DEVELOPING A FLIGHT DELAY PREDICTION MODEL USING MACHINE LEARNING

PROJECT REPORT

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1. INTRODUCTION:

One of the Key business issues that airlines face is that the vital prices that are related to flight being delayed because of natural occurrences and operational shortcomings that is an upscale affair for the airlines, making issues in scheduling and operations for the end-users therefore inflicting unhealthy name and client discontent. As we all know that we have a tendency to not get the flight delay before departure as customers of the Airline Company neither the airline company's ground staff gets the airline. Delay prediction supported varied conditions.

1.1 Project Overview：

Over the last twenty years, air travel been increasingly preferred among travelers, mainly that because of its speed and in some cases comfort. This has led to phenomenal growth in air traffic and on the ground. An increase in air traffic growth has also resulted in massive levels of aircraft delays on the ground and in the air. These delays are responsible for large economic and environmental losses. The main objective of the model is to predict flight delays accurately in order to optimize flight operations and minimize delays.

1.6 Purpose:

Using a machine learning model, we can predict flight arrival delays. The input to our algorithm is rows of feature vector like departure date, departure delay, distance between the two airports, scheduled arrival time etc. We then use decision tree classifier to predict if the flight arrival will be delayed or not. A flight is considered to be delayed when difference between scheduled and actual arrival times is greater than 15 minutes. Furthermore, we compare decision tree classifier with logistic regression and a simple neural network for various figures of merit.

2. LITERATURE SURVEY

2.1 Existing Problem:

An accurate estimation of flight delay is critical for airlines because the results can be applied to increase customer satisfaction and incomes of airlines agencies .There have been many researches on modeling and predicting flight delays , where most of them have been trying to predict the delay through extracting important characteristics and most related features .However , most of the proposed methods are not accurate enough because of massive volume data , dependencies and extreme number of parameters .

2.2 References:

1. REBOLLO JJ, BALA KRISHNAN H. Characterization and prediction of air traffic delays. Transportation Res Part C Emery Technol. 2014; 44:231-41.

2. THIAGARAJAN B, et al. A machine learning approach for prediction of on-time performance of flights. In 2017 IEEE/AIAA 36th Digital Avionics Systems Conference .(DASC). New York: IEEE. 2017.

3. REYNOLDS-FEIGHAN AJ, Button K. An assessment of the capacity and congestion levels at European airports. J Air Transport Manager. 1999; 5(3):113-34.

4. Hunter G, BOISVORT B, RAMAMOORTHY K. Advanced national airspace traffic flow management simulation experiments and venation. In 2007 Winter Simulation Conference. New York: IEEE. 2007.

5. AHMAD BEYGI S, et al. Analysis of the potential for delay propagation in passenger airline networks. J Air Transport Manager. 2008; 14(5):221-36.

2.3 Problem Statement Definition :

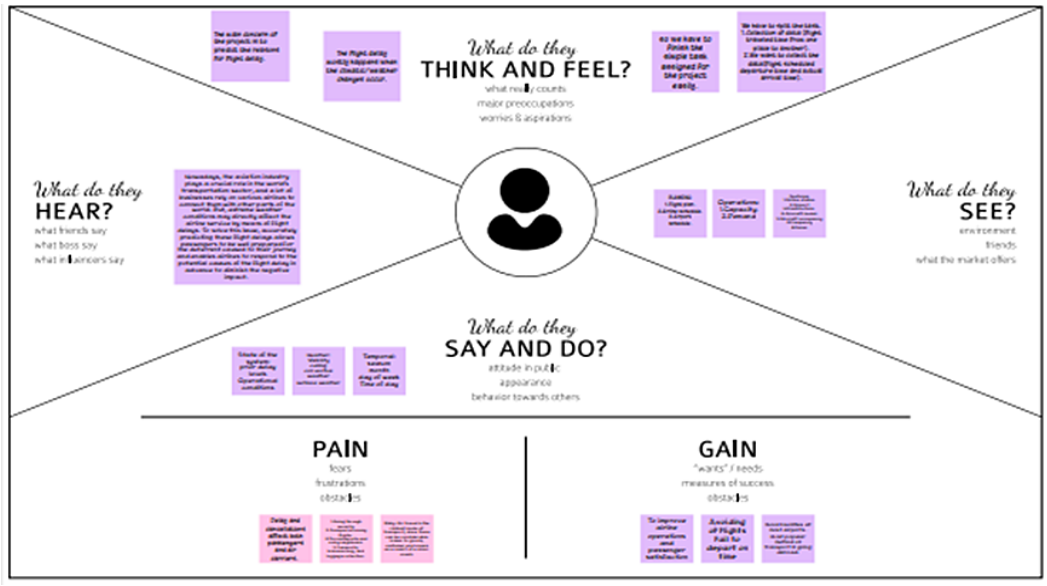
Reference: https://miro.com

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	customer	Solve the problem faced by the common peoples	The flight delay is happening frequently	The main reason is weather and airways traffic	More frustration

