DEVELOPING A FLIGHT DELAY PREDICTION MODEL USING MACHINE LEARNING

A Project report submitted in partial fulfilment of 7th semester in degree of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

Submitted By

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CONTENTS 1. **INTRODUCTION**

CHAPTER 1

INTRODUCTION

Travelers have begun to favor air travel more and more over the past 20 years, primarily due to its quickness and occasional comfort. Both on the ground and in the air, as a result, have experienced amazing growth. Massive amounts of ground and airborne aircraft delays have also been brought on by an increase in air traffic. Large economic and environmental losses are the result of these delays. The model's primary goal is to correctly forecast flight delays in order to improve aircraft operations and reduce delays.

1.1. PROJECT OVERVIEW

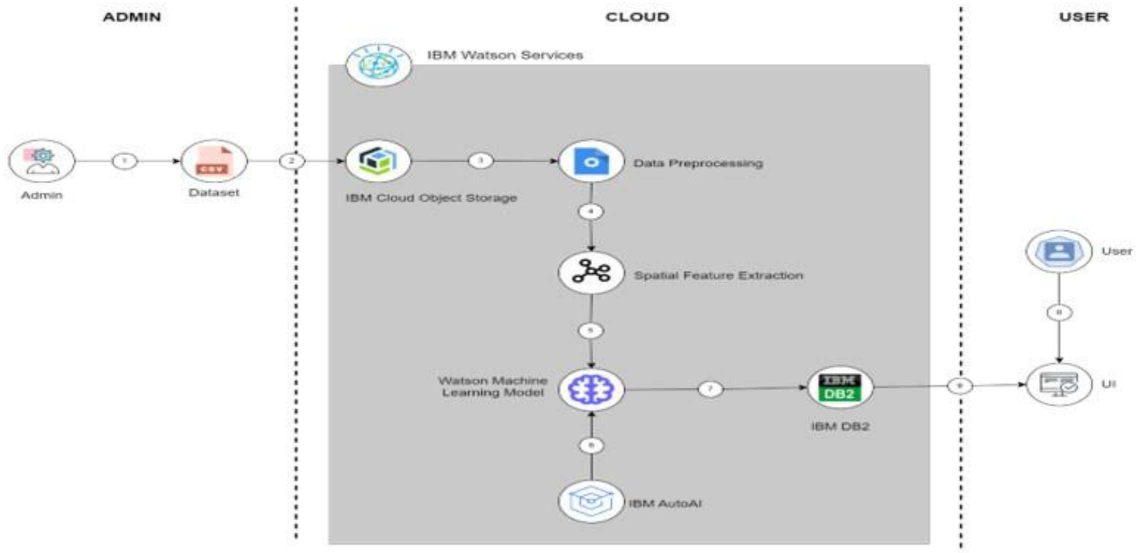


Figure 1.1. Technical Architecture

Flight arrival delays can be predicted using a machine learning algorithm. Rows of feature vectors, such as departure date, delay, travel time between the two airports, and scheduled arrival time, provide the input to our algorithm. The decision tree classifier is then used to determine whether or not the flight arrival will be delayed. When there is more than a 15-minute gap between the scheduled and actual arrival timings, a flight is deemed to be delayed. For various figures of merit, we contrast the decision tree classifier with logistic regression and a straightforward neural network.

1.2. PURPOSE

The main goal of this project is to predict the flight delay using machine learning algorithms. Flight planning is one of the difficulties in the industrial environment because there are many unpredictabilities. One such condition is the incidence of delays, which can result from a variety of causes and impose significant expenses on airlines, operators, and passengers. Delays in departure can be brought on by inclement weather, seasonal and holiday demands, airline policies, technical issues with airport infrastructure, baggage handling, and mechanical equipment, and a buildup of delays from earlier flights. Hence Predicting flight delays can improve airline operations and passenger satisfaction, which will result in a positive impact on the economy.

CHAPTER 2

LITERATURE SURVEY

1. Flight Delay Prediction System - Yogita Borse , Dhruvin Jain , Shreyash Sharma , Viral Vora, Aakash Zaveri (2020)

Statistical analysis

Statistical model requires the use of correlation analysis, parametric and non parametric tests, multivariate analysis and econometric models. Government agencies have invested in these econometric models to understand the relationship between delay and Passenger demand, fare, size of aircraft etc

Probabilistic models

Probabilistic model requires analysis tools that estimates the probability of an event based on the historic data. The estimated outcome is given in form of a distribution function of the probability. The factor of randomness always makes an impact on the decision or the outcome produced by the probabilistic model.

2.A deep learning approach to flight delay prediction - Young Jin Kim; Sun Choi; Simon Briceno; Dimitri Mavris(2016)

Deep learning has achieved significant improvement in various machine learning tasks including image recognition, speech recognition, machine translation and etc. Inspired by the huge success of the paradigm, there have been lots of tries to apply deep learning algorithms to data analytics problems with big data including traffic flow prediction. However, there has been no attempt to apply the deep learning algorithms to the analysis of air traffic data. This paper investigates the effectiveness of the deep learning models in the air traffic delay prediction tasks. By combining multiple models based on the deep learning paradigm, an accurate and robust prediction model has been built which enables an elaborate analysis of the patterns in air traffic delays. In particular, Recurrent Neural Networks (RNN) has shown its great accuracy in modeling sequential data. Day-to- day sequences of the departure and arrival flight delays of an individual airport have been modeled by the Long ShortTerm Memory RNN architecture. It has been shown that the accuracy of RNN improves with deeper architectures. In this study, four different ways of building deep RNN architecture are also discussed. Finally, the accuracy of the proposed prediction model was measured, analyzed and compared with previous prediction methods. It shows best accuracy compared with all other methods.

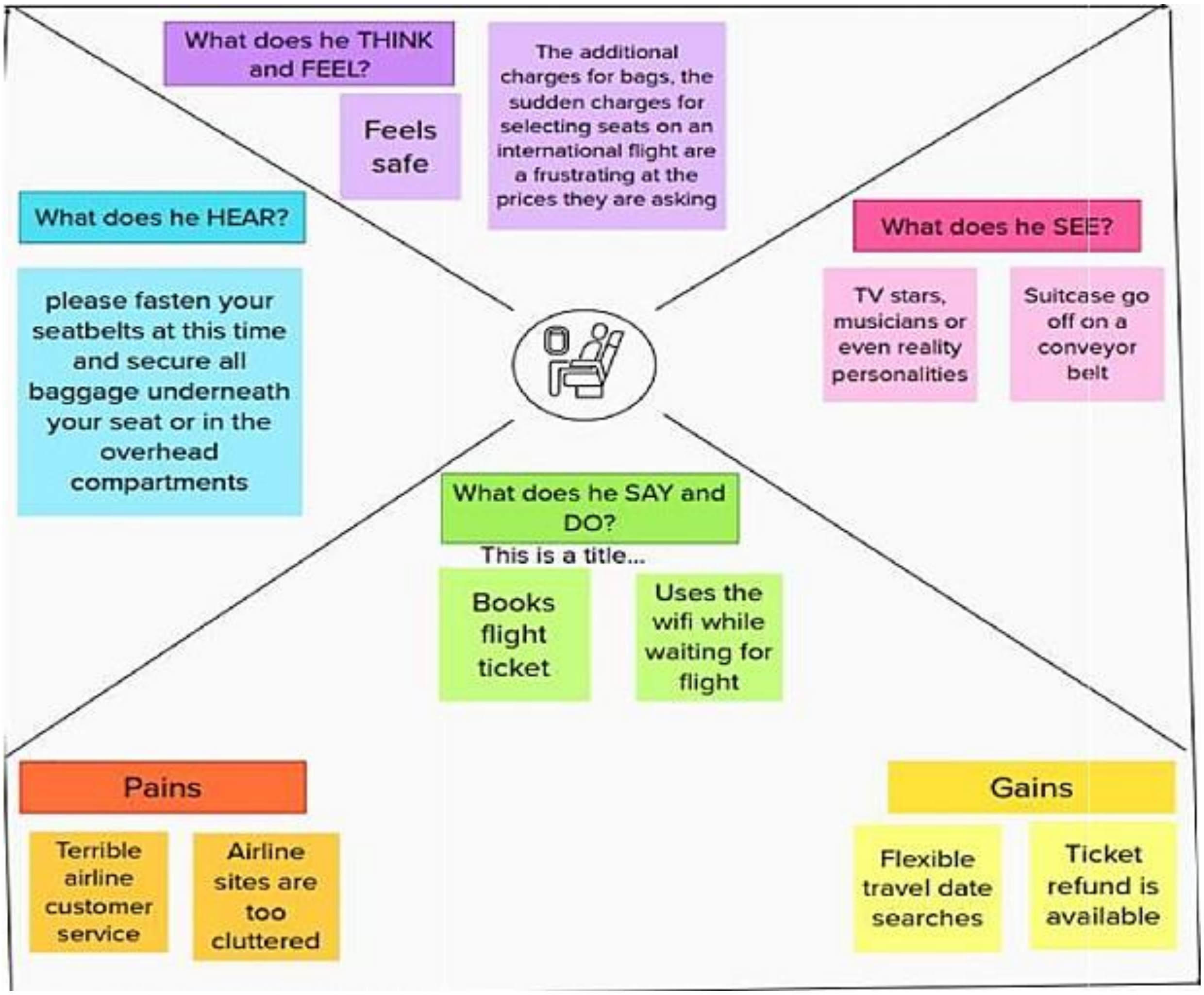
3.Research on Flight Delay Prediction Based on Random Forest - Peng Hu; Jianping Zhang; Ning Li(2021)

Based on the random forest model, this paper proposes a flight delay prediction model. By analyzing the departure flight data of Guangzhou Baiyun

International Airport in June 2020, and selecting the data of ten landing airports, it analyzes the distribution of delayed, punctual, and early arrived. It studies the selection of features that impact on flight delays, and establishes random forest predictions model. Through case study, it researches the mean square error of different leaf sizes when the forest scale is 50 trees. The results show that the optimal leaf size is 5, and the minimum mean square error is 0.1096. And it analyzes the importance of features such as departure flight delay time, scheduled flight time, number of scheduled departure flights on the day, date, and landing airport. The research results also found that, when the forest size is 100 trees and the leaf size is 5, the out-of-bag mean square error is 0.1090, and the accuracy of the prediction model is high, which is close to 90%.

