## **A PROJECT REPORT**

## **ON**

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

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### INTRODUCTION

* 1. **Project Overview**

India is an agricultural nation, thus a healthy monsoon will keep the secondary agro- based economy steady. The length of the monsoon season determines how quickly the economy grows each year. A severe monsoon may destroy some crops, which might lead to a shortage of certain agricultural items, which could then lead to food inﬂation, insecurity, and discontent among the populace. In our investigation, we want to comprehend how India's rainfall has changed over time, by month and other sub divisions. Predicting crop yields is a signiﬁcant agricultural issue. Weather factors including temperature, rainfall, and other factors heavily inﬂuence agricultural productivity. For the purpose of managing agricultural risk and generating projections for the future, accurate knowledge of crop production history is crucial.

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 analysing the weather data.

### Purpose

Rainfall has been a major source of concern recently. For the time being, weather patterns are shifting. Rainfall forecasting is critical since it may lead to a variety of calamities. Irregular severe rainfall can destroy crops and produce ﬂooding, which can endanger human life. It is critical to precisely estimate rainfall in order to make the best use of water resources, increase crop output, and prepare ahead of time for water

infrastructure. The project's goal is to construct a forecasting machine learning-based model that will be important in the development of an early warning system that can minimise threats to people and property while also enhancing agricultural work management.

1. **LITERATURE SURVEY**

# Existing problem

The rainfall has been predicted with the help of deep learning algorithms.Two deep learning techniques which were used are Multilayer Perceptron and Linear Regression. Although some of the approaches showed good performances in predicting rainfall, most approaches do not provide any transparent reasons behind predicted outcomes.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.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. So as 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.

### References

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

### 2.3 Problem Statement Deﬁnition

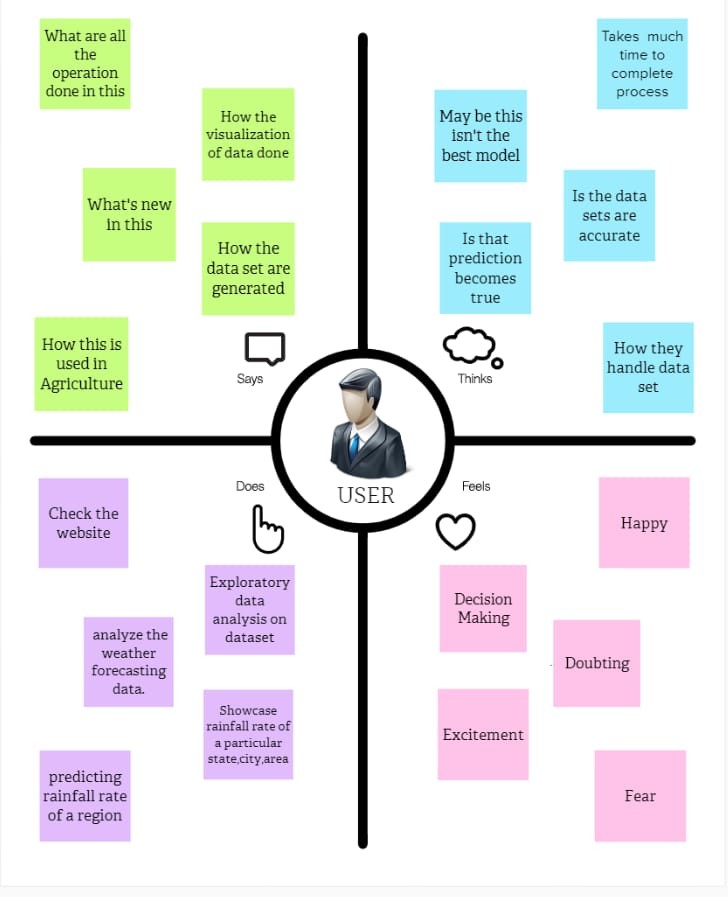
Rainfall is one of the most complex and diﬃcult elements of the hydrology cycle to understand and to model due to the complexity of the atmospheric processes that generate rainfall and the tremendous range of variation over a wide range of scales both in space and time. Heavy rainfall prediction is a major problem for meteorological department as it is closely associated with the economy and life of human. It is a cause for natural disasters like ﬂood and drought which are encountered by people across the globe every year. Accuracy of rainfall forecasting has great importance for countries like India whose economy is largely dependent on agriculture. Due to dynamic nature of atmosphere, Statistical techniques fail to provide good accuracy for rainfall forecasting. Thus, accurate rainfall prediction is one of the greatest challenges in operational hydrology. On a worldwide scale, large numbers of attempts have been made by different researchers to predict rainfall accurately using various techniques. But due to the nonlinear nature of rainfall, prediction accuracy obtained by these techniques is still below the satisfactory level.