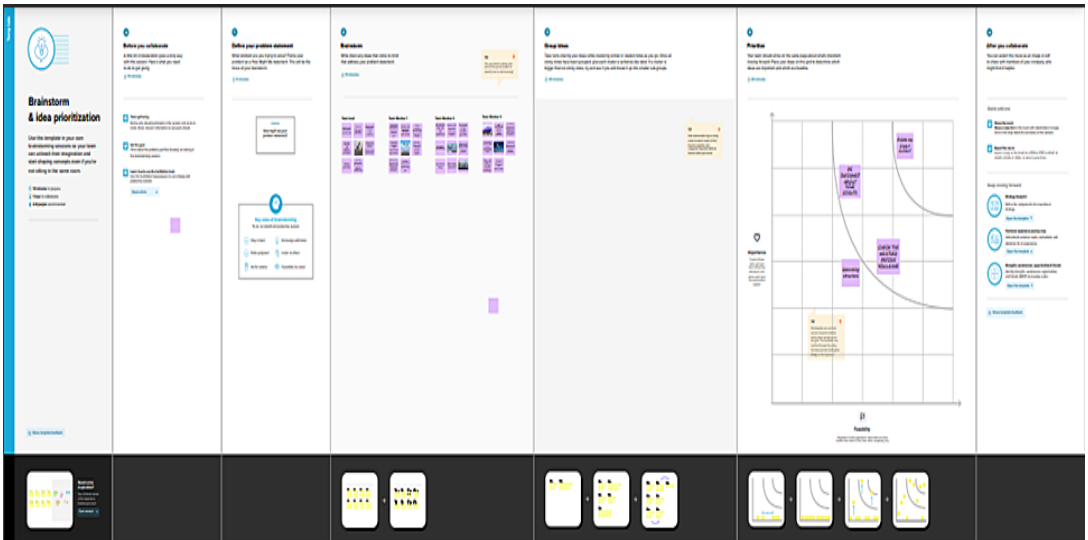
PS-2	Working in airport	Avoid the effects and causes of many negative problems faced by the passengers	We can't able to solve the passenger inconvenience happening between the passengers and the airlines	The weather as changing frequently and the airways traffic	More frustration

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:



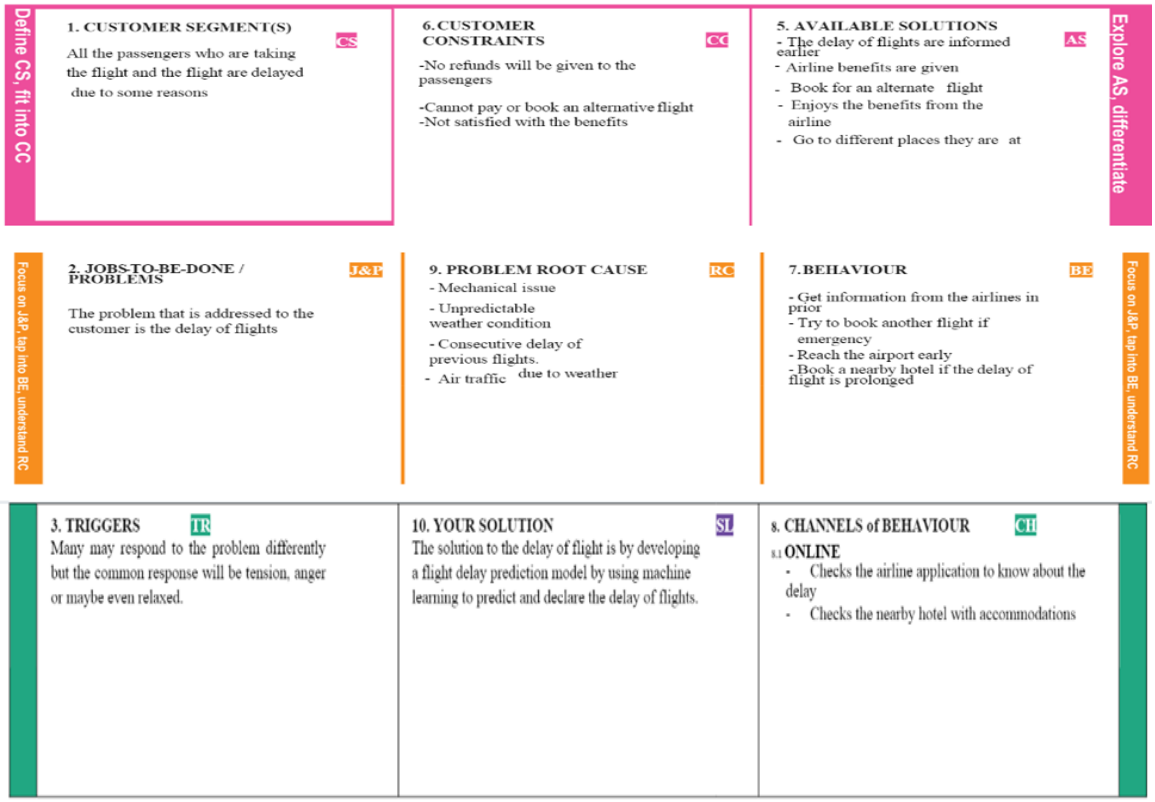
3.2 Ideation & Brainstorming:



