remembers the previous inputs and outputs over time and since the data is a time series data, the LSTM model proves to be beneficial when optimized with RMSE Propagation.

1.2 Purpose

- To accurately predict crude oil prices in tandem with the state of the economy.
- To make trading crude oil stocks a viable passive income strategy.
- To reduce the risk of incurring heavy losses on a bad trade.
- Accurate prediction of crude oil prices and potential future economic recessions
- Accept user feedback on the performance of the model

- User friendly way to forecast crude oil prices

LITERATURE SURVEY

2.1 Existing problem

- Price Prediction accuracy is low.
- Production cost is high due to
- It requires more time to train.
- While using LSTM dropout is harder to implement.
- It requires lots of data to store the information on the entire network .
- Low efficiency in working model.
- Low quality in predicting the prices.

2.2 References

[1] Wiri Leneenadogo, Sibeate Pius U, 2012, “Linear and Non-Linear Modelling of Crude Oil Price Prediction.

[2] Nalini Gupta, Shobhit Nigam, 2015, “Crude Oil Price Prediction using Artificial Neural Networks”

[3] Parviz Sohrab, Hesam Deghani, Ramin Rafie, source: time plot, 2018, “Forecasting of WTI Crude oil using combined ANN”

[4] Ghazala Othman, Szira Zoltan, Varga Erika, Zeman Zoltan, 2020, “The Complexity of Crude Oil Prices”

[5] Amano, Hesam Deeghani, Zoltan Gupta, 2017, “Crude Oil Price Prediction using LSTM

[6] Abdullah S. N and Zeng X, 2018, “Crude Oil Price Prediction with Artificial Neural Network.

[7] Maryan Ebrahimi, Amir Daneshvar, 2019, “Brent Crude Oil Price Prediction.

[8] Minggang Wang, Longfeng Zhao, Ruijin Du, Lin Chen, 2020, “Forecasting Crude Oil Prices using Artificial Intelligence”.

[9] Manel Hamdi and Chaker Aloui, 2020, “Forecasting Crude Oil Price using ANN”.

[10] Wei Yin Loh, University of Wiscosin, Madison, 2020, “Crude oil Price Prediction”.

2.3 Problem Statement Definition

- Crude oil is the world's most important fuel, and its prices have a significant impact on the global environment; forecasts are extremely useful to governments, businesses, and individuals.
- Continuous use of statistical and econometric techniques, including AI, for crude oil price prediction may result in degraded prediction performance.
- Because crude oil price fluctuations have a significant impact on the world's economies, price

  forecasting can help reduce the risks posed by this volatility.