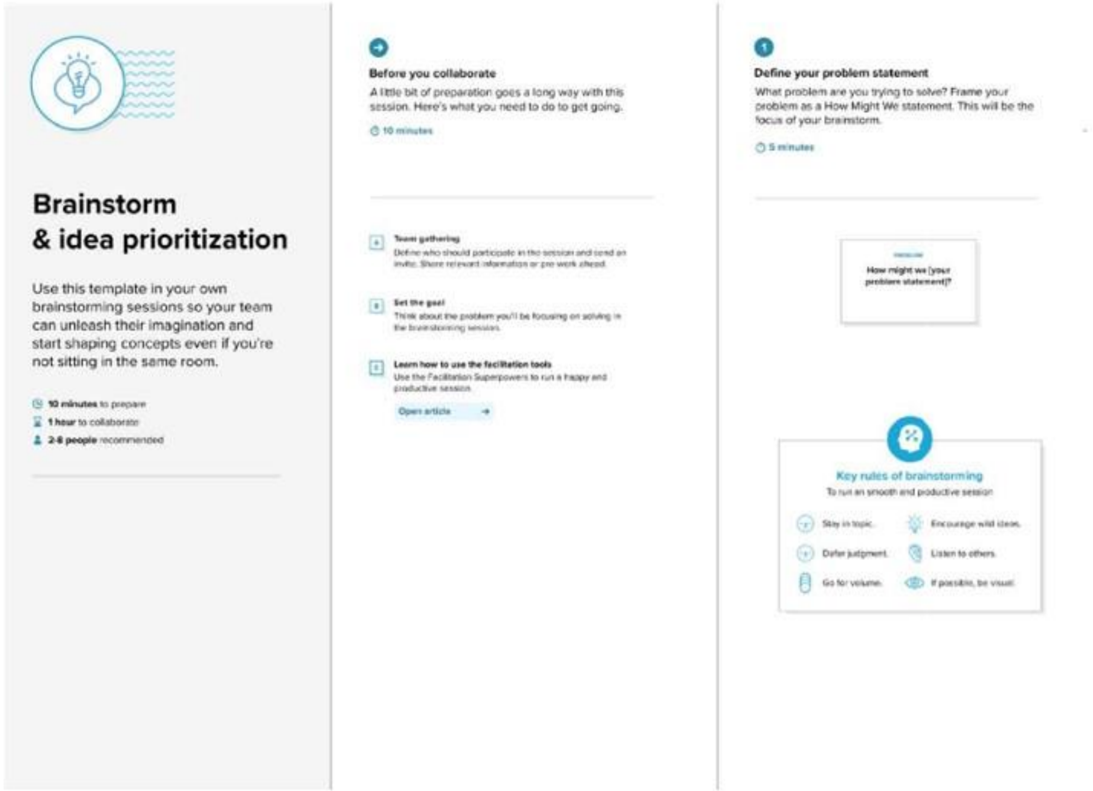
IDEATION & PROPOSED SOLUTION

3.1.EMPATHY MAP CANVAS


What does he THINK and FEEL?
Feels safe
The additional charges for bags, the sudden charges for selecting seats on an international flight are a frustrating at the prices they are asking
What does he HEAR?
please fasten your seatbelts at this time and secure all baggage underneath your seat or in the overhead compartments
What does he SEE?
TV stars, musicians or even reality personalities
Suitcase go off on a conveyor belt
What does he SAY and DO?
This is a title...
Books flight ticket
Uses the wifi while waiting for flight
Pains
Terrible airline customer service
Airline sites are too cluttered
Gains
Flexible travel date searches
Ticket refund is available

3.2. IDEATION & BRAINSTORMING

Step 1 - Team Gathering, Collaboration and Selecting the Problem Statement



Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare
1 hour to collaborate
2-8 people recommended

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

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

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

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.

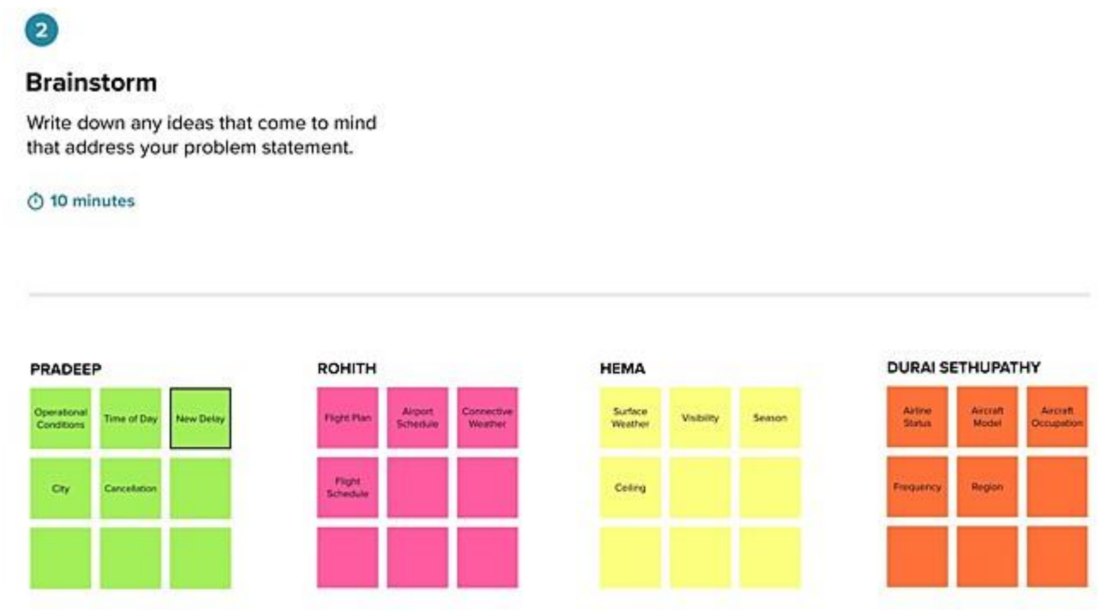
5 minutes

How might we [your problem statement]?

Key rules of brainstorming
To run an smooth and productive session

- Stay in topic.
- Encourage wild ideas.
- Defer judgment.
- Listen to others.
- Go for volume.
- If possible, be visual.

Step-2: Brainstorm, Idea Listing and Grouping



2

Brainstorm

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

10 minutes

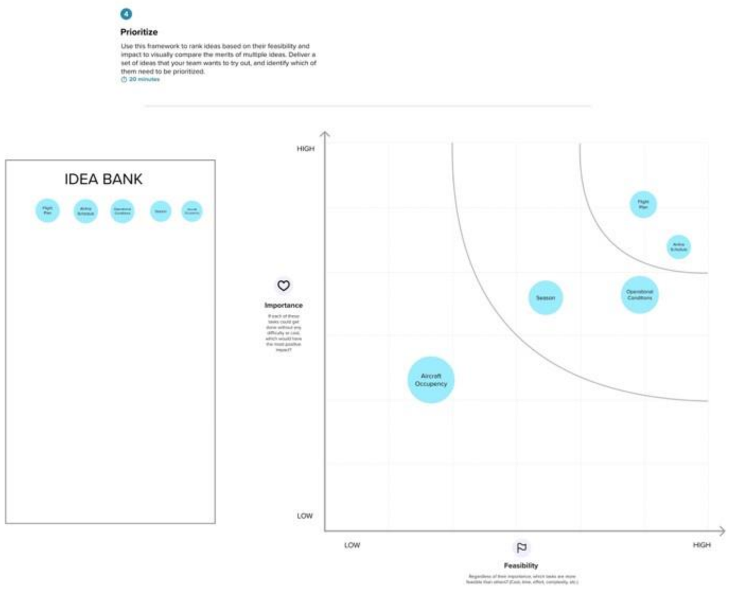
PRADEEP
- Operational Conditions
- Time of Day
- New Delay
- City
- Cancellation

ROHITH
- Flight Plan
- Airport Schedule
- Connective Weather
- Flight Schedule

HEMA
- Surface Weather
- Visibility
- Season
- Ceiling

DURAI SETHUPATHY
- Airline Status
- Aircraft Model
- Aircraft Occupation
- Frequency
- Region

Step 3 - Idea Prioritization



4

Prioritize

Use this framework to rank ideas based on their feasibility and impact to visually compare the merits of multiple ideas. Deliver a set of ideas that your team wants to try out, and identify which of them need to be prioritized.

