

EXPLORATORY ANALYSIS OF RAIN FALL DATA IN INDIA FOR AGRICULTURE

PROJECT BASED LEARNING (NALAIYA THIRAN) ON PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

Submitted by

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**ADHIPARASAKTHI ENGINEERING COLLEGE
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ABSTRACT

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.

The main purpose of our project is to detect the rainfall detection in Agricultural area in India with a help of machine learning. To design a disaster management system by forecasting a flood event to control flood risk by recommending an evacuation area from flood hazard areas which ultimately helps to manage the environment and water resource system. This also serves a purpose of the Early warning system by training a model and selecting the best prediction algorithm among the classifiers. The occurrence of flash floods can cause catastrophic damage to the society. They first mainly affect the people living near to the riverbeds. Evacuating them from the hazard areas and providing them the shelter they needed

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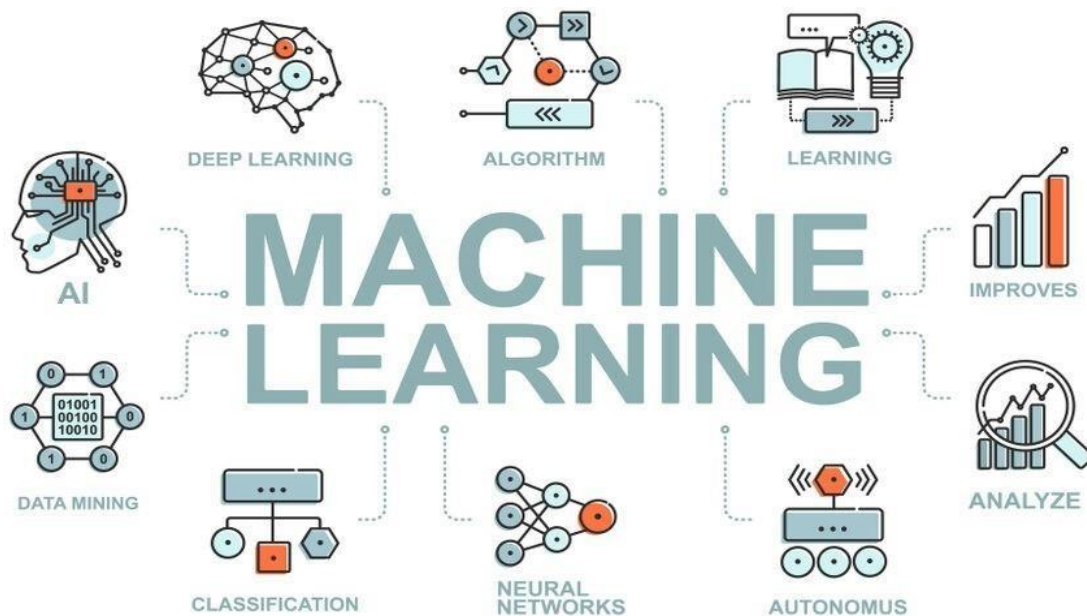
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CHAPTER 1

INTRODUCTION

What is Machine Learning?

Machine learning is a growing technology which enables computers to learn automatically from past data. Machine learning uses various algorithms for building mathematical models and making predictions using historical data or information. Currently, it is being used for various tasks such as image recognition, speech recognition, email filtering, Face book auto-tagging, recommender system, and many more. This machine learning tutorial gives you an introduction to machine learning along with the wide range of machine learning techniques such as Supervised, Unsupervised, and Reinforcement learning. You will learn about regression and classification models, clustering methods, hidden Markov models, and various sequential models.



Supervised and unsupervised learning:

In Supervised Learning, a machine is trained using 'labelled data'. Datasets are said to be labelled when they contain both input and output parameters. In other words, the data has already been tagged with the correct answer. So, the technique mimics a classroom environment where a student learns in the presence of a supervisor or teacher. On the other hand, unsupervised learning algorithms let the models discover information and learn on their own data items in their experience.

Supervised machine learning is immensely helpful in solving real-world computational problems. The algorithm predicts outcomes for unforeseen data by learning from labeled training data. Therefore, it takes highly- skilled data scientists to build and deploy such models. Over time, data scientists also use their technical expertise to rebuild the models to maintain the integrity of the insights given.

It is neither based on supervised learning or unsupervised learning. Moreover, here the algorithms learn to react to an environment on their own. It is rapidly growing and moreover producing a variety of learning algorithms. These algorithms are useful in the field of Robotics, Gaming etc.

For a learning agent, there is always a start state and an end state. However, to reach the end state, there might be a different path. In the Reinforcement Learning Problem an agent tries to manipulate the environment. The agent travels from one state to another. The agent gets the reward (appreciation) on success but will not receive any reward or appreciation on failure. In this way, the agent learns from the environment.



Types of ML algorithm problems:

- Classification
- Regression
- Clustering

Clustering, Classification, Regression

In the field of machine learning we all know the type of problems are different, sometimes we predict the value of the previous set of data – Where data learns from available dataset, or sometimes grouping them into some cluster. So today we are going to see what these terms are – **Clustering, Classification and Regression** means in the Data science field. Let's dive into this concept.

Generally machine learning algorithms are categorized on the basis of output type and type of problem that need to be addressed. So these algorithm are divided into three categories –

1. Classification
2. Regression
3. Clustering

Classification:

Classification is the type of supervised machine learning. For any given input, the classification algorithm helps in the prediction of the class of the output variables. There can be multiple types of classification – binary classification, multi-class classification.

Types of classification:

- ❖ K – Nearest Neighbour
- ❖ Logistic regression
- ❖ Decision tree
- ❖ Random forest
- ❖ Naive Bayes
- ❖ SVM (Support vector machine)

Regression:

Regression is the type of supervised machine learning. When the output is continuous like age, height etc. one of the very popular regression algorithms is **Linear Regression**.

Clustering:

Clustering is an unsupervised machine learning algorithm; it is used to group data points having similar characteristics as clusters.

Clustering is divided into two groups

1. Hard clustering – In hard clustering, the data point is assigned to one of the clusters only.
2. Soft clustering – It provides a probability of a data point to be in each of the clusters.

1.1 Project Overview

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: 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 analyzing the weather data.

The website is designed for farmers which is based on science and technology to predict the condition of the atmosphere for a given location and time. It is a statement saying what the weather will be like the next day or for the next few days. Accurate forecasting can help to save lives and minimize property damage using machine learning.

1.2 Purpose

Rainfall Prediction Model has a main purpose in prediction of the amount of rain in a specific well or division in advance by using various regression technique and find out which one is best for rainfall prediction. This model also helps the farmer for agriculture to decide the crop, helping the watershed department for water storage.

India is an agricultural country and secondary agro based market will be steady with a good monsoon. The economic growth of each year depends on the amount of duration of monsoon rain, bad monsoon can lead to destruction of some crops, which may result in scarcity of some agricultural products which in turn can cause food inflation, insecurity and public unrest. In our analysis we are trying to understand the behaviors of rainfall in India over the years, by months and different subdivisions.

The Purpose of this project is:

- It can help with a farmer's business decisions.
- Forecast's can help them plan for the many day to day decisions. These decisions include crop irrigation, time to fertilize, and what days are suitable working in the field.
- The decisions that farmers make will result in a profitable crop or failure.
- The crop losses can be reduced substantially by affecting adjustments through timely and accurate weather forecasts.

CHAPTER 2

LITERATURE SURVEY

Title	Keywords	Problem Definition	Methodology (Algorithm, Protocol Etc.)	Input Parameters	Result
Machine Learning in Weather Prediction and Climate Analyses Applications and Perspectives. (2022)	Machine learning, weather; numerical weather prediction, climate.	Machine learning methods will be a key feature in future weather forecasting.	Deep Learning, Random Forest, XGBoost, Kmeans Clustering, Principal Component Analysis.	wind, precipitation , temperature, pressure, and radiation.	The results of the prediction models tested with the best values obtained by the hyper parameter search.
Rainfall prediction system using machine learning fusion for smart cities. (2022)	Rainfall, Machine learning, data fusion, fuzzy system.	Real-time rainfall prediction system for smart cities using machine leaning.	Classification and regression, ANN- based hybrid technique, Decision tree.	The simulation data files. A real time rainfall dataset of the city.	The output will be indicate whether there will rain or not.
Weather based crop prediction in India using Big data Analytics.(2021)	Agriculture, big data analysis, k-means clustering, map reduce, recommendatio n system.	Prediction of crops in India using big data analytics.	By using map reduce, time delay recurrent, neural network and feed forward neural network.	Temperature , rainfall, wind speed, humidity, soil type, seed type.	Sowing of crops according to your input month.
Rainfall forecasting model using Machine Learning.(2021)	Forecasting rainfall, ML, Decision forecast regression.	Whether there is an extreme changes in the occurrence and frequency of heavy rainfall.	Decision forest regression, Neural network regression, Boosted decision tree regression.	10 stations rainfall data.	The table shows best model result to predict rainfall based on ACF.