IDEATION & PROPOSED SOLUTION

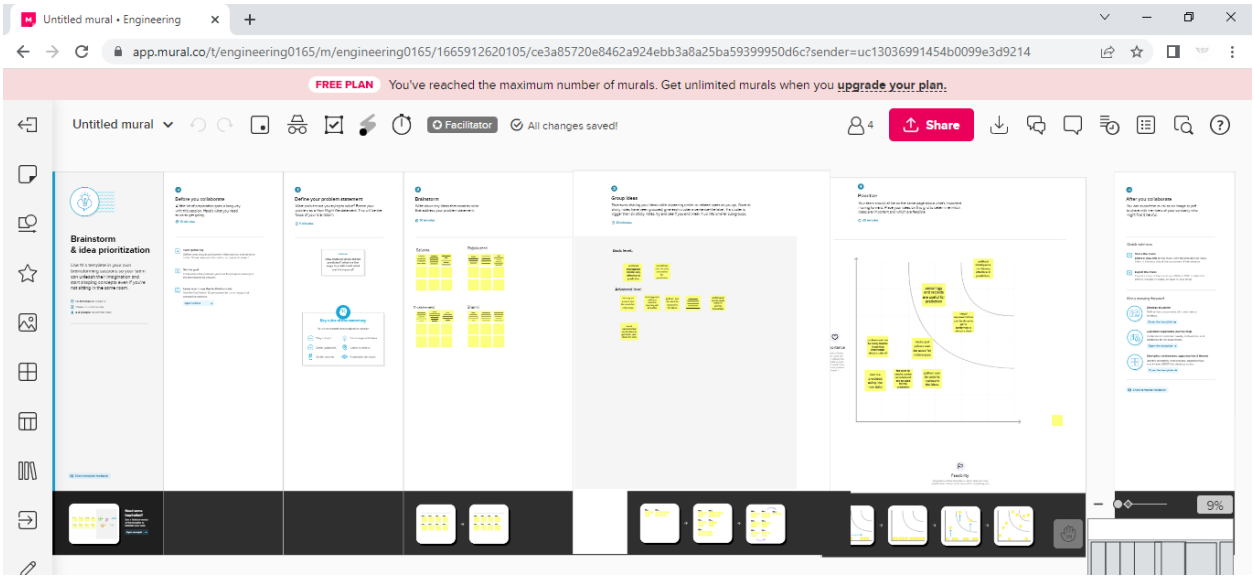
3.1 Empathy Map Canvas

An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agile community.

3.2 Ideation & Brainstorming

Ideation is often closely related to the practice of brainstorming, a specific technique that is utilized to generate new ideas. A principal difference between ideation and brainstorming is that ideation is commonly more thought of as being an individual pursuit, while brainstorming

is almost always a group activity.



3.3 Proposed Solution

- Crude oil is the world's most important fuel, and its prices have a significant impact on the global environment; forecasts are extremely useful to governments, businesses, and individuals.
- Continuous use of statistical and econometric techniques, including AI, for crude oil price prediction may result in degraded prediction performance.
- Because crude oil price fluctuations have a significant impact on the world's economies, price forecasting can help reduce the risks posed by this volatility.
- Price projections are critical for a wide range of stakeholders, including governments, public and private businesses, legislators, and investors.
- It is used to forecast future prices and use oil accordingly.
- This price has a direct impact on a variety of items, and its fluctuations affect the capital markets.
- Oil prices can be influenced by major events in addition to economic factors.
- It is used to predict future oil prices and allocate oil accordingly.
- This price has a direct impact on a wide range of items, and its fluctuations have an impact on the financial markets.
- In addition to economic factors, major events can have an impact on oil prices.

- PCA, MDS, and LLE methods are used to reduce the dimensions of the data.
- Increase the RNN and LSTM models' accuracy.

3.4 Problem Solution fit

Customer Segment(s) :

This project is aimed towards investors who seek to make profits from crude oil stock price.

Jobs-To-Be-Done :

- The application interface should be simple to use.
- Delivery of precise results.

Triggers :

- Economical.
- Early forecasting can help to avoid major problems.

Available Solutions:

- If the price of crude oil falls, the simplest way to profit is to fleece the bears.
- Buying oversold oil or gas stocks can be a great way to profit now and reap the benefits later when the bears realise their mistake and oil prices rebound.

Customer Constraints :

- Reliable internet access is required.
- For accurate results, the user must enter the necessary information.
- Read the guidelines for proper usage.

Behaviour :

- The closing price of a stock is the last price at which it trades during a regular trading session.
- The Closing Price assists the investor in understanding the stock market sentiment over time.
- It is the most accurate matrix for determining stock valuation until the market resumes trading the following day.

Channels Of Behaviour :

- Conducting fundamental analysis.
- Technical evaluation. ● Risk Administration

Problem Root Cause:

- The shifting pattern of oil prices.
- Professionals with little experience. **Your Solution :**

- The primary goal of this Guided Project is to use Neural Networks to forecast crude oil prices.
- This decision allows us to purchase crude oil at the right time.
- Time series analysis is the best option for this type of prediction because we are using past crude oil prices to forecast future crude oil prices.
- In order to complete the task, we will use RNN (Recurrent Neural Network) and LSTM (Long Short Term Memory).

REQUIREMENT ANALYSIS

Requirements analysis, also called requirements engineering, is the process of determining user expectations for a new or modified product. These features, called requirements, must be quantifiable, relevant and detailed. In software engineering, such requirements are often called functional

specifications.

4.1 Functional requirement :

- User Registration - Registration through Form.
- Graph - Showing graph by obtaining the data from the dataset
- Fetching input data - Give the model the input data.
- News - Information of the oil prices will be updated by admin.
- Database - Information of the User will be stored.

