FLIGHT DELAY PREDICTION USING MACHINE LEARNING

HX8001- PROFESSIONAL READINESSFOR INNOVATION,EMPLOYABILITY AND ENTREPRENEURSHIP

Submitted by

CELCIYA J	**19P209**
SHARON SHAJU	**19P240**
SHEELADHARSHINI I	**19P241**
SWETHA G	**19P245**

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ANNA UNIVERSITY :: CHENNAI 600 025

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CONTENT

CHAPTER NO. TITLE

CHAPTER 1
INTRODUCTION

Air transportation system is one of the crucial modes of modern versatility. With increasing congestion in air traffic and passenger-traffic, it is important to maintain persistence and resilience. Availability of land and resources contribute to the infrastructure of airports. The norms of improving technology and procedure are to maintain safety, efficiency, capacity, etc., Therefore, the National Airspace System (NAS) focuses on minimizing the environmental effects as a result of improvisation. With the current technology in hand, passengers can visualise their flight path, altitude, heading and other related parameters during their journey. However, air-traffic authorities continuously try to depreciate the delay in departure and arrival of flights. Though their efforts were in phase, the outcome is undesirable as the delays are in terms of hours sometimes causing chaos. Some important parameters that cause delay include weather, maintenance, security, and carrier. Corporate travel and tourism are the two major contributors to flight transportation system which is expected to be doubled by 2030.

As a result of this increase, the air traffic is also expected to increase in the same multiple. To minimise the air-traffic congestion new airports can be constructed. But, the complexity still grows exponentially. Hence, the only possible way of minimizing the delay is to improvise the existing airports. Considering the limited availability of land resources, the latter is more of a logical solution. Delay basically represents the period by which the aircraft is late or cancelled. Commercial aviation is likely to be affected if there is a delay in their mobility. This delay results in the dissatisfaction of trusted customers and sometimes even marketing strategies. With a view of understanding the flight system, scientists and researchers stored the vast amount of data recorded over the entire course of a flight journey.

1.1 PROJECT OVERVIEW

As population increases tremendously and time is everything for many billionaire. Here the importance of Flights were raised, but due to high cost and some continuous delay of flight made less eyes on flights in 1960’s, but due to government help many companies have been started manufacturing flights with less cost and more comfort and many Airports, this made control of airlines traffic. Airlines Economy play a predominant role in countries economy, so there is huge losses had occurred, we all know recent technology of Machine learning is one of the way to determine the flight delays. Mining techniques for instances applied to airlines topics rise rapidly due to their high concert in predicting outcomes, reducing costs of cancellation, promoting excellent airline transportation, improves customers counting and making real time choice to save people’s time, money and completing their work smoothly.

1.2 PURPOSE

The demand for air transport has increased over the last few decades. On average 44000 flights flew carrying 2.9 Million passengers and 121 Billion pounds of freight daily in 2018. Between 2011 and 2017, the total number of commercial flights operating in a year decreased by around 6.7%, while the total number of delayed minutes increased by the same percentage (Figure 1.1.1). Although the number of flights1 has declined since 2013, the ratio between total delay minutes per year to the number of flights has increased. The Federal Aviation Agency (FAA) forecast predicts that flight operations will increase by nearly 35% in the next 20 years, i.e., around 1.5% each year for all commercial airlines (Aviation Administration, n.d.), which is likely to increase the total delays even further. According to the National Center of Excellence for Aviation Operations Research (NEXTOR) Report published in 2010, the total cost (direct and indirect cost) of domestic airline delays to the US economy was around $32 Billion in 2007 (Ball et al., 2010). The total cost to the US economy due to the airline delay was around $26.6 Billion in 2017 (Airlines For America, 2018). The cost to airlines fell from $82.2/minute to $68.48/minute, while the cost to passengers increased from $37.6/hour to $49/hour between 2007 and 2017 (Airlines For America, 2018; Ball et al., 2010). Over the next 20 years, the number of passengers traveling via commercial airlines is expected to grow from 840.8 Million in 2017 to 1.28 Billion (Bureau of Transportation Statistics, 2017).

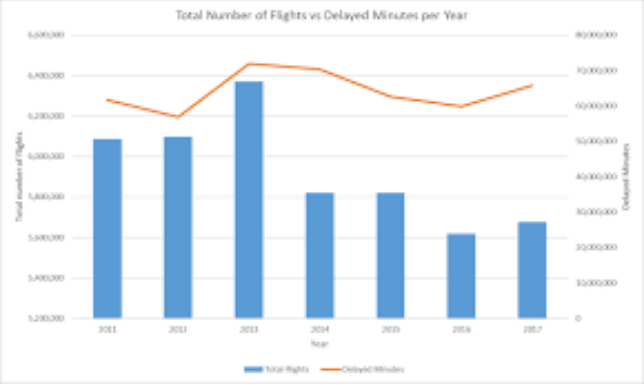


Figure1.1.1:NumberofFlightsvsDelayedMinutes(2011-2017)

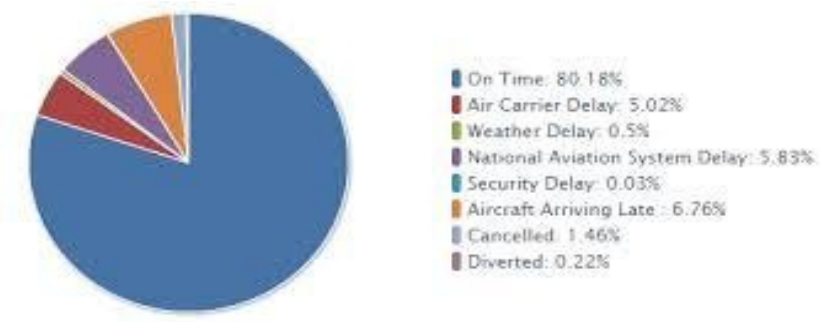


Figure1.1.2:On-TimeAirlinePerformance(Jan2017-Dec2017)(BureauofTransportationStatistics, 2017)

