

# **EXPLORATORY ANALYSIS OF RAIN FALL DATA IN INDIA FOR AGRICULTURE**

**Academic Year 2019-2023**

**IBM Project :** 42906-1662634564

**Team ID :** PNT2022TMID4420

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SUBMITTED IN THE PARTIAL FULFILLMENT FOR REQUIREMENTS  
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**ELECTRONICS AND COMMUNICATION ENGINEERING**  
BUILDERS ENGINEERING COLLEGE  
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# **1. INTRODUCTION**

## **a. Project overview**

In India, Agriculture contributes major role to Indian economy. For agriculture, Rainfall is important but during these days' rainfall prediction has become a major challenging problem. Good prediction of rainfall provides knowledge and know in advance to take precautions and have better strategy about theirs crops. Rainfall has been a major concern these days. Weather conditions have been changing for time being. Rainfall forecasting is important otherwise, it may lead to many disasters. Irregular heavy rainfall may lead to the destruction of crops, heavy floods that can cause harm to human life. It is important to exactly determine the rainfall for effective use of water resources, crop productivity, and pre-planning of water structures. This comparative study is conducted concentrating on the following aspects: modeling inputs, Visualizing the data, modeling methods, and pre-processing techniques. The results provide a comparison of various evaluation metrics of these machine learning techniques and their reliability to predict rainfall by analyzing the weather data. We will be using classification algorithms such as Decision tree, Random forest, KNN, and xgboost. We will train and test the data with these algorithms. From this best model is selected and saved in pkl format. Once the model is saved, we integrate it with flask application and also deploy the model in IBM. Rainfall remains one of the most influential meteorological parameters in many aspects of our daily lives. With effects ranging from damage to infrastructure in the event of a flood to disruptions in the transport network, the socio-economic impacts of rainfall are noteworthy. Rainfall forecasting has been around for years using traditional methods that employ statistical techniques to assess the correlation between rainfall, geographic coordinates (such as latitude and longitude), and other atmospheric factors (like pressure, temperature, wind speed, and humidity). However, the complexity of rainfall such as its non-linearity makes it difficult to predict

## **b. Purpose**

Rainfall Prediction is the application area to predict the state of the atmosphere. It is important to predict the rainfall intensity for effective use of water resources and crop production to reduce mortality due to flood and any disease caused by rain.

## **2. LITERATURE SURVEY**

### **a. Existing Problem**

Basically, during the summers, the Indian subcontinent heats up more as compared to the Indian ocean as the sun is directly over the landmass. Flooding in key agriculture production areas can lead to widespread damage to crops, fencing and loss of livestock. This affects the farming community just as much as a famine does. As if the crop losses through rain damage, soils that are waterlogged and delayed harvesting are not enough, all these problems are further compounded by transportation problems caused by flooded roads and other damaged infrastructures like fallen trees and electric poles, farmers are often challenged not just by a dearth of water for irrigation but also by floods or an over-abundance of water. Flooding can ruin fields and destroy crops by causing erosion and soil displacement.

### **b. References**

- V. Brahmananda Rao.K. Hada 1994: An experiment with linear regression in forecasting of spring rainfall over south Brazil
- K. Hrona<sub>a</sub>, P. Filzmoser<sub>b</sub> and K. Thompson<sub>c</sub> 2009: Linear regression with compositional explanatory variables.
- A. Bardossy and E. J. Plate. Space-time model for daily rainfall using atmospheric circulation patterns. Water Resources Research, 28(5):1247–1259, 1992
- [S. P. Charles, B. C. Bates, I. N. Smith, and J. P. Hughes. Space-time model for daily rainfall using atmospheric circulation patterns. Hydrological Processes, 18:1373–1394, 2004

### **c. Problem Statement Definition**

Exploratory Analysis of Rainfall is very important because heavy and irregular rainfall can have many impacts like destruction of crops and farms, damage of property so a better forecasting model is essential for an early warning that can minimize risks to life and property and also managing the agricultural farms in better way.

#### **Whom does the problem affect?**

The problem mainly affects the farmers as the prediction of the rain fall is the major key to get a better yield of crops. If it's been misled it could affect the harvesting of the crops which may lead to an increase in the price of food resources.

#### **What are the boundaries of the problems?**

- a. Data of rainfall could be difficult analysis
- b. For the analysis part, we will need reliable data
- c. Prediction of rain fall some times may vary
- d. Optimizing pricing structure

#### **What is the issue?**

If any wrong prediction happens, then it will totally affect the production of the crops and wrong decisions could lead to a massive affect in the urban cities.

#### **When does the issue occur?**

- Excess or poor rainfall as prediction is not always true
- Rainfall fails as on prediction for a certain period of crops
- Harvesting gets affected if there is excessive rain in spite of prediction