4.2 Non-Functional requirements :

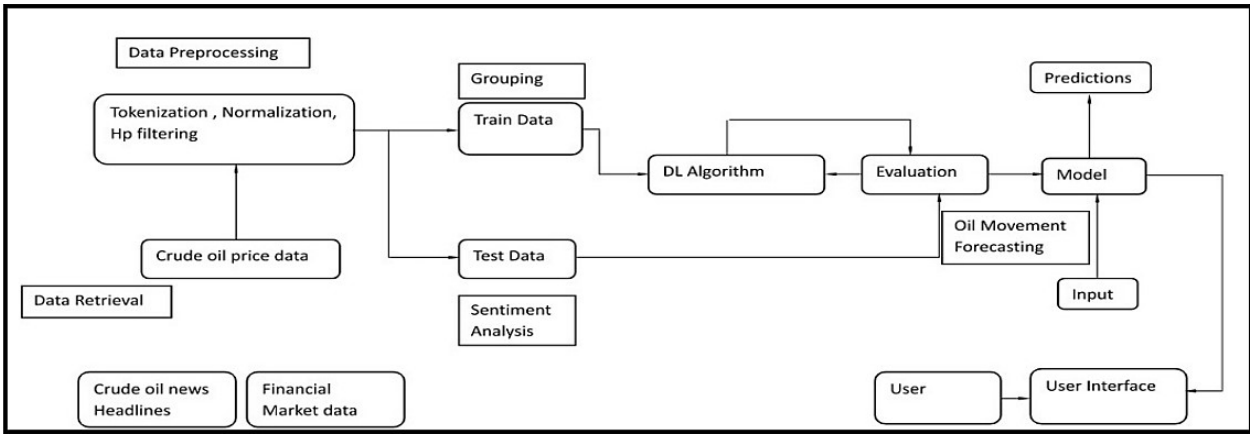
- Usability - It can be used by a wide range of clients because it is simple to learn and use.
- Security - We will use login for the user, and the information will be hashed, making it very secure to use.
- Reliability - It will be reliable in that it can update in a short period of time, resulting in good accuracy.
- Performance - Even at low bandwidth, it will perform quickly and securely.
- Availability - Prediction will be available to all users, but only premium users will receive news, database, and price alerts.
- Scalability - I t is scalable that we will use data in kb so that a sufficient amount of

storage is provided.

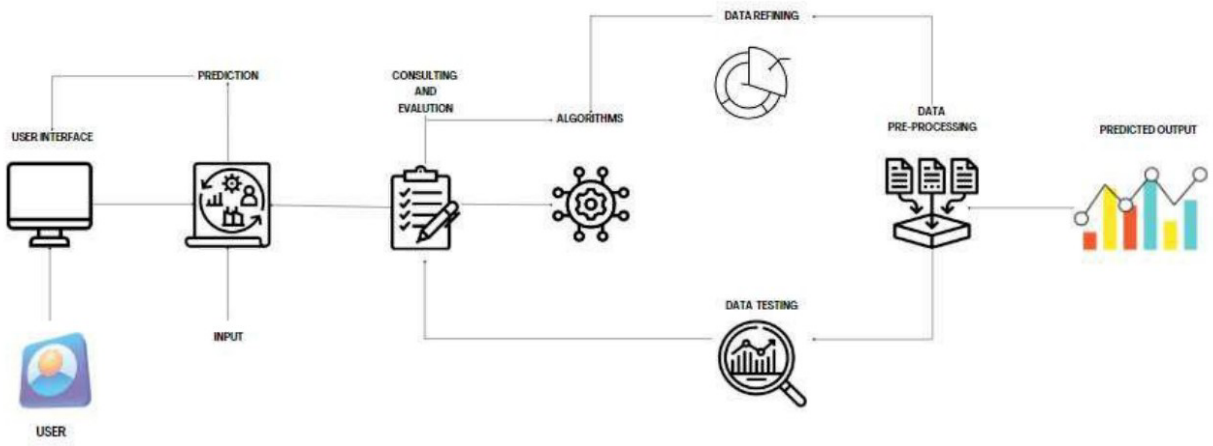
PROJECT DESIGN

Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information.

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



5.3 User Stories

Customer (Mobile User) :

Registration :

USN-1 - Asauser,Icanregisterfortheapplication byenteringmyemail,password,and confirming my password.
USN-2 - As a user,I will receive confirmation email once I have registered for the application.
USN-3 - As a user,I can register for the application through Facebook.
USN-4 - As a user,I can register for the application through Gmail.