3.3 Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The flight delay prediction can be solved by using the techniques machine learning
2.	Idea / Solution description	Can be solved flight delay prediction by using machine learning,probabilitic models and statistical analysis.
3.	Novelty / Uniqueness	The uniqueness in this project is time tracking the fight delay
4.	Social Impact / Customer Satisfaction	Cause a decrease in efficiency,an increase capital costs reallocation of flight crews and aircraft,and additional crews expenses.
5.	Business Model (Revenue Model)	The main goal of this work is to implement a predictor of the arrival delay.Flight delays are frequent all over the world and they are estimated to have an annual cost billans of dollars.
6.	Scalability of the Solution	An aspects or rather a functional quality of a system , software in flight delay prediction.

3.4 Problem Solution Fit:



4. REQUIREMENT ANALYSIS

4.1 Functional Requirements:

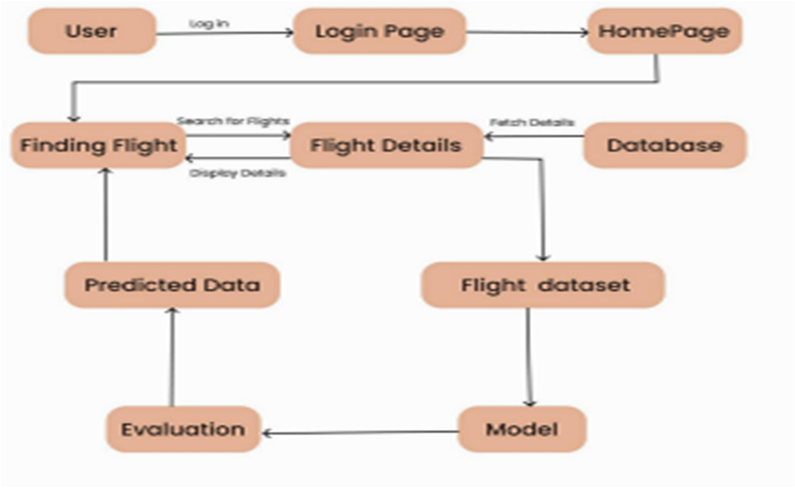
FR.NO	FUNCTIONAL REQUIREMENTS	SUB REQUIREMENTS
FR-1	User Registrations	Registration through Gmail
FR-2	User Confirmation	Confirmation through Gmail
FR-3	User Login	Login through credentials
FR-4	Authorizations	Accepting terms and conditions
FR-5	Flight Data	Enter Flight Details
FR-6	Prediction	Predict through Models
FR-7	End process	Log Out

4.2 Non –Functional Requirements:

NFR.NO	NON-FUNCTIONAL REQUIREMENTS	DESCRIPTIONS
NFR-1	Usability	Effectiveness, efficiency, and overall satisfaction of the user while interacting with the application.
NFR-2	Security	Authentication and encryption of the application.
NFR-3	Reliability	Probability of failure-free operations in a specified environment for a specified time.
NFR-4	Performance	How the application is functioning and how responsive the application is to the end-users.
NFR-5	Availability	In spite of the lack of an active internet connection all features of the application are accessible. Synchronization of data cannot be done.
NFR-6	Availability	The capacity of the application to handle growth, especially in handling more users.