2.1 Existing Problem

- Weather forecasting is the prediction of the state of the atmosphere for a given location using the application of science and technology
- This includes temperature, rain, cloudiness, wind speed and humidity.
- Weather warning is a special kind of short range forecast carried out for the protection of human life.
- The forecast may be short range or long range. It's very interesting and challenging task.

2.2 Reference

1. Machine Learning in Weather Prediction and Climate Analyses Applications and Perspectives.(2022)

Source link:

https://www.researchgate.net/publication/358047856_Machine_Learning_in_Weather_Prediction_and_Climate_Analyses-Applications_and_Perspectives

2. Rainfall prediction system using machine learning fusion for smart cities. (2022)

Source link:

[https://scholar.google.co.in/scholar?q=Rainfall+prediction+system+using+machine+learning+fusion+for+smart+cities.+\(2022\)&hl=en&as_sdt=0&as_vis=1&oi=scholar](https://scholar.google.co.in/scholar?q=Rainfall+prediction+system+using+machine+learning+fusion+for+smart+cities.+(2022)&hl=en&as_sdt=0&as_vis=1&oi=scholar)

3. Weather based crop prediction in India using Big data Analytics.(2021)

Source link:

<https://ieeexplore.ieee.org/abstract/document/9557312>

4. Rainfall forecasting model using Machine Learning.(2021)

Source link:

<https://www.sciencedirect.com/science/article/pii/S2090447920302069>

2.3 Problem Statement Definition

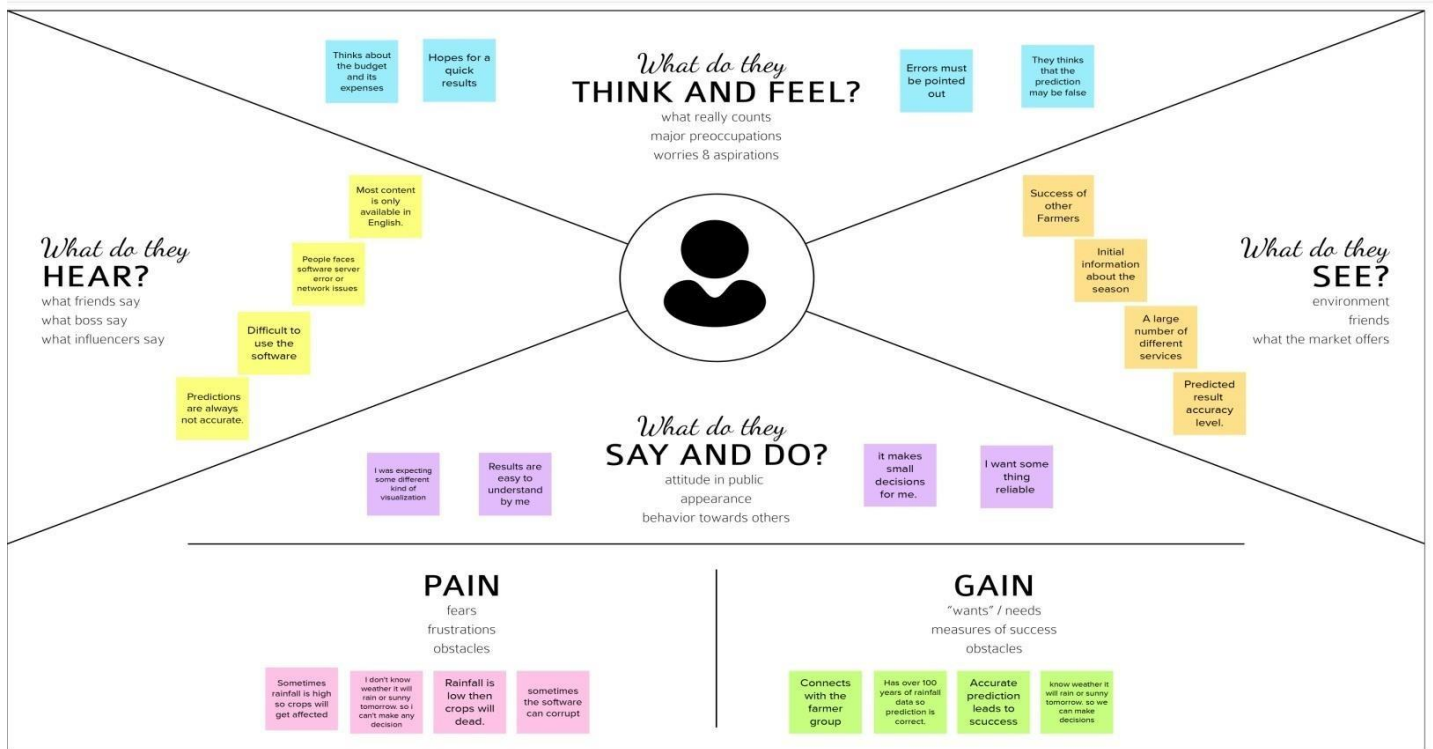
Making a good prediction of climate is always a major task now a day because of the climate changes. A bad rainfall prediction can affect the agriculture mostly framers as their whole crop is depend on the rainfall and agriculture is always an important part of every economy. So, making an accurate prediction of the rainfall somewhat good. There are number of techniques are used of machine learning but accuracy is always a matter of concern in prediction made in rainfall. There are number of causes made by rainfall affecting the Agriculture ex. Drought, Flood and intense summer heat etc. And it will also affect water resources. Our major concern is the agriculture was affected by the weather.

- Farmers need to check their Predicted data in the respective applications.
- Farmers can put their certain date and location details that will calculate and provide the probable chances.
- Farmers need this platform to get the idea about the weather data. It can assist farmer determining when they should work most efficiently in the day to day operations

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

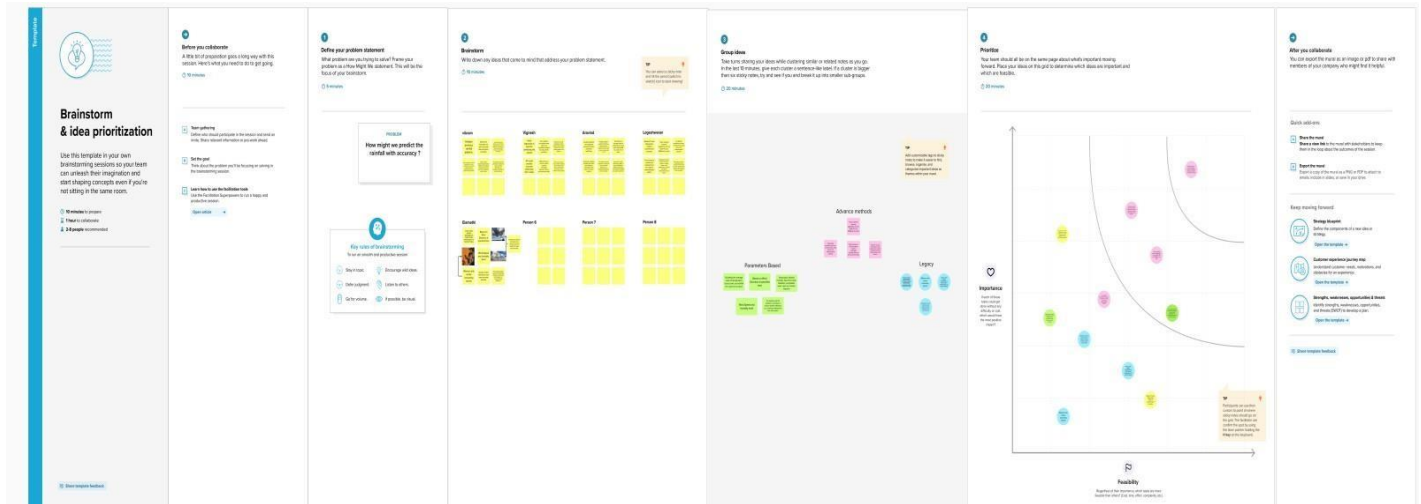


EMPATHY MAP:

<https://app.mural.co/invitation/mural/edaofraindatainindiaforagric7031/1661419827144?sender=ue93948e838775b2aeb193102&key=147ac29e-4a45-4934-9828-ad7f3f9f9a1c>

3.2 Ideation & Brainstorming

EDA technique is used to analyze, visualize, investigate, interpret, discover and summarize data. The main purpose of EDA is to help look at data before making any assumptions. It can help identify obvious errors, as well as better understand patterns within the data, detect outliers or anomalous events, find interesting relations among the variables.