#### **Why is it important to fix the issue?**

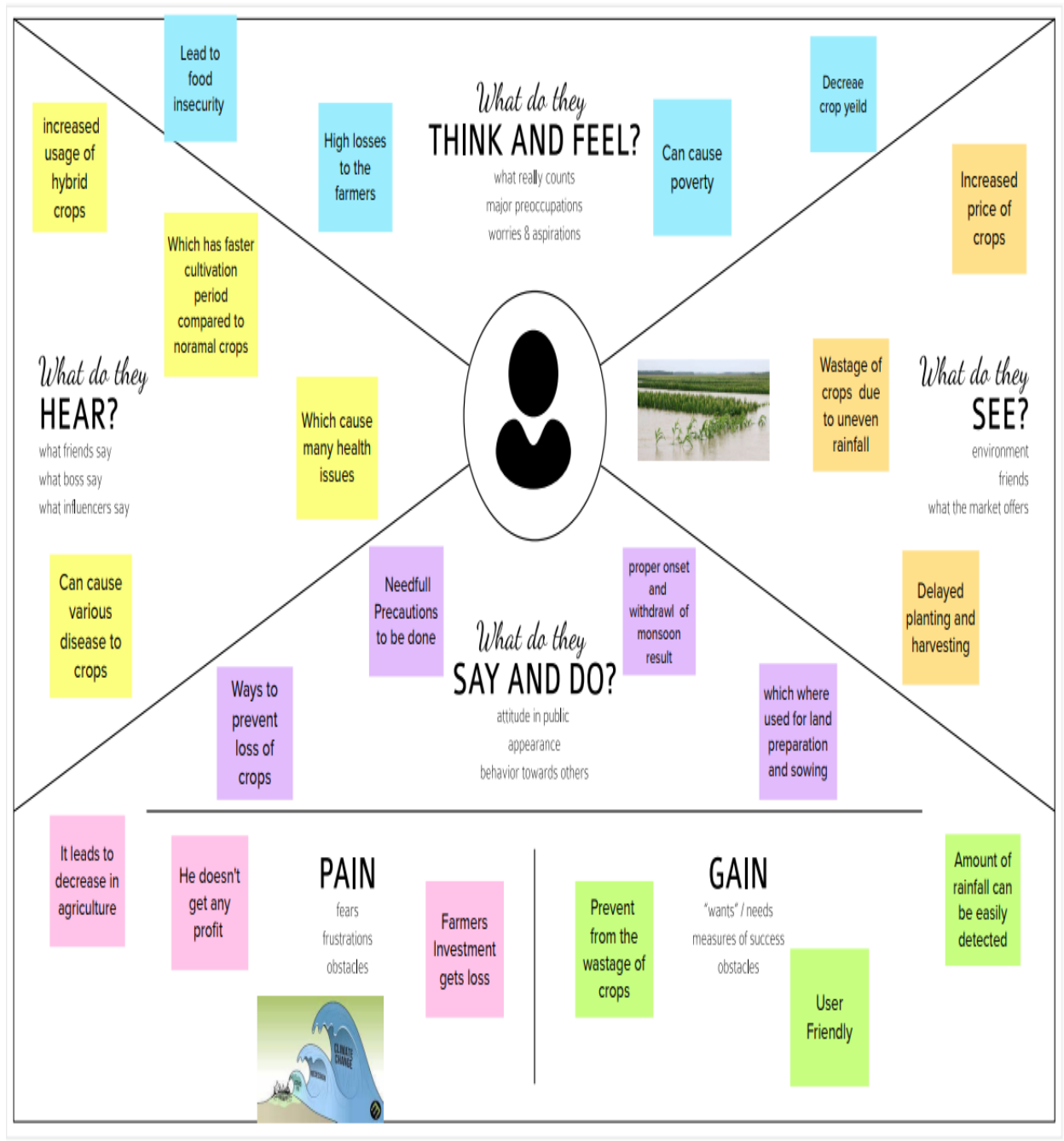
- It is necessary to fix the issues immediately when found because the issues gives a negative result apart from expected result
- If such issues occurs the farmers get mostly affected in cropping and harvesting.
- Sometimes it may also leads to a huge impact which results in loss of lives or loss of food and shelter also.

#### **Where the issue occurs?**

- The improper collection of data could be able to lead the wrong prediction of the rainfall

### 3. IDEATION & PROPOSED SOLUTION

#### a. Empathy Map Canvas



## b. Ideation & Brainstroming



### 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.

[Open article](#) →

### EXPLORATORY ANALYSIS OF RAINFALL DATA IN INDIA FOR AGRICULTURE

#### PROBLEM STATEMENT

Heavy and irregular rainfall can have many irregular impacts on crops and farming lands. Leading to poor growth and overall health of crop

## Harini G

Identify the problem

predicting the amount of rainfall in advance

cultivate the crops based on water needs

Poor environmental conditions

water can be stored efficiently through dams and reservoirs

Usage of natural fertilizers

## Sharulatha R

adaption of new technologies

following new cropping patterns

Trying to find new sources

Cultivate seasonal based crops

Monsoon forecasting is being monitored

Temperature changes are analysed

## Vasanth Priya V

Altered climate changes

Make a rain saucer

Find new ideas to predict crops

Rain gauge is used to measure the amount of rain

Set up a rain cover

Developing Data Science platform to predict the rainfall analysis

## Yogashree J

Analysis rainfall using new technologies like rainfall

Detect the direction of the wind

Machine learning algorithm is used for predicting rainfall

Consulting Meteorologists about weather conditions

Advanced planning in storage of grains

Adopt rainwater harvesting techniques



3

### Group ideas

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

🕒 20 minutes

predicting  
the amount  
of rainfall in  
advance

monsoon  
forecasting  
is being  
monitored

Developing  
Data Science  
platform to  
predict the  
rainfall analysis

Machine  
learning  
algorithm is  
used for  
prediction

4

### Prioritize

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

🕒 20 minutes



→

### After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

#### Quick add-ons

- A Share the mural**  
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- B Export the mural**  
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

#### Keep moving forward

- Strategy blueprint**  
Define the components of a new idea or strategy.  
[Open the template →](#)
- Customer experience journey map**  
Understand customer needs, motivations, and obstacles for an experience.  
[Open the template →](#)
- Strengths, weaknesses, opportunities & threats**  
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.  
[Open the template →](#)

[Share template feedback](#)

## **c. Proposed Solution**

### *Problem Statement*

- Heavy and irregular rainfall can have many impacts like destruction of crops and farmer lands
- Limited food access
- Unsustainable Agricultural practice
- Leading poor growth and overall health of crop

### *Idea/Solution Description*

- Proper analysis of amount of rainfall helps to prevent crop losses
- By calculating the product of the rainfall intensity and the duration (i.e., the rainfall depth) for each rainfall duration, the cumulative rainfall distribution can be derived
- It is important to exactly determine the rainfall for effective use of water resources, crop productivity and pre-planning of water structures
- With advance in science and technology numerous techniques such as Data Mining, Artificial Intelligence, Deep Learning and Machine Learning are employed in the field of rainfall prediction

### *Uniqueness*

- Application uses IBM Watson to predict the future outcomes
- With the help of Machine Learning we can predict rainfall by extracting the hidden patterns from historical weather data
- The speed and accuracy of AI technologies when it comes to processing data in extreme weather conditions that scientist will have a better chance of alerting people in danger
- Exploratory Data Analysis is valuable to Machine learning problem since it allows to get closer to the certainty that the future results will be valid, correctly interpreted and applicable to desired business contexts