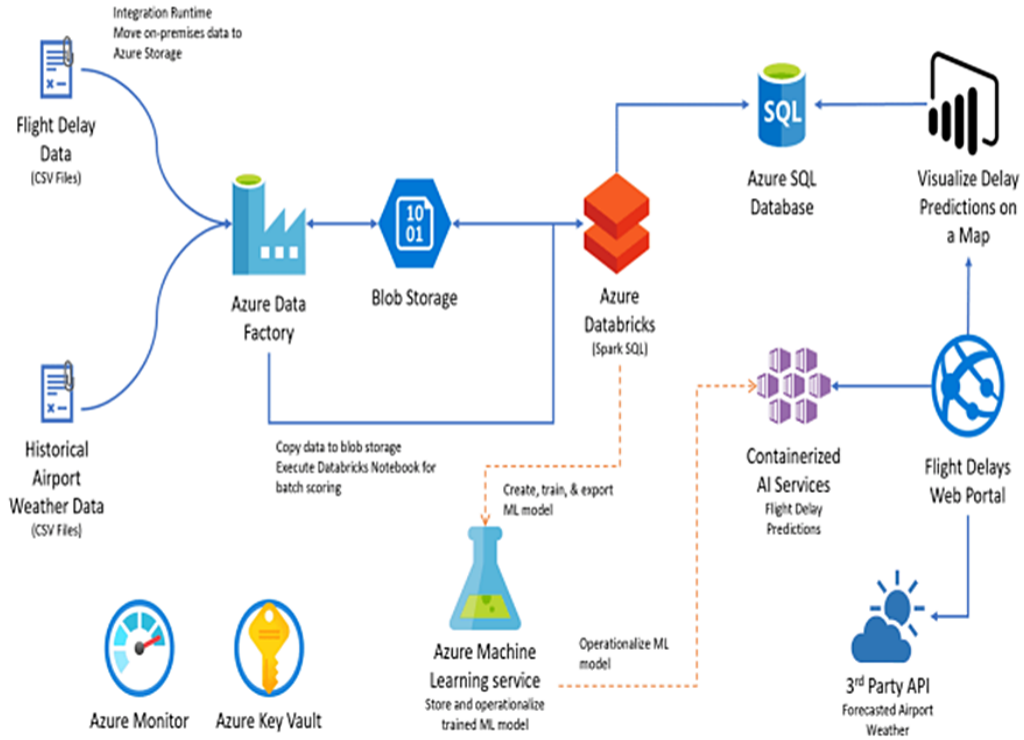
5. PROJECT DESIGN

5.1 Data Flow Diagram:

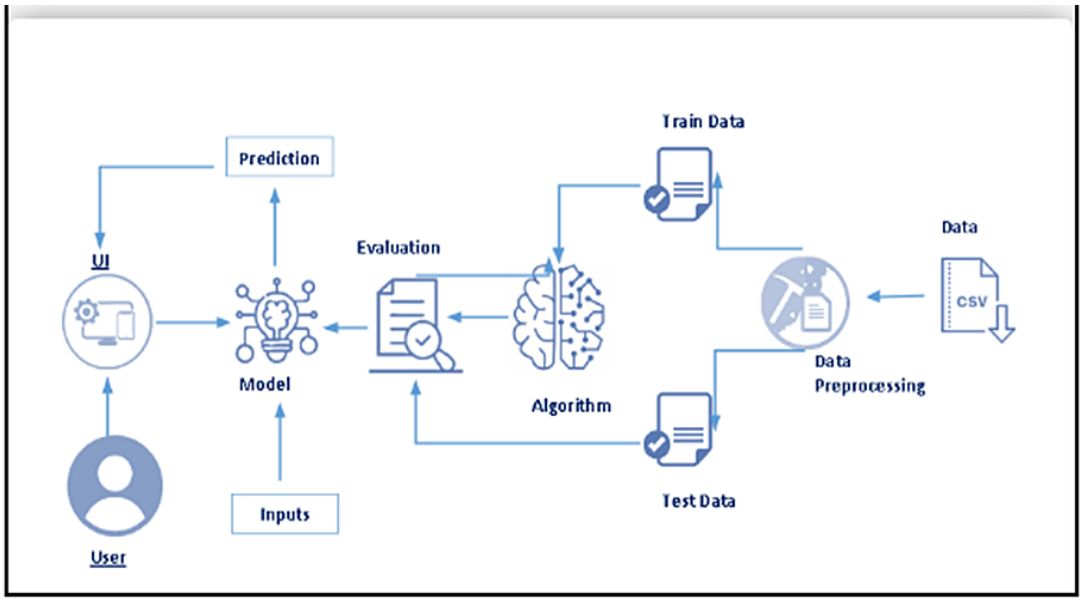


5.2 Solution & Technical Architecture:

Solution Architecture:



Technical Architecture:



5.3 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 account/ dashboard	High	Sprint-1
	Login	USN-2	As a user, I can log into the application by entering email & password	I can access the Features by Login	High	Sprint-1
	Dashboard	USN-3	As a user, I can navigate through different pages using the dashboard	I can access various pages	High	Sprint-1
	Search	USN-4	As a user, I can search for flights for different locations	I can receive information on different flights for various locations	High	Sprint-2
	View	USN-5	As a user, I can view the details of flights	I will get the information such as flight no, departure and arrival time, etc...	High	Sprint-2
	Receive notifications	USN-6	As a user, I will receive notifications about the flight	I will get frequent updates of the flight's location	Low	Sprint-3
	Track	USN-7	As a user, I can track the location of my flight	I can track my flight	Medium	Sprint-3,4
Admin	GPS	USN-8	As an admin, I will need the location of flights	I can track my flight	High	Sprint-3,4
	Analyze	USN-9	As an admin, I will analyze the given dataset	I can analyze the dataset	High	Sprint-2
	Predict	USN-10	As an admin, I will predict the delays	I can predict the flight delays	High	Sprint-2