BRAINSTORM IDEATION:

<https://app.mural.co/invitation/mural/edaofraindatainindiaforagric7031/1661420191477?sender=ue93948e838775b2aeb193102&key=3647fc6a-369e-44b5-a194-b238d1105422>

3.3 Proposed Solution

S No	Parameter	Description
1.	Problem Statement (Problem to be solved)	How might we predict the rainfall with accuracy?
2.	Idea / Solution description	Once EDA is complete and insights are drawn, its features can then be used for more sophisticated data analysis or modelling, including machine learning.
3.	Novelty / Uniqueness	We are planning to add new feature. i.e. rainfall forecast for a particular period. This helps the farmers to plant the right crops at the right time.
4.	Social Impact / Customer Satisfaction	A good balance rainfall prediction helps proper irrigation. And it can lead to faster-growing plants, which can cut down on germination time and the length between seeding and harvest.
5.	Business Model (Revenue Model)	Subscription based business model.
6.	Scalability of the Solution	The persistence forecasts are 60-70% accurate as well.

3.4 Problem Solution Fit

1. CUSTOMER SEGMENTS Micro, small or marginal, emerging and large or commercial farmers.	6. CUSTOMER LIMITATIONS Customer can only access and see the given data's predictions.	5. AVAILABLE SOLUTIONS Observational data collected by doppler radar, radiosondes, weather satellites, buoys and other instruments are fed into computerized NWS numerical forecast models.
2. PROBLEMS / PAINS Because of the long gap between rains, crops face water stress. Short-term crops Their vegetative phase would be cut short and they will go into early flowering, leading to a drop in yield	9. PROBLEM ROOT/CAUSE Weather there can be unpredictable. one minute it's blue skies and the next minute it's pouring rain.	7. BEHAVIOR Erosion of the topsoil occurs due to the flooding occurs, and due to unpredictable rain an increase in the number of pathogens and pest infestations on crop commodities that result in a decrease in crop yield.
3. TRIGGERS TO ACT Weather is made up of many factors, when it occurs, its frequency or duration, as well as some other factors.	10. YOURS SOLUTION We are planning to add new feature. i.e. rainfall forecast for a particular period with the help of EDA. This helps the farmers to plant the right crops at the right time.	8. CHANNELS OF BEHAVIOR <div> ONLINE: See the rainfall prediction through online. </div> <div> OFFLINE: Observe the current saturation weather data. </div>
4. EMOTIONS Joy, Trust, and Belonging.		

Micro, small or marginal, emerging and large or commercial farmers. Pains of the long gap between rains, crops face water stress. Short-term crops their vegetative phase would be cut short and they will go into early flowering, leading to a drop in yield. Weather is made up of many factors, when it occurs, its frequency or duration, as well as some other factors joy, trust, and belonging. Observational data collected by Doppler radar, radiosondes, weather satellites, buoys and other instruments are fed into computerized NWS numerical forecast models. Erosion of the topsoil occurs due to the flooding occurs, and due to unpredictable rain an increase in the number of pathogens and pest infestations on crop commodities that result in a decrease in crop yield. We are planning to add new feature. i.e. rainfall forecast for a particular period with the help of EDA. This helps the farmers to plant the right crops at the right time.

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 Functional Requirement

FR NO	Functional Requirement(Epic)	User Story/Task
1	Download and load the dataset	Download and load the appropriate dataset.
2	Pre-processing of data	Preparation of raw data and make it suitable for building of machine learning model.
3	Building machine learning model	<ul style="list-style-type: none"> ✓ Exploring the data and choose the suitable algorithm. ✓ Prepare and clean the dataset. ✓ Split the prepared dataset and make cross validation. ✓ Perform machine learning optimization ✓ Deploy the model.
4	Train the data	Train the model using training set.
5	Test the data	At last, test the model for evaluation of final model.

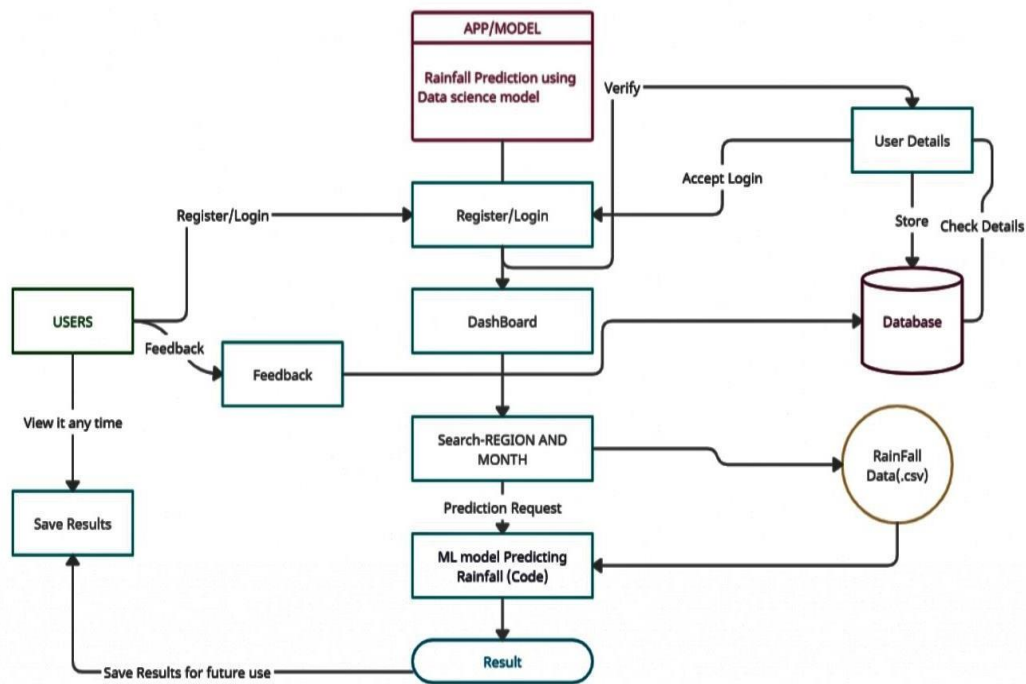
4.2 Non-Functional Requirements

FR NO	Non-Functional Requirements	Description
1	Usability	Local presence/traceability of WIS source in the farming community.
2	Security	Providing secure system networks then determine authenticity, originality and security.
3	Reliability	System will operate without failure for a specific period of time
4	Performance	Our model predictions are same as the true values. So, the performance is higher.
5	Availability	Available to different groups of farmers including women, older persons, etc.
6	Scalability	In our model, Prediction of data will be faultless.