### IDEATION & PROPOSED SOLUTION

* 1. **Empathy Map Canvas**

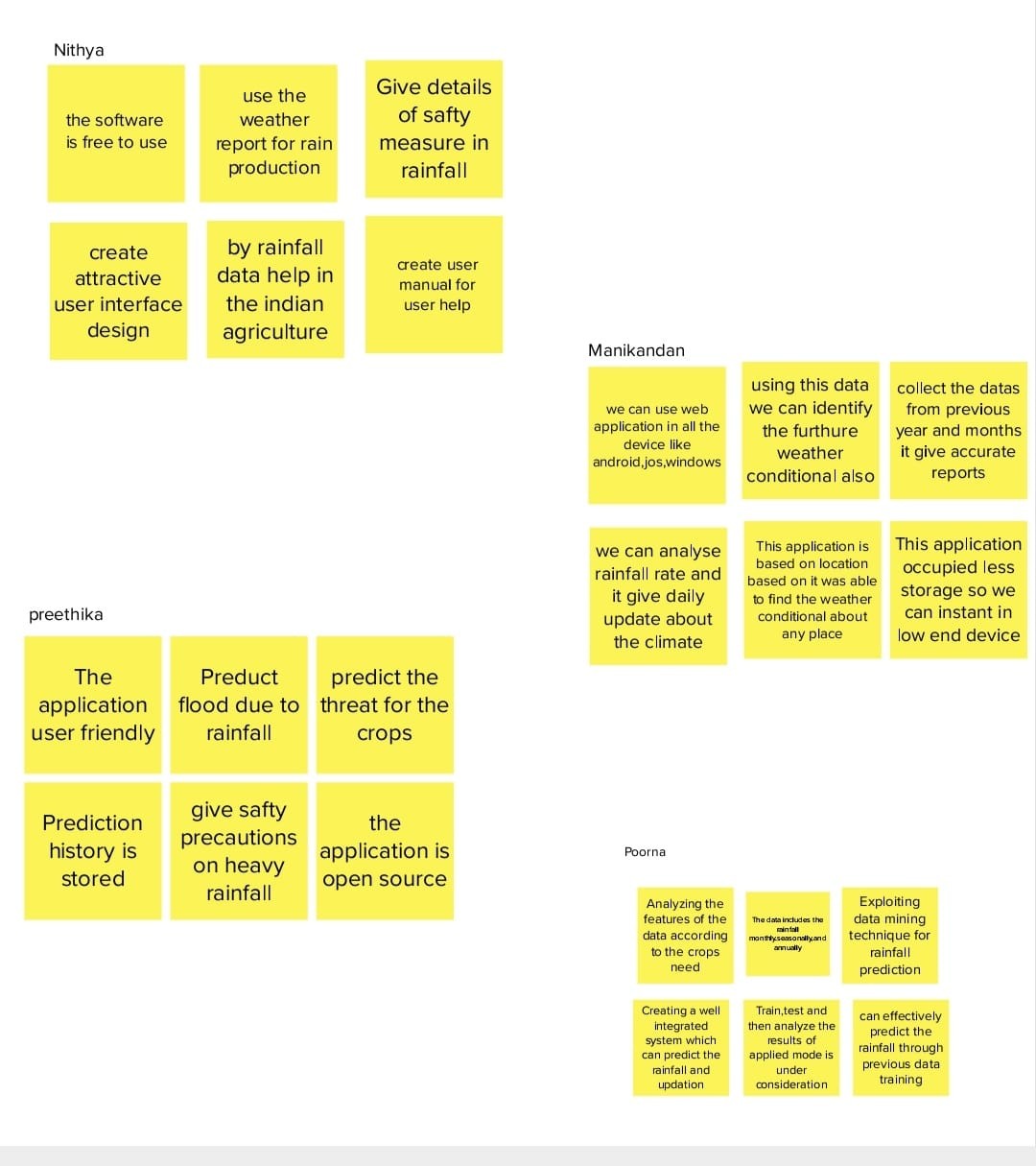
An empathy map is a simple, easy-to-digest visual that captures knowledge about a user’s behaviours and attitudes. It is a useful tool to helps teams better understand their users.Creating an effective solution requires understanding the true problem and the

person who is experiencing it. The exercise of creating the map helps participants consider things from the user’s perspective along with his or her goals and challenges.