With the expected increase in passengers and cargo transported using airlines, the per minute and the total cost due to airline delays is likely to increase substantially. Statistical models can be utilized to assist airlines in predicting flight delays. Thus, the goals for this dissertation are to develop classification models for airline delays and predict the amount of delay time using different machine learning algorithms using different factors (controllable and uncontrollable 3 variable). The classification andprediction models can assist airlines in reducing cost due to airline delays through improveddecision making.

CHAPTER 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 airline 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 proposedmethods are not accurate enough because of massive volume data, dependencies and extreme number of parameters.Disadvantages: Finding an accuracy of flight delay is less.It does not have required parameters for finding flight delay.

2.2 REFERENCES

1. Amachinelearningapproachforpredictionofon-timeperformanceof flights:

One of the major business problems that airlines face is the significant costs that areassociated with flights being delayed due to natural occurrences and operational short comings, whichis an expensive affair for the airlines, creating problems in scheduling and operations for the end-users thus causing bad reputation and customer dissatisfaction. In our paper, a two-stage predictive model was developed employing supervised machine learning algorithmsfor the prediction offlight ontimeperformance. The first stage of the model performs binary classification to predict theoccurrence of flight delays and the second stage does regression to predict the value of the delay in minutes. The dataset used for evaluating the model was obtained from historical data which contains flight schedules and weather data for 5 years. It was observed that, in the classification stage, Gradient Boosting Classifier performed the bestand inthe regression stage, Extra-Trees Regressor performed the best. The performance of the other algorithms is also extensively documented in the paper.Further more, a real-time Decision Support Tool was built using the model which utilizes features that are

readily available before the departure of an airplane and can inform passengers and airlines about flight delays in advance, helping them reduce possiblemonetary losses.

2.Analysis ofthe potentialfor delaypropagation inpassenger airlinenetworks:

The paper analyzes the potential for delays to propagate in passenger airline networks. The aim is to better understand the relationship between the scheduling of aircraft and crew, and the operational performance of such schedules. In particular, when carriers decide how to schedule costly resources, the focus is primarily on achieving highlevels of utilization. The resulting plans, however, often have little slack, limiting the schedule's ability to absorb disruption; instead, initial flight delays may propagate todelay subsequentflights as well. Understanding the relationship between planned schedules anddelay propagationis are quisite precursorto developing tools for building more robust airline plans. This relationship is investigated using the flightdata provided by two major UScarriers, onetraditional hub-and-spoke and one low-fare carrier operating apredominantly point-to-point network

3.Estimation ofarrival flightdelay anddelay propagationin abusy hub-airport:

In recent years, flight delay problem blocks the development of the civil aviation industry all overthe world.And delay propagation always is a main factor thatimpacts the flight's delay. All kinds of delays often happen in nearly-saturated or overloaded airports. This paper we take one busy hub-airport as the main research object to estimate the arrival delay in this airport, and to discuss the influence of propagation within and from this airport. First, a delay propagation model is described qualitatively in mathematics after sorting and analyzing the relationships between all flights, especially focused on the frequently type, named aircraft correlation. Second,an arrival delay model is established based on Bayesian network. By training the model, the arrival delay in this airport can be estimated. Third, after clarifying the

arrival status of one airport, the impact from propagation of arrival delays within and from this busy airport is discussed, especially between the flights belonging to one same air company. All the data used in our experiments is come from real records, forthe industrysecret, thename ofthe airportand theair companyis hidden.

4.Flight delayprediction systemusing weightedmultiple linearregression:

Airline delays caused by bad weather, traffic control problems and mechanical repairs are difficult to predict. If your flight is canceled, most airlines will rebook you on the earliest flight possible to your destination, at no additional charge. Unfortunately for airline travelers, however, many of these flights do not leave on-time. The issue of delayis paramountfor anyairlines. Thereforewe intendto aidthe airlinesby predictingthe delaysby usingcertain datapatterns fromthe previousinformation. This system explores what factors influence the occurrence of flight delays along with the intensity of the delays. Our method is based on archived data at major airports in current flight information systems. Classification in this scenario is hindered by the large number of attributes, which might occlude the dominant patterns of flight delays. The results of data analysis will suggest that flight delays follow certain patterns that distinguishthem fromon-time flights.Our system also provides current weather detailsalong withthe weatherdelay probability.We haveachieved much betteraccuracy in predicting delays. We may also discover that fairly good predictions can bemade onthe basison afew attribute.

5. Machine LearningApproach forFlight DepartureDelay PredictionandAnalysis:

The expectedgrowth inair traveldemand andthe positivecorrelation with the economic factors highlight the significant contribution of the aviation community tothe U.S. economy. On-time operations play a key role in airline performance andpassenger satisfaction.Thus, an accurate investigation of the variables that causedelays is of major importance. The application

of machine learning techniques in datamining has seen explosive growth in recent years and has garnered interest from abroadening variety of research domains including aviation. This study employed a support vector machine (SVM) model to explore the non-linear relationship between flight delay outcomes. Individual flight data were gathered from 20 days in 2018 to investigate causes and patterns of air traffic delay at three major New York Cityairports. Considering the black box characteristic of the SVM, a sensitivity analysis wasperformed toassess therelationship between dependent and explanatory variables. The impacts of various explanatory variables are examined in relation to delay,weather information,airport groundoperation,demand-capacity, andflow management characteristics. The variable impact analysis reveals that factors such as pushbackdelay, taxi-outdelay, ground delay program,and demand-capacityimbalance with the probabilities of 0.506, 0.478, 0.339, and 0.338, respectively, aresignificantly associated with flight departure delay. These findings provide insight forbetter understanding of the causes of departure delays and the impacts of various explanatory factors on flight delaypatterns.