Login :

USN-5 - As a user,I can log into the application by entering email & password .

Line\Bar gragh :

USN-5 - After entering the inputs,the model will display predictions in Line\Bar Gragh Format.

Customer (Web user) :

Login :

USN-1 - As the web user,I can login simply by using Gmail or Facebook account.

Customer Care Executive :

Support :

USN-1 - The Customer care service will provide solutions for any FAQ and also provide ChatBot.

PROJECT PLANNING & SCHEDULING

Project planning is all about choosing and designing effective policies and methodologies to attain project objectives. While 'Project scheduling' is a procedure of assigning tasks to get them

completed by allocating appropriate resources within an estimated budget and time-frame.

6.1, 6.2 Sprint Planning & Estimation and Sprint Delivery Schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	10	High	SAIUSHA S
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	10	High	SHARMI S
Sprint-1	Login	USN-3	As a user, I can log into the application by entering email & password.	15	High	SAIUSHA S
Sprint-2	Input Necessary Details	USN-4	As a user, I can give Input Details to Predict Likeliness of crude oil	15	High	RAJA LEKSHMI P
Sprint-2	Data Pre-processing	USN-5	Transform raw data into suitable format for prediction.	15	High	SIVABHARATHI B
Sprint-3	Prediction of Crude Oil Price	USN-6	As a user, I can predict Crude oil using machine learning model.	20	High	SAIUSHA S
Sprint-3		USN-7	As a user, I can get accurate prediction of crude oil	5	Medium	SHARMI S
Sprint-4	Review	USN-8	As a user, I can give feedback of the application.	20	High	RAJA LEKSHMI P

CODING & SOLUTIONING

7.1 Feature 1

Session based authentication using Flask.

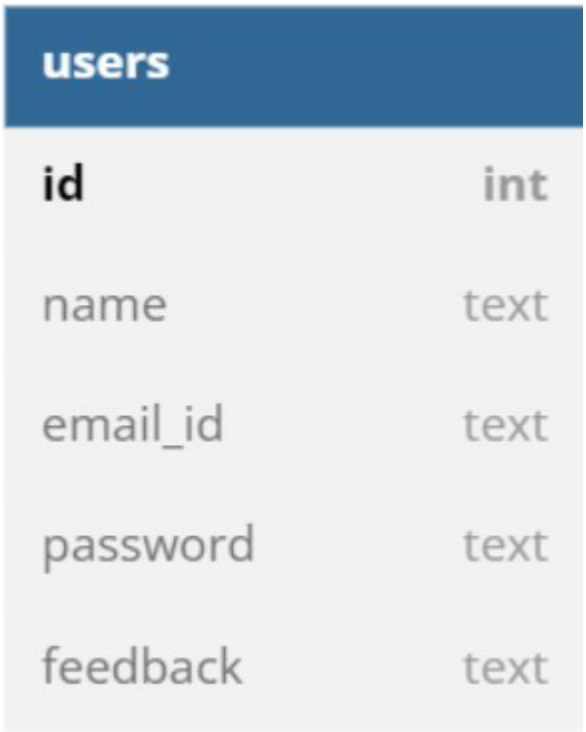
7.2 Feature 2

Future crude oil price prediction using RNN.

7.3 Feature 3

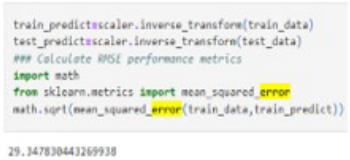
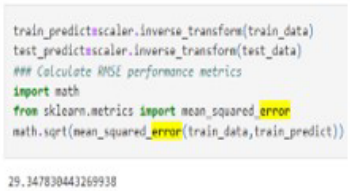
Accept user's feedback on the predicted price.

7.3 Database Schema (if Applicable)



RESULTS

9.1 Performance Metrics

S.No.	Parameter	Values	Screenshot
1.	Model Summary	It accepts data in the shape of n,1 where n Is the number of inputs and predicts n number of outputs.	
2.	Accuracy	Training Accuracy – 71.06% Validation Accuracy – 70.98%	

ADVANTAGES & DISADVANTAGES

10.1 Advantage :

- Low time consumption.
- Cost efficient
- Continuously captures the unstable pattern.
- Short term price forecasting.
- Price prediction accuracy.
- Grasp the structure of data dynamically over time with high prediction capacity.