20 minutes

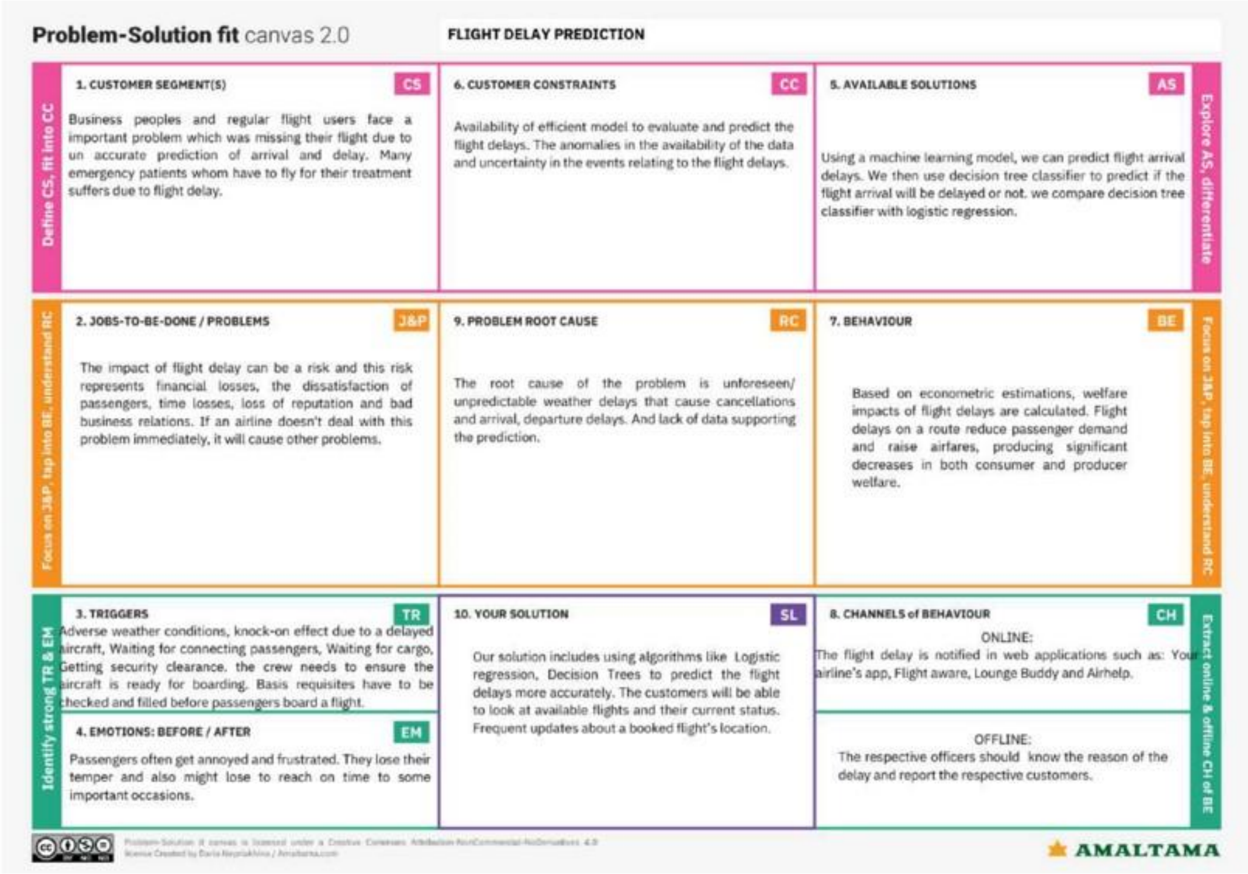
IDEA BANK
HIGH
LOW
Importance
If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?
LOW
HIGH
Feasibility
Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)
Flight Plan
Airline Schedule
Season
Operational Conditions
Aircraft Occupency

3.3. PROPOSED SOLUTION

S.No.	Parameter	Description

1.	Problem Statement (Problem to be solved)	Flight delays have been the most challenging area for airlines to improve. They have been affecting the air industry directly and indirectly causing unforeseen expenses thereby reducing the reputation of the industry and the airlines. Thus, knowing if a flight would be delayed beforehand can let passengers and airlines be prepared for the circumstances. This solution aims at making it possible by predicting arrival and departure delays using Machine learning.
2.	Idea / Solution description	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.
3.	Novelty / Uniqueness	The solution takes into account all possible reasons for delay(crew delys, weather, air traffic, aircraft type) to provide an accurate prediction. Apart from predicting arrival delays, departure delays are also predicted in order for the passengers to prepare accordingly and for the airline to make arrangements suitably.
4.	Social Impact / Customer Satisfaction	By predicting the flight delay in advance the passengers can plan accordingly.
5.	Business Model (Revenue Model)	Knowing the probability of flight delay or cancellation is a crucial tool for travellers, so we set about creating a model to predict longterm flight delays. Rather than looking at disruptions caused by punctual factors like weather, we wanted to see which flights and itineraries had the highest probability of delays or cancellations over time

3.4. PROBLEM SOLUTION FIT



Problem-Solution fit canvas 2.0

FLIGHT DELAY PREDICTION

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Business peoples and regular flight users face a important problem which was missing their flight due to un accurate prediction of arrival and delay. Many emergency patients whom have to fly for their treatment suffers due to flight delay.

6. CUSTOMER CONSTRAINTS CC

Availability of efficient model to evaluate and predict the flight delays. The anomalies in the availability of the data and uncertainty in the events relating to the flight delays.

5. AVAILABLE SOLUTIONS AS

Using a machine learning model, we can predict flight arrival delays. We then use decision tree classifier to predict if the flight arrival will be delayed or not. we compare decision tree classifier with logistic regression.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS J&P

The impact of flight delay can be a risk and this risk represents financial losses, the dissatisfaction of passengers, time losses, loss of reputation and bad business relations. If an airline doesn't deal with this problem immediately, it will cause other problems.

9. PROBLEM ROOT CAUSE RC

The root cause of the problem is unforeseen/ unpredictable weather delays that cause cancellations and arrival, departure delays. And lack of data supporting the prediction.

7. BEHAVIOUR BE

Based on econometric estimations, welfare impacts of flight delays are calculated. Flight delays on a route reduce passenger demand and raise airfares, producing significant decreases in both consumer and producer welfare.

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TR

Adverse weather conditions, knock-on effect due to a delayed aircraft, Waiting for connecting passengers, Waiting for cargo, Getting security clearance. the crew needs to ensure the aircraft is ready for boarding. Basis requisites have to be checked and filled before passengers board a flight.

4. EMOTIONS: BEFORE / AFTER EM

Passengers often get annoyed and frustrated. They lose their temper and also might lose to reach on time to some important occasions.

10. YOUR SOLUTION SL

Our solution includes using algorithms like Logistic regression, Decision Trees to predict the flight delays more accurately. The customers will be able to look at available flights and their current status. Frequent updates about a booked flight's location.

8. CHANNELS of BEHAVIOUR CH

ONLINE:

The flight delay is notified in web applications such as: Your airline's app, Flight aware, Lounge Buddy and Airhelp.

OFFLINE:

The respective officers should know the reason of the delay and report the respective customers.

Extract online & offline CH of BE

AMALTAMA

CHAPTER 4

REQUIREMENT ANALYSIS

4.1. FUNCTIONAL REQUIREMENT

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail
FR-2	User Confirmation	Confirmation via Email
FR-3	User Login	Login using credentials
FR-4	User Verification	To check if a user is authorized or not
FR-5	Search Flights	The system should allow users to search for their flight details .
FR-6	Flights Status Notification	Passengers can view the status of their flight anytime.