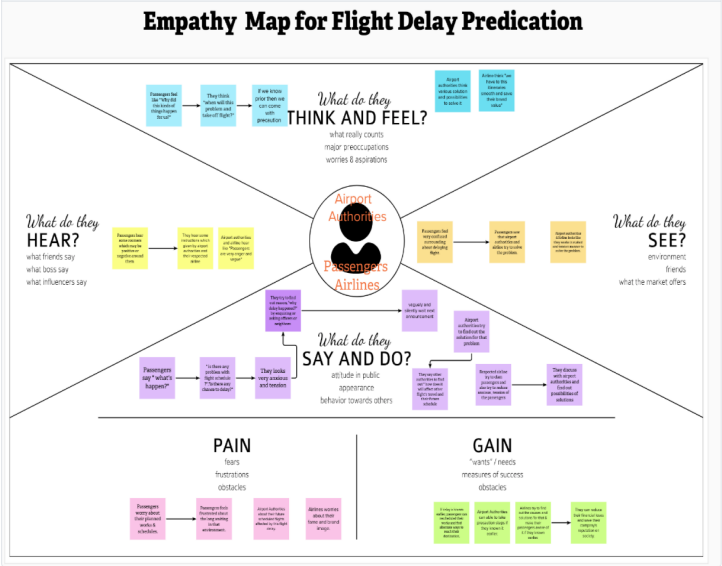
2.3 PROBLEM STATEMENT DEFINITION:

My case study was about LaGuardia Airport in New York, Logan International Airport in Boston, San Francisco International Airport in San Francisco, and O'Hare International Airport in Chicago, which are four major airports in the United States of America. But we focused the idea and research on LaGuardia International Airport. Compared with the data produced by all airports in USA, the data which we gathered was very limited, but it gave us a great direction on how weather plays a part in flight delays. In this project, the goal is to use exploratory analysis and to build machine learning models to predict airline departure and arrival delays.

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS:



3.2 IDEATION & BRAINSTORMING:

2

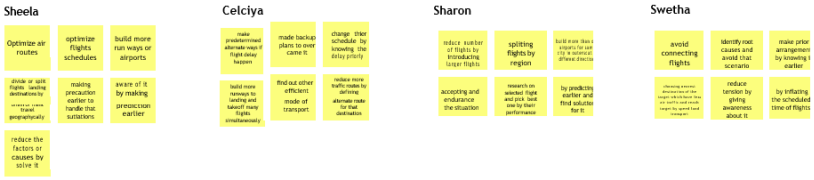
Brainstorm

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

10 minutes

TIP

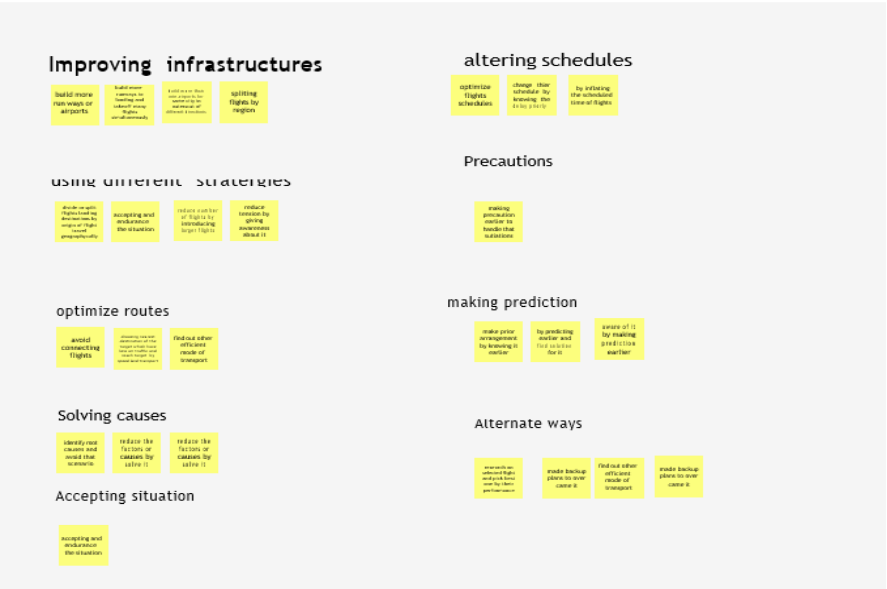
You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