10.2 Disadvantage :

- Not 100% accurate.
- Low efficiency.
- Long term price speculations.

CONCLUSION

- Proposing a new approach for oil price prediction based on stream learning.
- Updating the model whenever new oil price data are available to capture the changing pattern of oil prices.
- Achieving the highest accuracy compared with 3 popular oil price prediction models.
- Accurate prediction of crude oil prices and potential future economic recessions
- Accept user feedback on the performance of the model ● User friendly way to forecast crude oil prices **FUTURE SCOPE**

- The model will be more accurate for predicting the prices.
- The real time oil prices will also be displayed in the website.
- For every three months the model will be retrained **.**
- The model will give the errorless prediction for predicting the prices of crude oil.

APPENDIX

13.1 Source Code

Index.html :

```
<!DOCTYPE html>
<html lang="en">
<head>
   <meta charset="UTF-8">
   <meta http-equiv="X-UA-Compatible" content="IE=edge">
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <script src="https://cdnjs.cloudflare.com/ajax/libs/Chart.js/2.9.4/Chart.js"></script>
   <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css"
```

```
rel="stylesheet">
  <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.bundle.min.js"></script>
  <title>Document</title>
  <style>
   .chart{
   height: 100vh;
  }
  </style>
</head>
<body>
  <!-- NAVBAR -->
  <section>
    <div>
      <nav class="navbar navbar-expand-lg navbar-dark bg-dark static-top">
        <div class="container">
          <a class="navbar-brand" href="#">
            <img src="https://placeholder.pics/svg/150x50/888888/EEE/Logo" alt="..."
height="36">
          </a>
          <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-
bstarget="#navbarSupportedContent" aria-controls="navbarSupportedContent" aria-
expanded="false" arialabel="Toggle navigation">
            <span class="navbar-toggler-icon"></span>
          </button>
        <div class="collapse navbar-collapse" id="navbarSupportedContent">
          <ul class="navbar-nav ms-auto">
            <li class="nav-item">
              <a class="nav-link active" aria-current="page" href="#">Home</a>
            </li>
```

```
                <li class="nav-item">
                  <a class="nav-link" href="#">Link</a>
                </li>
                <li class="nav-item dropdown">
                  <a class="nav-link dropdown-toggle" href="#" id="navbarDropdown" role="button"
databs-toggle="dropdown" aria-expanded="false">
                    Dropdown
                  </a>
                  <ul class="dropdown-menu dropdown-menu-end" aria-
labelledby="navbarDropdown">
                    <li><a class="dropdown-item" href="#">Action</a></li>
                    <li><a class="dropdown-item" href="#">Another action</a></li>
                    <li>
                      <hr class="dropdown-divider">
                    </li>
                    <li><a class="dropdown-item" href="#">Something else here</a></li>
                  </ul>
                </li>
              </ul>
</div>
            </div>
          </nav>
      </div>


      <div class="container text-center">
        <h1>Hello {{username}}</h1>
        <p>Here are the price prediction of past 6 months</p>
      </div>
```

```
    <div class="d-flex justify-content-center align-items-center chart">
      <canvas id="myChart" style="width:100%; max-width:70%"></canvas>
    </div>
  </section>


  <section>
    <div class="container">
      <div class="text-center">
        <h1>PREDICTION</h1>
      </div>
      <form action="predict" method="post">

        <div class="text-center pt-1">
          <input type="text" name="year" id = "year" placeholder="Enter the amount of days you
want to predict" class="col-8">
        </div>
        <div class="text-center p-3">
          <input type="submit" class="btn btn-primary">Submit</input>
        </div>
      </form>
    </div>
    <div class="container">
     <div class="text-center">
      <h1>
       {{showcase}}
      </h1>
     </div>
    </div>
```

```
    </section>
    <script>
//     var xValues = {{data_x |safe
|tojson}}; var yValues =
[73,74,73,74,75,76,75] var xValues =
[1,2,3,4,5,6,7]
// var yValues =
[10,20,30,40,50,60,70,80].reverse()
console.log(xValues) console.log(yValues)
new Chart("myChart", {
  type: "line",
  data: {
    labels: xValues,
    datasets: [{
      fill: false,
      lineTension: 0,
      backgroundColor: "rgba(0,0,255,1.0)",
      borderColor: "rgba(0,0,255,0.1)",
      data: yValues
    }]
  },
  options: {
    legend: {display: false},
    scales: {
      yAxes: [{
        ticks: {min: 70, max:100},
        scaleLabel: {
           display: true,
           labelString: 'Prices'
        }
```

```
    }],
     xAxes: [{
       ticks: {min: 1, max:7},
       scaleLabel: {
          display: true,
        labelString: 'Month'
       }
     }]
   }
 }
});
   </script>
</body>
</html>
```