### *Social Impact /Customer Satisfaction*

- It is very useful to take decision for farmers
- It prevents from the damage of crops ☐ Irrigation method is improved with the help of weather forecasting
- Accurate weather data can assist farmers in determining when they should work most efficiently in their day-to-day operations
- Business Model
- Implementing this method can help the farmers to cultivate the crops based on the water need ☐ This method can prevent the wastage of crops

- By predicting the rainfall in correct manner, it helps the farmer to cultivate seasonable crops and have a better gain
- It avoids the wastage of crops and provide better yield for the farmers

#### *Scalability Of Solution*

- This will help the major Agriculture based company to maximize their growth efficiency, save resources and optimize their production
- It will predict the amount of rain in a specific well or division in advance by various regression technique
- It will help to make a proper plan

### **d. Problem Solution Fit**

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify behavioral patterns and recognize what would work and why.

#### *Purpose:*

- Solve complex problems in a way that fits the state of your customers.
- Succeed faster and increase your solution adoption by tapping into existing mediums and channels of behavior.
- Sharpen your communication and marketing strategy with the right triggers and messaging.
- Increase touch-points with your company by finding the right problembehavior fit and building trust by solving frequent annoyances, or urgent or costly problems
- Understand the existing situation in order to improve it for your target group.

|   |  |  |
|---|--|--|
| <p>1. CUSTOMER SEGMENT(S)</p> <ul style="list-style-type: none"> <li>❑ Customers are the farmers in urban and rural areas.</li> </ul> | <p>6. CUSTOMER CONSTRAINTS</p> <ul style="list-style-type: none"> <li>❑ Lack of awareness</li> <li>❑ Financial situation</li> <li>❑ Unaccustomed to modern farming practices.</li> </ul> | <p>5. AVAILABLE SOLUTIONS</p> <ul style="list-style-type: none"> <li>❑ This project provides solution to farmers during the periods of heavy rainfall.</li> <li>❑ Well planned drainage system</li> <li>❑ Set upping a rain cover</li> </ul> |
|---|--|--|

|  |  |  |   |
|--|--|--|---|
| <p>2. JOBS-TO-BE-DONE / PROBLEMS</p> <ul style="list-style-type: none"> <li>❑ Updates of the rainfall data</li> <li>❑ Exploring the data</li> <li>❑ Visualising the data.</li> </ul> <p>The problems are,</p> <ul style="list-style-type: none"> <li>❑ Wrong input</li> <li>❑ Data latency</li> <li>❑ Precision</li> </ul> | <p>9. PROBLEM ROOT CAUSE</p> <ul style="list-style-type: none"> <li>❑ Improper water management.</li> <li>❑ Poor resource management</li> <li>❑ Unpredictable weather</li> </ul> | <p>7. BEHAVIOUR</p> <ul style="list-style-type: none"> <li>❑ Seek Institutional aid</li> <li>❑ Take on excessive debt</li> <li>❑ Rely on uneducated guidance.</li> </ul> | <p>Focus on J&amp;P, tap into BE, understand RC</p> |
|--|--|--|---|

|  |   |   |
|--|---|---|
| <p>3. TRIGGERS</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> The Triggers of this project are,</li> <li><input type="checkbox"/> Repeated financial loss and</li> <li><input type="checkbox"/> Poor yield</li> </ul> | <p>10. YOUR SOLUTION <span>SL</span></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Our historical rainfall data.</li> <li><input type="checkbox"/> Predict the rainfall pattern for a given period.</li> <li><input type="checkbox"/> Categorize the intensity of rain.</li> <li><input type="checkbox"/> Develop a webpage to provide necessary guidelines for farmers.</li> </ul> | <p>8.CHANNELS of BEHAVIOR</p> <p>The Channels that support behaviors are</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Proper Visualization of data</li> <li><input type="checkbox"/> Choosing correct data</li> <li><input type="checkbox"/> Proper marketing and advertising</li> </ul> |
| <p>4. EMOTIONS: BEFORE / AFTER</p> <p>Before: Panic in case of excess rainfall oncers regarding results in damage of crops and financial hardships</p> <p>After: can easily know the amount of rainfall in advance</p>                     |   |   |

## 4. REQUIREMENT ANALYSIS

### a. Functional Requirements:

#### Functional Requirements:

Following are the functional requirements of the proposed solution.

| FR No. | Functional Requirement (Epic)                                     | Sub Requirement (Story / Sub-Task)   |
|--------|---|--|
| FR-1   | Annual rainfall data analysis                                     | The annual rainfall data is analyzed and the variation in distribution over the area is studied with the statistical parameters          |
| FR-2   | Intensity of Rainfall   | 1. The rate of which it is falling<br>2. Intensity represents the depth of precipitation accumulated per unit time                       |
| FR-3   | Rainfall gauge  | Collects water falling on it and records the change over time in the rainfall depth  |
| FR-4   | Rainy season and dry season in tropical and semi tropical regions | During rainy season crop's water need is covered by rainfall and during dry season the major supply of water should come from irrigation |
| FR-5   | Agriculture in India still dependent on rainfall                  | Agriculture in India is dependent on the monsoon season because farmers are not well equipped with the manual of manual irrigation       |
| FR     | Rainfall prediction   | The prediction helps people to take preventive measures and more over the should be accurate   |

## **b. Non-functional Requirements:**

Following are the non-functional requirements of the proposed solution

### **Non-functional Requirements:**

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

| FR No. | Non-Functional Requirement | Description   |
|--------|----------------------------|---|
| NFR-1  | <b>Usability</b>           | The system should be easy to install and simple to use          |
| NFR-2  | <b>Security</b>            | The system should authenticate users                            |
| NFR-3  | <b>Reliability</b>         | The system should perform the intended tasks for a specific.    |
| NFR-4  | <b>Performance</b>         | The system should perform the intended tasks                    |
| NFR-5  | <b>Availability</b>        | The system should be available all the time when it is required |

|       |                    |  |
|-------|--------------------|--|
| NFR-6 | <b>Scalability</b> | The system must be scalable enough to support 1,000,000 visits |
|-------|--------------------|--|