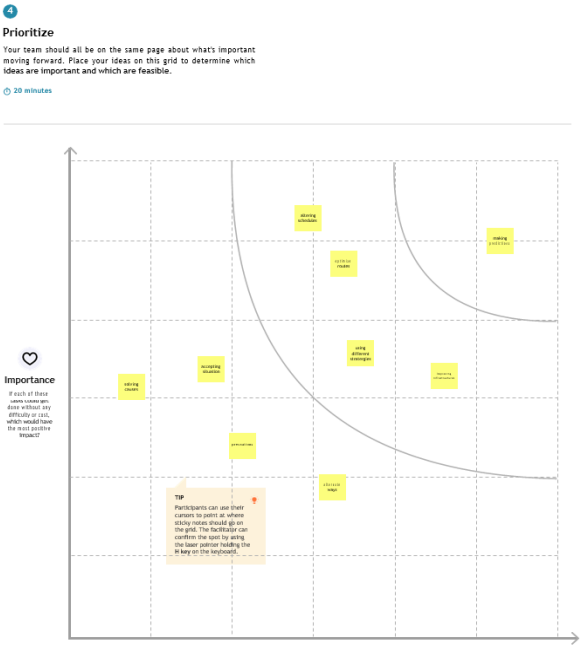


Group ideas

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

20 minutes





3.3 PROPOSED SOLUTION:

Project Design Phase-I
Proposed Solution Template

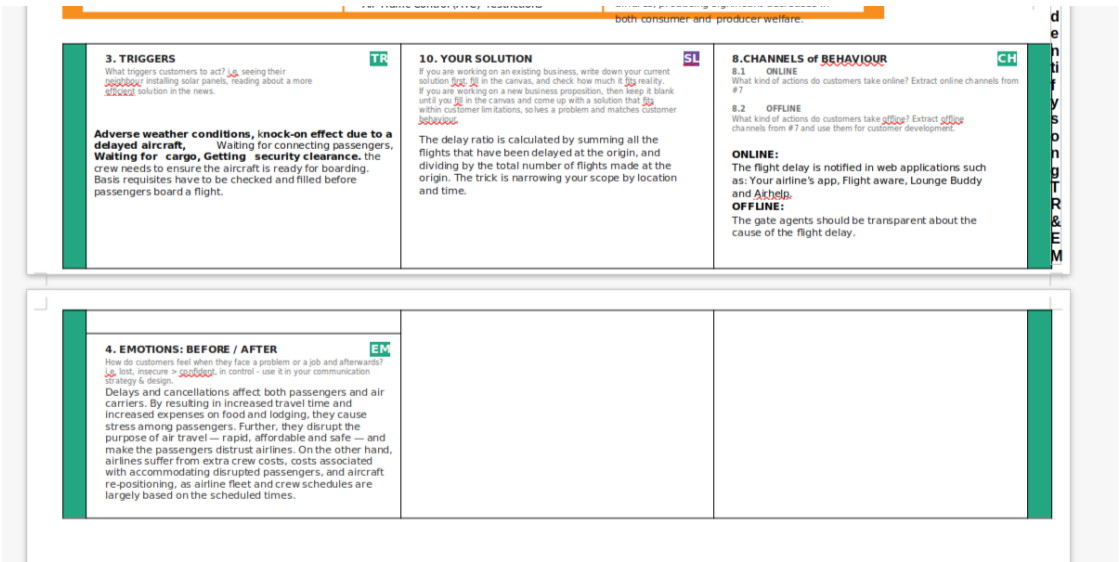
Date	1 November 2022
Team Id	PNT2022TMID12521
Project Name	Project – Developing a flight delay prediction model by using machine learning
Maximum Marks	2 Marks

Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The main objective of the model is to predict flight delays accurately in order to optimize flight operations and minimize delays.
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	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 and a simple neural network
4.	Social Impact / Customer Satisfaction	It makes the air transportation more efficient and saves more time for the passengers
5.	Business Model (Revenue Model)	Using this model, we can create a revenue by giving appropriate solution about the delay to the people
6.	Scalability of the Solution	This makes the people to take the action according to the delay and it improves time management, business value and more

3.4 PROBLEM SOLUTION FIT:



both consumer and producer welfare.

3. TRIGGERS TR

What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.

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.

10. YOUR SOLUTION SL

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

The delay ratio is calculated by summing all the flights that have been delayed at the origin, and dividing by the total number of flights made at the origin. The trick is narrowing your scope by location and time.

8.CHANNELS of BEHAVIOUR CH

8.1 ONLINE
What kind of actions do customers take online? Extract online channels from #7

8.2 OFFLINE
What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

ONLINE:
The flight delay is notified in web applications such as: Your airline's app, Flight aware, Lounge Buddy and Airhelp.
OFFLINE:
The gate agents should be transparent about the cause of the flight delay.

identifyscongTR&EM

4. EMOTIONS: BEFORE / AFTER EM

How do customers feel when they face a problem or a job and afterwards?
i.e. lost, insecure > confident, in control - use it in your communication strategy & design.

Delays and cancellations affect both passengers and air carriers. By resulting in increased travel time and increased expenses on food and lodging, they cause stress among passengers. Further, they disrupt the purpose of air travel — rapid, affordable and safe — and make the passengers distrust airlines. On the other hand, airlines suffer from extra crew costs, costs associated with accommodating disrupted passengers, and aircraft re-positioning, as airline fleet and crew schedules are largely based on the scheduled times.

CHAPTER 4
REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Registered User -Login	Login through password Login through Gmail Login through LinkedIn
FR-4	Verify the link provided by the user	User inputs the link to be verified
FR-5	Display the result	If the site link is a prediction site, user must be aware and read the precautions displayed If the site link is legit exit the application
FR-6	Share Queries	If any doubts, send query Read FAQs

4.2 NON-FUNCTIONAL REQUIREMENTS

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Describes the ease of use for the customers.
NFR-2	**Security**	Assures all data inside the system or its part will be protected against malware attacks or unauthorized attacks.
NFR-3	**Reliability**	Specifies the probability of the software performing without failure for a specific number of uses or amount of time.
NFR-4	**Performance**	Deals with the measure of the system's response time under different load conditions.
NFR-5	**Availability**	Describes how likely the system is accessible for a given user at a given point of time.
NFR-6	**Scalability**	Assesses the highest workloads under which the system will still meet the performance requirements.

