Date	17 November 2022
Team ID	PNT2022TMID10661
Project Name	Exploratory Analysis Of Rainfall Data In India For Agriculture

1. INTRODUCTION

1.1 Project Overview

Farming is the backbone of the Indian economy, albeit it requires more assistance than any other. India has a population of over a billion people, with over 70% of the population living in the country. Agriculture is a significant industry and a crucial influencer of the Indian economy, employing 40% of the country's workers. Regardless, its commitment to the 2.3 lakh crore rupee economy is a pathetic 16% of total GDP. Rainfall is a serious problem these days. For the time being, the weather has been shifting. Rainfall forecasting is critical since it can lead to a variety of disasters. Irregular severe rainfall can destroy crops and produce flooding, which can endanger human life.

It is critical to precisely determine rainfall in order to make the best use of water resources, increase crop output, and plan ahead of time for water infrastructure.

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.

Agriculture in India requires institutional consideration, bank support in the form of loans and welfare schemes, and suffers from a slew of calamities such as depleting groundwater levels in rural areas, environmental change, dry seasons, floods, unwarranted value fixing of produce, relocation of farmers to urban communities in search of better-paying jobs, and much more. Agriculture is one section in responsibility of feeding everyone, but the general populace is the last to be dealt with. After coming up short on institutions, time has unquestionably wished innovation to take management of the alteration.

Classification techniques such as Decision tree, Random forest, KNN, and xgboost will be used. These algorithms will be used to train and test the data. The best model is chosen and saved in pkl format. After saving the model, we connect it with the flask application and deploy it to IBM.

1.2 Purpose

The project objectives are as follows:

1. To develop a decision support system for determining the best crops to cultivate based on agro-meteorological criteria and determine the rainfall based on the given information.
2. To assess the precision of various categorization techniques.
3. Modify specific parameters in the classification algorithms employed and investigate the consequences and accuracy of the alteration.
4. Determine the optimal algorithm for this dataset.

The deliverables of the idea can be stated as

1. Crop requirement analysis
2. Assists farmers in making better use of available resources.
3. Assists farmers in selecting the best crops to produce in maximise yield.
4. Determine the variations in crop prediction accuracy based on various categorization techniques.

2.LITERATURE SURVEY

2.1Existing Problem

Weather conditions changes then and often. This can lead to Severe threats to all the living beings including human beings. So predicting weather, especially Irregular heavy rainfall can cause huge floods and economic losses. This also decreases crop productivity and may lead into Food shortage. Predicting the Rainfall plays a vital role in our life time. Farmers will get benefit due to this and Our country's GDP will rise. Collection of previous 10 years data may give us an idea about the pattern of Rainfall. Using all these Datas, Appropriate farming activities can be performed. Water is the vital mineral for a life.

So, these datas can help us in predicting Rainfall during summer days to save water. Agriculture definitely requires gallons of waters. We use APPLIED DATA SCIENCE to solve this problem. There are so many algorithms available such as Decision tree, Random Forest, KNN, Xgboost, etc. We will test and train the data with one of these algorithms. From these, the best algorithm is selected and the model is being developed. We visualize the datas and models. The results provides us various evaluation metrics of the Machine Learning techniques.

- ➤ Understanding the variability in rainfall, analysis of Indian Summer monsoon rainfall using Spatial resolution.
- ➤ Presents about the analysis of Crop-climate relationships for India, using historical predictions.
- ➤ This Study shows that, India has two monsoon rainfall season one is north west monsoon and second one is south east monsoon.

2.2References

[1] Markand Oza and C.M.Kishtawal - Spatial analysis of Indian Summer monsoon Rainfall (Mar 26,2014).

[2] K.Krishna kumar, K.Rupa Kumar, R.G.Ashrit, N.R.Deshpande and J.W.Hansen - Climate impacts on Indian Agriculture. (16 June,2004).

[3] Anusha Gajinkar - Exploratory data Analysis of Indian Rainfall Data.

2.3Problem Statement Definition

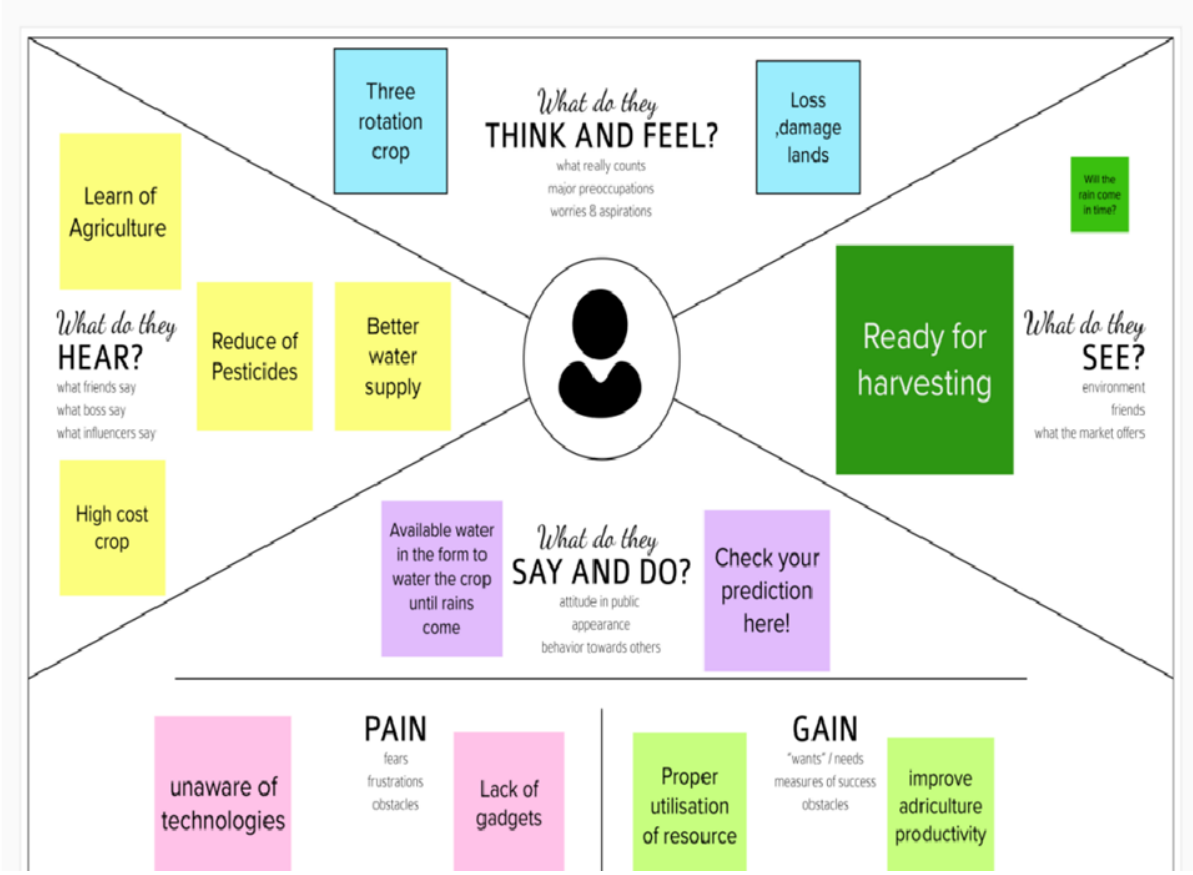
Rainfall has been a major concern these days. Weather conditions have been changing for time being. Rainfall forecasting is important otherwise, it may lead to many disasters. Irregular heavy rainfall may lead to the destruction of crops, heavy floods that can cause harm to human life. It is important 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.