6. PROJECT PLANNING AND SCHEDULING

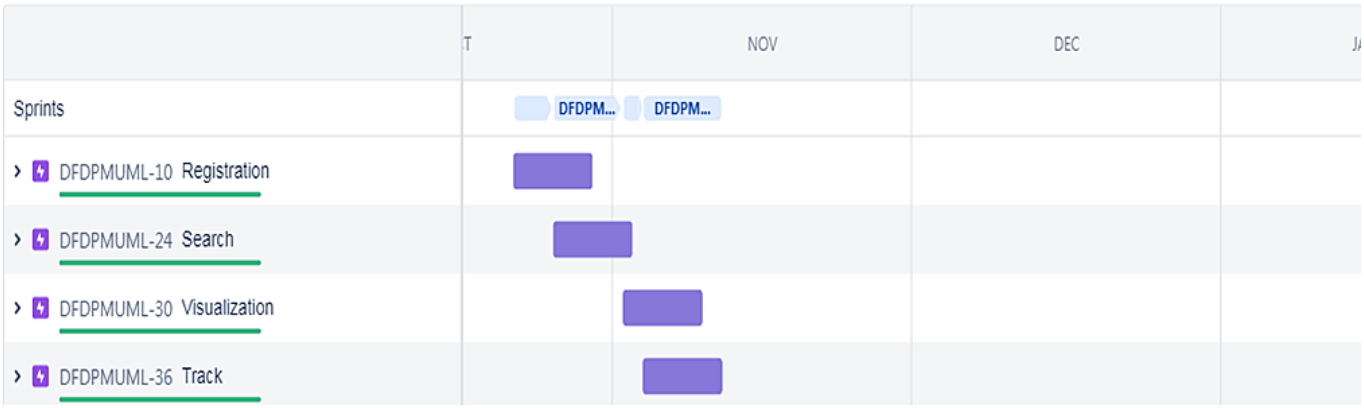
6.1 Sprint planning and Estimation:

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.	3	High	Elavarasi S
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Margeret Cecilia Sharon J
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	Vanmughil K
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Daniel F
Sprint-1	Profile Page	USN-6	As a user, I can view my profile	1	High	Margeret Cecilia Sharon J
Sprint-2		USN-3	As a user, I can register for the application through Facebook, Instagram, other social media	2	Low	Elavarasi S
Sprint-2	Search	USN-7	As a user, I can search for flights for different locations	2	High	Daniel F
Sprint-2	View	USN-8	As a user, I can view the details of flights	1	High	Vanmughil K
Sprint-2	Analyse	USN-12	As an admin, I will analyse the given dataset	5	High	Margeret Cecilia Sharon J
Sprint-2	Predict	USN-13	As an admin, I will predict the delays	8	High	Elavarasi S

6.2 Sprint Delivery Schedule:

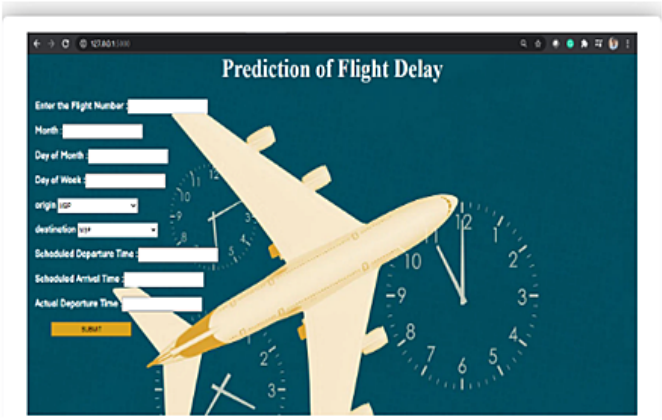
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-3	Visualisation		Visualize the predicted data	5	High	Daniel F
Sprint-3, 4	Receive notifications	USN-9	As a user, I will receive notifications about the flights	3	Low	Vanmughil K
Sprint-3, 4			Backend for notifications	5	Low	Elavarasi S
Sprint- 3, 4	Track	USN-10	As a user, I can track the location of my flight	3	Medium	Margeret Cecilia Sharon J
Spint-3, 4	GPS	USN-11	As an admin, I will need the location of flights	3	High	Vanmughil K

6.3 Report from Jira:



7. CODING & SOLUTIONING

7.1 Feature 1:



. The prediction page user gives the input for predicting the output where they can give input as Flight Number, Month, Day Of Month ,Week, Origin, Destination, Schedule Departure Time, Schedule Arrival Time, Actual Departure Time then click to submit the output

7.2 Feature 2:

- In the prediction page user will get the output based on the inputs they given in the prediction page.

8. TESTING

8.1 Test Cases:

			Project - Developing a Flight Delay Prediction Model using Machine l					
		Maximum Marks	4 marks					
Component	**Test Scenario**	**Pre-Requisite**	**Steps To Execute**	**Test Data**	**Expected Result**	**Actual Result**	**Status**	**Commnets**
Home Page	Verify user is able to see the Prediction input page when user clicked on URL	Any Latest Browser	1.Enter URL and click go 2.Verify Prediction input displayed or not	Flask App	Prediction input page should display	Working as expected	Pass	
Home Page	Verify the UI elements in Prediction page	Any Latest Browser	1.Enter URL and click go 2.Verify Prediction page with below UI elements: a.Flight number b.Date c.Origin and Destination dropdown d.Flight Timings e.Prediction button	Flask App	Application should show below UI elements: a.Flight Number b.Date c.Origin and Destination dropdown d.Flight Timings e.Prediction button	Working as expected	Pass	
Home page	Verify user is able to predict the flight with the proper details	Any Latest Browser	1.Enter URL and click go 2.Enter valid flight number 3.Enter Valid date 4.Enter valid origin and destination 5.Enter valid flight timings 6.Click predict	Flight Number: 23587 Month: 12 Day: 12 Origin: ALT Destination: SEA Scheduled Dept Time: 1215	User should navigate to result page and input details are recieved properly	Working as expected	Pass	
Home Page	Verify user is able to log into application with Invalid input	Any Latest Browser	1.Enter URL and click go 2.Enter valid flight number 3.Enter Valid date 4.Enter valid origin and destination 5.Enter valid flight timings 6.Click predict	Flight Number: 23587 Month: 12 Day: 12 Origin: ALT Destination: ALT Scheduled Dept Time: 1215	Application should show 'origin and destination airport cant be same airport ' validation message.	Working as expected	Fail	The origin airport and the destination airport cannot be the same
Home Page	Verify user is able to log into application with Invalid input	Any Latest Browser	1.Enter URL and click go 2.Enter valid flight number 3.Enter Valid date 4.Enter valid origin and destination 5.Enter valid flight timings 6.Click predict	Flight Number: 23587 Month: 14 Day: 12 Origin: ALT Destination: SEA Scheduled Dept Time: 1215	Application should show 'month value cant be more than 12 ' validation message.	Working as expected	Fail	The month value can't be more than 12
			1.Enter URL and click go 2.Enter the correct input values	Flight Number: 23587 Month: 12 Day: 12	Application should show	Working		