# Ideation & Brainstorming

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving.

Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions. Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room. 

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Parameter** | **Description** |
| 1. | Problem Statement (Problem tobesolved) | * Climate is a important aspect of human life. So, 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 onto detect the patterns in   Climate change as it affects the economy in  production to infrastructure |
| 2. | 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 extras upport to maintain the Agriculture |

**Proposed Solution**

|  |  |  |
| --- | --- | --- |
| 3. | Novelty / Uniqueness | * This application is useful forthebeginners in agriculture. * Seed maturity selection features are available. |
| 4. | Social Impact/  Customer Satisfaction | * Different types of crops can be plantedfor goodhealth. * Helps in producing healthy crops andgood fields. |
| 5. | Business Model(Revenue  Model) | * This comparative study is conducted   concentrating on the following aspects: modeling inputs, Visualizingthe data,modeling methods, and pre- processing techniques. The results providea  comparison of various evaluation metrics of these machine learning techniques and theirreliability to predictrainfall by  analyzing the weather data. Wewill be using  classification algorithms such as Decisiontree, Random forest,KNN, and xgboost. |

**Problem Solution ﬁt**

### CUSTOMER SEGMENT(S) /CS

* + - Farmers
    - Sale Peoples
    - public

### JOBS-TO-BE-DONE / J&P PROBLEMS

. To forecast the amount of rainfall and the crops that might be cultivated in a specific area based on the amount of rainfall.

### TRIGGERS/ TR

To develop a weather prediction invention to conserve water and agriculture.

### EMOTIONS:

EM Lack of available storage for water in arid areas – relying on rainfall

### AVAILABLE SOLUTIONS/ AS

Internet -Using on line weather forecasting resources like Ø Application Knowledge

### CUSTOMER CONSTRAINTS /CC

1. Cashless
2. Budget

### BEHAVIOUR/ BE

* + - Find the best crop that could be cultivated in their area and foresee the advantages.
    - Customers will experience inner calm and relaxation, which is direct association.

### PROBLEM ROOT CAUSE/ RC

1. Loss of biodiversity
2. climate change
3. Investments

### YOUR SOLUTION SL

1. Considerable need for an effective irrigation system given the growing water shortage
2. Reducing post-harvest losses

### REQUIREMENT ANALYSIS

* 1. **FUNCTION**

Following are the functional requirements of the proposed solution.

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Functional**  **Requirement(Epic)** | **Sub Requirement (Story / Sub-Task)** |
| FR-1 | User Registration | Registration through Form Registration through Gmail  Registration through LinkedIN |
| FR-2 | User Confirmation | Confirmation via Email Confirmation via OTP |
| FR-3 | Reliability | The prediction will be provided by the systemerror-  free. |
| FR-4 | Performance | The expected output will be produces  Immediately to the user without much delay. |
| NFR-5 | Availability | The system would be available 24/7 |
| NFR-6 | Scalability | The system would be available on web application  and any user can login and use it without any disruptions. |