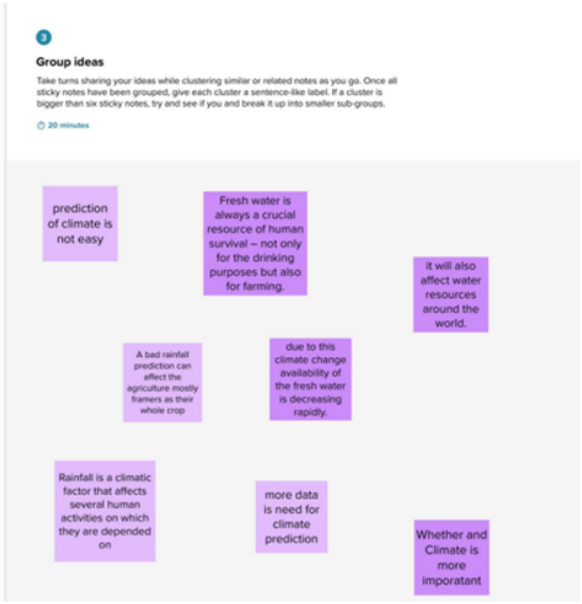
We will be using classification algorithms such as Decision tree, Random forest, KNN, and xgboost. We will train and test the data with these algorithms. From this best model is selected and saved in pkl format. Once the model is saved, we integrate it with flask application and also deploy the model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

3.IDEATION & PROPOSED SOLUTION

3.1Empathy Map Canvas



3.2Ideation & Brainstroming



3.3 Proposed Solution

• We are trying to understand and analyse the behaviour of rainfall in India over the years, by months and different subdivisions.

• Climate is an important aspect of human life. Therefore, the Prediction should accurate as much as possible. In this paper, we try to deal with the prediction of the rainfall which is also a major aspect of human life and which provide the major resource of human life, which is Fresh Water.

• Now, climate change is the biggest issue all over the world. Peoples are working on to detect the patterns in climate change as it affects the economy in production to infrastructure.

Idea / Solution description

• In rainfall also making prediction of rainfall is a challenging task with a good accuracy rate. Making prediction on rainfall cannot be done by the traditional way, so scientist is using machine learning and deep learning to find out the pattern for rainfall prediction.

• Provides extra support to maintain the agriculture

Novelty / Uniqueness

• This application is useful for the beginners in agriculture.

• Seed maturity selection features are available.

Social Impact / Customer Satisfaction

• Different types of crops can be planted for good health.

• Helps in producing healthy crops and good fields

Business Model (Revenue Model)

• The loss of production and economy for formers in agriculture, so we create a huge project. And increase their economy in agriculture

• This comparative study is conducted concentrating on the following aspects: modelling inputs, Visualizing the data, modelling 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 analysing the weather data. We will be using classification algorithms such as Decision tree, Random forest, KNN, and xgboost.

Scalability of the Solution

• When we predict rainfall correctly, it helps growth of crop and yielding will be better.

• Scalability of solution of our project is to make any farmers to deserve our rainfall data and we build an information office for non-improved village to get our data's.

3.4 Problem Solution fit

1. CUSTOMER SEGMENT(S)

- Small Margin farmers
- Large scale farmers

2. JOBS-TO-BE-DONE / PROBLEMS

- To predict the rainfall and the crops that could be grown on a particular region based

on the rainfall that that has been predicted.

- Estimate the average rainfall in India

3. TRIGGERS TR

- Seeing their neighbors using our application, planting/growing the crops and getting benefitted with the huge amount of profit.

4. EMOTIONS: BEFORE / AFTER EM

- Dejected, insecure
- Confident, in control, satisfactory

5. AVAILABLE SOLUTIONS

- Depending on Weather News
- With available weather forecasting sites like Accuweather, windy and the weather channel.

6. CUSTOMER CONSTRAINTS

- Budget issues
- Wrong estimation of Rainfall

7. BEHAVIOUR BE

- Directly related: find the right crop that could be grown on their region, predict the benefits.
- Indirectly associated: customers will have a relaxation and inner peace.

8. CHANNELS of BEHAVIOUR CH

8.1ONLINE

- They would search in for online weather prediction site

8.2OFFLINE

- Try to predict the weather using traditional method, ask suggestion from their near ones

4.REQUIREMENT ANALYSIS

4.1 Functional Requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User (both marginal and large scale farmers)	Collect data of their soil type, amount of water availability and quantity of water needed for crops.
FR-2	Check weather	Farmers can check the weather by selecting their area and region.
FR-3	Suggest crop	According to the area and regions, the crops are suggested to the farmers
FR-4	Estimate rainfall	Percent of precipitation and rainfall can be estimated for their regions.