CHAPTER 5

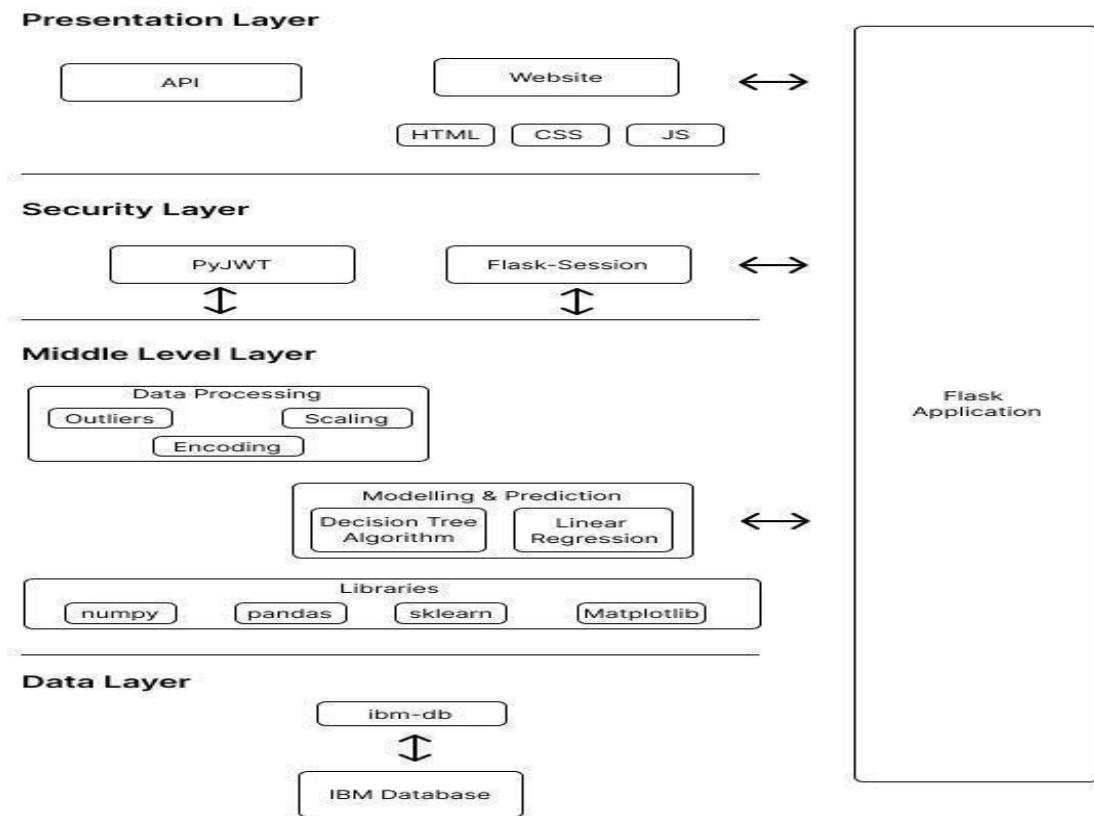
PROJECT DESIGN

5.1 Data Flow Diagrams

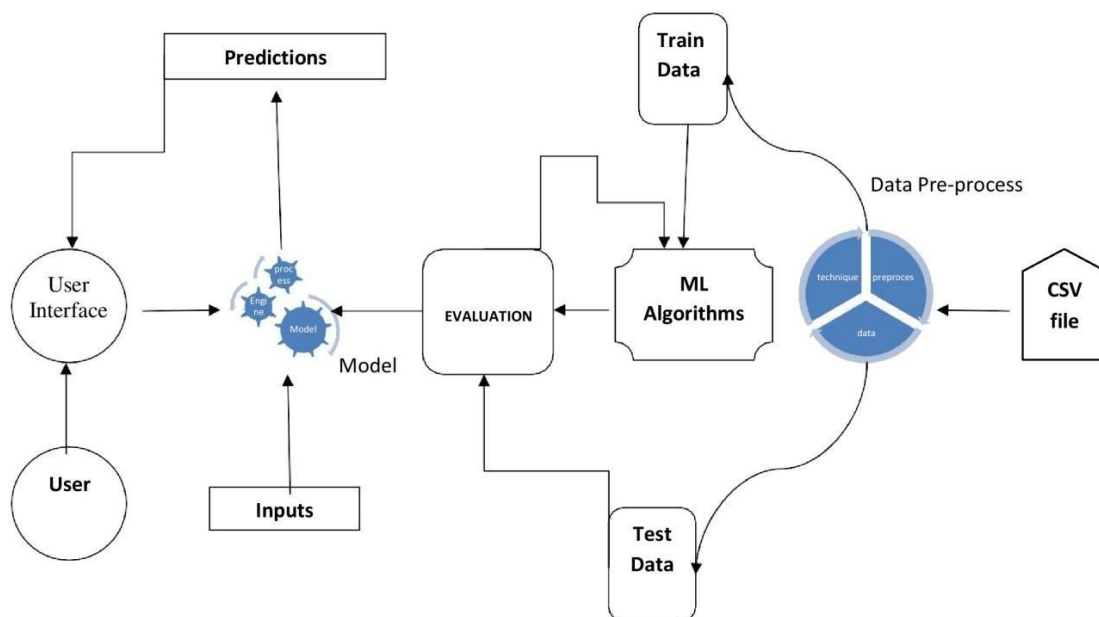


A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enter and leaves the system, what changes the information, and where data is stored.

5.2 Technical Architecture



Solution Architecture



5.3 User Stories

User Story Number	User Story / Task
USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.
USN-2	As a user, I will receive confirmation email once I have registered for the application.
USN-3	As a user, I can log into the application by entering email & password.
USN-4	As a user, I can view the details about the system and can navigate through the pages.
USN-5	As a user, I can enter the rainfall amount and get the prediction results
USN-6	As a user, I can view latest news articles related to agriculture
USN-7	As a user, I can ask queries regarding the system
USN-8	As a user, I can interact with chatbot to ask queries
USN-9	As a user, I can register for the application by entering my email, password, and confirming my password.
USN-10	As a user, I can see the prediction result from the model trained by the system administrator.

CHAPTER 6

PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning

Sprint	Functional Requirement [Epic]	User Story Number	User Story / Task / Activity	Story Points	Team Members
Sprint-1	Registration	USN-1	User can register for the application by entering his or her email, password, and confirming the password.	5	Vikram, Vignesh, Logeshwaran, Aravind
Sprint-1		USN-2	User will receive confirmation email or message once registered for the application.	3	Vikram, Vignesh, Logeshwaran, Aravind
Sprint-1	Login	USN-3	Enter the username and login to the application.	2	Vikram, Vignesh, Logeshwaran, Aravind
Sprint-2	Dashboard	USN-4	User can view the visualization of the rainfall data for a specific region in India or for a specific time period	3	Vikram, Vignesh
Sprint-2		USN-5	User can change his/her password and can view the account details and search history	5	Vikram, Vignesh
Sprint-3	Support	USN-6	User can give the feedback on the accuracy of the prediction and on the user Interface	5	Logeshwaran, Aravind
Sprint-3		USN-7	Responds to user queries via email	2	Vikram, Vignesh
Sprint-3		USN-8	The team must respond immediately to the queries based on the priority	5	Logeshwaran, Aravind
Sprint-4	Core Function	USN-9	User can enter the temperature condition of the environment	8	Vikram, Vignesh, Logeshwaran, Aravind

Sprint-4		USN-10	Prediction of rainfall and displaying of result	2	Vikram, Vignesh, Logeshwaran, Aravind
Sprint-4		USN-11	The website is responsive on all the devices and the screen sizes.	5	Vikram, Vignesh, Logeshwaran, Aravind

Estimation

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed	Sprint Release Date (Actual)
Sprint-1	10	6 Days	28 Oct 2022	02 Oct 2022	10	03 Oct 2022
Sprint-2	7	5 Days	03 Oct 2022	07 Nov 2022	07	08 Nov 2022
Sprint-3	12	6 Days	08 Nov 2022	13 Nov 2022	12	14 Nov 2022
Sprint-4	15	5 Days	14 Nov 2022	18 Nov 2022	15	19 Nov 2022

Velocity:

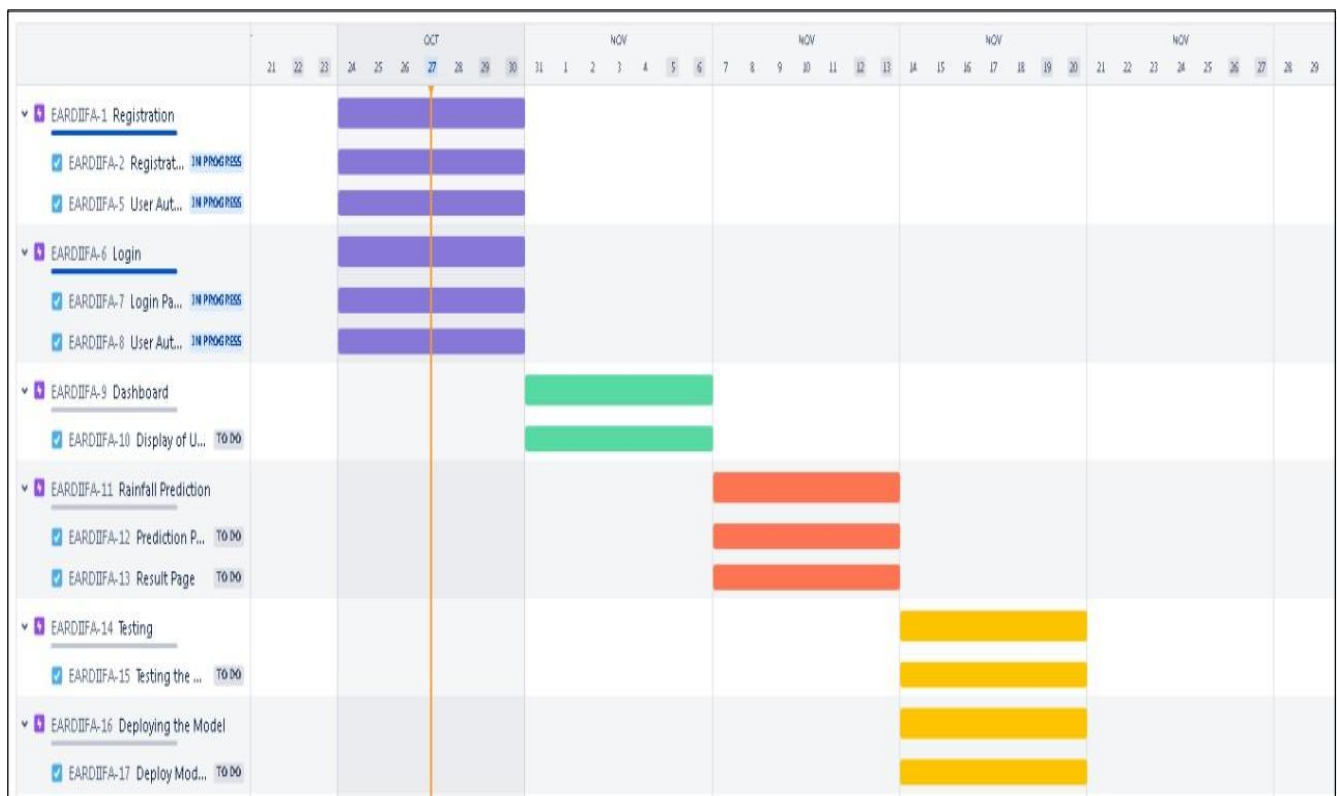
$$\begin{aligned}
 \text{Average Sprint Velocity} &= \frac{\text{Story Points to be completed out of all user stories}}{\text{Total Number Of Sprints}} \\
 &= 44/4 \\
 &= 11
 \end{aligned}$$

Therefore, The Amount Of work to be done on each Sprint is an average of **11 Story Points**.