CHAPTER 5
PROJECT DESIGN

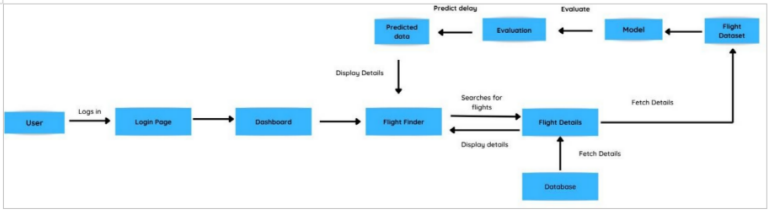
5.1 DATA FLOW DIAGRAM

Project Design Phase-II
Data Flow Diagram & User Stories

Date	03 November 2022
Team ID	PNT2022TMID12521
Project Name	Project – Developing a flight delay prediction model by using machine learning
Maximum Marks	4 Marks

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.



User Stories

Use the below template to list all the user stories for the product.

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
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for	I can register &	Low	Sprint-2

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
			the application through Facebook	access the dashboard with Facebook Login		
	Login	USN-5	As a user, I can log into the application by entering email & password	I can access the dashboard	High	Sprint-1
	Dashboard	USN-6	As a user, I can navigate through different pages using the dashboard	I can access various pages	High	Sprint-1
	Search	USN-7	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-8	As a user, I can view the details of flights.	I will get the information such as flight number, departure and arrival time.	High	Sprint-2
	Receive notifications	USN-9	As a user, I will receive notifications about the flight.	I will get frequent updates of the flight's location	Low	Sprint-3

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
	Track	USN-10	As a user, I will track the location of my flight.	I can track my flight.	High	Sprint-3,4
Administrator	GPS	USN-11	As an admin, I will need the location of flights	I can track my flight.	High	Sprint-3,4
	Analyse	USN-12	As an admin, I will analyse the given dataset	I can analyse the dataset	High	Sprint-2
	Predict	USN-13	As an admin, I will predict the delays	I can predict the flight delays	High	Sprint-2

5.2 SOLUTION & TECHNICAL ARCHITECTURE:

Project Design Phase-I
Solution Architecture

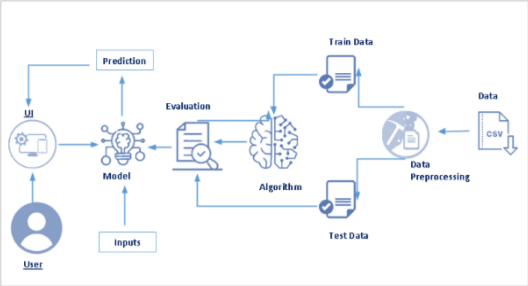
Date	1 November 2022
Team Id	PNT2022TMID12521
Project Name	Project – Developing a flight delay prediction model using machine learning
Maximum Marks	4 Marks

Solution Architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.

Example - Solution Architecture Diagram:



CHAPTER 6
PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Oct 2022
Sprint-3	25	6 Days	07 Nov 2022	12 Nov 2022	19	07 Oct 2022
Sprint-4	25	6 Days	14 Nov 2022	19 Nov 2022	20	14 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) periteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Sprint 1& Sprint 2:

AV= 20/6 =3.3

Sprint 3& Sprint 4:

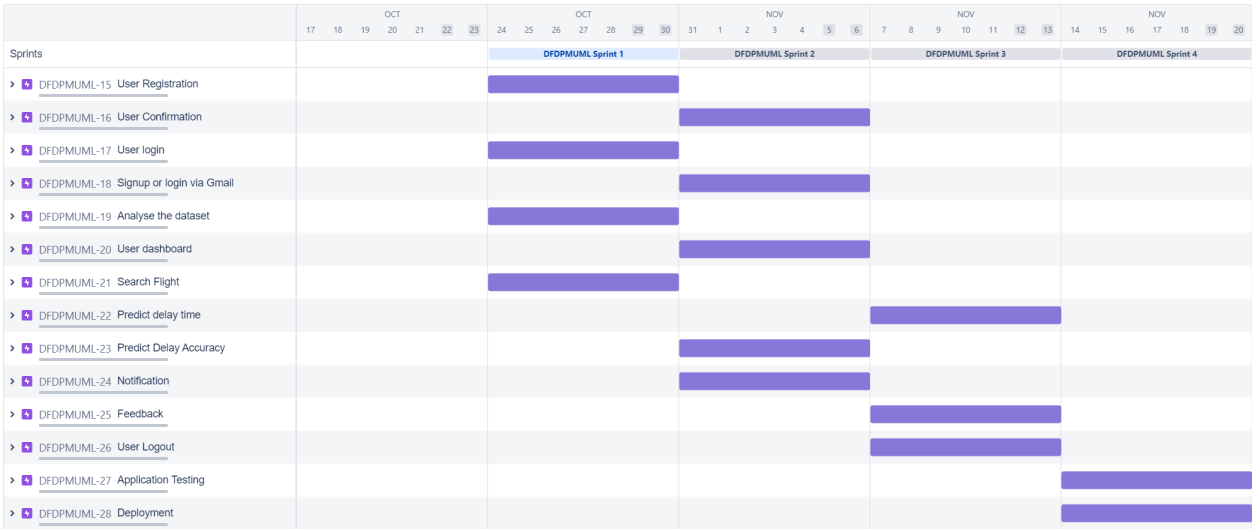
AV=25/6=4.1

6.2 SPRINT DELIVERY SCHEDULE

Use the below template to create product backlog and sprint 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.	2	High	Celciya
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Sheela
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	Swetha
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	Sharon
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Swetha
Sprint-3	Dashboard	USN_6	To view dashboard on our project and check Customer information.	2	High	Sharon
Sprint-4	Review	USN-7	As a customer review our site.	1	High	Sheela