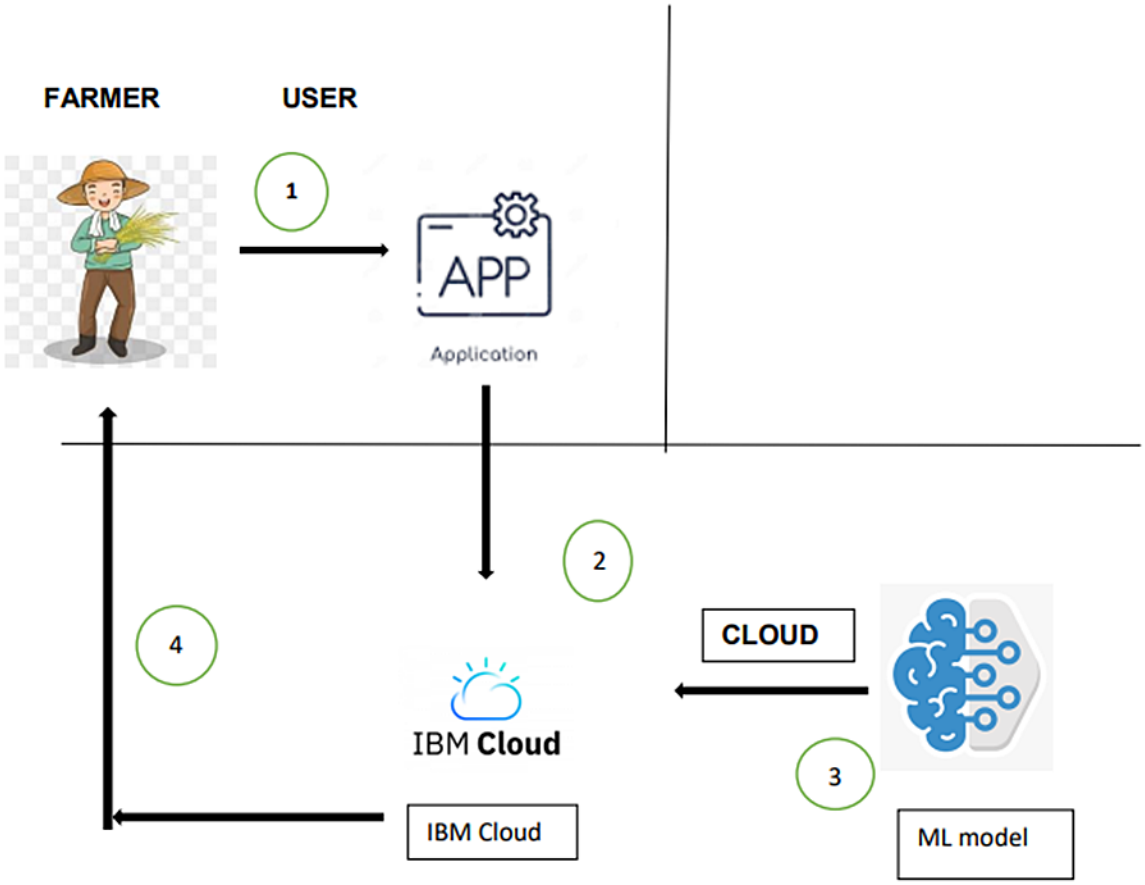
4.2 Non-Functional Requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	1. The farmers and other people can easily use the application and it is user friendly no prior knowledge is required for using it. 2. They need to register with the application by providing simple details such as their region and type of soil.
NFR-2	**Security**	· All data will be protected against malware attacks.
NFR-3	**Reliability**	1. Based on the type of soil, the system will suggest best applicable crops. 2. Estimates the percent of

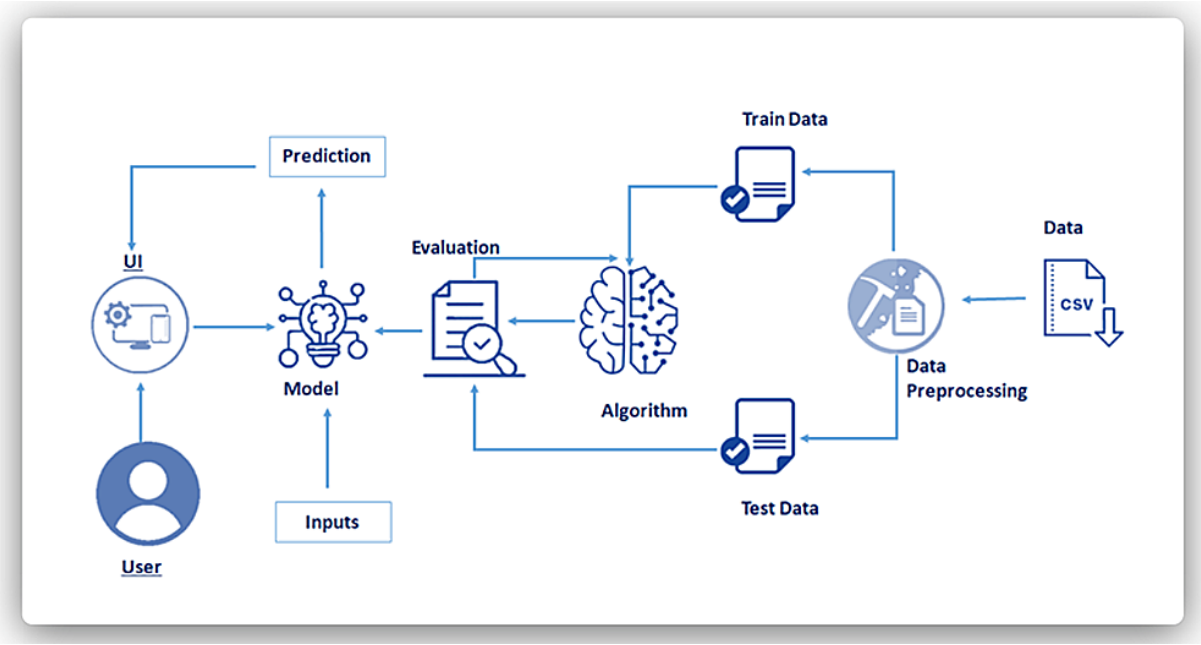
		precipitation with more perfection.
NFR-4	**Performance**	1. The expected output will be produces immediately to the user without much delay. 2. Predictions will be more accurate.
NFR-5	**Availability**	· The application will be available all the time with continuous customer support.

5.PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



5.3User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (web user)	Check Weather	USN-1	As a customer, I can check the rainfall by giving the region as input.	I can view the predicted rainfall status by entering information	High	Sprint-2
	Suggested Crop	USN-2	As a customer, With the predicted rainfall I can view the suggested crops for higher productivity	I can view the suggested crops with the predicted rainfall	High	Sprint-2

6. PROJECT PLANNING & SCHEDULING

6.1Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Rainfall prediction and ML data set	USN-1	1. Collect the data set of rainfall in India of all regions about past 50 years. 2. Cleaning the dataset to get accurate results. 3. Ensuring that the values in the dataset are accurate to the results.	3	Medium	Konduru Tharun, Faroon,Pasith

Sprint-1	Split the dataset	USN-2	1. Split the dataset into training and testing dataset values. 2. 70% of the dataset values are used for training the model and remaining 30% is used for testing purpose to calculate the accuracy of the model.	4	High	Puthin, Konduru Tharun
Sprint-1		USN-3	· Credentials are used for multiple system login	2	Low	Pasith, Faroon

Sprint-2	Registration	USN-4	· As a user, I can register for the application through Gmail	2	Medium	Faroon and Puthin
Sprint-2	Login	USN-5	· As a user, I can log into the application by entering email & password	1	Low	Puthin
Sprint-3	Dashboard	USN-6	· Dashboard should be user friendly.	3	Medium	Tharun Faroon
Sprint	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Story Points**	**Priority**	**Team Members**
Sprint-3	Testing	USN-7	1. Test the model with the testing dataset and calculate the accuracy. 2. Ensure that the accuracy of the model	5	High	Konduru Tharun, Faroon, Pasith, Puthin