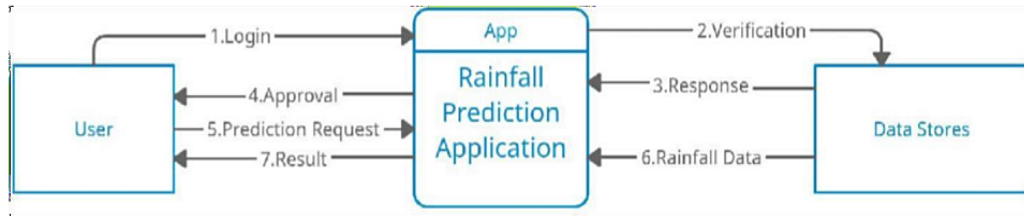


## 5. PROJECT DESIGN

### a. Data Flow Diagrams

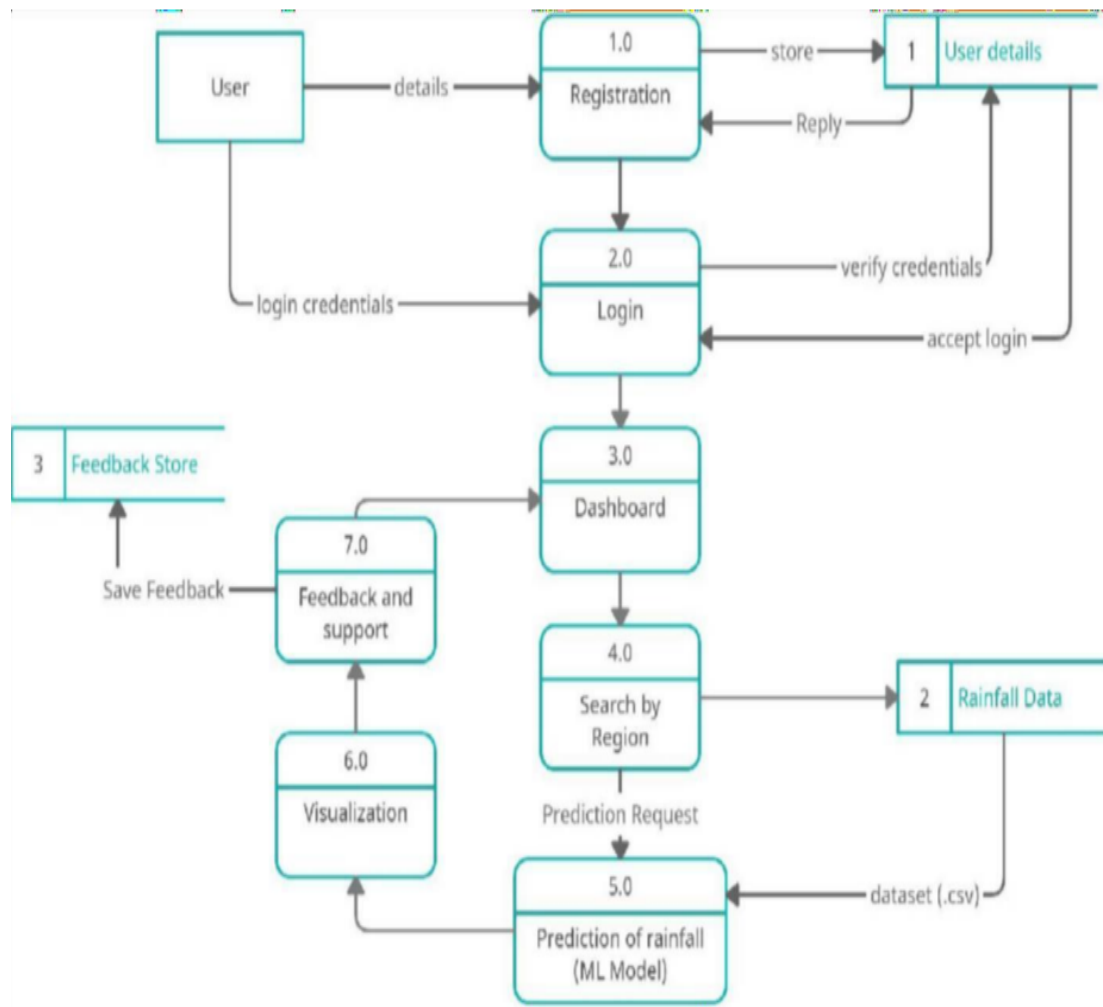
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system