Non-Functional requirements

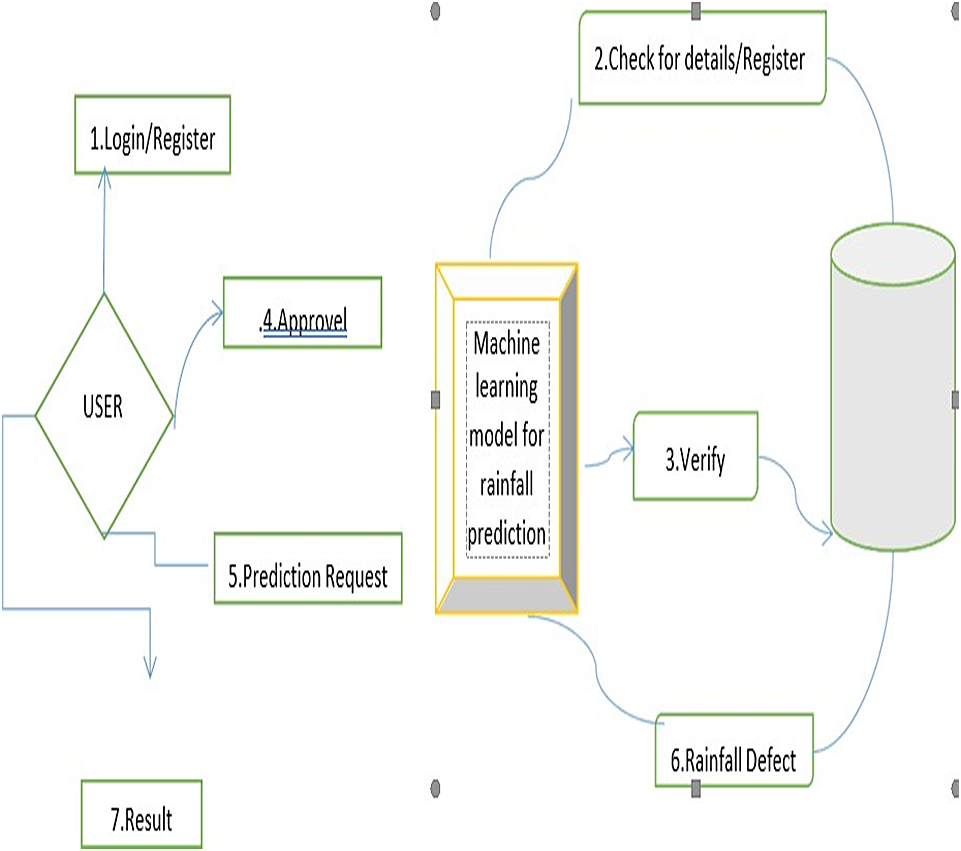
Following are the non-functional requirements of the proposed solution.

|  |  |  |
| --- | --- | --- |
| **FR**  **No.** | **Non- Functional**  **Requirement** | **Description** |
| NFR-1 | **Usability** | Can be used anywhere(remote villages  to metropolitan cities), anybody (kids to old age) |
| NFR-2 | Security | Security is given over the model, so the user can use this with full trust. However, there are no  Personal details required to use this. |
| NFR-3 | **Reliability** | Good connectivity and a supporting device can provide good results up to an  extent. |
| NFR-4 | **Performance** | This model can give a high accuracy prediction. |
| NFR-5 | **Availability** | Any person can use this and this is an open- source model. |

### DATA FLOW DIAGRAM

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 sand leaves the system, what changes the information, and where data is stored.

LEVEL DATA FLOW DIAGRAM



### Solution Architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and

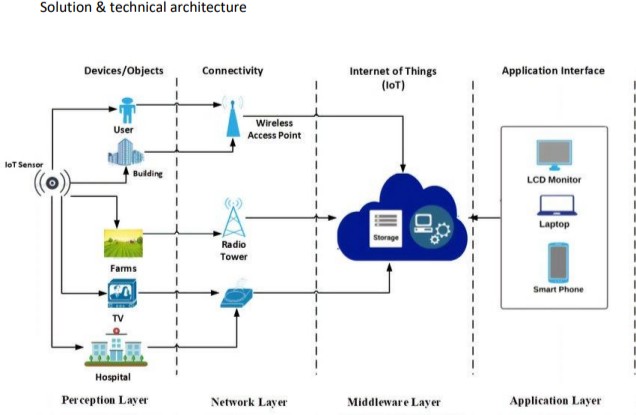
technology solutions. Its goals are to:

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

### Technical Architecture:

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2Technology architecture associates application components from application

Architecture with technology components representing software and hardware components. Its components are generally acquired in the marketplace and can be assembled and configured to constitute the enterprise’s technological infrastructure.