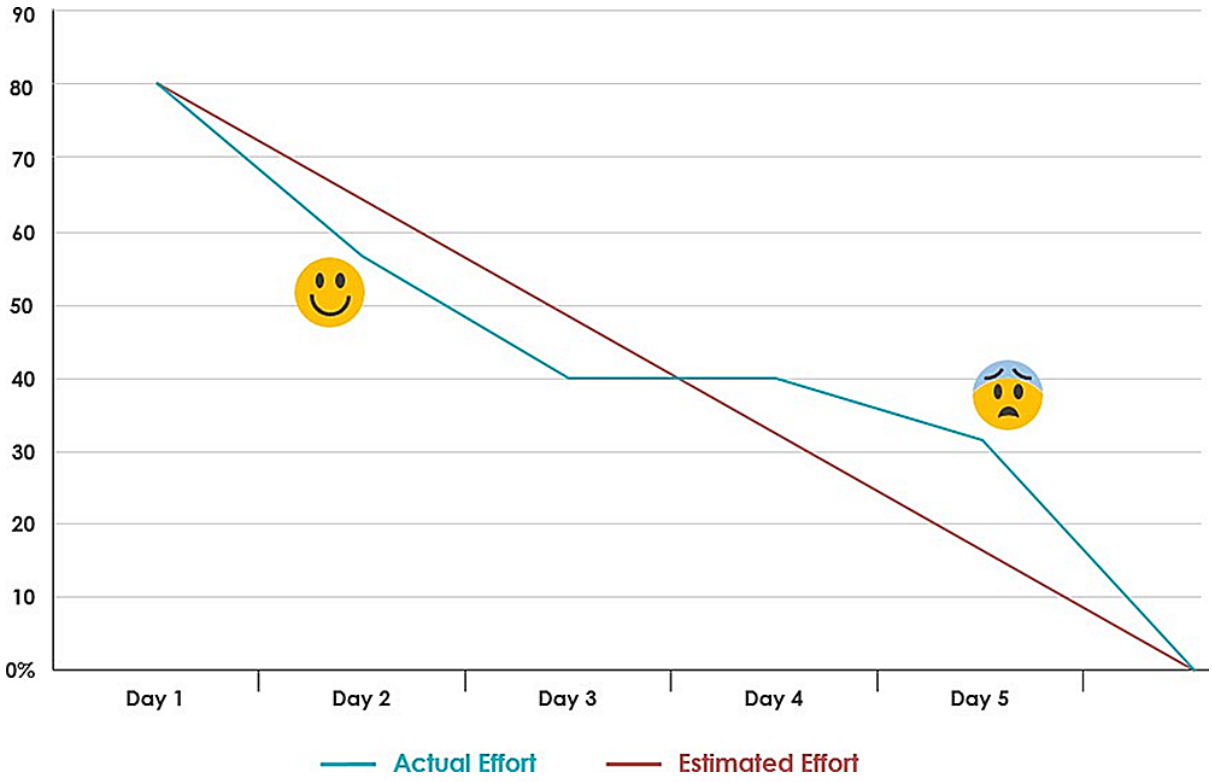
			should be greater than 90%.			
Sprint-4	Deploy the model	USN-8	1. If the accuracy of the model is greater than 90%, then deploy the model to the IBM cloud. 2. Otherwise	4	Medium	Tharun,Pasith

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	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	18	5 Nov 2022

Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	19	14 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	23 Nov 2022

6.3 Reports from Jira



Duration: 6 days

Sprint backlog: 10 tasks

Velocity: 90 available hours

7.CODING & SOLUTIONING

7.1 Feature 1

The application has an interactive user interface where user needs to upload all the necessary details to predict the rainfall

index.html

Location" required>

```
<option value="">Click to select a Location</option>
<option value="0">Adelaide</option>
<option value="1">Albany</option>
<option value="2">Albury</option>
<option value="3">AliceSprings</option>
<option value="4">BadgerysCreek</option>
<option value="5">Ballarat</option>
<option value="6">Bendigo</option>
<option value="7">Brisbane</option>
<option value="8">Cairns</option>
<option value="9">Canberra</option>
<option value="10">Cobar</option>
<option value="11">CoffsHarbour</option>
<option value="12">Dartmoor</option>
<option value="13">Darwin</option>
<option value="14">GoldCoast</option>
<option value="15">Hobart</option>
<option value="16">Launceston</option>
<option value="17">Melbourne</option>
<option value="18">MelbourneAirport</option>
<option value="19">Mildura</option>
<option value="20">Moree</option>
<option value="21">MountGambier</option>
<option value="22">MountGinini</option>
```

```
                    <option value="23">Newcastle</option>
                    <option value="24">Nhil</option>
                    <option value="25">NorahHead</option>
                    <option value="26">NorfolkIsland</option>
                    <option value="27">Nuriootpa</option>
                    <option value="28">PearceRAAF</option>
                    <option value="29">Penrith</option>
                    <option value="30">Perth</option>
                    <option value="31">PerthAirport</option>
                    <option value="32">Portland</option>
                    <option value="33">Richmond</option>
                    <option value="34">Sale</option>
                    <option value="35">SalmonGums</option>
                    <option value="36">Sydney</option>
                    <option value="37">SydneyAirport</option>
                    <option value="38">Townsville</option>
                    <option value="39">Tuggeranong</option>
                    <option value="40">WaggaWagga</option>
                    <option value="41">Walpole</option>
                    <option value="42">Watsonia</option>
                    <option value="43">Williamtown</option>
                    <option value="44">Witchcliffe</option>
                    <option value="45">Wollongong</option>
                    <option value="46">Woomera</option>
                  </select><br>
                <input class="form-control" type="text" name="mintemp"
placeholder="Minimum Temperature"><br>
                <input class="form-control" type="text" name="maxtemp"
placeholder="Maximum Temperature"><br>
                <input class="form-control" type="text" name="Rainfall"
placeholder="Rainfall"><br>
                <input class="form-control" type="text" name="windgustspeed"
```

```
placeholder="Wind Gust Speed"><br>
            <input class="form-control" type="text" name="windspeed9am"
placeholder="Wind Speed at 9am"><br>
            <input class="form-control" type="text" name="windspeed3pm"
placeholder="Wind Speed at 3pm"><br>
            <input class="form-control" type="text" name="humidity9am"
placeholder="Humidity at 9am"><br>
            <input class="form-control" type="text" name="humidity3pm"
placeholder="Humidity at 3pm"><br>
            <input class="form-control" type="text" name="pressure9am"
placeholder="Pressure at 9am"><br>
            <input class="form-control" type="text" name="pressure3pm"
placeholder="Pressure at 3pm"><br>
            <input class="form-control" type="text" name="temperature9am"
placeholder="Temperature at 9am"><br>
            <input class="form-control" type="text" name="temperature3pm"
placeholder="Temperature at 3pm"><br>
            <input class="form-control" type="text" name="risk" placeholder="risk"><br>
            <select class="form-control" name="Raintoday"  default="Rain today?"
required><br>
                <option value="">Rain today</option>
                <option value="1">Yes</option>
                <option value="0">No</option>
            </select><br>
            <select class="form-control" name="WindGustDirection"  default="Click to
choose the wind gust direction..." required><br>
                <option value="">Click to choose the wind gust direction...</option>
                <option value="0">E</option>
                <option value="1">ENE</option>
                <option value="2">ESE</option>
                <option value="3">N</option>
                <option value="4">NE</option>
```

```
                <option value="5">NNE</option>
                <option value="6">NNW</option>
                <option value="7">NW</option>
                <option value="8">S</option>
                <option value="9">SE</option>
                <option value="10">SSE</option>
                <option value="11">SSW</option>
                <option value="12">SW</option>
                <option value="13">W</option>
                <option value="14">WNW</option>
                <option value="16">WSW</option>
            </select><br>
            <select class="form-control" name="WindDir9am"  default="Click to choose the wind direction at 9am..." required><br>
                <option value="">Click to choose the wind direction at 9am...</option>
                <option value="0">E</option>
                <option value="1">ENE</option>
                <option value="2">ESE</option>
                <option value="3">N</option>
                <option value="4">NE</option>
                <option value="5">NNE</option>
                <option value="6">NNW</option>
                <option value="7">NW</option>
                <option value="8">S</option>
                <option value="9">SE</option>
                <option value="10">SSE</option>
                <option value="11">SSW</option>
                <option value="12">SW</option>
                <option value="13">W</option>
                <option value="14">WNW</option>
                <option value="16">WSW</option>
            </select><br>
```

```
            <select class="form-control" name="WindDir3pm"  default="Click to choose the wind direction at 3pm..." required><br>
                <option value="">Click to choose the wind direction at 3pm...</option>
                <option value="0">E</option>
                <option value="1">ENE</option>
                <option value="2">ESE</option>
                <option value="3">N</option>
                <option value="4">NE</option>
                <option value="5">NNE</option>
                <option value="6">NNW</option>
                <option value="7">NW</option>
                <option value="8">S</option>
                <option value="9">SE</option>
                <option value="10">SSE</option>
                <option value="11">SSW</option>
                <option value="12">SW</option>
                <option value="13">W</option>
                <option value="14">WNW</option>
                <option value="16">WSW</option>
            </select><br>
        </div>
```