4.2. NON-FUNCTIONAL REQUIREMENTS

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Ease of use Ease of access
NFR-2	Security	Information about the users and their flight details is kept private. Provides assurance to users by informing them of possible flight delay
NFR-3	Reliability	Should provide accurate predictions
NFR-4	Performance	Should provide an uninterrupted connection. High- speed performance

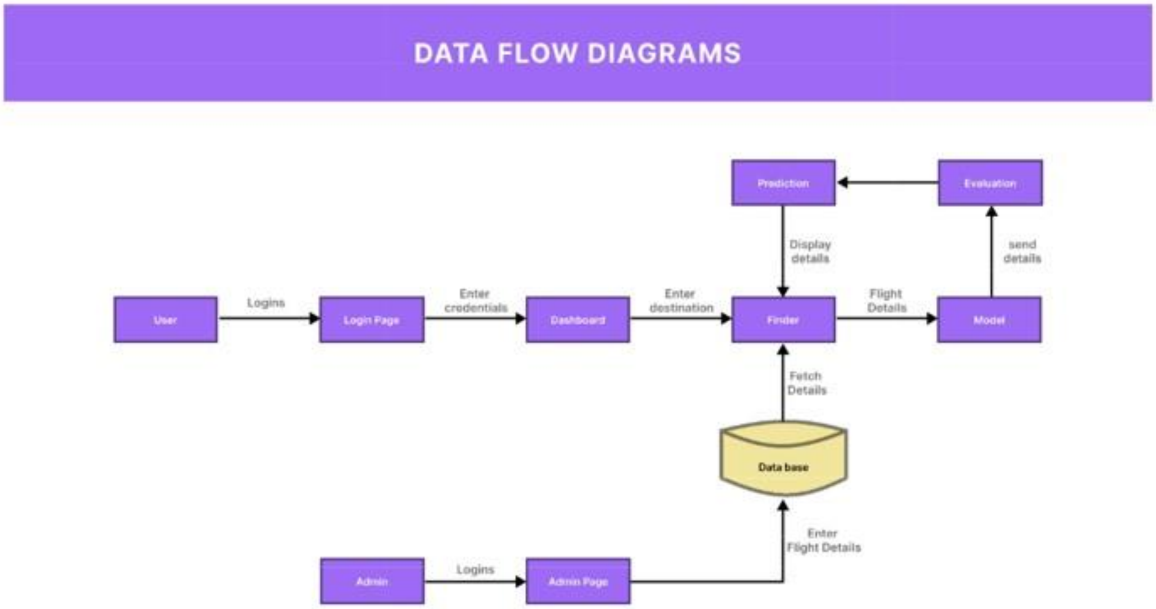
NFR-5	Availability	The system should be available at all times.
NFR-6	Scalability	Can handle multiple users at the same time Accessible even in remote areas

CHAPTER 5

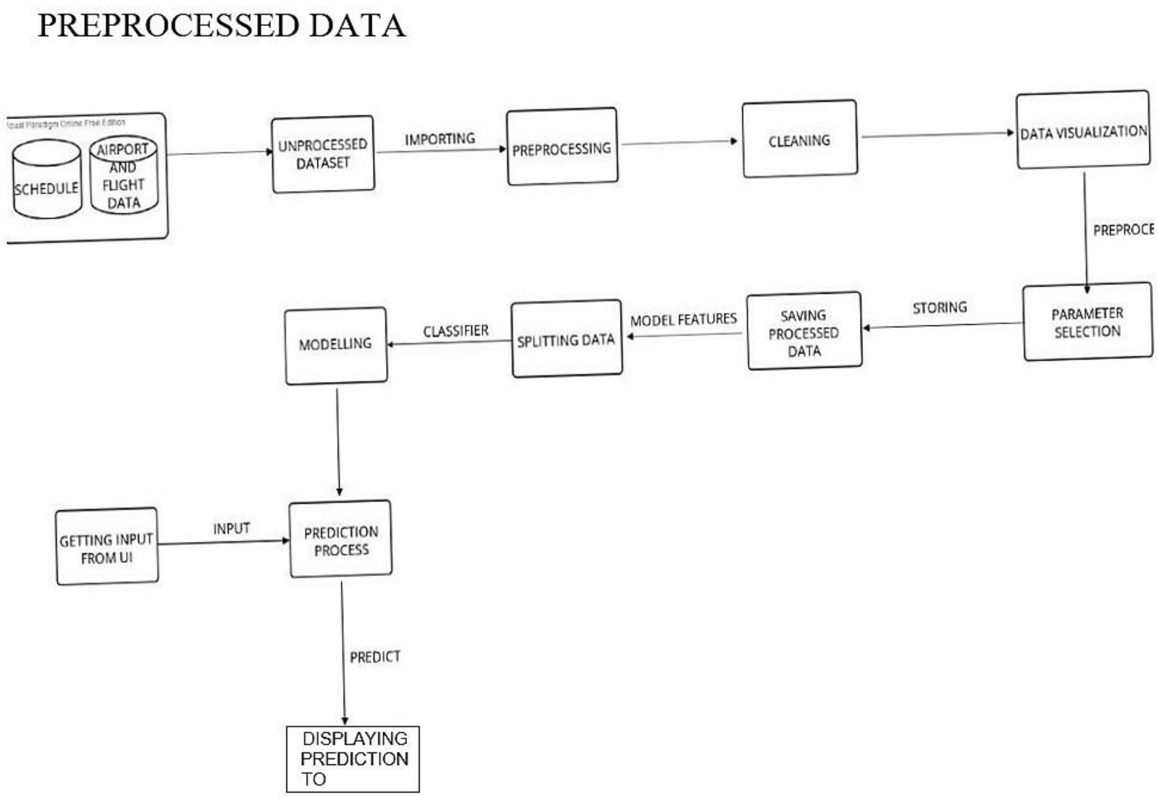
PROJECT DESIGN

5.1. DATA FLOW DIAGRAMS

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



5.2. SOLUTION & TECHNICAL ARCHITECTURE



Technology Stack

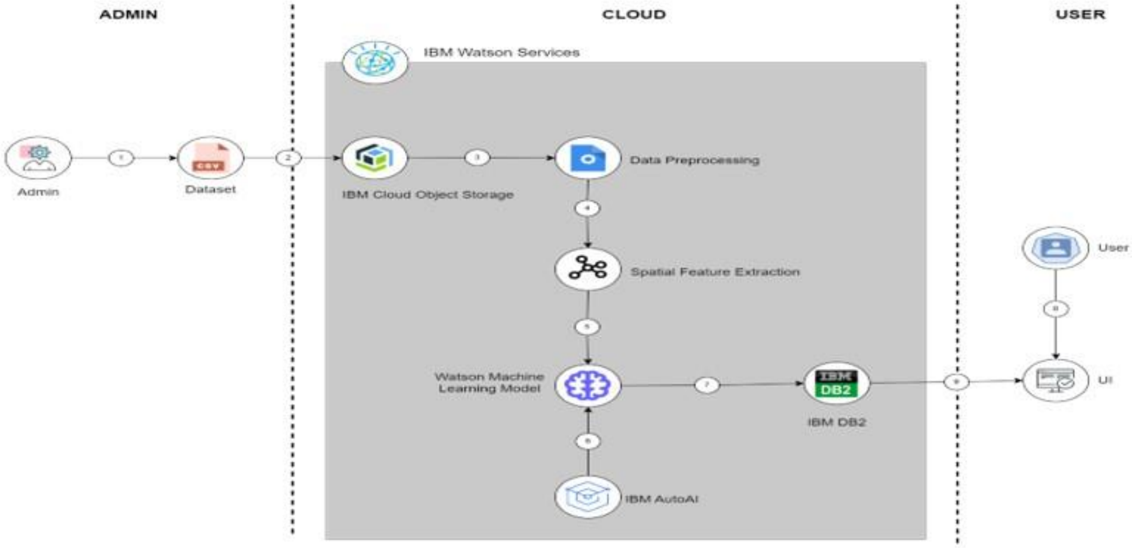


Figure 1.1. Technical Architecture

Components & Technologies

S.No	Component	Description	Technology
1.	User Interface	User can interacts with application through Web UI.	HTML , CSS , JavaScript , Bootstrap , Flask
2.	Application Logic-1	The user can enter the data in it is sent for the machine learning model for the prediction	Python
3.	Application Logic-2	The application is directly deployed in the IBM cloud	IBM Watson STT service
4.	Database	The user credentials are stored ,which is used to send notification of any updates	MySQL
5.	Cloud Database	Database Service on Cloud	IBM DB2
6.	File Storage	File storage requirements	IBM Block Storage

7.	Machine Learning Model	The model is used to predict whether the Flight Delayed or not.	Prediction Model
8.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Cloud Foundry

Application Characteristics

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Open-source frameworks used is IBM Watson	Technology of Opensource framework IBM Watson
2 .	Security Implementations	Authorization access scenarios and definitions, hand-over procedures for patient records	IBM Watson STT service
		between wards	
3.	Scalable Architecture	Horizontal scaling is provided by adding more machines to the pool of servers. Vertical scaling is achieved by adding more CPU and RAM to the existing machines.	IBM Watson STT service
4.	Availability	The Web interface is made available using load balancers, distributed servers etc.	IBM Watson

5.	Performance	IBM Watson –automate processes, The deep learning model is trained using IBM Watson studio for better performance, Cache, CDN’s, etc..	IBM Watson

5.3. User Stories

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Registration and Login	USN-1	As a new user, I can register for the application by entering my email and my password.	2	High
Sprint-2	Confirmation email	USN-2	As a user, I will receive confirmation email once I have registered for the application	2	Medium
Sprint-1	User login	USN-3	As a user, I can login into the application by entering the registered email-id and password	2	High
Sprint-2	Admin Panel	USN-4	As an admin, I can authenticate the registration and login credentials of the	2	High
			passengers		
Sprint-3	Arrival and Departure time of flights	USN-5	As a user, I can find all the details of a specific flight with its number or name	2	High
Sprint-3		USN-6	As a user, I can find exactly how long the flight will be delayed	2	High

6.1. SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration and Login	USN-1	As a new user, I can register for the application by entering my email and my password.	2	High	Pradeep A Durai Sethupathy A
Sprint-2	Confirmation email	USN-2	As a user, I will receive confirmation email once I have registered for the application	2	Medium	Hema T Durai Sethupathy A
Sprint-1	User login	USN-3	As a user, I can login into the application by entering the registered email-id and password	2	High	Durai Sethupathy A Pradeep A
Sprint-2	Admin Panel	USN-4	As an admin, I can authenticate the registration and login credentials of the passengers	2	High	PradeepA Rohith M
Sprint-3	Arrival and Departure time of flights	USN-5	As a user, I can find all the details of a specific flight with its number or name	2	High	Hema T Rohit hM
Sprint-3		USN-6	As a user, I can find exactly how long the flight will be delayed	2	High	Durai Sethupathy M Hema T Rohith M

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	5 Days	28 October 2022	02 November 2022	20	03 November 2022
Sprint-2	20	5 Days	03 November 2022	08 November 2022	20	09 November 2022
Sprint-3	20	5 Days	09 November 2022	14 November 2022	20	14 November 2022

CHAPTER 7 CODING AND SOLUTIONING

7.1. FEATURE 1 - CORRELATION BETWEEN THE VARIABLES IN THE DATASET

This will help us to find out the correlation between the variables in the dataset which would help us to find out the columns that are unnecessary and hence to be dropped.