6.2 Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed	Sprint Release Date (Actual)
Sprint-1	10	6 Days	28 Oct 2022	02 Oct 2022	10	03 Oct 2022
Sprint-2	7	5 Days	03 Oct 2022	07 Nov 2022	07	08 Nov 2022
Sprint-3	12	6 Days	08 Nov 2022	13 Nov 2022	12	14 Nov 2022
Sprint-4	15	5 Days	14 Nov 2022	18 Nov 2022	15	19 Nov 2022

6.3 Reports from JIRA



CHAPTER 7

CODING & SOLUTIONING

7.1 Feature

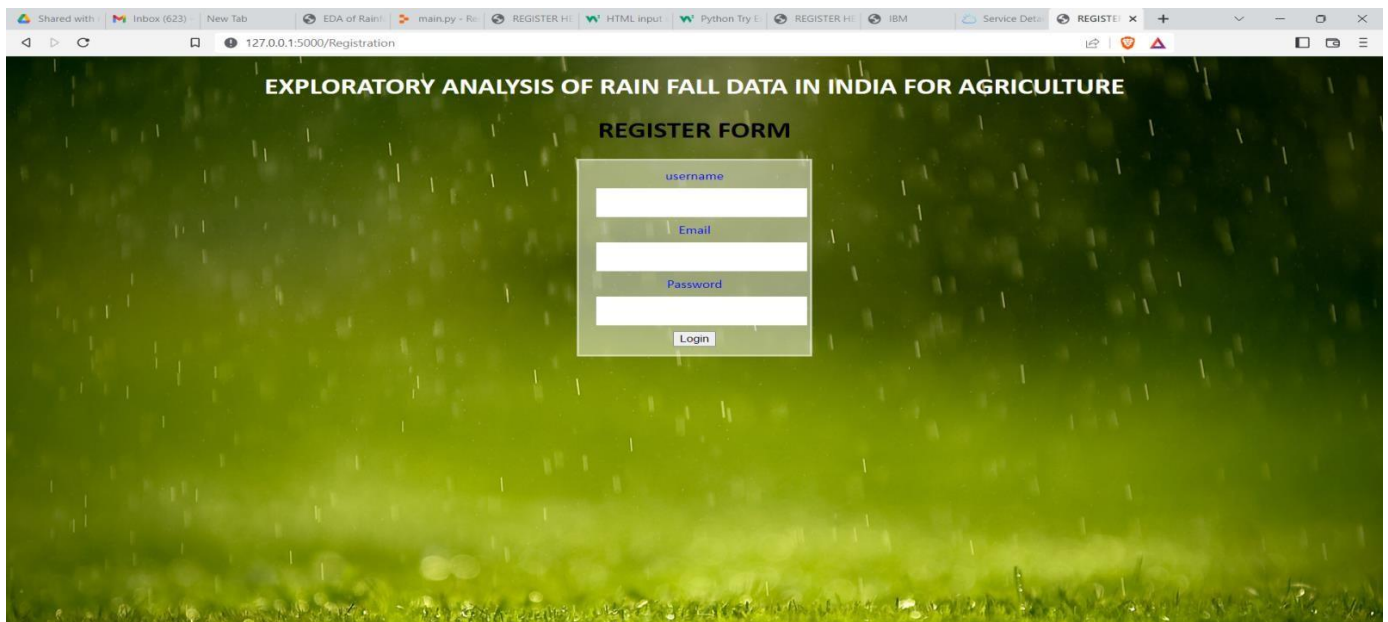
Rainfall prediction

In features, we have designed a webpage using Hyper Text Markup Language (version 5) to predict the rainfall. The user can login into the webpage using username and password .After successful login; the user will be redirected to the home page. After entering into the home page, we have to choose the thing that we want. The choices are About, Contact us and Predictor.

In our about page, we loaded the information about prediction rate. In news page, the past and current information of weather forecasting is available. In Contact page, If customer have any queries that should be cleared through two ways Feedback message and Direct contact.

In predictor page, We need to give certain location and Date, after submitting, the predicted data will be displayed(chances of rainfall). we can select sowing month, the details of the suitable crops and harvesting period will be displayed.

SIGN UP PAGE

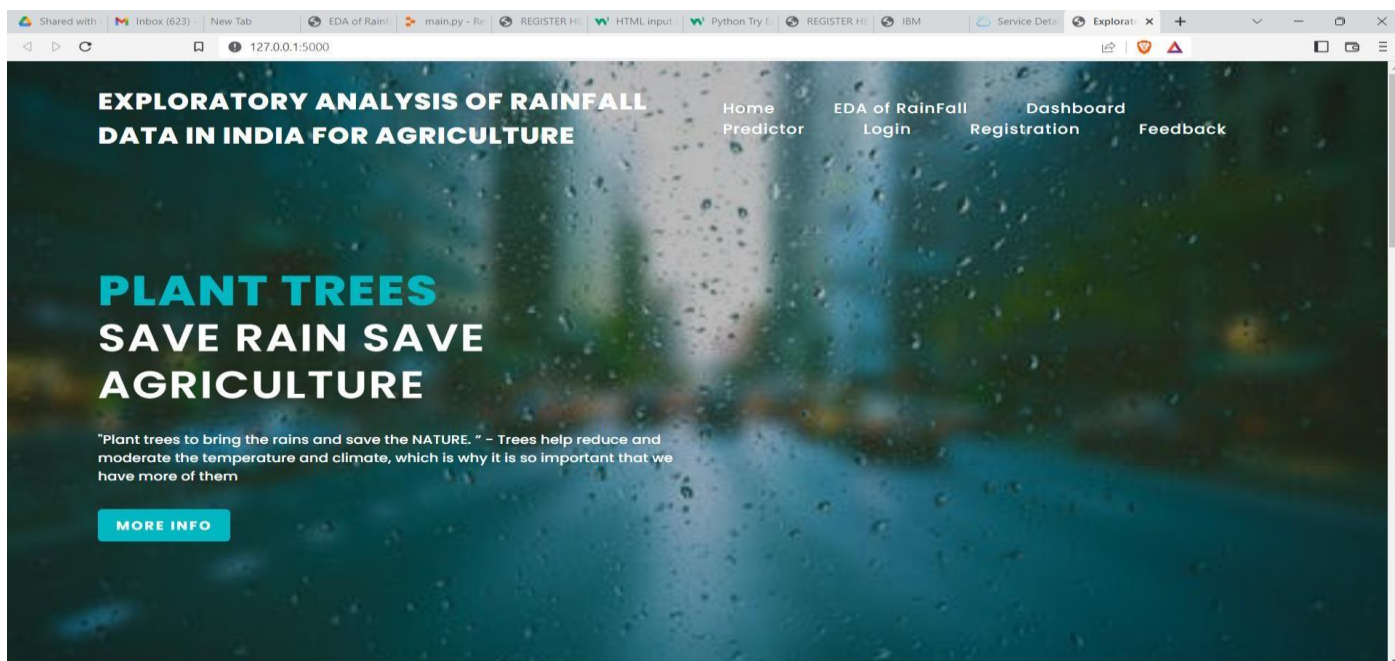


The screenshot displays a web browser window with multiple tabs. The active tab shows a registration form titled "EXPLORATORY ANALYSIS OF RAIN FALL DATA IN INDIA FOR AGRICULTURE". The form is titled "REGISTER FORM" and contains the following fields and buttons:

- A "username" label above a text input field.
- An "Email" label above a text input field.
- A "Password" label above a text input field.
- A "Login" button at the bottom of the form.

The background of the webpage is a green field with rain falling.