7.2 Feature 2

app.py

```
import numpy as np
import pickle
import joblib
import matplotlib
import matplotlib.pyplot as plt
import time
import pandas
import os
```

```
from sklearn import *
from flask import Flask,request,jsonify,render_template,redirect,url_for
app = Flask(__name__, static_folder='static')
model = pickle.load(open("./rainfall.pkl","rb"))
scale= pickle.load(open("./scale.pkl","rb"))
encoder = pickle.load(open("encoder.pkl","rb"))
@app.route('/')
def home():
  return render_template('index.html')
@app.route('/pred',methods=["POST","GET"])
def pred():
  inp_feature = [x for x in request.form.values()]
  inp_feature=inp_feature[:18]
  print(inp_feature)
  feature_values = [np.array(inp_feature)]
  names = [['Location', 'MinTemp', 'MaxTemp', 'Rainfall', 'WindGustSpeed',
        'WindSpeed9am', 'WindSpeed3pm', 'Humidity9am', 'Humidity3pm',
        'Pressure9am', 'Pressure3pm', 'Temp9am', 'Temp3pm', 'risk', 'RainToday',
        'WindGustDir', 'WindDir9am', 'WindDir3pm']]
  data = pandas.DataFrame(feature_values,columns=names)
  data = scale.fit_transform(data)
  print(data)
  data = pandas.DataFrame(data,columns=names)
  print(data)
  prediction = model.predict(data)
  if prediction == "Yes":
    return render_template("predict1.html")
  else:
    return render_template("predict2.html")
if __name__ == '__main__':
  app.run(debug= True)
```

8. TESTING

8.1 Test Cases

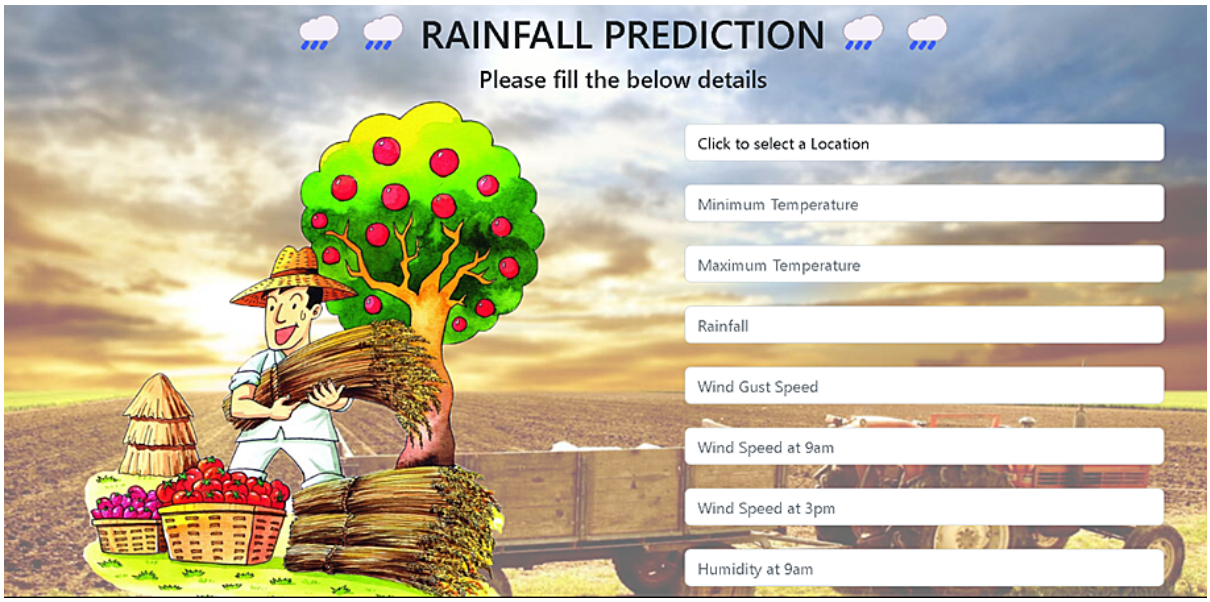
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