7.2. FEATURE 2 - ONE HOT ENCODING

The cities in both Origin and Destination are one-hot encoded using the above code.

7.3. FEATURE 3 - SAVING THE MODEL WEIGHTS FOR DEPLOYMENT

The above code will save the model weights for further deployment in IBM Cloud and also measure the performance metrics.

7.4. FEATURE 4 - FLASK INTERFACE - UI

7.5. FEATURE 5 - HTML PAGES FOR FRONTEND DESIGN

```
@import
url("https://fonts.googleapis.com/css2?family=Poppins:wght@200;300;400;500;600;700;800&di
splay=swap");


* {
  margin: 0;
  padding: 0;
  box-sizing: border-box;
}


body, input
{
  font-family: "Poppins", sans-serif;
}


.container {
  position: relative;
  width: 100%;
  background-color: #fff;
  min-height: 100vh;
  overflow: hidden;
}
.forms-container {
  position: absolute;
  width: 100%;
  height: 100%;
  top: 0;
left: 0;
}
.signin-signup {
  position: absolute;
```

```css
  top: 50%;
  transform: translate(-50%, -50%);
  left: 75%;
  width: 50%;
  transition: 1s 0.7s ease-in-out;
  display: grid;
  grid-template-columns: 1fr;
  z-index: 5;
}

form {
  display: flex;
  align-items: center;
  justify-content: center;
  flex-direction: column;
  padding: 0rem 5rem;
  transition: all 0.2s 0.7s;
  overflow: hidden;
  grid-column: 1 / 2;
  grid-row: 1 / 2;
}

form.sign-up-form {
  opacity: 1;
  z-index: 1;
}

form.sign-in-form {
  z-index: 2;
}
.title {
  font-size: 2.5rem;
  color: #444;
  margin-bottom: 10px;
}

.input-field {
  max-width: 380px;
  width: 100%;
  background-color: #f0f0f0;
  margin: 10px 0;
  height: 55px;
  border-radius: 55px;
  display: grid;
  grid-template-columns: 15% 85%;
  padding: 0 0.4rem;
  position: relative;
  box-shadow: 0 2px 5px  rgba(0, 0, 0, 0.6);
}

.input-field i {
  text-align: center;
  line-height: 55px;
  color: #acacac;   transition:
0.5s;
  font-size: 1.1rem;
}

.input-field input {
  background: none;
  outline: none;
  border: none;
  line-height: 1;
  font-weight: 600;
  font-size: 1.1rem;
  color: #333;
}

.input-field input::placeholder {
  color: #aaa;
  font-weight: 500;
}
.social-text {
  padding: 0.7rem 0;
  font-size: 1rem;
}
```

```
.social-media {
  display: flex;
  justify-content: center;
}
.social-icon {
  height: 46px;
  width: 46px;
  display: flex;
  justify-content: center;
  align-items: center;
  margin: 0 0.45rem;
  color: #333;
  border-radius: 50%;
  border: 3px solid #333;
  text-decoration: none;
  font-size: 1.3rem;
  transition: 0.3s;
}
.social-icon:hover {
  color: #f7543f;
  border-color: #b83120;
}
.btn {
  width: 150px;   background-color: #ee6654;
  border: none;
  outline: none;
  height: 49px;
  border-radius: 49px;
  color: #fff;
  text-transform: uppercase;
  font-weight: 600;
  margin: 10px 0;
  cursor: pointer;
  transition: 0.5s;
  box-shadow: 0 2px 5px  rgba(0, 0, 0, 0.6);
}

.btn:hover {
```

```css
  background-color: #f14b35;
}
.panels-container {
  position: absolute;
  height: 100%;
  width: 100%;
  top: 0;
left: 0;
  display: grid;
  grid-template-columns: repeat(2, 1fr);
}
.container:before {
  content: "";
  position: absolute;
  height: 2000px;
  width: 2000px;
  top: -10%;
  right: 48%;
  transform: translateY(-50%);
  background:#FF4955;
  transition: 1.8s ease-in-out;
  border-radius: 50%;
  z-index: 6;
}

.image {
  width: 70%;
  transition: transform 1.1s ease-in-out;
  transition-delay: 0.4s;
}
.panel {
  display: flex;
  flex-direction: column;
  align-items: center;
  justify-content: space-around;
  text-align: center;
  z-index: 6;
}
```

```
.left-panel {
  pointer-events: all;
  padding: 3rem 17% 2rem 12%;
}

.right-panel {
  pointer-events: none;
  padding: 3rem 12% 2rem 17%;
  align-items: flex-end;
}
.panel .content {
  color: #fff;
  transition: transform 0.9s ease-in-out;
  transition-delay: 0.6s;
}
.panel h3 {
  font-weight: 600;
  line-height: 1;
  font-size: 1.5rem;
}
.panel p {
  font-size: 0.95rem;   padding:
0.7rem 0; }
.btn.transparent {
  margin: 0;
  background: none;
  border: 3px solid #fff;
  width: 130px;
  height: 41px;
  font-weight: 600;
  box-shadow: none;
  font-size: 0.8rem;
}
.right-panel .image,
.right-panel .content {
  transform: translateX(800px);
}
```

```
/* ANIMATION */

.container.sign-up-mode:before {
  transform: translate(100%, -50%);
  right: 52%;
}
.container.sign-up-mode .left-panel .image,
.container.sign-up-mode .left-panel .content {
  transform: translateX(-800px);
}
.container.sign-up-mode .signin-signup {
  left: 25%;
}
.container.sign-up-mode form.sign-up-form {
  opacity: 1;
  z-index: 2;
}
.container.sign-up-mode form.sign-in-form {
  opacity: 0;
  z-index: 1;
}
.container.sign-up-mode .right-panel .image,
.container.sign-up-mode .right-panel .content {
  transform: translateX(0%);
}
.container.sign-up-mode .left-panel {
  pointer-events: none;
}
.container.sign-up-mode .right-panel {
  pointer-events: all;
}
@media (max-width: 870px) {
  .container {
    min-height: 800px;
    height: 100vh;
  }
  .signin-signup {
    width: 100%;
    top: 95%;
    transform: translate(-50%, -100%);
    transition: 1s 0.8s ease-in-out;
  }

  .signin-signup,
  .container.sign-up-mode .signin-signup {
    left: 50%;
  }

  .panels-container {
    grid-template-columns: 1fr;
    grid-template-rows: 1fr 2fr 1fr;
  }
  .panel {
    flex-direction: row;
    justify-content: space-around;
    align-items: center;
    padding: 2.5rem 8%;
    grid-column: 1 / 2;
  }

  .right-panel {
    grid-row: 3 / 4;
  }

  .left-panel {
    grid-row: 1 / 2;
  }
  .image {
    width: 200px;
    transition: transform 0.9s ease-in-out;
    transition-delay: 0.6s;
  }

  .panel .content {
    padding-right: 15%;
    transition: transform 0.9s ease-in-out;
    transition-delay: 0.8s;
  }
  .panel h3 {
    font-size: 1.5rem;
  }
  .panel p {
    font-size: 0.7rem;
    padding: 0.5rem 0;
  }

  .btn.transparent {
    width: 110px;
    height: 35px;
    font-size: 0.7rem;
  }

  .container:before {
    width: 1500px;
    height: 1500px;
    transform: translateX(-50%);
    left: 30%;
    bottom: 68%;
    right: initial;
    top: initial;
    transition: 2s ease-in-out;
  }
  .container.sign-up-mode:before {
    transform: translate(-50%, 100%);
    bottom: 32%;
    right: initial;
  }
  .container.sign-up-mode .left-panel .image,
  .container.sign-up-mode .left-panel .content {
    transform: translateY(-300px);
  }
  .container.sign-up-mode .right-panel .image,
  .container.sign-up-mode .right-panel .content {
    transform: translateY(0px);
  }

  .right-panel .image,
  .right-panel .content {
    transform: translateY(300px);
  }
  .container.sign-up-mode .signin-signup {
    top: 5%;
    transform: translate(-50%, 0);
  }
}
@media (max-width: 570px) {
  form {
    padding: 0 1.5rem;
  }

  .image {
    display: none;
  }
  .panel .content {
    padding: 0.5rem 1rem;
  }
  .container {
    padding: 1.5rem;
  }

  .container:before {
    bottom: 72%;
    left: 50%;
  }
  .container.sign-up-mode:before {
    bottom: 28%;
    left: 50%;
  }
                                                  }
```