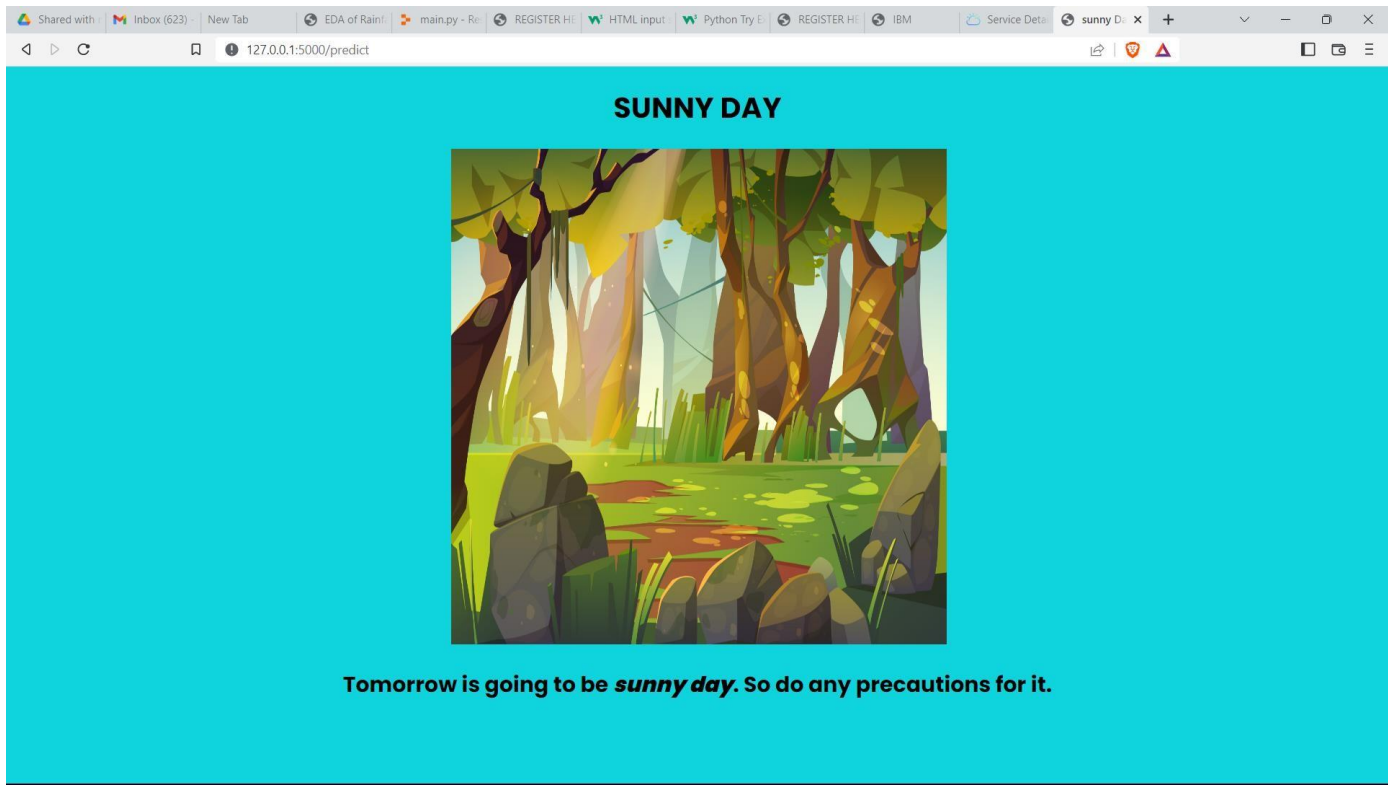
HOME PAGE



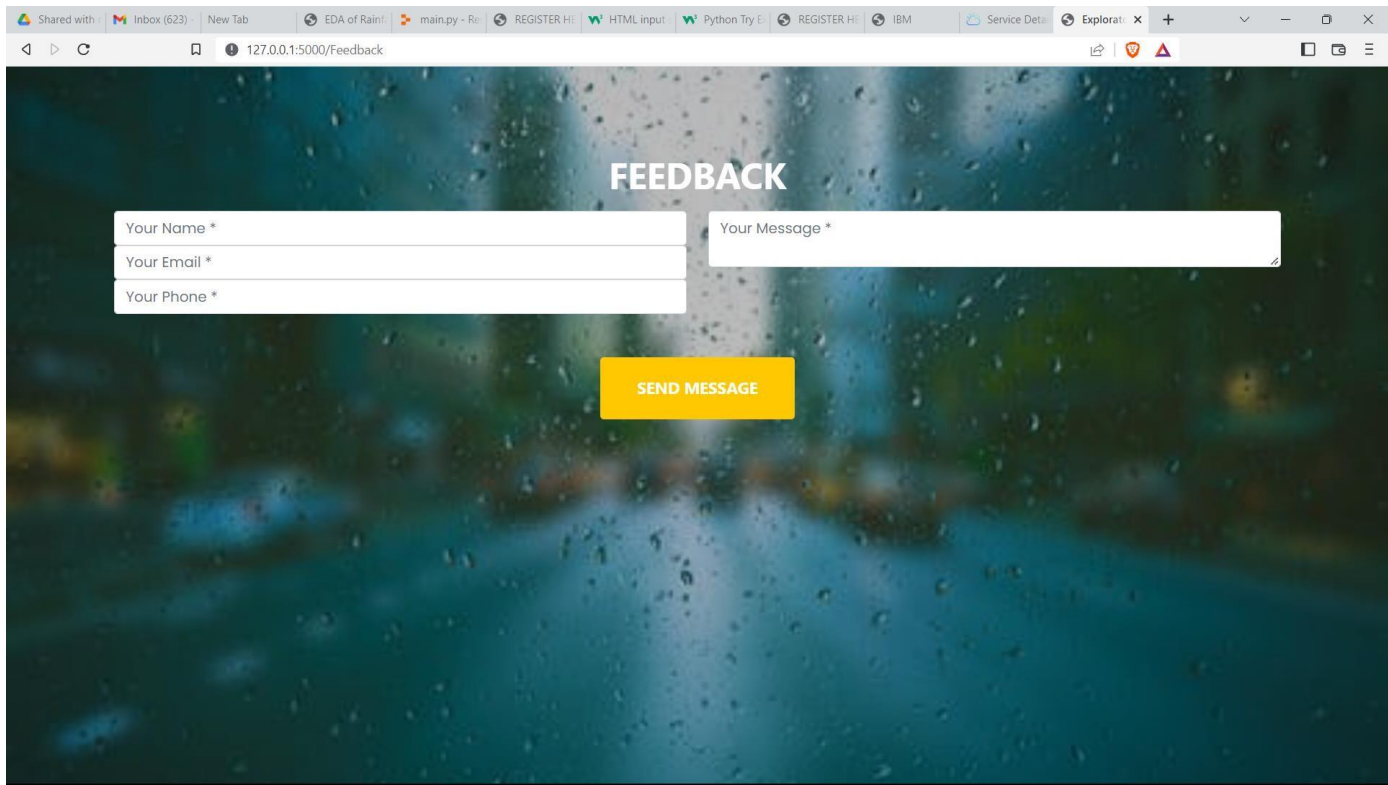
PREDICTOR PAGE

The screenshot shows the 'Predictor' page of the web application. The browser's address bar displays '127.0.0.1:5000/predict'. The page has a purple sidebar and a light green header with the title 'Predictor'. The main content area is a form with two columns of input fields. The left column includes fields for 'Date' (with a calendar icon), 'Maximum Temperature', 'Evaporation', 'Wind Gust Speed', 'Wind Speed 3pm', 'Humidity 3pm', 'Pressure 3pm', 'Temperature 3pm', and 'Cloud 3pm'. The right column includes fields for 'Minimum temperature', 'Rainfall', 'Sunshine', 'Wind Speed 9am', 'Humidity 9am', 'Pressure 9am', 'Temperature 9am', 'Cloud 9am', and a 'Location' dropdown menu with the text 'Select Location'.