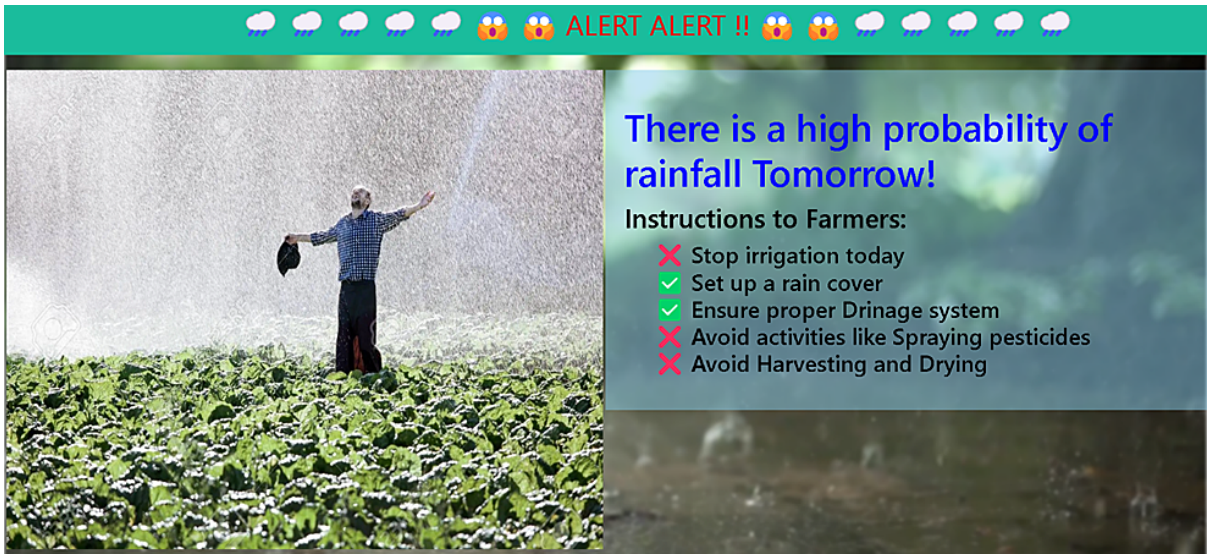
8.2 User Acceptance Testing

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

9. RESULTS

9.1Performance Metrics




ALERT ALERT !!
There is a high probability of rainfall Tomorrow!
Instructions to Farmers:
Stop irrigation today
Set up a rain cover
Ensure proper Drinage system
Avoid activities like Spraying pesticides
Avoid Harvesting and Drying

10. AVANTAGES & DISADVANTAGES

Advantages

1. High quality of data:

One of the main advantages of weather radar is the fact that the data collected by the radar is of high quality and can be used to determine various aspects of the weather reliably.

2. Reliable weather forecasts:

The forecasting of the weather is one of the most important uses of weather radar. Through radar technology, experts have been able to reliably predict the weather and sometimes even measure the exact amount of rainfall or precipitation.

3. More accurate results:

Using weather radar to determine the weather and even to predict the weather results in much more accurate results. Radar can easily measure the exact amount or quantity of a particular weather element and use this to determine the expected forecasts.

4. Locate precipitation:

Weather radar can also be used to locate precipitation in any given area of the earth. This information comes in handy when determining the exact amount of rainfall that is expected.

5. Can calculate the speed of precipitation:

Besides locating precipitation, weather radar can also be used to calculate the exact speed of precipitation, a fete that was previously impossible using conventional means.

6. Can determine the structure of storms:

Weather radar has been used extensively by experts to determine the structure of storms. This information is then used to build the profile of expected storms and put in place mitigating measures.

7. Hail detection:

We can also use weather radar to detect hailstorms that are expected within a particular locality. This information is important in determining the exact nature of the hailstorms and helps prevent their effects.

8. Research:

Weather radar also comes in handy in the field of research where experts can use it to profile the weather of a given area and use the patterns to predict the climate of that area and help people in planning.

9. Flood forecasting:

Weather radar can also be used for flood forecasting to predict the occurrence of floods.

10. Weather surveillance:

Weather radar helps in profiling the weather of a given area provides people with the confidence of the climate and also advises on the expected weather at a given time.

Disadvantages

1. Cannot detect fog:

Weather radar has the limitation of not being able to detect fog. This creates a gap in weather forecasting where an area that is likely to receive fog is not properly profiled.

2. Cannot detect wind independently:

A weather radar is not known to detect wind independently unless with the use of additional remote sensing. This also creates a gap in weather forecasting.

3. Not entirely reliable:

Weather radar has a variety of limitations that makes it lack some of the most important forecasting principles. This means the radar is not entirely reliable in terms of weather forecasting.

4. Requires expertise to analyze:

The usage of weather radar to forecast the weather is not an easy thing and requires some level of expertise to analyze the data that comes through it.

5. Relies on intense datasets:

There is a huge dataset associated with the weather radar that needs to be analyzed before any decision is made. This data is so big that it may take a considerable amount of time to analyze fully.

6. The analysis is not instant:

The weather analysis done through weather radar is not always instant and therefore the information is not real-time.

7. Weather changes all the time:

The weather is a phenomenon that changes all the time. This means that any delay in data collection may sometimes result in useless data.

8. The estimates can be wrong:

The estimates obtained from weather radar are not 100 percent accurate. This means that the data may be wrong in some cases and this may impact the final decision making.

9. Radar technology keeps growing:

Radar technology is not static. It is dynamic and it keeps growing at a really fast pace. This means that scientists need to keep up with the technology which can be expensive and time-consuming.

10. More interference:

Radar technology experiences interference from various aspects of the weather including water, wind, and so on. This may affect the quality of the data and hence the results of the analysis.

11. CONCLUSION

Rainfall Prediction is the application area of data science and machine learning 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. This paper analyzed various machine learning algorithms for rainfall prediction. Three machine learning algorithms such as MLR, FR, and XGBoost were presented and tested using the dataset.

The Rainfall prediction accuracy can be improved using sensor and meteorological datasets with additional different environmental features. Hence, in future work, big data analysis can be used for rainfall prediction if the sensor and meteorological datasets are used for the daily rainfall amount prediction study.

12. FUTURE SCOPE

Apart from predicting weather,algorithms can be used to scan satellite images to automatically derive plant count and production estimates .

Predicting weather accurately doesn’t just help our daily lives but has deeper impact for food security and disaster management. Good news for monsoon-dependent India is that we are getting better at predicting. New technologies, such as Internet of Things (IoT) and Artificial Intelligence are helping meteorological experts to give better information to predict agricultural output and natural disasters.