6.3 REPORTS FROM JIRA



CHAPTER 7
CODING & SOLUTIONING

7.1 FEATURE 1

1.contact.html

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Document</title>
    <link
href="https://fonts.googleapis.com/css2?family=Poppins&family=Roboto+Slab&displ
ay=swap" rel="stylesheet">
    <link rel="stylesheet" href="static/css/Contact.css">
    <link rel="stylesheet" href="https://stackpath.bootstrapcdn.com/font-
awesome/4.7.0/css/font-awesome.min.css" integrity="sha384-
wvfXpqpZZVQGK6TAh5PVlGOfQNHSoD2xbE+QkPxCAFlNEevoEH3Sl0sibVcOQVnN"
crossorigin="anonymous"><link rel="stylesheet"
href="https://stackpath.bootstrapcdn.com/font-awesome/4.7.0/css/font-
awesome.min.css" integrity="sha384-
wvfXpqpZZVQGK6TAh5PVlGOfQNHSoD2xbE+QkPxCAFlNEevoEH3Sl0sibVcOQVnN"
crossorigin="anonymous">
</head>
<body>




    <div class="container">
        <header>
            <h1>Contact Us</h1>
            <p>
                we here to support<br> pls ask your querries<br>
            </p>
        </header>
        <div class="content">
            <div class="content-form">
                <section>
                    <i class="fa fa-map-marker fa-2x" aria-hidden="true"></i>
                    <h2>address</h2>
```

```
                <p>
                    abc<br>
                    efgh<br>
                    ijkl<br>
                    mnop<br>
                    xyz
                </p>
            </section>

            <section>
                <i class="fa fa-phone fa-2x" aria-hidden="true"></i>
                <h2>Phone</h2>
                <p>123-456-78901548</p>
            </section>

            <section>
                <i class="fa fa-envelope fa-2x" aria-hidden="true"></i>
                <h2>E-mail</h2>
                <p>squad1234@gmail.com</p>
            </section>
        </div>
    </div>

<form>
    <div class="form">
        <div class="right">
            <div class="contact-form">
                <input type="text" required>
                <span>Full Name</span>
            </div>

            <div class="contact-form">
                <input type="E-mail" required>
                <span>E-mail Id</span>
            </div>
            <div class="contact-form">
                <textarea name="text">

                </textarea>
                <span> Type your Message....</span>
            </div>

            <div class="contact-form">
                <input type="submit" name="submit">
            </div>
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              </div>
            </div>
          </div>
    </form>
        <div class="media">
            <li><i class="fa fa-facebook-square fa-2x" aria-
hidden="true"></i></li>
            <li><i class="fa fa-instagram fa-2x" aria-hidden="true"></i></li>
            <li><i class="fa fa-whatsapp fa-2x" aria-hidden="true"></i></li>
            <li><i class="fa fa-twitter-square fa-2x" aria-
hidden="true"></i></li>
        </div>
        <div class="empty">

        </div>
    </div>
    <figure>
        <img src="static/img/contact.jfif">
    </figure>
</body>
</html>
```

2.failed.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://kit.fontawesome.com/64d58efce2.js" crossorigin="anonymous"></script>
    <link rel="stylesheet" href="path/to/font-awesome/css/font-awesome.min.css">
    <!-- CSS only -->
    <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css"
rel="stylesheet"
        integrity="sha384-
Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1WTRi"
crossorigin="anonymous">
    <link rel="stylesheet" href="static/css/result.css">
    <title>Result of Prediction</title>
```

```
</head>

<body>
   <div class="circle"></div>
   <div class="content">
      <div class="textBox">
         <h1 id="mesg">The flight will be delayed</h1><br>


         <h2>We are sorry!!!<i class="fa-regular fa-face-pensive"></i></h2>
      </div>

   </div>


</body>

</html>
```

3.form.html

```
<!DOCTYPE html>
<!-- Created By CodingLab - www.codinglabweb.com -->
<html lang="en" dir="ltr">
  <head>
    <meta charset="UTF-8">
    <!---<title> Responsive Registration Form | CodingLab </title>--->
    <link rel="stylesheet" href="static/css/form1.css">
     <meta name="viewport" content="width=device-width, initial-scale=1.0">
   </head>
<body>
   <div class="main">

      <div class="navbar">
         <header>
            <h2><a href="#" class="logo">SQUAD</a></h2>
            <div class="navigation">
```

```
        <a href="{{ url_for('home') }}">HOME</a>
  <a href="{{ url_for('form1') }}">Prediction</a>

  <a href="{{ url_for('contact') }}">Contact</a>

      </div>
    </header>
</div>

<div class="form11">

   <div class="container">

      <div class="title">Details</div>
      <div class="content">
       <form action="predict11" method="POST">
        <div class="user-details">
          <div class="input-box">
            <span class="details">MONTH</span>
            <input type="text" placeholder="Enter here" name="month" required>
           </div>
           <div class="input-box">
            <span class="details">DATE</span>
            <input type="text" placeholder="Enter here" name="date" required>
           </div>

          <div class="input-box">
           <span class="details">Flight_No</span>
           <input type="text" placeholder="Enter here" name="Flight_No" required>
          </div>
          <div class="input-box">
           <span class="details">ORGIN_AIRPORT_ID</span>
           <input type="text" placeholder="Enter here"  name="origin_airport_id" required>
          </div>
          <div class="input-box">
           <span class="details">DEST_AIRPORT_ID</span>
           <input type="text" placeholder="Enter here" name="dest_airport_id" required>
          </div>
```

```
                <div class="input-box">
                  <span class="details">CRS_Dep_Time</span>
                  <input type="text" placeholder="Enter here" name="crs_dep_time" required>
                </div>
                <div class="input-box">
                  <span class="details">CRS_Arr_TIME</span>
                  <input type="text" placeholder="Enter here"name="crs_arr_time" required>
                </div>
                <div class="input-box">
                  <span class="details">Dep_TIME</span>
                  <input type="text" placeholder="Enter here"name="dep_time" required>
                </div>
               </div>


                <div class="button">
                  <input type="submit" value="PREDICT">
                </div>
              </form>
            </div>
          </div>

      </div>

   </div>

</body>
</html>
```