OUTCOME PAGE



FEEDBACK PAGE



PYTHON CODE FOR RAINFALL PREDICTION

```
from flask import Flask,render_template,url_for,request,jsonify
from flask_cors import cross_origin
import pandas as pd
import numpy as np
import datetime
import pickle
import database as db

app = Flask(__name__, template_folder="template")
model = pickle.load(open("./models/cat.pkl", "rb"))
print("Model Loaded")

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

@app.route("/predict",methods=['GET', 'POST'])
@cross_origin()
def predict():
    if request.method == "POST":
        # DATE
        date = request.form['date']
        day = float(pd.to_datetime(date, format="%Y-%m-%dT").day)
        month = float(pd.to_datetime(date, format="%Y-%m-%dT").month)
        # MinTemp
        minTemp = float(request.form['mintemp'])
        # MaxTemp
        maxTemp = float(request.form['maxtemp'])
        # Rainfall
        rainfall = float(request.form['rainfall'])
        # Evaporation
```

```
evaporation = float(request.form['evaporation'])
# Sunshine
sunshine = float(request.form['sunshine'])
# Wind Gust Speed
windGustSpeed = float(request.form['windgustspeed'])
# Wind Speed 9am
windSpeed9am = float(request.form['windspeed9am'])
# Wind Speed 3pm
windSpeed3pm = float(request.form['windspeed3pm'])
# Humidity 9am
humidity9am = float(request.form['humidity9am'])
# Humidity 3pm
humidity3pm = float(request.form['humidity3pm'])
# Pressure 9am
pressure9am = float(request.form['pressure9am'])
# Pressure 3pm
pressure3pm = float(request.form['pressure3pm'])
# Temperature 9am
temp9am = float(request.form['temp9am'])
# Temperature 3pm
temp3pm = float(request.form['temp3pm'])
# Cloud 9am
cloud9am = float(request.form['cloud9am'])
# Cloud 3pm
cloud3pm = float(request.form['cloud3pm'])
# location
location = float(request.form['location'])
# Wind Dir 9am
windDir9am = float(request.form['winddir9am'])
# Wind Dir 3pm
windDir3pm = float(request.form['winddir3pm'])
```

```

# Wind Gust Dir
windGustDir = float(request.form['windgustdir'])

# Rain Today
rainToday = float(request.form['raintoday'])

input_lst = [location , minTemp , maxTemp , rainfall , evaporation , sunshine ,
              windGustDir , windGustSpeed , windDir9am ,
windDir3pm , windSpeed9am , windSpeed3pm ,
              humidity9am , humidity3pm , pressure9am , pressure3pm ,
cloud9am , cloud3pm , temp9am , temp3pm ,
              rainToday , month , day]

pred = model.predict(input_lst)
output = pred
if output == 0:
    return render_template("after_sunny.html")
else:
    return render_template("after_rainy.html")

return render_template("predictor.html")

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

@app.route("/result", methods=['POST','GET'])
def result():
    if request.method == 'POST':
        email = str(request.form['email'])
        password = str(request.form['pwd'])
        if len(email)<=40 and len(password)<=30:
            if db.login(email,password):
                return render_template("predictor.html")
            else:
                return render_template("Login.html",status="Invalid data")

@app.route("/Registration",methods=['GET', 'POST'])

```

```

def Registration():
    return render_template("Registration.html",status="")

@app.route("/Registrte",methods=['GET', 'POST'])
def Registrte():
    if request.method == 'POST':
        username = str(request.form['username'])
        email = str(request.form['email'])
        password = str(request.form['pwd'])
        if len(username)<25 and len(email)<40 and len(password)<30:
            if db.registration(username,email,password):
                return render_template("predictor.html")
            else:
                return render_template("Registration.html",status="Invalid data")

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

@app.route("/submit",methods=['GET', 'POST'])
def submit():
    if request.method == 'POST':
        username = str(request.form['username'])
        email = str(request.form['email'])
        phone_number = str(request.form['ph'])
        message = str(request.form['msg'])
        if len(username)<=25 and len(email)<=40 and len(phone_number)<=15 and
len(message)<=250:
            if db.feedback(username,email,phone_number,message):
                return render_template("index.html")
            else:
                return render_template("predictor.html")

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

```


CHAPTER 8

TESTING

8.1 Test Cases

Test case ID	Feature Type	Component	Test Scenario	Pre requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status
HomePage_TC_OO1	UI	Home Page	User is able to see the form along with UI elements		Enter URL and click go	http://127.0.0.1:5000/	Homepage should be displayed	Working as expected	Pass
Prediction_TC_OO2	Functional	Home Page	User fills the form to view the prediction		1.Enter URL and click go 2.Fill the form 3.Click Predict	[15.9,21.7,2.2,31,15,13,89,91,1010.5,1004.2,15.9,17]	Page showing "Expect Rain Today" along with necessary suggestions	Working as expected	Pass
PredictionPage_TC_OO3	Functional	Home page	User fills the form to view the prediction		1.Enter URL and click go 2.Fill the form 3.Click Predict	[13.4,22.9,0.6,44,20,24,71,22,1007.7,1007.1,16.9,21.8]	Page showing "No Chances of Rain Today" along with necessary suggestions	Working as expected	Pass

8.2 User Acceptance Testing

1. Purpose of Document

The goal of this document is to give a short summary of the Exploratory Analysis of Rainfall Data in India for Agriculture project's test coverage and open issues 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 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	2	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

3. Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
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

CHAPTER 9

RESULTS

9.1 Performance Metrics

Software quality is a measurement of something intangible, “how good” a software product really is. Some of the aspects of software quality taken are

- a) Scalability
- b) Speed
- c) Stability
- d) Reliability
- e) Security
- f) Maintainability and code quality

LOAD TEST

TITLE	DESCRIPTION
Scenario Name	Load Test – Exploratory Analysis of Rainfall Data in India for Agriculture
Scenario Type	Load Test – Duration 1 hour
Scenario Objective	To Simulate the peak load and to monitor the performance of the Website
Steps	The online load will be maintained at steady state
Entry Criteria	The online load will be maintained at steady state
Exit Criteria	The online load will be maintained at steady state

STRESS TEST

TITLE	DESCRIPTION
Scenario Name	Stress Test - Exploratory Analysis of Rainfall Data in India for Agriculture
Scenario Type	Stress Test
Scenario Objective	Objective is to verify that the application can handle the projected growth and to discover the breaking point
Steps	Ramp up to 150% of peak volume and continuously increase load until breaking point
Entry Criteria	All the monitors are in place Test Data is set up Peak load test completed successfully
Exit Criteria	Test completion report is agreed upon as per expectation

ENDURANCE / SOAK TEST

TITLE	DESCRIPTION
Scenario Name	Soak Test - Exploratory Analysis of Rainfall Data in India for Agriculture
Scenario Type	Endurance – Duration 8 hours
Scenario Objective	To discover memory issues and bottlenecks that might occur under daily usage of the application
Steps	Steady state is maintained for 8 hours with half of the peak load.
Entry Criteria	All the monitors are in place to test data is set up peak load test completed successfully
Exit Criteria	Test completion report is agreed upon as per expectation

CHAPTER 10

ADVANTAGES & DISADVANTAGES

Advantages:

- Has over 100 years of rainfall data so prediction is correct.
- Accurate prediction of rainfall to success.
- Technological solutions to improve their production.
- Weather monitoring can be cut costs, product higher crop yields, and prevent over or under water.
- Sensors allow farmers to make better decisions about pesticides, watering and preventing diseases.
- Forecast's based on temperature and precipitation are important to agriculture ,and therefore to traders within commodity markets.

Disadvantages:

- People face software server error or network issues.
- Sometimes the software can corrupt.
- Predictions are always not accurate.
- Forecast's are never completely accurate-Forecast's are never 100% and it is almost impossible to predict the future with certainty.
- Problems concern availability, timeliness, and quality of observational data; time constraints on forecast preparation; the nature and reliability of communication system available for forecast
- Meteorologists need to track multiple conditions and variables at the same time across vast areas, and many of these variables interact and affect one another

CHAPTER 11

CONCLUSION AND FUTURE SCOPE

11.1 Conclusion

This Paper has presented a supervised rainfall learning model which used machine learning algorithms to classify rainfall data. We used different machine learning algorithm to check the accuracy of rainfall prediction. From the Random forest is the Machine learning algorithm which is suitable for rainfall prediction in India.

Currently machine learning used in industries. As the data increases the complexity of that data will increase and for that we are using machine for the better understanding of that data. In Weather predictions it's pretty helpful with good accuracy score and in rainfall also its gives pretty good predictions. Our rainfall prediction is 87% accuracy in India for agriculture.

11.2. FUTURE SCOPE

- The demand for weather and climate forecast information in support of critical decision making has grown rapidly during the last decade and will grow even faster in coming years.
- Great Advances have been made in the utilization of prediction in many areas of human activities.
- Weather forecast is the prediction of the state of the atmosphere for a given location using this website.
- Using this website, weather warning can be identified .It is a special kind of short range forecast carried out for the protection of human life.