13. APPENDIX

index.html

```
<!DOCTYPE html>
<html lang="en">
   <link rel = "icon" href =
"/static/images/ibm.png"
      type = "image/x-icon">
   <style>
      body{
         background-image: url('static/images/agriculture1.png');
         background-repeat: no-repeat;
         background-attachment: fixed;
         background-size: cover;



      }
   </style>

<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>&#127783 Rainfall Prediction &#127783</title>
   <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css"
rel="stylesheet" integrity="sha384-
Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1WTRi"
crossorigin="anonymous">
</head>
<body>
   <div class="p-3 mb-2 bg-transparent text-dark">
```

```
    <div class="container-fluid">
        <div class="row d-flex justify-content-center">
            <div class="col-md-12 d-flex justify-content-center">
                <h1>&#127783 &#127783 RAINFALL PREDICTION &#127783
&#127783</h1><br>
            </div>
        </div>
        <div class="row d-flex justify-content-center">
            <div class="col-md-12 d-flex justify-content-center">
                <h4>Please fill the below details</h4>
            </div>
        </div>
        <div class="row d-flex justify-content-center">
            <div class="col-md-6">
                    <img src="static/images/image4.png"  alt="rain img1" class="img-fluid"
height="80%" width="80%">
                    <img src="static/images/image1.png"  alt="rain img1" class="img-fluid"
height="80%" width="80%">


            </div>
            <div class="col-md-5">
                <br>
                <form action="/pred" method="POST">
                    <select class="form-control" name="Location" size="=3" default="Click to
select a Location" required><br>
                        <option value="">Click to select a Location</option>
                        <option value="0">Adelaide</option>
                        <option value="1">Albany</option>
                        <option value="2">Albury</option>
                        <option value="3">AliceSprings</option>
                        <option value="4">BadgerysCreek</option>
```

```
<option value="5">Ballarat</option>
<option value="6">Bendigo</option>
<option value="7">Brisbane</option>
<option value="8">Cairns</option>
<option value="9">Canberra</option>
<option value="10">Cobar</option>
<option value="11">CoffsHarbour</option>
<option value="12">Dartmoor</option>
<option value="13">Darwin</option>
<option value="14">GoldCoast</option>
<option value="15">Hobart</option>
<option value="16">Launceston</option>
<option value="17">Melbourne</option>
<option value="18">MelbourneAirport</option>
<option value="19">Mildura</option>
<option value="20">Moree</option>
<option value="21">MountGambier</option>
<option value="22">MountGinini</option>
<option value="23">Newcastle</option>
<option value="24">Nhil</option>
<option value="25">NorahHead</option>
<option value="26">NorfolkIsland</option>
<option value="27">Nuriootpa</option>
<option value="28">PearceRAAF</option>
<option value="29">Penrith</option>
<option value="30">Perth</option>
<option value="31">PerthAirport</option>
<option value="32">Portland</option>
<option value="33">Richmond</option>
<option value="34">Sale</option>
<option value="35">SalmonGums</option>
<option value="36">Sydney</option>
```

```
                    <option value="37">SydneyAirport</option>
                    <option value="38">Townsville</option>
                    <option value="39">Tuggeranong</option>
                    <option value="40">WaggaWagga</option>
                    <option value="41">Walpole</option>
                    <option value="42">Watsonia</option>
                    <option value="43">Williamtown</option>
                    <option value="44">Witchcliffe</option>
                    <option value="45">Wollongong</option>
                    <option value="46">Woomera</option>
                  </select><br>
                <input class="form-control" type="text" name="mintemp"
placeholder="Minimum Temperature"><br>
                <input class="form-control" type="text" name="maxtemp"
placeholder="Maximum Temperature"><br>
                <input class="form-control" type="text" name="Rainfall"
placeholder="Rainfall"><br>
                <input class="form-control" type="text" name="windgustspeed"
placeholder="Wind Gust Speed"><br>
                <input class="form-control" type="text" name="windspeed9am"
placeholder="Wind Speed at 9am"><br>
                <input class="form-control" type="text" name="windspeed3pm"
placeholder="Wind Speed at 3pm"><br>
                <input class="form-control" type="text" name="humidity9am"
placeholder="Humidity at 9am"><br>
                <input class="form-control" type="text" name="humidity3pm"
placeholder="Humidity at 3pm"><br>
                <input class="form-control" type="text" name="pressure9am"
placeholder="Pressure at 9am"><br>
                <input class="form-control" type="text" name="pressure3pm"
placeholder="Pressure at 3pm"><br>
                <input class="form-control" type="text" name="temperature9am"
```

```
placeholder="Temperature at 9am"><br>
            <input class="form-control" type="text" name="temperature3pm"
placeholder="Temperature at 3pm"><br>
            <input class="form-control" type="text" name="risk" placeholder="risk"><br>
            <select class="form-control" name="Raintoday"  default="Rain today?"
required><br>
                <option value="">Rain today</option>
                <option value="1">Yes</option>
                <option value="0">No</option>
            </select><br>
            <select class="form-control" name="WindGustDirection"  default="Click to
choose the wind gust direction..." required><br>
                <option value="">Click to choose the wind gust direction...</option>
                <option value="0">E</option>
                <option value="1">ENE</option>
                <option value="2">ESE</option>
                <option value="3">N</option>
                <option value="4">NE</option>
                <option value="5">NNE</option>
                <option value="6">NNW</option>
                <option value="7">NW</option>
                <option value="8">S</option>
                <option value="9">SE</option>
                <option value="10">SSE</option>
                <option value="11">SSW</option>
                <option value="12">SW</option>
                <option value="13">W</option>
                <option value="14">WNW</option>
                <option value="16">WSW</option>
            </select><br>
            <select class="form-control" name="WindDir9am"  default="Click to choose the
wind direction at 9am..." required><br>
```

```
                <option value="">Click to choose the wind direction at 9am...</option>
                <option value="0">E</option>
                <option value="1">ENE</option>
                <option value="2">ESE</option>
                <option value="3">N</option>
                <option value="4">NE</option>
                <option value="5">NNE</option>
                <option value="6">NNW</option>
                <option value="7">NW</option>
                <option value="8">S</option>
                <option value="9">SE</option>
                <option value="10">SSE</option>
                <option value="11">SSW</option>
                <option value="12">SW</option>
                <option value="13">W</option>
                <option value="14">WNW</option>
                <option value="16">WSW</option>
            </select><br>
            <select class="form-control" name="WindDir3pm"  default="Click to choose the wind direction at 3pm..." required><br>
                <option value="">Click to choose the wind direction at 3pm...</option>
                <option value="0">E</option>
                <option value="1">ENE</option>
                <option value="2">ESE</option>
                <option value="3">N</option>
                <option value="4">NE</option>
                <option value="5">NNE</option>
                <option value="6">NNW</option>
                <option value="7">NW</option>
                <option value="8">S</option>
                <option value="9">SE</option>
                <option value="10">SSE</option>
```

```
                    <option value="11">SSW</option>
                    <option value="12">SW</option>
                    <option value="13">W</option>
                    <option value="14">WNW</option>
                    <option value="16">WSW</option>
                </select><br>
            </div>
        </div>
        <div class="row d-flex justify-content-center">
            <div class="col"></div>
            <div class="col-md-4">
                <input type="submit" class="btn btn-dark" name="submit" value="Predict
Rainfall" style="background-color: green;">
                </form>
            </div>
        </div>
    </div>
    </div>
    </body>
    </html>
</body>
</html>
```