TESTING

8.1. TEST

User No	Flight No	Month	Day of month	Day of week	Origin	Destination	Scheduled Departure Time	Scheduled Arrival Time	Actual Departure Time	Actual Inputs
1	1232	1	1	1	ATL	MSP	1905	2305	1945	Delayed
2	1399	1	1	1	ATL	SEA	1805	2410	1855	Delayed
3	2351	1	2	3	ATL	DTW	1305	2305	1305	Not Delayed
4	2637	2	1	3	DTW	ATL	1500	2410	1505	Not Delayed

8.2. USER ACCEPTANCE TESTING

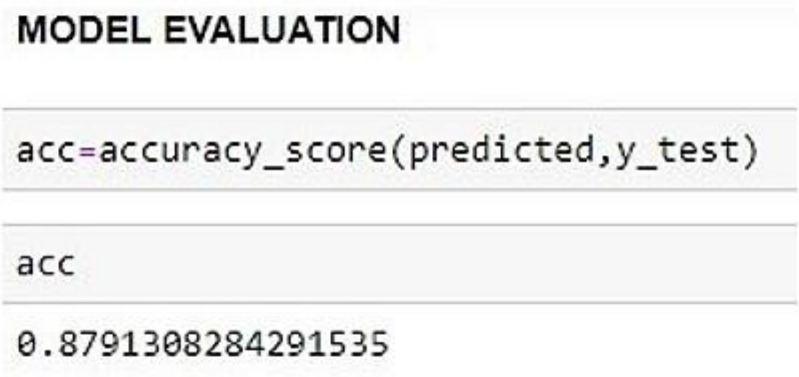
This report shows the number of test cases that have passed and failed

User No	Flight No	Month	Day Of Month	Day Of Week	Origin	Destination	Scheduled Departure Time	Scheduled Arrival Time	Actual Departure Time	Actual Output	Predict-ed Output	Correct-ness
1	1232	1	1	1	ATL	MSP	1905	2305	1945	Delayed	Delayed	Correct
2	1399	1	1	1	ATL	SEA	1805	2410	1855	Delayed	Delayed	Correct
3	2351	1	2	3	ATL	DTW	1305	2305	1305	Not Delayed	Not Delayed	Correct
4	2637	2	1	3	DTW	ATL	1500	2410	1505	Not Delayed	Not Delayed	Correct

RESULTS

9.1. PERFORMANCE METRICS

Training Accuracy



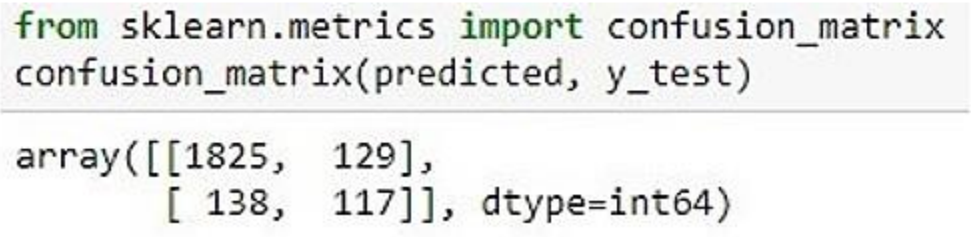
MODEL EVALUATION

```
acc=accuracy_score(predicted,y_test)
```

```
acc
```

```
0.8791308284291535
```

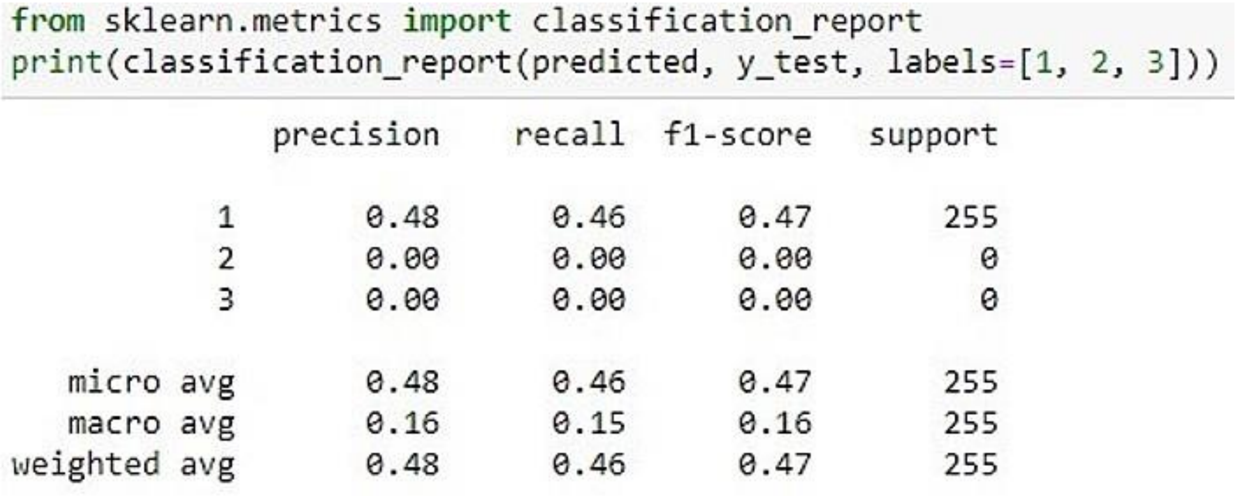
Confusion Matrix



```
from sklearn.metrics import confusion_matrix
confusion_matrix(predicted, y_test)
```

```
array([[1825,  129],
       [ 138,  117]], dtype=int64)
```

Classification Model



```
from sklearn.metrics import classification_report
print(classification_report(predicted, y_test, labels=[1, 2, 3]))
```

```
              precision    recall  f1-score   support

           1       0.48      0.46      0.47       255
           2       0.00      0.00      0.00         0
           3       0.00      0.00      0.00         0

   micro avg       0.48      0.46      0.47       255
   macro avg       0.16      0.15      0.16       255
weighted avg       0.48      0.46      0.47       255
```

ADVANTAGES AND DISADVANTAGES

Advantages

1. Customers are happy
2. The available flights are easily identified
3. Prior information will be sent if in case the flight is delayed
4. The current status of the flight can be tracked

Disadvantages

1. Wrong prediction due to noise of input data
2. If the prediction is wrong, then there will be extra expenses for the agencies, passengers and airport
3. Passengers with medical emergencies gets affected

CHAPTER 11

CONCLUSION

In this project, we use flight data, weather, and demand data to predict flight departure delay. In the end, our model correctly predicts the delayed and non-delayed flights correctly. As a result, there can be additional features related to the causes of flight delay that are not yet discovered using our existing data sources.

CHAPTER 12

FUTURE SCOPE

Based on data analysis from the year 2008, this project. There is a sizable dataset accessible from 1987 to 2008, but managing a larger dataset necessitates extensive preprocessing and purification of the data Therefore, adding a larger dataset is a part of this project's future effort. Preprocessing a bigger dataset can be done in a variety of methods, such as establishing a Spark cluster on a computer or using cloud services like AWS and Azure. Now that deep learning has advanced, we can employ neural networks algorithms to analyze aviation and meteorological data. Neural networks employ a form of pattern matching.

The project's focus is primarily on flight and weather data for India, but we can also include data from other nations like China, the United States, and Russia. We can broaden the project's scope by including flight information from international flights rather than just domestic flights.