#### 0 – LEVEL DATA FLOW DIAGRAM:

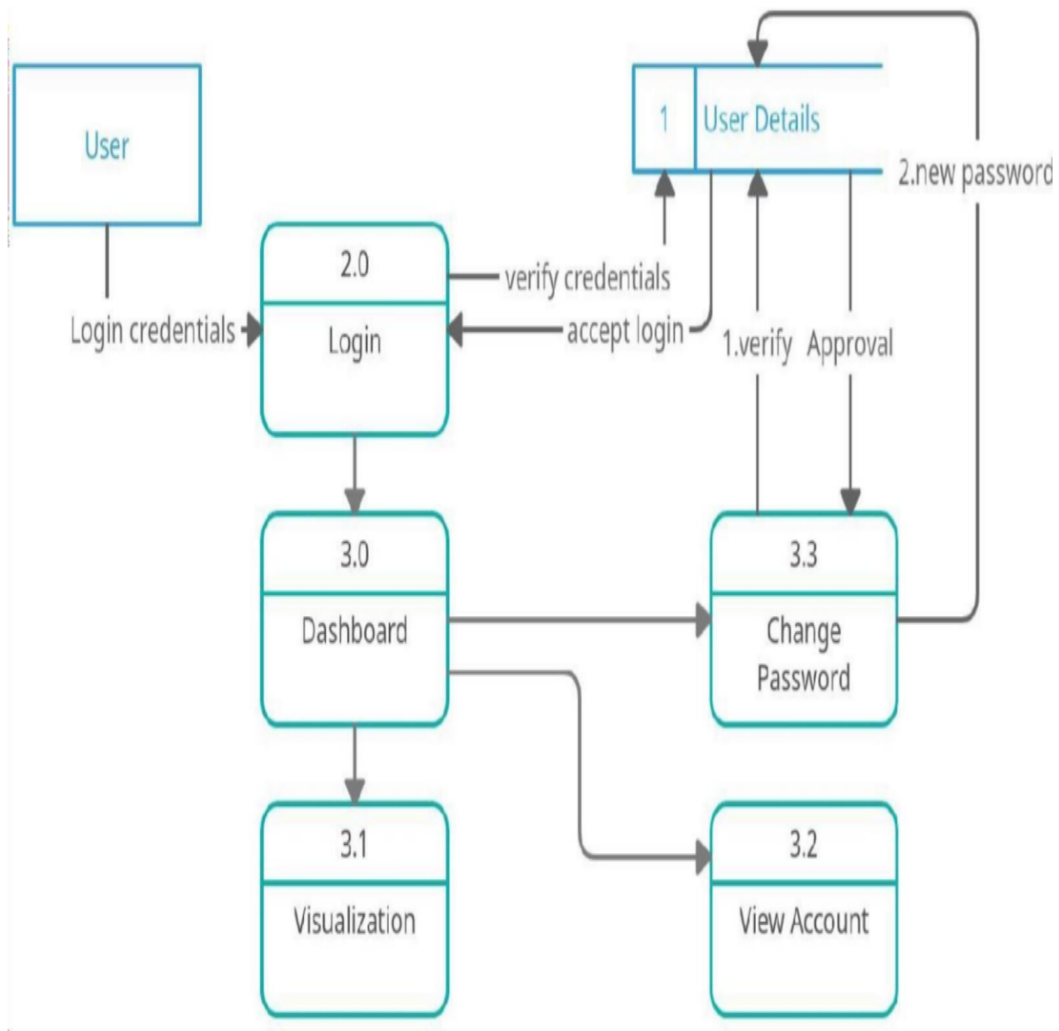


1. User logs in to the application using his or her credentials.
2. Verification of credentials is done using the data stored in the database.
3. Application getting the response from the database.
4. Approval of login or else an error message for incorrect credentials.
5. Prediction request for the particular area or region is sent by the user.
6. Application getting the dataset of previous year/month/day rainfall data from the database/cloud.
7. The result has been sent to the user as an output after the prediction has been made using the machine learning model in the application.

## 1-Level Data Flow Diagram



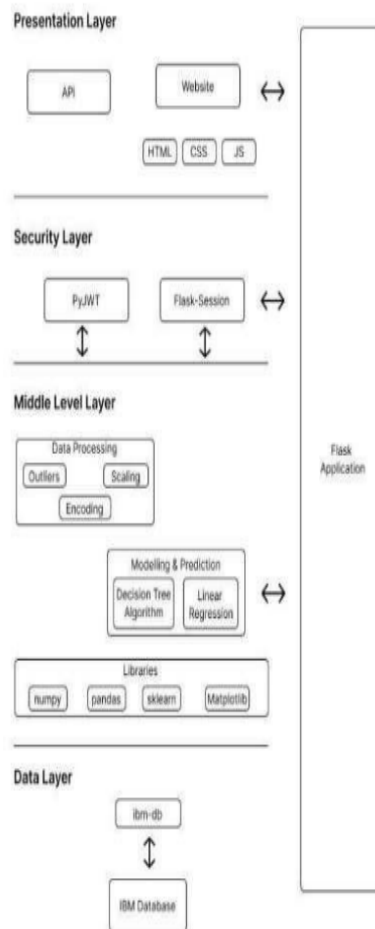
## 2-level Data Flow Diagram



## **b. Solution & Technical Architecture**

### **Technical Architecture:**

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2



**Table-1 : Components & Technologies:**

| S.No | Component              | Description   | Technology   |
|------|------------------------|---|--|
| 1.   | Website                | User interacts with the prediction model through website to predict the rainfall data | HTML, CSS, JavaScript  |
| 2.   | Cloud Database         | The model is provided with data from IBM cloud database                               | IBM Cloud DB, ibm_db(python package)                           |
| 3.   | API                    | Used to extend the service to other applications                                      | Flask Application  |
| 4.   | JWT & Sessions         | It is used for Handling JSON web tokens (signing, verifying, decoding)                | PyJWT, Flask-Sessions  |
| 5.   | Machine Learning Model | It is developed to predict the rainfall using ML algorithms.                          | Sklern, Algorithms - DT & MLR                                  |
| 6.   | Data processing        | Data is pre-processed and then used for prediction.                                   | Pandas, Numpy, Matplotlib                                      |
| 7.   | File Storage           | File storage requirements   | IBM Block Storage or Other Storage Service or Local Filesystem |

**Table-2: Application Characteristics:**

| S.No | Characteristics          | Description   | Technology                          |
|------|--------------------------|---|-------------------------------------|
| 1.   | Open-Source Frameworks   | Backend Framework, CSS Styling framework, Relational Database         | PyJWT, Flask, IBM Cloud DB          |
| 2.   | Security Implementations | Request authentication using JWT Tokens                               | HS-256, Encryptions, SSL Certs      |
| 3.   | Scalable Architecture    | Support for Multiple Sample prediction using Excel File               | Pandas, Numpy                       |
| 4.   | Availability             | Availability is increased by Distributed Servers in Cloud VPS         | IBM Cloud Hosting                   |
| 5.   | Performance              | The application is expected to handle multiple predictions per second | Load Balancers, Distributed Servers |