8.2 User Acceptance Testing:

2. 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	5	3	1	16
Duplicate	0	0	0	0	0
External	5	0	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	0	1	1
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	23	7	7	23	60

3. Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
Model Evaluation	10	0	0	10
Client Application	20	0	0	20
Exception Reporting	5	0	0	5
Final Report Output	2	0	0	2

9. RESULT

9.1 Performance Metrics:

Import Required Libraries

```
import sys
import numpy as np #Linear Algebra
import pandas as pd #Data Processing
import seaborn as sns #Data Visualizaton
import pickle
%matplotlib inline
from sklearn.preprocessing import LabelEncoder #LabelEncoding From Sklearn
from sklearn.preprocessing import OneHotEncoder #One-Hot Encoding From Sklearn
from sklearn.model_selection import train_test_split #Split Data in Train & Test Array
from sklearn.preprocessing import StandardScaler
from sklearn.tree import DecisionTreeClassifier #ML Algorithm
from sklearn.metrics import accuracy_score #Calculate Accuracy Score
import sklearn.metrics as metrics #Confusion Matrix
```

Importing the Dataset

Dataset

```
dataset= pd.read_csv("flightdata.csv")
```

Output:

```
df.head()
```

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings
0	M	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	15
1	M	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	7
2	F	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	9
3	M	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	10
4	I	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	7

Analyze the Data

```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 11231 entries, 0 to 11230
Data columns (total 26 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   YEAR                 11231 non-null  int64
 1   QUARTER              11231 non-null  int64
 2   MONTH                11231 non-null  int64
 3   DAY_OF_MONTH         11231 non-null  int64
 4   DAY_OF_WEEK          11231 non-null  int64
 5   UNIQUE_CARRIER       11231 non-null  object
 6   TAIL_NUM             11231 non-null  object
 7   FL_NUM               11231 non-null  int64
 8   ORIGIN_AIRPORT_ID    11231 non-null  int64
 9   ORIGIN               11231 non-null  object
 10  DEST_AIRPORT_ID      11231 non-null  int64
 11  DEST                 11231 non-null  object
 12  CRS_DEP_TIME         11231 non-null  int64
 13  DEP_TIME             11124 non-null  float64
 14  DEP_DELAY            11124 non-null  float64
 15  DEP_DEL15            11124 non-null  float64
 16  CRS_ARR_TIME         11231 non-null  int64
 17  ARR_TIME             11116 non-null  float64
 18  ARR_DELAY            11043 non-null  float64
 19  ARR_DEL15            11043 non-null  float64
 20  CANCELLED            11231 non-null  float64
 21  DIVERTED             11231 non-null  float64
 22  CRS_ELAPSED_TIME     11231 non-null  float64
 23  ACTUAL_ELAPSED_TIME  11043 non-null  float64
 24  DISTANCE             11231 non-null  float64
 25  Unnamed: 25          0 non-null      float64
dtypes: float64(12), int64(10), object(4)
memory usage: 2.2+ MB
```

Handling Missing Values

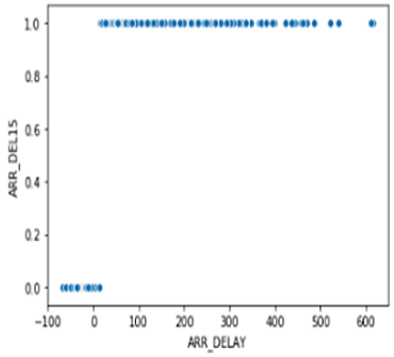
```
dataset.isnull().sum()
```

```
YEAR                    0
QUARTER                 0
MONTH                   0
DAY_OF_MONTH            0
DAY_OF_WEEK             0
UNIQUE_CARRIER          0
TAIL_NUM                0
FL_NUM                  0
ORIGIN_AIRPORT_ID       0
ORIGIN                  0
DEST_AIRPORT_ID         0
DEST                    0
CRS_DEP_TIME            0
DEP_TIME              107
DEP_DELAY             107
DEP_DEL15             107
CRS_ARR_TIME            0
ARR_TIME              115
ARR_DELAY             188
ARR_DEL15             188
CANCELLED               0
DIVERTED                0
CRS_ELAPSED_TIME        0
ACTUAL_ELAPSED_TIME   188
DISTANCE                0
Unnamed: 25         11231
dtype: int64
```