Login.html :

```
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="UTF-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Document</title>
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css"
rel="stylesheet">
  <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.bundle.min.js"></script>
  <link rel="stylesheet" href="{{url_for('static', filename='style.css')}}">
```

```
</head>

<body>
  <div class="d-flex justify-content-center align-items-center form">
    <div class="bgimg d-flex justify-content-center">
      <img src="{{url_for('static', filename='Price Prediction.svg')}}" class=" col-6 img-fluid " alt="">
</div>
    <form class="col d-flex justify-content-center align-items-center col-sm-50 col-md-50 h-100"
action="login"
      method="POST">
      <div class="col-sm-8">
      <h1 class="d-flex justify-content-center">Sign in</h1>
       {%if error%}
       <span class="text-danger">Invalid username/password</span>
       {%endif%}
       <div class="form-group pt-3">
         <label for="exampleInputEmail1">Email address</label>
         <input type="text" class="form-control" id="exampleInputEmail1" name="username"
ariadescribedby="emailHelp"
           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 pt-3">
         <label for="exampleInputPassword1">Password</label>
         <input type="password" name="password" class="form-control"
id="exampleInputPassword1" placeholder="Password">
       </div>
       <div class="d-flex justify-content-end">
         <p><a href="#">Forgot Password?</a></p>
```

```
      </div>
      <div class="pt-3 d-flex justify-content-center">
        <input type="submit" class="btn btn-primary col-12"></input>
      </div>
      <div><small class="form-text text-muted d-flex justify-content-center pt-3">Don't have an
account? <a  href="register">Click here</a>&nbspto create one.</small>
      </div>
    </div>
  </form>
 </div>
</body>
</html>
```

Register.html :

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=\, initial-scale=1.0">
  <title>Document</title>
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css"
rel="stylesheet">
  <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.bundle.min.js"></script>
  <link rel="stylesheet" href="{{url_for('static', filename='style.css')}}">
</head>
<body>
  <div class="d-flex justify-content-center align-items-center form flex-wrap">
    <div class="bgimg d-flex justify-content-center ">
      <img src="{{url_for('static', filename='Login.jpg')}}" class="w-50 col-2 img" alt="">
    </div>
```

```
    <form class="col d-flex justify-content-center align-items-center container-sm h-100 "
action="register" method="POST">
        <div class="col-sm-8">
          <h1 class="d-flex justify-content-center">Register</h1>

          <div class="form-group pt-3">
            <label>Username</label>
            <input type="text" name = "username" class="form-control" placeholder="Enter
Username">
          </div>
          {%if error%}
          <span class = "text-danger">This user already exists</span>
          {%endif%}
          <div class="form-group pt-3 gap-2 d-flex">
            <div class="d-grid">
              <label>First Name</label>
              <input type="text" name = "firstname" class="form-control" placeholder="Enter First
Name">
            </div>
            <div class="d-grid">
              <label>Last Name</label>
              <input type="text" name="lastname" class="form-control" placeholder="Enter Last
Name">
            </div>
          </div>
          <div class="form-group pt-3">
            <label for="exampleInputEmail1">Email address</label>
            <input type="email" class="form-control" name = "email" id="exampleInputEmail1"
ariadescribedby="emailHelp" placeholder="Enter email">
            {%if email_error%}
```