### c. User Stories

| User Type       | Functional Requirement (Epic) | User Story Number | User Story / Task  | Acceptance criteria  | Priority | Release  |
|-----------------|-------------------------------|-------------------|--|--|----------|----------|
| User in Website | Registration                  | USN-1             | User can register for the application by entering his or her email, password, and confirming the password.         | Account specific tasks and actions can be performed.               | High     | Sprint-1 |
|                 |                               | USN-2             | User will receive confirmation email or message once registered for the application.                               | Verify the registered Account.                                     | High     | Sprint-1 |
|                 |                               | USN-3             | Validation of the user can be done directly using email or OTP.  | Account validated and got access to profile dashboard.             | Medium   | Sprint-1 |
|                 | Login                         | USN-4             | Enter the username and password to login to the application  | Right account credentials should be entered.                       | High     | Sprint-1 |
|                 |                               | USN-5             | The existing credentials should be used for login on multiple systems  |  | Medium   | Sprint-1 |
|                 | Dashboard                     | USN-6             | User can view the visualization of the rainfall data for a specific region in India or for a specific time period. | Searching for the region in India will be accepted only.           | High     | Sprint-2 |
|                 |                               | USN-7             | User can change his/her password and can view the account details and search history                               | Verification will be required, and new password should be entered. | Medium   | Sprint-2 |
|                 |                               | USN-8             | User can search for the region where he/she wants to know the prediction of rainfall.                              | Searching for the region in India will be accepted only.           | High     | Sprint-2 |

| User Type             | Functional Requirement (Epic) | User Story Number | User Story / Task   | Acceptance criteria   | Priority | Release  |
|-----------------------|-------------------------------|-------------------|---|---|----------|----------|
|                       |                               | USN-9             | The prediction or analysis request can be asked for the desired region for future or past events respectively.      |   | High     | Sprint-2 |
|                       |                               | USN-10            | User can give the feedback on the accuracy of the prediction and on the user interface                              |   | High     | Sprint-3 |
| Support Team          | Support                       | USN-11            | Responds to user queries via telephone, email etc.  | Queries can be raised in situation of doubts                            | Medium   | Sprint-3 |
|                       |                               | USN-12            | The team must analyse all the queries and try to debug and make plans so that such queries wouldn't be raised again |   | Low      | Sprint-3 |
|                       |                               | USN-13            | Organize for a FAQ session where commonly asked doubts can be redressed by the team                                 | The user will get all their doubt clarified                             | Low      | Sprint-3 |
|                       |                               | USN-14            | The team must respond immediately to the queries based on the priority  | Queries should get resolved   | High     | Sprint-3 |
| Core Development Team | Core Function                 | USN-13            | Design, develop the application in such a way that the best user interface and maintenance should be taken care of. | Easy and self-understandable user interface                             | High     | Sprint-4 |
|                       |                               | USN-14            | The website is responsive on all the devices and the screen sizes   | User experience should be good irrespective of the devices or platforms | Medium   | Sprint-4 |

| User Type | Functional Requirement (Epic) | User Story Number | User Story / Task  | Acceptance criteria   | Priority | Release  |
|-----------|-------------------------------|-------------------|--|---|----------|----------|
|           |                               | USN-15            | The updates should be on time with the solutions of the raised queries | The existing functionalities should not be affected by the update | High     | Sprint-4 |

## 6. PROJECT PLANNING & SCHEDULING

### a. Sprint Planning & Estimation

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 | Rainfall Prediction ML Model (Dataset) | USN-1             | Weather Dataset Collection, Datapreprocessing, Data Visualization.                  | 5            | High     | Harini G, Sharulatha R, Vasantha Priya V, Yogashree J |
| Sprint-1 |  | USN-2             | Train Model using Different machine learning Algorithms                             | 5            | High     | Yogashree J, Sharulatha R, Vasantha Priya V, Harini G |
| Sprint-1 |  | USN-3             | Test the model and give best  | 10           | High     | Vasantha Priya V, Yogashree J, Harini G, Sharulatha R |
| Sprint-2 | Registration                           | USN-4             | As a user, they can register for the application through Gmail. Password is set up. | 5            | Medium   | Vasantha Priya v, Sharulatha R, Harini G, Yogashree J |
| Sprint-2 | Login                                  | USN-5             | As a user, they can log into the application by entering email & password           | 5            | Medium   | Sharulatha R, Harini G, Yogashree J, Vasantha Priya V |



|          |                     |       |   |    |        |  |
|----------|---------------------|-------|---|----|--------|--|
| Sprint-2 |                     | USN-6 | Credentials should be used for multiplesystems and verified | 4  | Medium | Vasantha Priya v,<br>Sharulatha R,<br>Harini G,<br>Yogashree J |
| Sprint-2 | Dashboard           | USN-7 | Attractive dashboard forecasting live weather               | 6  | Low    | Sharulatha R,<br>Harini G,<br>Yogashree J,<br>Vasantha Priya V |
| Sprint-3 | Rainfall Prediction | USN-8 | User enter the location, temperature, humidity              | 10 | High   | Harini G,<br>Sharulatha R,<br>Vasantha Priya V,<br>Yogashree J |
| Sprint-3 |                     | USN-9 | Predict the rainfall and display the result                 | 10 | High   | Yogashree J,<br>Sharulatha R,<br>Vasantha Priya V,<br>Harini G |

| Sprint   | Functional Requirement (Epic) | User Story Number | User Story / Task   | Story Points | Priority | Team Members   |
|----------|-------------------------------|-------------------|---|--------------|----------|--|
| Sprint-4 | Testing                       | USN-10            | Test the application  | 10           | High     | Vasantha Priya v,<br>Sharulatha R,<br>Harini G,<br>Yogashree J |
| Sprint-4 | Deploy Model                  | USN-11            | Deploy the model in IBM cloud to make user friendly application | 10           | High     | Harini G,<br>Sharulatha R,<br>Vasantha Priya V,<br>Yogashree J |

#### Project Tracker, Velocity & Burndown Chart: (4 Marks)

| 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   | 31Oct 2022        | 05 Nov 2022               | 20  | 05 Nov 2022                  |
| Sprint-2 | 20                 | 6 Days   | 05 Nov 2022       | 10 Nov 2022               | 20  | 10 Nov 2022                  |
| Sprint-3 | 20                 | 6 Days   | 10 Nov 2022       | 15 Nov 2022               | 20  | 15 Nov 2022                  |
| Sprint-4 | 20                 | 6 Days   | 15 Nov 2022       | 21 Nov 2022               | 20  | 21 Nov 2022                  |