predict1.html

```
<!DOCTYPE html>
<html lang="en">
  <link rel = "icon" href =
"/static/images/ibm.png"
      type = "image/x-icon">
<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>Yes it rains</title>
    <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css"
rel="stylesheet" integrity="sha384-
Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1WTRi"
crossorigin="anonymous">
</head>
<style>
    #myVideo {
  width: 100vw;
  height: 100vh;
  object-fit: cover;
  position: fixed;
  left: 0;
  right: 0;
  top: 0;
  bottom: 0;
  z-index: -1;
  filter: blur(2px);
}
.content {
  position: fixed;
  background: rgba(135, 206, 235, 0.5);
  color:black;
  padding: 20px;
}
.header {
  padding: 0px;
  text-align: center;
  background: #1abc9c;j
  color: white;
```

```
  font-size: 30px;
}
</style>
<body>
   <div class="header">
      <p style="color: red;align-content: center;"><marquee scrollamount="20">&#127783
&#127783 &#127783 &#127783 &#127783 &#128561 &#128561 ALERT ALERT !!
&#128561 & #128561 &#127783 &#127783 &#127783 &#127783
&#127783</marquee></p>
     </div>
    <video autoplay muted loop id="myVideo">
       <source src="/static/images/rain.mp4" type="video/mp4">
     </video>
    <div class="container-fluid">
       <div class="row d-flex justify-content-center">
          <div class="col d-flex justify-content-center">
             <img src="/static/images/rain1.jpg" alt="no rain img" height="120%"
width="103%" >
          </div>
          <div class="col d-flex justify-content-center"><br><br><br><br>
             <div class="content">
             <p ><h1 style="color: blue;">There is a high probability of rainfall Tomorrow!
<br>
                </h1>
             <h3>Instructions to Farmers:</h3>
             <h4>
                <ul>
                   &#10060 Stop irrigation today
                  <br> &#9989 Set up a rain cover
                  <br> &#9989 Ensure proper Drinage system
                  <br> &#10060 Avoid activities like Spraying pesticides
                  <br> &#10060 Avoid Harvesting and Drying
```

```
                </ul>
                </h4>
            </p>
            </div>
        </div>
    </div>
</body>
</html>
```

predict2.html

```
<!DOCTYPE html>
<html lang="en">
    <link rel = "icon" href =
"/static/images/ibm.png"
        type = "image/x-icon">
<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>no it isn't rains</title>
    <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css"
rel="stylesheet" integrity="sha384-
Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1WTRi"
crossorigin="anonymous">
</head>
<style>
    #myVideo {
  width: 100vw;
  height: 100vh;
  object-fit: cover;
```

```
  position: fixed;
  left: 0;
  right: 0;
  top: 0;
  bottom: 0;
  z-index: -1;
  filter: blur(2px);
}
.content {
  position: fixed;
  background: rgba(135, 206, 235, 0.5);
  color:black;
  padding: 20px;
}
.header {
  padding: 0px;
  text-align: center;
  background: yellowgreen;
  color: white;
  font-size: 30px;
}
</style>
<body>
    <div class="header">
        <p style="color: red; align-content: center;"><marquee scrollamount="20">&#127774
&#127748 &#127748 &#127748 &#127748 &#128539 &#128539 Don't Panic !! &#128539
&#128539 &#127748 &#127748 &#127748 &#127748 &#127774</marquee></p>
      </div>
    <video autoplay muted loop id="myVideo">
        <source src="/static/images/sun1.mp4" type="video/mp4">
      </video>
    <div class="container-fluid">
```

```
      <div class="row d-flex justify-content-center">
         <div class="col d-flex justify-content-center">
            <img src="/static/images/sun2.jpg" alt="no rain img" height="120%"
width="103%">
         </div>
         <div class="col d-flex justify-content-center px-4"><br><br><br>
            <div class="content">
               <p ><h1 style="color: blue;">There will be no rainfall Tomorrow! <br>
                  </h1>
               <h3>Instructions to Farmers:</h3>
               <h4>
                  <ul>
                     &#10060 Stop sowing of seeds
                     <br> &#9989 Can go to farming work like Harvesting
                     <br> &#9989 Plan for proper irrigation
                     <br> &#10060 Do not plough the land
                     <br> &#9989 Enjoy the Sunshine &#128512
                    </ul>
                    </h4>
               </p>
               </div>
         </div>
      </div>
   </div>
</body>
</html>
```

app.py

```
import numpy as np
import pickle
import joblib
import matplotlib
```

```
import matplotlib.pyplot as plt
import time
import pandas
import os
from sklearn import *
from flask import Flask,request,jsonify,render_template,redirect,url_for
app = Flask(__name__, static_folder='static')
model = pickle.load(open("./rainfall.pkl","rb"))
scale= pickle.load(open("./scale.pkl","rb"))
encoder = pickle.load(open("encoder.pkl","rb"))
@app.route('/')
def home():
  return render_template('index.html')
@app.route('/pred',methods=["POST","GET"])
def pred():
  inp_feature = [x for x in request.form.values()]
  inp_feature=inp_feature[:18]
  print(inp_feature)
  feature_values = [np.array(inp_feature)]
  names = [['Location', 'MinTemp', 'MaxTemp', 'Rainfall', 'WindGustSpeed',
        'WindSpeed9am', 'WindSpeed3pm', 'Humidity9am', 'Humidity3pm',
        'Pressure9am', 'Pressure3pm', 'Temp9am', 'Temp3pm', 'risk', 'RainToday',
        'WindGustDir', 'WindDir9am', 'WindDir3pm']]
  data = pandas.DataFrame(feature_values,columns=names)
  data = scale.fit_transform(data)
  print(data)
  data = pandas.DataFrame(data,columns=names)
  print(data)
  prediction = model.predict(data)
  print(prediction)
  if prediction == "Yes":
    return render_template("predict1.html")
```

```
    else:
        return render_template("predict2.html")
if __name__ == '__main__':
    app.run(debug= True)
```

GitHub link

https://github.com/IBM-EPBL/IBM-Project-23482-1659883810

Project Demonstration

https://drive.google.com/drive/folders/1SLgtp6AELzoG0jajSUUCA3bIp2qv_uPg?usp=sharing