```
                <span class = "text-danger">This email is already taken</span>
                {%else%}
                <small id="emailHelp" class="form-text text-muted">We'll never share your email with
anyone else.</small>
                {%endif%}
              </div>
               <div class="form-group pt-3">
                <label for="exampleInputPassword1">Password</label>
                <input type="password" class="form-control" name="password"
id="exampleInputPassword1" placeholder="Password">
               </div>
               <div class="pt-3 d-flex justify-content-center">
               <button type="submit" class="btn btn-primary col-12">Register</button>
               </div>
               <div>
                <small class="form-text text-muted d-flex justify-content-center pt-3">Already have
an account? <a href="login.html"> Login</a></small>
              </div>
            </div>
        </form>
    </div>
</body>
</html>
```

App.py:

```
from flask import Flask, render_template, request, redirect, url_for, session
import sqlite3
from flask_sqlalchemy import SQLAlchemy
import pickle import numpy as np import tensorflow as tf
import keras import pandas as pd from flask import json app
```

```
= Flask(__name__)
app.config['SQLALCHEMY_DATABASE_URI'] =
'sqlite:///test.db' db = SQLAlchemy(app)

db.init_app(app) data=pd.read_excel(r"/home/lichking/Projects/flask-
auth/Crude Oil Prices Daily.xlsx") data.dropna(axis=0,inplace=True)
data_oil=data.reset_index()['Closing Value'] data_y = data.reset_index()['Date']
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler(feature_range=(0,1))
data_oil=scaler.fit_transform(np.array(data_oil).reshape(-1,1))

app.secret_key='asdsdfsdfs13sdf_df%&'

class User(db.Model): id =
    db.Column(db.Integer, primary_key=True)
    username = db.Column(db.String(80),
    unique=True, nullable=False)
   email = db.Column(db.String(120), unique=True, nullable=False)
    password = db.Column(db.String(120), nullable=False)
    fullname = db.Column(db.String(120), nullable=False)
    def __repr__(self):
        return '<User %r>' % self.username

with app.app_context():
    db.create_all()

@app.route('/')
def home():
    return redirect(url_for('login'))
```

```
@app.route('/register',methods=['POST','GET'])
def register():
    if request.method == 'POST':
        username = request.form.get('username')
        email = request.form.get('email')
        password = request.form.get('password')
firstname = request.form.get('firstname')
        lastname = request.form.get('lastname')
        fullname = firstname + " " + lastname
        user =User.query.filter_by(username=username).first()
        if user:
            return render_template('register.html',error=True)
        user = User.query.filter_by(email=email).first()
        if user:
            return render_template('register.html',email_error=True)
        user = User(username=username, email=email, password=password, fullname=fullname)
        db.session.add(user)
        db.session.commit()
       return redirect(url_for('login'))
    return render_template('register.html')

@app.route('/login',methods=['POST','GET'])
def login():
    if request.method == 'POST':
        username = request.form.get('username')
        password = request.form.get('password')
        user = User.query.filter_by(username=username, password=password).first()
        if user is not None:
            session['username'] = username
            return redirect(url_for('index',id=user.id))
```

```
        else:
            return render_template('login.html',error = True)

    return render_template('login.html')

@app.route('/dashboard')
def index():
    user = session.get('username')
    data_y = scaler.inverse_transform(data_oil)
    print(data_y.reshape(1,8216).tolist())
    data_y = list(map(int, data_y.reshape(1,8216).tolist()[0]))
    return render_template('index.html',username=user, data_x = json.dumps([i*10 for i in
range(1,7)]), data_y = json.dumps(data_y[len(data_y)-6:]))

@app.route("/predict", methods=['POST'])
def predict():
    if request.method == 'POST':
        model = pickle.load(open(r'/home/lichking/Projects/flask-auth/model(1).pkl', 'rb'))
        int_features = [int(x) + 1 for x in range(int(request.form['year']))]
        final_features = [np.array(int_features).reshape(len(int_features),1)]
        prediction = scaler.inverse_transform(model.predict(final_features)).tolist()
       # for i in range(len(prediction)):
        #     prediction[i] = int(prediction[i][0])
       return render_template('index.html', showcase='The predicted prices are:
$ {}'.format(prediction))
    return
render_template('index.html') if
__name__ == '__main__':
    app.run(debug=True)
```

13.2 GitHub & Project Demo Link

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-49651-1660832240

Project Demo Link:

https://drive.google.com/file/d/1Bszdg5EY-5nOu3WHNo-KuS-rzFii9B-j/view?usp=drivesdk