#### Velocity:

Imagine we have a 5-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

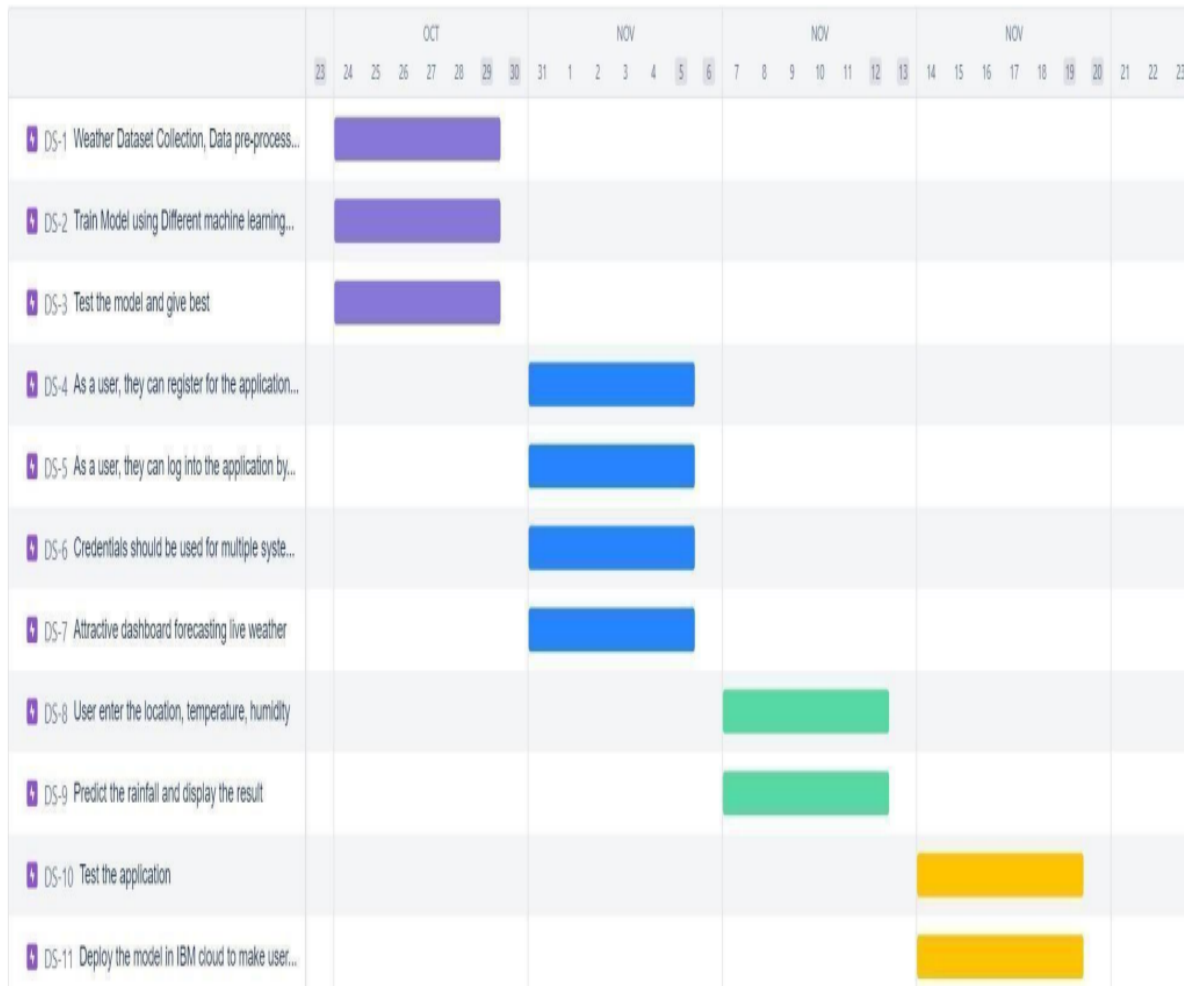
$$AV = \text{Sprint duration} / \text{Velocity} = 20/5 = 4 \text{ Total}$$

$$\text{Average Velocity} = 4$$

## **b. Reports From JIR**

### Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



## **7. CODING & SOLUTIONING**

### **a. Feature 1**

Rainfall has been a major concern these days. Weather conditions have been changing for time being. Rainfall forecasting is important otherwise, it may lead to many disasters. Irregular heavy rainfall may lead to the destruction of crops, heavy floods that can cause harm to human life. It is important to exactly determine the rainfall for effective use of water resources, crop productivity, and pre-planning of water structures.

This comparative study is conducted concentrating on the following aspects: modeling inputs, Visualizing the data, modeling methods, and pre-processing techniques. The results provide a comparison of various evaluation metrics of these machine learning techniques and their reliability to predict rainfall by analyzing the weather data.

We will be using classification algorithms such as Decision tree, Random forest, KNN, and xgboost. We will train and test the data with these algorithms. From this best model is selected and saved in pkl format. Once the model is saved, we integrate it with flask application and also deploy the model in IBM.

#### **Software Requirements:**

1. Python flask
2. MongoDB
3. Jupyter Notebook
4. WebBrowser (Chrome, Edge,...)

#### **Hardware Requirements:**

1. RAM -4GB
2. Harddisk -10GB

### **b. Feature 2**

To design a system the predicts rainfall occurrences in major areas and rainfall for crops so that the farmers can plan their crops and users can plan their trips accordingly. This system is more suited for farmers because rainfall plays an important role in agriculture.