Data Visualization

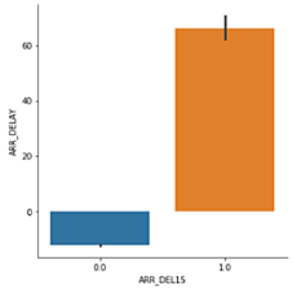
```
sns.scatterplot(x='ARR_DELAY',y='ARR_DEL15',data=flight_data)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x2857c574208>
```



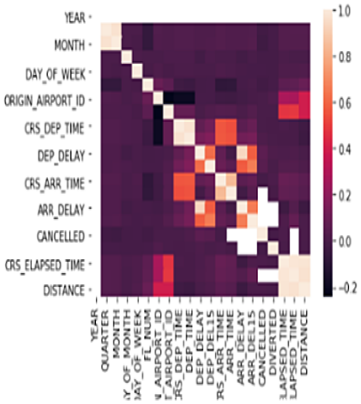

```
sns.catplot(x="ARR_DEL15",y="ARR_DELAY",kind='bar',data=flight_data)
```

```
<seaborn.axisgrid.FacetGrid at 0x2857c493a88>
```




```
sns.heatmap(dataset.corr())
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x2857a89a7c8>
```



10. ADVANTAGES:

1. There are no federal laws requiring airlines to provide passengers with money or other compensation.
2. Each airline has its own policies about what it will do for delay passengers.
3. If your flight is expiring a long delay , ask airline staffs if they will pay for meals or a hotel room.

DISADVANTAGES:

1. Delays are also been shown to affect airlines revenues and costs through increase fuel.
2. Staffing .
3. Maintenance.
4. Potential rebooking cost.

11. CONCLUSION:

This project aims to predict the flight's delay along with the estimation of delay time in minutes using machine learning algorithms namely Decision Tree Algorithm (XG Boost) and Linear regression. Data set of both flights and weather will be taken to compare with the given inputs and validate them by applying classification and Regression concepts of Machine Learning. Also having done feature extraction, handling missing values using appropriate methods, sampling to handle imbalanced data and also tuning the hyper parameters with which better accuracy was able to be achieved.

12. FUTURE SCOPE:

Further supportive study is required to correlate all the Problem, scope and method for getting most accurate result. Although weather conditions are the major reasons for flight delay, other unprecedented events such as major calamities, natural or man-made can cause major delay in flight.

13. APPENDIX:

Source Code

HTML CODE

Home HTML Code:

```
<!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>Home</title>
  <link rel="stylesheet" href="./css/home.css" />
 </head>
 <body>
  <div id="heading">
   <h1>Developing A Flight Delay Prediction Model Using Machine Learning</h1>
   <h2>Team Id : PNT2022TMID36161</h2>
  </div>
  <div class="container">
   <form action="/predict" method="post" >

    <label>Enter the flight number:</label>
    <input type="text" id="flightnumber" name = "flightNumber" style="margin-left: 118px" />
    <br />

    <span>Enter the date:</span>
    <input type="date" id="date" name ="date" style="margin-left: 185px" />
    <br />
```

```
      <span>Enter the Origin:</span>
      <input type="text" id="origin" name ="origin" style="margin-left: 169px" />
      <br />

      <span>Enter the destination:</span>
      <input type="text" id="destination" name ="destination" style="margin-left: 136px" />
      <br />

      <span style="margin-right: 145px">Departure delay:</span>
      <input type="radio" id="y_delay" name ="deptDelay" value="yes" style="margin-left: 23px"
onclick="y_check()"/>
      <span>yes</span>
      <input type="radio" id="n_delay" value="no" style="margin-left: 23px" onclick="n_check()" />
      <span>no</span>
      <br />
      <span>Enter the Scheduled Arrival time:</span>
      <input type="time" id="s_arr_time" name = "scheduledArrivalTime"style="margin-left: 50px" />
      <br />

      <input type="submit" value="submit" style="margin-left: 250px" class="submit-btn"/>
    </form>
    <br>

  </div>
 </body>
 <script>
  const y_delay = document.getElementById("y_delay");
  const n_delay = document.getElementById("n_delay");
```

```
  function y_check() {
    if (y_delay.checked) {
      n_delay.checked = false;
    }
  }
  function n_check() {
    if (n_delay.checked) {
      y_delay.checked = false;
    }
  }
 </script>
</html>
```

Submit HTML Code:

```
<!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>Submit</title>
  <link rel="stylesheet" href="./css/submit.css" />
 </head>
 <body>
  <div id="heading">
    <h1>Developing A Flight Delay Prediction Model Using Machine Learning</h1></br></br>
    <h2>Team Id : PNT2022TMID36161</h2></br></br>
    <h2>Team Leader : ELAVARASI S </br></br>
```

```
        Team member : MARGERET CECLIA SHARON J</br></br>
        Team member : VANMUGHIL K</br></br>
        Team member : DANIEL F </br></br>
      </h2></br></br></br>
      <h1>     <label >{{result}}</label></h1>
   </div>
</html>
```