CHAPTER 12

APPENDIX

12.1 SOURCE CODE

Index code:

```
<!DOCTYPE html>
<html lang="en" dir="ltr">
  <head>
    <meta charset="utf-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Exploratory Analysis Of RainFall</title>
    <link rel="stylesheet" href={{ url_for('static',filename='style1.css')}}>
    <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/5.14.0/css/all.min.css">
  </head>
  <body>
    <section>
      <input type="checkbox" id="check">
      <header>
        </div>
        <h2><a href="#" class="logo">Exploratory Analysis Of RainFall Data In India For
Agriculture</a></h2>
        <div class="navigation">
          <a href="#">Home</a>
          <a href="#about">EDA of RainFall</a>
          <a href="#dashboard">Dashboard</a>
          <a href="/predict">Predictor</a>
          <a href="/Login">Login</a>
          <a href="/Registration">Registration</a>
          <a href="/Feedback">Feedback</a>
        </div>
        <label for="check">
```

```

<i class="fas fa-bars menu-btn"></i>
<i class="fas fa-times close-btn"></i>
</label>
</header>
<div class="content" style="margin-top: 8%;">
  <div class="info">
    <h2>Plant Trees <br><span>Save Rain Save Agriculture</span></h2>
    <p> "Plant trees to bring the rains and save the NATURE. ” - Trees help reduce and
moderate the temperature and climate, which is why it is so important that we have more of
them</p>
    <a href="#about" class="info-btn">More info</a>
  </div>
</div>
</section>
<section id="about">
  <h2>Exploratory Analysis of Rainfall</h2>
  <p class="about" style="text-align: center;"> Exploratory Analysis of Rainfall is a web
app 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.

```
</p>
</section>
<section id="dashboard">
  <h2>Dashboard</h2>
  <p class="dashboard" style="text-align: center;">This dashboard is done using a
software called Power BI which is a product of Microsoft.
  So to see the visualizations interactive I am attaching my <a href="../static/rain.pbix"
style="color: black; font-weight: bold;">Power BI</a>
  dashboard file. This requires Power BI software to open the file. The usage of
dashboards like
  these is to bring a better understanding about the dataset and also to bring some
beautiful insights</p>
```

```

<div>
  
  
  
  
  
  
  
  
</div>
</section>
</body>
</html>
```

Login code:

```
<!Doctype Html>
```

```
<Html>
```

```
<Head>
```

```
<Title>
```

```
EDA of Rainfall LOGIN!!
```

```
</Title>
```

```
<style type=text/css>
```

```
body
```

```
{
```

```
height: 125vh;
```

```
margin-top: 20px;
```

```
padding: 30px;
```

```
font-family: sans-serif;
```

```
}
```

```
</style>
```

```
</Head>
```

```
<Body>
```

```
<h1 style="color:white;">
```

```
<center> EXPLORATORY ANALYSIS OF RAIN FALL DATA IN INDIA FOR  
AGRICULTURE</h1> </center>
```

```
<h2 style="color:white;">
```

```
<center> <marquee> A Single Gentle Rain Makes The grass Many Shades Greener
```

```
</marquee></h2>
```

```
<Title>
```

```
LOGIN PAGE
```

```
</Title>
```

```
<center><style type=text/css>
```

```
Body {
```

```
font-family: Calibri, Helvetica, sans-serif;
```

```

font-size: 190,90;
background-image: url({ {url_for('static',filename="nature-green-water_drops-leaves-grass-
field.jpg")} });
background-position: center;
background-repeat: no-repeat;
background-attachment: fixed;
background-size: cover;
}
<style>
Body {
    font-family: Calibri, Helvetica, sans-serif;
    background-color: white;
}
button {
    background-color: rgba(0, 13, 255, 0.446);
    width: 100%;
    color: rgb(255, 255, 255);
    padding: 15px;
    margin: 10px 18px;
    border: blue;
    cursor: pointer;
}
form {
    border: 3px solid #ffffff8a;
    background-color: #ffffff8a;
padding: 10px 18px;
    width:50%;
    margin-left:25%;
    margin-right:25%;
    color: blue;
}

```

```
input[type=text], input[type=password] {  
    width: auto;  
    margin: 8px 0;  
    padding: 10px 18px;  
    display: inline-block;  
    border: 2px blue;  
    box-sizing: border-box;  
}
```

```
button:hover {
```

```
padding: 10px 18px;  
    width:50%;  
    margin-left:25%;  
    margin-right:25%;  
}
```

```
.subbtn
```

```
{  
    padding: 10px 18px;  
    width:50%;  
    margin-left:25%;  
    margin-right:25%;  
}
```

```
.cancelbtn {
```

```
padding: 10px 18px;  
    width:50%;  
    margin-left:25%;  
    margin-right:25%;  
}
```

```
.regbtn {
```

```
padding: 10px 18px;  
width:50%;
```

```

margin-left:25%;
margin-right:25%;
}
}
.container {
padding: 25px;
background-image: url("rain7.jpg");
background-position: center;
background-repeat: no-repeat;
background-attachment: fixed;
background-size: cover;
}
</style>
</head>  <center><body background="rain7.jpeg"></center>
<center><style type=text/css>
Body {
font-family: Calibri, Helvetica, sans-serif;
font-size: 1000,1000;
}
}
<style>
</style>
</head>
<body>
<center> <h1> LOGIN FORM </h1> </center>
<form action="/result" method="post" style="margin: auto; width: 220px;">
<div class="container">

<label>Email</label>
<input type="text" id="email" name="email" size="20">
<br>

```

```

    <label>Password</label>
    <input type="text" id="pwd" name="pwd" size="30">
    <br>
    <input type="submit" value="Login" class="subbtn" id="login">
</div>
</form>
</body>
</html>
</p>
</Body>
</Html>

```

Feedback Code:

```

<!DOCTYPE html>
<html lang="en" dir="ltr">
<head>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Exploratory Analysis Of RainFall Feedback</title>
  <link rel="stylesheet" href={ { url_for('static',filename='style1.css') } }>
  <link rel="stylesheet" href={ { url_for('static',filename='styles.css') } }>
</head>
<body>
  <section class="page-section">
    <div class="container">
      <div class="text-center">
        <h2 class="section-heading text-uppercase">Feedback</h2>
      </div>
      <!-- * * * * * * * * * * * * * * * * * * * * -->
      <!-- * * SB Forms Contact Form * * -->
      <!-- * * * * * * * * * * * * * * * * * * * * -->

```

```

<!-- This form is pre-integrated with SB Forms.-->
<!-- To make this form functional, sign up at-->
<!-- https://startbootstrap.com/solution/contact-forms-->
<!-- to get an API token!-->
<form id="contactForm" data-sb-form-api-token="API_TOKEN"
action="/submit" method="post">
  <div class="row align-items-stretch mb-5">
    <div class="col-md-6">
      <div class="form-group">
        <!-- Name input-->
        <input class="form-control" id="name" type="text" placeholder="Your
Name *" data-sb-validations="required" name="username"/>
        <div class="invalid-feedback" data-sb-feedback="name:required">A
name is required.</div>
      </div>
      <div class="form-group">
        <!-- Email address input-->
        <input class="form-control" id="email" type="email"
placeholder="Your Email *" data-sb-validations="required,email" name="email" />
        <div class="invalid-feedback" data-sb-feedback="email:required">An
email is required.</div>
        <div class="invalid-feedback" data-sb-feedback="email:email">Email is
not valid.</div>
      </div>
      <div class="form-group mb-md-0">
        <!-- Phone number input-->
        <input class="form-control" id="phone" type="tel" placeholder="Your
Phone *" data-sb-validations="required" name="ph" />
        <div class="invalid-feedback" data-sb-feedback="phone:required">A
phone number is required.</div>
      </div>
    </div>
  </div>

```

```

</div>
<div class="col-md-6">
  <div class="form-group form-group-textarea mb-md-0">
    <!-- Message input-->
    <textarea class="form-control" id="message" placeholder="Your
Message *" data-sb-validations="required" name="msg"></textarea>
    <div class="invalid-feedback" data-sb-feedback="message:required">A
message is required.</div>
  </div>
</div>
</div>
</div>
<!-- Submit success message-->
<!------>
<!-- This is what your users will see when the form-->
<!-- has successfully submitted-->
<div class="d-none" id="submitSuccessMessage">
  <div class="text-center text-white mb-3">
    <div class="fw-bolder">Form submission successful!</div>
    To activate this form, sign up at
    <br />
    <a href="https://startbootstrap.com/solution/contact-
forms">https://startbootstrap.com/solution/contact-forms</a>
  </div>
</div>
<!-- Submit error message-->
<!------>
<!-- This is what your users will see when there is-->
<!-- an error submitting the form-->
<div class="d-none" id="submitErrorMessage"><div class="text-center text-
danger mb-3">Error sending message!</div></div>
<!-- Submit Button-->

```



```
<div class="text-center"><button class="btn btn-primary btn-xl text-uppercase "
id="submitButton" type="submit">Send Message</button></div>

</form>

</div>

</section>

</body>

</html>
```

12.2. GitHub Link

<https://github.com/IBM-EPBL/IBM-Project-345-1658296487>

12.3 Project Demo Link

<https://youtube.com/watch?v=b3rvnNjszrA&feature=share>