# User Stories

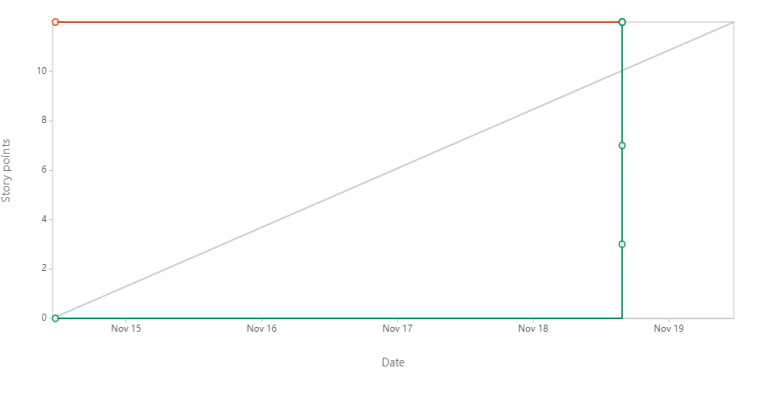
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **User type** | **Functional Requirem en**  **T** | **Usersto ry numbe**  **r** | **Userstory / Task** | **Acceptanc ecriteria** | **Priori ty** | **Relea se** |
| Customer | Registration | USN-1 | I can sign up for | I can | High | Sprint-1 |
| (mobile user) |  |  | the application as | Access my  dashboa |  |  |
|  |  |  | a user by | rdor account. |  |  |
|  |  |  | providing my |  |  |  |
|  |  |  | email address, a |  |  |  |
|  |  |  | password, and a |  |  |  |
|  |  |  | password |  |  |  |
|  |  |  | confirmation. |  |  |  |
|  |  | USA-2 | When I register | can click theconfirm | High | Sprint-2 |
|  | for the | Button in a |  |  |
|  | application as a | confirmation email. |  |  |
|  | user, I will get |  |  |  |
|  | a confirmation |  |  |  |
|  | email. |  |  |  |
|  | Login | USA-3 | I can access the | can get to the | High | Sprint-1 |
|  |  | application as a | system's |  |  |
|  |  | user by using my | dashboard. |  |  |
|  |  | registered email |  |  |  |
|  |  | and password. |  |  |  |
|  |  | USA-4 | option to check their history and password | New password must  be supplied and verification is neccessary. | High | Sprint-1 |
|  |  | USA-5 | For  Numerous system s, the already- existing login information should be used. |  | Medium | Sprint-1 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Dash Board | USA-6 | I can view the page's specifics and navigate through the entire page as a  user. | is able to traverse the pages. | Medium | Sprint-1 |
|  | Prediction | USA-7 | The user can conduct a search for the location or area where they want to receive rainfall  forecasts. | Only searches for regions in India are acceptable. | High | Sprint-1 |
|  |  | USA-8 | the analysis or forecast for the selected area for either upcoming or historical  events. |  | High | Sprint-1 |
|  |  | USA-9 | The visualisation  of the rain is available to users .information for a given time period for a particular region of INDIA. |  | High | Sprint-1 |

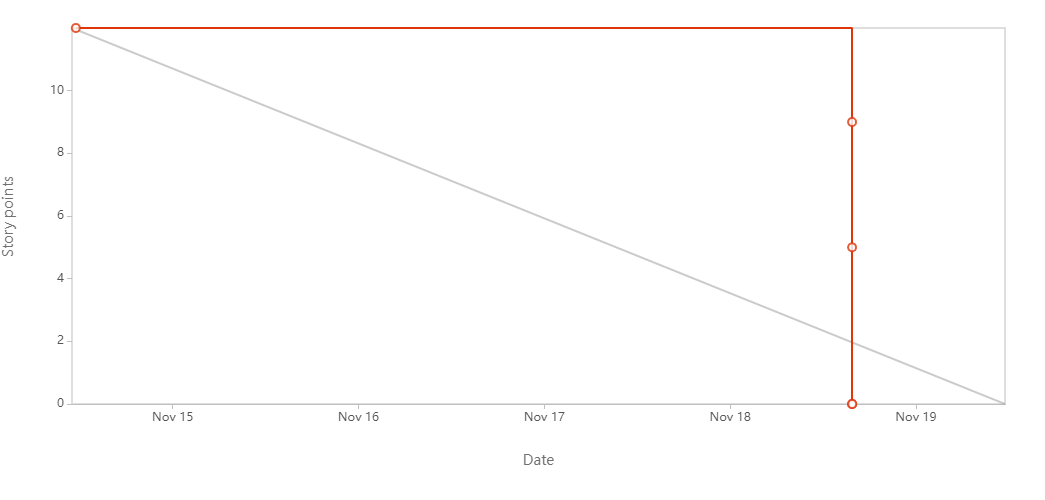
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | News | USA-  10 | Users can view  the most recent agricultural-relat ed news articles. | I am able  to see the news stories. | Medium | Sprint-2 |
| Customer care Executi ve | Support | USA-  11 | User inquiries  about the system are welcome. | I can clear  Up my doubts. | High | Sprint-3 |
|  |  | USA-  12 | The group must  examine each query and fix it in the up coming updat e. |  | High | Sprint-3 |
|  |  | USA-  13 | Prepare a  FAQ session. |  | Low | Sprint-3 |
| Core development Team | Core Function | USA-14 | The program should be designed in such way that the optimal user interface and maintained and user |  | High | Sprit-1 |
|  |  | USA -15 | On all devices and Screen Size the Websites | The User Experience should be positive regardless of the platforms. | High | Sprint-1 |
|  |  | USA-16 | The Updates must contain the answers to the asked Questions in Manner | The Updates Should not impact on the already available functionalites | High | Sprit-1 |