4)home.html

```
<!DOCTYPE html>
<html>
<head>
 <title></title>
 <link rel="stylesheet" type="text/css" href="static/css/home.css">
 <link href="https://fonts.googleapis.com/css?family=Josefin+Sans&display=swap"
rel="stylesheet">
</head>
```

```
<body>
<header>
 <div class="mainheader">
  <div >
    <a class="logo">SQUAD</a>

  </div>

  <nav>
    <a href="{{ url_for('home') }}">HOME</a>
    <a href="{{ url_for('form1') }}">Prediction</a>

    <a href="{{ url_for('contact') }}">Contact</a>

  </nav>

  <div class="menubtn">
   <button> <a href="{{ url_for('logout') }}">LOG OUT</a></button>

  </div>
 </div>

<!--   DONATION FOR SUPPORT:    PhonePay = vinodbahadur@ybl      GooglePay:
vbthapa55@oksbi
 Believe me, all this money will be used to make more quality videos and to make my channel
grow. So that I can always provide you awesome free videos :) -->

 <main>
  <section class="left-sec">
   <h1> flight Delay Prediction</h1>
   <h2>using data science</h2><br><br>
   <nav>
   <button ><a href="https://dl.acm.org/doi/fullHtml/10.1145/3497701.3497725"> learn
more</a></button></nav>
  </section>

  <!-- <section class="right-sec">
```

```
  <figure>
   <img src="/static/img/home.jfif">
  </figure>
 </section> -->
</main>
</header>
</body>
</html>
```

5)login.html

```
<!DOCTYPE html>

<html lang="en" dir="ltr">
  <head>
    <meta charset="utf-8">
    <title>Login Form Design | CodeLab</title>
    <link rel="stylesheet" href="static/css/login.css">
  </head>
  <body>

    <div class="wrapper">
      <div class="title">
        Login
      </div>
      <form action="{{ url_for('login') }}" method="POST">
        <div class="field">
          <input type="text" name="email" required>
          <label>Email Address</label>
        </div>
        <div class="field">
          <input type="password" name="password" required>
          <label>Password</label>
        </div>
        <div class="content">
          <div class="checkbox">
            <input type="checkbox" id="remember-me">
```

```
            <label for="remember-me">Remember me</label>
          </div>
          <div class="pass-link">
           <a href="#">Forgot password?</a>
        </div>
      </div>
      <div class="field">
        <input type="submit" value="Login">
      </div>
      <div class="signup-link">
        Not a member? <a href="{{ url_for('register') }}">Register</a>
      </div>
    </form>
  </div>
</body>
</html>
```

6)register.html

```
<!DOCTYPE html>

<html lang="en" dir="ltr">
  <head>
    <meta charset="utf-8">
    <title>register Form Design | CodeLab</title>
    <link rel="stylesheet" href="static/css/regiter.css">
  </head>
  <body>
    <div class="wrapper">
      <div class="title">
        Register
      </div>
      <form action="{{ url_for('register') }}" method="POST">
        <div class="field">
          <input type="text" name="name" required>
          <label>User name</label>
         </div>
        <div class="field">
```

```
            <input type="text" name="email" required>
            <label>Email Address</label>
          </div>
          <div class="field">
            <input type="password" name="password" required>
            <label>Password</label>
          </div>
          <div class="content">
            <div class="checkbox">
              <input type="checkbox" id="remember-me">
              <label for="remember-me">Remember me</label>
            </div>
            <div class="pass-link">
             <a href="#">Forgot password?</a>
            </div>
          </div>
          <div class="field">
            <input type="submit" value="Register">
          </div>
          <div class="Login-link">
            already a member? <a href="{{ url_for('logout') }}">LOGIN</a>
          </div>
      </form>
    </div>
</body>
</html>
```