CHAPTER 13

APPENDIX SOURCE CODES

PYTHON FLASK

```
import  requests  import
flask
from flask import url_for, request, render_template
from   flask_cors   import   CORS   import
requests
```

```
# NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud
account.
API_KEY = "zCU3gbntxqL8kInfTM2Q95jPfkfkVI9Mt8sLNC8NRipq" 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}


app = flask.Flask(__name__, static_url_path='')
CORS(app)

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


@app.route('/signupPage', methods=['GET']) def
signupPage():
  print("signup")
  return render_template('signup.html')


@app.route('/index', methods=['GET', 'POST']) def
sendindexPage():
  print("index")
  return render_template('index.html')


@app.route('/signupfn',methods = ['POST', 'GET']) def
signupfn():
  if request.method == 'POST':
    try:
      emailid = request.form['emailid']
      passwrd = request.form['password']
      usrname = request.form['username']
      with sql.connect("flightdelay.db") as con:
        cur1 = con.cursor()
        cur1.execute("select * from user_login where email=?",(emailid))
        check=cur1.rowcount
      if(check!=0):
        error1="User with this Email ID already Exists !!"
      else:
        cur = con.cursor()
        cur.execute("INSERT INTO user_login (email,password,name) VALUES
(?,?,?)",(emailid,passwrd,usrname) )
        con.commit()
        error1="User Sign Up Successfull ! Proceed Login"
        flash("Record successfully added!")
    except:
      con.rollback()

    finally:
      return render_template("Signup.html",error=error1)
      con.close()

@app.route('/loginfn',methods = ['POST', 'GET']) def
loginfn():
   emailid = request.form["emailid"]
   passwrd = request.form["password"]
   with sql.connect("flightdelay.db") as con:
      try:
        cur = con.cursor()
        cur.execute("select * from user_login where email=? and password=? limit
1",(emailid,passwrd))
        records=cur.fetchall
        session['email']=emailid
        if not records:
          record1="No Such Users Found"
        else:
          record1=records
      except:
        msg = "Incorrect Password / No Such Users Found"
      finally:
        return render_template("index.html",msg=record1)

@app.route('/category')    def
prefn():
  emailid = session['email']
  preferences = request.form["preferences"]
  with sql.connect("flightdelay.db") as con:
    try:
      cur = con.cursor()
      cur.execute("select * from user_data where email=?",(emailid))
      record=cur.fetchall
      if not record:
        cur1 = con.cursor()
        cur1.execute("INSERT INTO user_data (email,choices) VALUES (?,?,?)",(emailid,preferences))
        con.commit()
      else:
        cur2 = con.cursor()
        cur2.execute("UPDATE user_data SET choices=? where email=?",(preferences,emailid))
        con.commit()
    except:
      return render_template("test.html",msg="Somthing Went Wrong")
    finally:
      return render_template("test.html",email=emailid,preferences=preferences)

@app.route('/predict', methods=['GET','POST'])
def predict():   print("predict")
 name = request.form['name']
 month = request.form['month']
 dayofmonth = request.form['dayofmonth']
 dayofweek = request.form['dayofweek']
 origin = request.form['origin']
 if (origin== "MSP"):
     origin1, origin2,origin3, origin4, origin5 = 0,0,0,0,1
 if (origin == "DTW"):
     origin1, origin2,origin3, origin4, origin5 = 1,0,0,0,0
 if (origin == "JFK"):
     origin1, origin2,origin3, origin4, origin5 = 0,0,1,0,0
 if (origin == "SEA"):
     origin1, origin2,origin3, origin4, origin5 = 0,1,0,0,0
 if (origin == "ATL"):
     origin1, origin2, origin3, origin4, origin5 = 0,0,0,1,0
 destination = request.form['destination']
 if (destination == "MSP"):
     destination1, destination2, destination3, destination4, destination5 = 0,0,0,0,1
 if(destination == 'DTW'):
     destination1,  destination2,  destination3,  destination4,  destination5  =  1,0,0,0,0      if
(destination == "JFk") :
     destination1,  destination2,  destination3,  destination4,  destination5  =  0,0,1,0,0       if
(destination == "SEA") :
     destination1,  destination2,  destination3,  destination4,  destination5  =0,1,0,0,0       if
(destination == "ATL") :
     destination1, destination2, destination3, destination4, destination5 = 0,0,0,1,0
 dept = request.form['dept']
 arrtime = request.form['arrtime']
 actdept = request.form['actdept']
 #dept15=int(dept)- int(actdept)
 total  =  [[name,  month,  dayofmonth,  dayofweek,arrtime,actdept,origin1,  origin2,  origin3,  origin4,
origin5, destination1, destination2, destination3, destination4, destination5 ]]
 payload_scoring = {"input_data": [{"field": [[name, month, dayofmonth,
dayofweek,arrtime,actdept,origin1,origin2, origin3, origin4, origin5, destination1, destination2,
 destination3, destination4, destination5 ]], "values": total}]}
 response_scoring = requests.post('https://eude.ml.cloud.ibm.com/ml/v4/deployments/abf3959e-
b7bd-4fde-9f341295348fea93/predictions?version=2022-11-18', json=payload_scoring,
headers={'Authorization': 'Bearer ' + mltoken})
 print(response_scoring)
 predictions = response_scoring.json()
 y_pred= predictions['predictions'][0]['values'][0][0]
 print("Final prediction :",predict)
 if(y_pred==[0.0]):
    ans= "The Flight will be on time"
 else:
    ans= "The Flight will be delayed"
 return render_template("predict.html", showcase = ans)


   # showing the prediction results in a UI# showing the prediction results in a UI
```

```
if __name__ == '__main__' :
    app.run(debug= True)
```

HTML SIGNUP PAGE

```
<!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://kit.fontawesome.com/64d58efce2.js"
    crossorigin="anonymous"
  ></script>
    <link rel="stylesheet" type="text/css"
href="{{url_for('static',filename='styles/homestyle.css')}}" />
    <title>signup</title>
</head>
<body>
    <form action="{{url_for('sendhomePage')}}" class="sign-up-form">
        <h2 class="title">Sign up</h2>
        <div class="input-field">
          <i class="fas fa-user"></i>
          <input type="text" placeholder="Username" />
        </div>
        <div class="input-field">
          <i class="fas fa-envelope"></i>
          <input type="email" placeholder="Email" />
        </div>
        <div class="input-field">
          <i class="fas fa-lock"></i>
          <input type="password" placeholder="Password" />
        </div>
        <input type="submit" class="btn" value="Sign up" />
        <p class="social-text">Or Sign up with social platforms</p>
        <div class="social-media">
```

```
     <a href="https://www.facebook.com/login/" class="social-icon">
      <i class="fab fa-facebook-f"></i>
     </a>
     <a href="https://twitter.com/login" class="social-icon">
      <i class="fab fa-twitter"></i>
     </a>

     <a href="https://www.linkedin.com/login" class="social-icon">
      <i class="fab fa-linkedin-in"></i>
     </a>
    </div>
   </form>
</body>
</html>
```

HTML INDEX PAGE

```
<!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>FLIGHT DELAY
PREDICTION</title>

</head>
<body>
 <style>
   body{
    background-image:
url('http://tripplanners.co.in/blogs/wpcontent/uploads/2014/12/
flight.jpg');     background-size: 100% 150%;
    background-repeat: no-repeat;
  }
  h1{
    color:white;
  }
 label{
    color:white;
  }



    </style>

   <center><h1>FLIGHT DELAY PREDICTION</h1></center>
   <style>
    div {
      margin-bottom: 20px;
    }
    label {
      display: inline-block;
      width: 200px;
    }
  </style>

<form action="{{url_for('predict')}}" method="POST">

  <label for="name">Enter Flight name:</label>
    <input type="number" id="name" name="name" required>     <br><br>

  <label for="month">Month:</label>
  <input type="number" name="month" required>
 <br><br>

 <label for="dayofmonth">Day of Month:</label>
 <input type="number"  name="dayofmonth" required>
<br><br>

 <label for="dayofweek">Day of Week:</label>
 <input type="number"  name="dayofweek" required>
<br><br>



  <label for="origin">origin:</label>
<select name="origin" id="og" required>
  <option value="SEA">SEA</option>
  <option value="MSP">MSP</option>
  <option value="DTW">DTW</option>
  <option  value="ATL">ATL</option>      <option
value="JFK">JFK</option>
</select> <br><br>

<label >Destination:</label>
<select name="destination" id="des" required>
  <option value="SEA">SEA</option>
  <option value="MSP">MSP</option>
  <option value="DTW">DTW</option>
  <option  value="ATL">ATL</option>      <option
value="JFK">JFK</option>
</select>
<br><br>

<label >Scheduled Departure Time:</label>
<input type="number" id="sdt" name="dept" required>
<br><br>

<label >Scheduled Arrival Time:</label>
<input type="number" id="sat" name="arrtime" required>
<br><br>

<label for="acttime">Actual Departure Time:</label>
<input type="number" id="adt" name="actdept" required>
<br><br>
<style>
  .block {
    display: block;
    width: 50%;
    border: none;
    background-color: #04AA6D;
    color: white;
    padding: 14px 28px;
    font-size: 16px;
    cursor: pointer;
    text-align: center;
  }

  .block:hover {
    background-color: #ddd;
    color: black;
  }
  </style>

<button class="block">Submit</button>

</form>
<h1>{{showcase}}</h1>

</body>
</html>
```