## 8. TESTING

### a. Test Cases

| Test Case ID | Features   | Components    | Test Scenario                                 | Steps to execute  | Test Data      | Expected output                              | Actual Result         | Status | BUG_ID | Executed by  |
|--------------|------------|---------------|---|---|----------------|--|-----------------------|--------|--------|--------------|
| LP_TC_001    | UI         | Login page    | Check UI elements in the login page.          | 1. Open the page.<br>2. Check if all the UI elements are displayed (Username, Password) | 127.0.0.1:5000 | The login page must be displayed properly.   | Working Successfully. | PASS   |        | Harini G     |
| LP_TC_002    | Functional | Login page    | Check if the user can press the login button. | 1. Open the page.<br>2. Click on login button.  | 127.0.0.1:5000 | The user should be redirected to form page.  | Working Successfully  | PASS   |        | Yogashree J  |
| RP_TC_001    | UI         | Register page | Verify UI elements in the register page.      | 1. Open page.<br>2. Check all the UI elements   | 127.0.0.1:5000 | The register page must be displayed properly | Working Successfully  | PASS   |        | Sharulatha R |

|           |            |                 |   |  |                |  |                      |      |  |                  |
|-----------|------------|-----------------|---|--|----------------|--|----------------------|------|--|------------------|
| RP_TC_002 | Functional | Register page   | Check if the user is able to enter the necessary details(user name, E-mail id, password, confirm password) and able to press the <b>register button</b> . | 1. Open page.<br>2. Enter the details.<br>3. Press the register button.      | 127.0.0.1:5000 | "Record added successfully" message is notified after pressing the register button. If not error is shown. | Working Successfully | PASS |  | Vasantha Priya v |
| PP_TC_001 | UI         | Prediction page | Check UI elements in the Prediction page.   | 1.Open the page.<br>2.Check if all the UI elements are displayed.            | 127.0.0.1:5000 | The Prediction page must be displayed properly   | Working Successfully | PASS |  | Yogashree J      |
| PP_TC_002 | Functional | Prediction page | Check if the user can enter all the necessary details( MinTemp, MaxTemp, Rain fall, etc...) and able to press <b>Submit button</b> .                      | 1. Open page.<br>2. Enter the details.<br>3. Press the <b>Submit</b> button. | 127.0.0.1:5000 | The result must be displayed in <b>Result Page</b>   | Working Successfully | PASS |  | Sharulatha R     |

|           |            |             |                                     |              |                |   |                      |      |  |                         |
|-----------|------------|-------------|-------------------------------------|--------------|----------------|---|----------------------|------|--|-------------------------|
| RP_TC_001 | Functional | Result page | Check whether the result is shown . | 1. Open page | 127.0.0.1:5000 | The result should be shown as predicted | Working Successfully | PASS |  | Harini G<br>Yogashree J |
|-----------|------------|-------------|-------------------------------------|--------------|----------------|---|----------------------|------|--|-------------------------|

## **b. User Acceptance**

### *1. Purpose of Document*

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

### *2. Defect Analysis*

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

| Resolution                | Severity<br>1 | Severity<br>2 | Severity<br>3 | Severity<br>4 | Subtotal |
|---------------------------|---------------|---------------|---------------|---------------|----------|
| <b>By Design</b>          | 1             | 0             | 1             | 0             | 2        |
| <b>Duplicate</b>          | 0             | 0             | 0             | 0             | 0        |
| <b>External</b>           | 1             | 1             | 2             | 0             | 4        |
| <b>Fixed</b>              | 4             | 1             | 0             | 1             | 6        |
| <b>Not<br/>Reproduced</b> | 0             | 0             | 1             | 0             | 1        |
| <b>Skipped</b>            | 0             | 0             | 1             | 1             | 2        |
| <b>Won't Fix</b>          | 1             | 0             | 0             | 1             | 2        |
| <b>Totals</b>             | 07            | 02            | 05            | 03            | 17       |

### **c. Test Case Analysis**

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

| Section             | Total Cases | Not Tested | Fail | Pass |
|---------------------|-------------|------------|------|------|
| Client Application  | 10          | 0          | 3    | 7    |
| Security            | 2           | 0          | 1    | 1    |
| Exception Reporting | 2           | 0          | 0    | 2    |
| Final Report Output | 4           | 0          | 0    | 4    |
| Version Control     | 2           | 0          | 0    | 2    |

## **9. ADVANTAGES & DISADVANTAGES**

### **Advantages:**

- Farmers can know when to plant or harvest their crops
- People can choose where and when to take their holidays to take advantages of good weather
- Surfers know when large waves are expected
- Regions can be evacuated if hurricanes or floods are expected
- Aircraft and shipping rely heavily on accurate weather forecasting Disadvantage
- Weather is extremely difficult to forecast correctly
- It is expensive to monitor so many variables from so many sources
- The computers needed to perform the millions of calculations necessary are expensive
- The weather forecasters get blamed if the weather is different from the forecast

### **Disadvantages:**

- Forecasts are never 100% accurate
- It can be time-consuming and resource-intensive
- It can also be costly



## ***10. CONCLUSION***

The weather prediction has become one of the most essential entities now a days. To improve the risk management systems and to know the weather in coming days in an automatic and in scientific way, many models have been emerging to assist in weather Prediction. In this paper, we have seen building a Weather Prediction Web Application from scratch by making use of 6 different ML algorithms namely Cat Boost Classifier, Random For set Classifier, Logistic Regression, Gaussian NB, KNN and XGB Classifier. In the result section, the results from the all the six models and its results such as Accuracy, Error rate, mean absolute error, Root mean squared error, Relative squared error, Root relative squared error and time taken to build the model are tabulated. The results show that the Cat Boost Classifier and XGB Classifier has output the results of high accuracy than all the other classifiers that were used. When coming to the time taken to build the model, The Cat Boost Classifier outperforms all the other classifiers in solving the Problem under scrutiny

## ***11. FUTURE SCOPE***

In upcoming future updates, the WEATHER FORECASTING application will have additional features such as:

- Live Location tracking
- News on Live Disasters
- Weather Forecast for next one week
- Will deploy as android app

## **12.APPENDIX**

### **a .GitHub & Project Demo Link**

Github: <https://github.com/IBM-EPBL/IBM-Project-42906-1660711118>

Demo link:

[https://drive.google.com/file/d/1pjxgXWR0TCtgQxnjuNXpVCnLIQX5zbrs/view?usp=share\\_link](https://drive.google.com/file/d/1pjxgXWR0TCtgQxnjuNXpVCnLIQX5zbrs/view?usp=share_link)