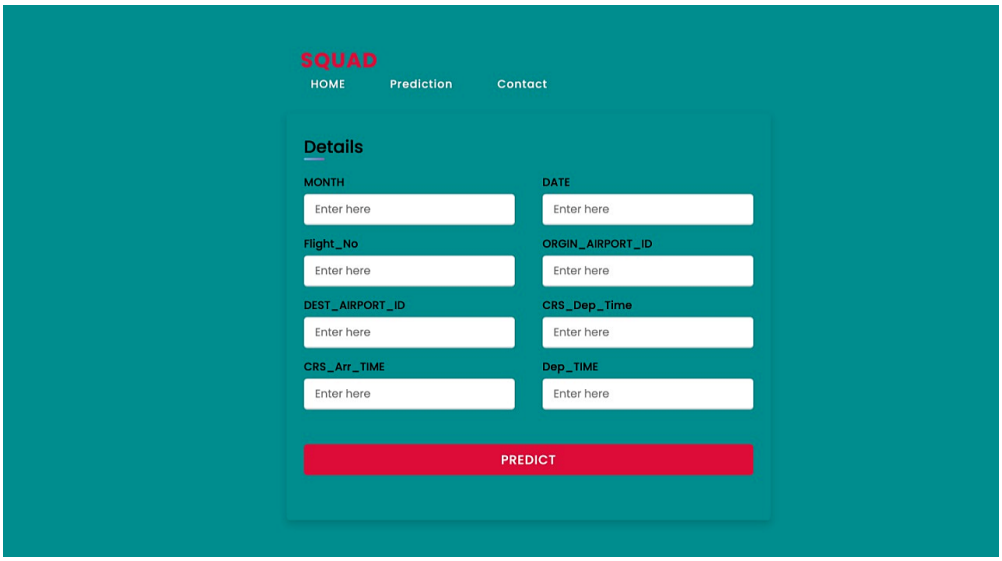
7)success.html

```
<!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://kit.fontawesome.com/64d58efce2.js" crossorigin="anonymous"></script>
    <link rel="stylesheet" href="path/to/font-awesome/css/font-awesome.min.css">
    <!-- CSS only -->
    <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css"
rel="stylesheet"
        integrity="sha384-
Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1WTRi"
crossorigin="anonymous">
    <link rel="stylesheet" href="static/css/result.css">
    <title>Result of Prediction</title>
</head>

<body>
    <div class="circle"></div>
    <div class="content">
        <div class="textBox">
            <h1 id="mesg">Happy and safe journey</h1><br>
            <h2>The Flight will be on Time.</h2><br>

            <h2><i class="fa-regular fa-face-pensive"></i></h2>
        </div>

    </div>


</body>

</html>
```

CHAPTER 8
TESTING

INPUT:



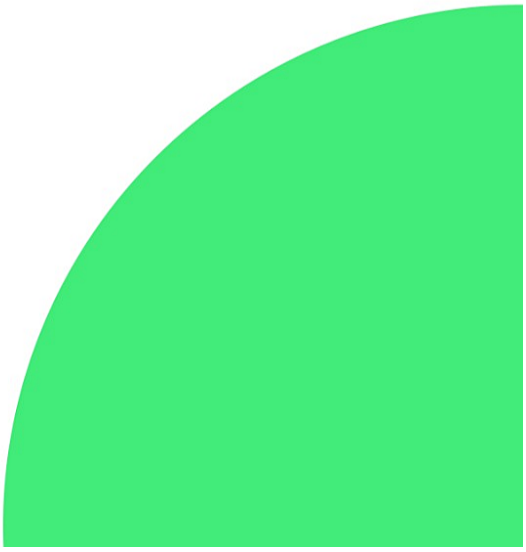
OUTPUT:

The flight will be delayed

We are sorry!!!

Happy and safe journey

The Flight will be on Time.



CHAPTER 9

9.RESULTS

9.1 Performance Metrics

	precision	recall	f1-score	support
0	0.89	0.95	0.92	22717
1	0.75	0.56	0.64	6375
accuracy			0.86	29092
macro avg	0.82	0.76	0.78	29092
weighted avg	0.86	0.86	0.86	29092

CHAPTER 10

ADVANTAGES AND DISADVANTAGES

- Due to the stochastic nature of delays, this research investigates the qualitative prediction of airline delays to implement necessary changes and provide better customer experience.
- The running time of all the algorithms increases almost linear.
- High in performance and data retrieval latency time.

CHAPTER 11

CONCLUSION

Predicting flight delays is on interesting research topic and required many attentions these years. Majority of research have tried to develop and expand their models in order to increase the precision and accuracy of predicting flight delays. Since the issue of flights being on-time is very important, flight delay prediction models must have high precision and accuracy.Based on the analysis of their results, it is evident that the integration of multidimensional heterogeneous data, combined with the application of different techniques for feature selection and regression can provide promising tools for inference in the cancer domain. Regardless of the type of prediction task at hand; regression or classification. It has become the state-of-the-art machine learning algorithm to deal with structured data. Compare to all algorithms MLP algorithm gives high accuracy that is 82%.

CHAPTER 12

FUTURE SCOPE

In future work, other machine learning technologies can be utilized to study flight delay prediction. Moreover, it can also pay close attention to weather influence on a flight delay. In this research, we does not add exact weather-related features in the prediction model but that does not mean weather influence is unimportant. On the contrary, we believe that studying the influence of weather on flight delays is a significant and complex issue. We will focus more on establishing reasonable features to measure the impact of weather on flight delays, especially for high-impact weather, and use machine learning correlation analysis technology to explore the relatedness between weather and flight delay.

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.

CHAPTER 13
APPENDIX

1. Bureau of Transportation Statistics, “Bureau of Transportation Statistics”.
2. M. Ball, C. Barnhart, M. Dresner et al., “Total delay impact study,” 2010.
3. E. Esmaeilzadeh and S. Mokhtarimousavi, “Machine learning approach for flight departure delay prediction and analysis,” *Transportation Research Record: Journal of the Transportation Research Board*, vol. 2674, no. 8, pp. 145–159, 2020.
4. N. L. Kalyani, G. Jeshmitha, U. Bindu Sri Sai, M. Samanvitha, J. Mahesh, and B. V. Kiranmayee, “Machine learning model - based prediction of flight delay,” in *Proceedings of the 2020 Fourth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)*, Palladam, India, November 2020.