HTML PREDICT PAGE

```
<!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>PREDICTIONS</title>
    <style>
        body{

        background-image:
url('data:image/jpeg;base64,/9j/4AAQSkZJRgABAQAAAQABAAD/2wCEAAkGBxIQEhU
         background-size: 100% 600%;
       background-repeat: no-repeat;
       }

       h1{
```

```
    color:rgb(214, 32, 32);
   }

     </style>
</head>
<body >

   <center>
   <h1>{{showcase}}</h1>
   <a color:green href ="{{url_for('sendindexPage')}}"> Go back </a>
    </center>
</body>
</html>
```

```
{
 "cells": [
  {
   "cell_type": "code",
   "execution_count": 5,
   "metadata": {},
   "outputs": [
    {
     "data": {
      "text/html": [
       "<div>\n",
       "<style scoped>\n",
       "    .dataframe tbody tr th:only-of-type {\n",
       "        vertical-align: middle;\n",
       "    }\n",
       "\n",
       "    .dataframe tbody tr th {\n",
       "        vertical-align: top;\n",
       "    }\n",
       "\n",
       "    .dataframe thead th {\n",
       "        text-align: right;\n",
       "    }\n",
"</style>\n",
"<table border=\"1\" class=\"dataframe\">\n",
"  <thead>\n",
"    <tr style=\"text-align: right;\">\n",
"      <th></th>\n",
"      <th>YEAR</th>\n",
"      <th>QUARTER</th>\n",
"      <th>MONTH</th>\n",
"      <th>DAY_OF_MONTH</th>\n",
"      <th>DAY_OF_WEEK</th>\n",
"      <th>UNIQUE_CARRIER</th>\n",
"      <th>TAIL_NUM</th>\n",
"      <th>FL_NUM</th>\n",
"      <th>ORIGIN_AIRPORT_ID</th>\n",
"      <th>ORIGIN</th>\n",
"      <th>...</th>\n",
"      <th>CRS_ARR_TIME</th>\n",
"      <th>ARR_TIME</th>\n",
"      <th>ARR_DELAY</th>\n",
"      <th>ARR_DEL15</th>\n",
"      <th>CANCELLED</th>\n",
"      <th>DIVERTED</th>\n",
"      <th>CRS_ELAPSED_TIME</th>\n",
"      <th>ACTUAL_ELAPSED_TIME</th>\n",
"      <th>DISTANCE</th>\n",
"      <th>Unnamed: 25</th>\n",
"    </tr>\n",
"  </thead>\n",
"  <tbody>\n",
"    <tr>\n",
"      <th>0</th>\n",
"      <td>2016</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>5</td>\n",
"      <td>DL</td>\n",
"      <td>N836DN</td>\n",
"      <td>1399</td>\n",
"      <td>10397</td>\n",
"      <td>ATL</td>\n",
"      <td>...</td>\n",
"      <td>2143</td>\n",
"      <td>2102.0</td>\n",
"      <td>-41.0</td>\n",
"      <td>0.0</td>\n",
"      <td>0.0</td>\n",
"      <td>0.0</td>\n",
"      <td>338.0</td>\n",
"      <td>295.0</td>\n",
"      <td>2182.0</td>\n",
"      <td>NaN</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>1</th>\n",
"      <td>2016</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>5</td>\n",
"      <td>DL</td>\n",
"      <td>N964DN</td>\n",
"      <td>1476</td>\n",
"      <td>11433</td>\n",
"     <td>DTW</td>\n",       "
<td>...</td>\n",
"      <td>1435</td>\n",
"      <td>1439.0</td>\n",
"      <td>4.0</td>\n",
"      <td>0.0</td>\n",
"      <td>0.0</td>\n",
"      <td>0.0</td>\n",
"      <td>110.0</td>\n",
"      <td>115.0</td>\n",
"      <td>528.0</td>\n",
"      <td>NaN</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>2</th>\n",
"      <td>2016</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>5</td>\n",
"      <td>DL</td>\n",
"      <td>N813DN</td>\n",
"      <td>1597</td>\n",
"      <td>10397</td>\n",
"      <td>ATL</td>\n",
"      <td>...</td>\n",
"      <td>1215</td>\n",
"      <td>1142.0</td>\n",
"      <td>-33.0</td>\n",
"      <td>0.0</td>\n",
"      <td>0.0</td>\n",
"      <td>0.0</td>\n",
"      <td>335.0</td>\n",
"      <td>300.0</td>\n",
"      <td>2182.0</td>\n",
"      <td>NaN</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>3</th>\n",
"      <td>2016</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>5</td>\n",
"      <td>DL</td>\n",
"      <td>N587NW</td>\n",
"      <td>1768</td>\n",
"      <td>14747</td>\n",
"      <td>SEA</td>\n",
"      <td>...</td>\n",
"      <td>1335</td>\n",
"      <td>1345.0</td>\n",
"      <td>10.0</td>\n",
"      <td>0.0</td>\n",
"      <td>0.0</td>\n",
"      <td>0.0</td>\n",
"      <td>196.0</td>\n",
"      <td>205.0</td>\n",
"      <td>1399.0</td>\n",
"      <td>NaN</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>4</th>\n",
"      <td>2016</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>1</td>\n",
"      <td>5</td>\n",
"      <td>DL</td>\n",
"      <td>N836DN</td>\n",
"      <td>1823</td>\n",
"      <td>14747</td>\n",
"      <td>SEA</td>\n",
"      <td>...</td>\n",
"      <td>607</td>\n",
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    "def __iter__(self): return 0\n",
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   "oh = OneHotEncoder()\n",
   "z=oh.fit_transform(data['ORIGIN'].values.reshape(-1,1)).toarray()\n",
   "t=oh.fit_transform(data['DEST'].values.reshape(-1,1)).toarray()"
  ]
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DEST_0  \\\n",
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  "y=data[[i for i in data.columns if i=='ARR_DEL15']].values"
 ]
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     ]
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    "metadata": {},
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  ]
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  "       0.000e+00, 0.000e+00, 0.000e+00, 0.000e+00, 1.000e+00]]"
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   "metadata": {},
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 ]
},
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      "Requirement already satisfied: importlib-metadata in /opt/conda/envs/Python3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (4.8.2)\n",
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  },
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onnx_rt22.2-py3.10-edt   f8a05d07-e7cd-57bb-a10b-23f1d4b837ac  base\n",
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      "   'output': []},\n",
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      "   'name': 'runtime-22.1-py3.9'},\n",
      "  'type': 'scikit-learn_1.0'},\n",
      " 'metadata': {'created_at': '2022-11-18T02:48:27.322Z',\n",
      "  'id': '1dfde4a2-7300-4e47-89a1-977b7135d2ed',\n",
     "  'modified_at': '2022-11-18T02:48:30.866Z',\n",
     "  'name': 'flightdelay',\n",
     "  'owner': 'IBMid-66300415QB',\n",
     "  'resource_key': 'd7c9b9ed-9974-4243-90a9-999467ee2ccd',\n",
     "  'space_id': 'd0a11148-f6ea-4361-aec2-6f11167aec40'},\n",
     " 'system': {'warnings': []}}"
    ]
   },
   "execution_count": 88,
   "metadata": {},
   "output_type": "execute_result"
  }
 ],
 "source": [
  "model_details"
 ]
},
{
 "cell_type": "code",
 "execution_count": 89,
 "metadata": {},
 "outputs": [
  {
   "data": {
    "text/plain": [
     "'1dfde4a2-7300-4e47-89a1-977b7135d2ed'"
    ]
   },
   "execution_count": 89,
   "metadata": {},
   "output_type": "execute_result"
  }
 ],
 "source": [
  "model_id = wml_client.repository.get_model_id(model_details)\n",     "model_id"
 ]
},
{
   "cell_type": "code",
   "execution_count": 90,
   "metadata": {},
   "outputs": [],
   "source": [
    "# Set meta\n",
    "deployment_props = {\n",
    "    wml_client.deployments.ConfigurationMetaNames.NAME:DEPLOYMENT_NAME,
\n",
    "    wml_client.deployments.ConfigurationMetaNames.ONLINE: {}\n",
    "}"
   ]
  },
  {
   "cell_type": "code",
   "execution_count": 91,
   "metadata": {},
   "outputs": [
    {
     "name": "stdout",
     "output_type": "stream",
     "text": [
      "\n",
      "\n",

"#####################################################################
##################\n",
      "\n",
      "Synchronous deployment creation for uid: '1dfde4a2-7300-4e47-89a1-
977b7135d2ed' started\n",
      "\n",

"#####################################################################
##################\n",
      "\n",
      "\n",
      "initializing\n",
      "Note: online_url is deprecated and will be removed in a future release. Use serving_urls
instead.\n",
      "\n",
      "ready\n",
      "\n",
      "\n",
      "-------------------------------------------------------------------------------------------------\n",
      "Successfully finished deployment creation, deployment_uid='abf3959e-b7bd-4fde-
9f34-1295348fea93'\n",
      "-------------------------------------------------------------------------------------------------\n",      "\n",
      "\n"
     ]
    }
   ],
   "source": [
    "# Deploy\n",
    "deployment = wml_client.deployments.create(\n",
    "    artifact_uid=model_id, \n",
    "    meta_props=deployment_props \n",
    ")"
   ]
  },
  {
   "cell_type": "code",
   "execution_count": null,
   "metadata": {},
   "outputs": [],
   "source": []
  }
 ],
 "metadata": {
  "colab": {
   "collapsed_sections": [],
   "provenance": []
  },
  "kernelspec": {
   "display_name": "Python 3.9",
   "language": "python",
   "name": "python3"
  },
  "language_info": {
   "codemirror_mode": {
    "name": "ipython",
    "version": 3
   },
   "file_extension": ".py",
   "mimetype": "text/x-python",
   "name": "python",
   "nbconvert_exporter": "python",
   "pygments_lexer": "ipython3",
   "version": "3.9.13"
  }
 },
 "nbformat": 4,
 "nbformat_minor": 1
}
```

GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project-38319-1660377953

DEMO LINK

https://drive.google.com/file/d/118dL30CuuwKDxkTKR_zTKDppbsVfsn7C/view?usp=drivesdk