Python Code(app.py)

```
from flask import Flask , request , render_template , flash
import numpy as np
import os
import pandas as pd
from gevent.pywsgi  import WSGIServer
import utils

app= Flask(__name__, template_folder='templates', static_folder='static/css')
app.config.update(SECRET_KEY=os.urandom(24))



@app.route('/predict' , methods=['GET', 'POST'])
def predict():
   result = ""
   err = 0
   flightNumber = request.form.get("flightNumber")
   availableFlightNumbers = utils.getFlightNumbers()
   if int(flightNumber) not in availableFlightNumbers:
      err = 1
```

```
    return render_template('home.html', result = "Invalid Flight Number")
date = request.form.get("date")
formattedArray = utils.convertDateToFormat(date)
month = formattedArray[0]
dayOfMonth = formattedArray[1]
dayOfWeek = formattedArray[2]
origin = request.form.get("origin")
if (origin == "ATL"):
    origin = 0
elif (origin == "DTW"):
    origin = 1
elif (origin == "JFK"):
    origin = 2
elif (origin == "MSP"):
    origin = 3
elif (origin == "SEA"):
    origin = 4
else:
    origin = 5
if origin > 4 :
    err = 1
    return render_template('home.html', result = "Please enter a valid origin airport")
dest = request.form.get("destination")

if (dest == "ATL"):
    dest = 0
elif (dest == "DTW"):
    dest = 1
elif (dest == "JFK"):
```

```
        dest = 2
    elif (dest == "MSP"):
        dest = 3
    elif (dest == "SEA"):
        dest = 4
    else :
        dest = 5
    if dest > 4 :
        err = 1
        return render_template("home.html", result = "Please select a valid destination airport")
    depDelay = request.form.get("depDelay")
    if (depDelay == "yes"):
        depDelay = 1
    else:
        depDelay = 0
    scheduledArrivalTime = request.form.get("scheduledArrivalTime")
    scheduledArrivalTime = int(str(scheduledArrivalTime).split(":")[0])

    #Load the model
    print(flightNumber , month , dayOfMonth , dayOfWeek , origin , dest, scheduledArrivalTime, depDelay)
    if err == 0:
        result = utils.get_prediction(flightNumber , month , dayOfMonth , dayOfWeek , origin , dest,
scheduledArrivalTime, depDelay)
        if (int(result) == 0):
            print("The Flight will be on time")
            msg = "The Flight will be on time"
        elif (int(result) == 1):
            print("The Flight will be delayed")
            msg = "The Flight will be delayed"
        return render_template('submit.html' , result = msg)
```

```
@app.route('/', methods=['POST' , 'GET'])
def home():
return render_template('home.html')

# predict()
if (__name__ == '__main__'):
app.run( debug = True , port = 5000)
```

Utils.py

```
from datetime import datetime
import requests
import pandas as pd
def convertDateToFormat(date):
date = datetime.strptime(date, '%Y-%m-%d')
dayofWeek = date.weekday()
month=date.month
dayOfMonth=date.day
return [month, dayOfMonth, dayofWeek]
def getFlightNumbers():
df = pd.read_csv("flightdata.csv")
flightNumbers = df['FL_NUM'].unique()
return flightNumbers
def get_prediction(flightNumber = 39, month =12 , dayofMonth = 9, dayofWeek = 5 , origin = 1 , dest = 3,
scheduledArrivalTime = 12, depDelay = 0 ):
values = [[flightNumber, month, dayofMonth, dayofWeek, origin, dest, scheduledArrivalTime, depDelay]]

# NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud account.
```

```
API_KEY = "kr_VNpRFqz0Mte9mcgQLk25-SFN2SevdqscISORzvMzj"

token_response = requests.post('https://iam.cloud.ibm.com/identity/token', data={"apikey":API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})

mltoken = token_response.json()["access_token"]


header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}


# NOTE: manually define and pass the array(s) of values to be scored in the next line

payload_scoring = {"input_data": [{"field": ["FL_NUM","MONTH","DAY_OF_MONTH","DAY_OF_WEEK","ORIGIN","DEST","CRS_ARR_TIME","DEP_DEL15","ARR_DEL15"], "values": values}]}


response_scoring = requests.post('https://us-south.ml.cloud.ibm.com/ml/v4/deployments/d68c1881-d3af-408c-a068-e97db487099a/predictions?version=2022-11-04', json=payload_scoring,

headers={'Authorization': 'Bearer ' + mltoken})

predictionResult = response_scoring.json()

print(predictionResult)

result = predictionResult["predictions"][0]["values"][0][0]

return result

getFlightNumbers()
```

DEMO VIDEO LINK:

https://github.com/IBM-EPBL/IBM-Project-39788-1660536135/blob/main/FINAL%20DELIVARABLES/PROJECT%20DEMO/PROJECT%20DEMO%20LINK.mp4