* 1. **Reports from JIRA**

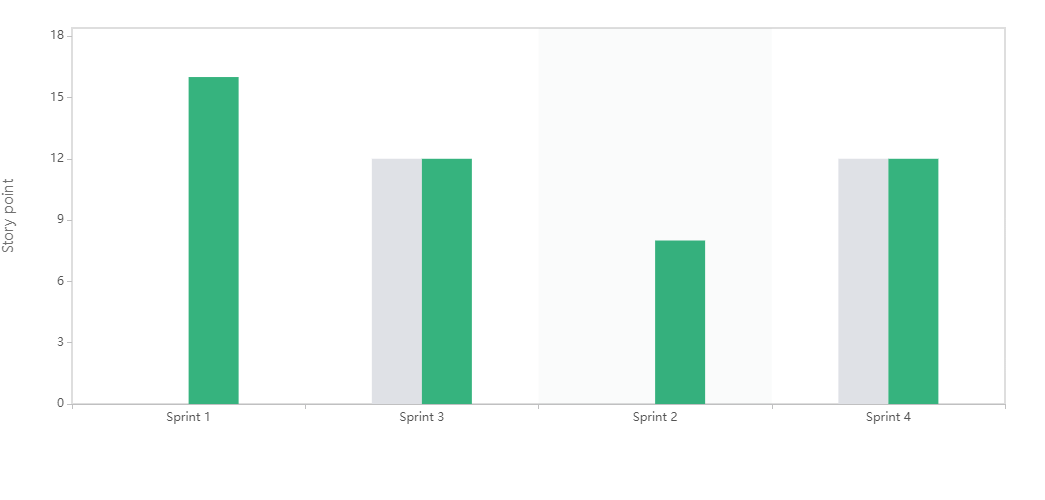
**Burn report**

****

**Sprint Burndown chart**

****

**Velocity report**

****

### CODING & SOLUTIONING

The main feature of this app is to predict if there is a possibility of rain or not. It's very useful for farmers to plan their agricultural practices.

**Feature 1: Adding Atmospheric Data**

This web app allows the user to enter the current state of the atmosphere like temperature, humidity, wind direction, wind speed , sunshine, etc. These data are collected in the index/landing page of the project.

***Code Snippet* :**

**<center><h1>Rainfall Prediction</h1></center><br><br>**

**<h2>Please enter the following details...</h2><br><br>**

**<center><form action="{{ url\_for('predict')}}"method="post">**

**</style></head>**

**<label for="Location">Location:</label>**

**<select id="Location" name="Location">**

**<option value=1>Albury</option>**

**<option value=2>BadgerysCreek</option>**

**<option value=3>Cobar</option>**

**<option value=4>CoffsHarbour</option>**

**<option value=5>Moree</option>**

**<option value=6>Newcastle</option>**

**<option value=7>NorahHarbour</option>**

**<option value=8>NorfolkIsland</option>**

**<option value=9>Penrith</option>**

**<option value=10>Richmond</option>**

**<option value=12>Sydney</option>**

**<option value=13>SydneyAirport</option>**

**<option value=11>WAggaWagga</option>**

**<option value=18>Williamtown</option>**

**<option value=14>Wollongong</option>**

**<option value=16>Canberra</option>**

**<option value=15>Tuggeranong</option>**

**<option value=17>MountGinini</option>**

**<option value=20>Ballarat</option>**

**<option value=19>Bendigo</option>**

**<option value=21>Sale</option>**

**<option value=22>MelbourneAirport</option>**

**<option value=23>Melbourne</option>**

**<option value=24>Mildura</option>**

**<option value=25>Nhil</option>**

**<option value=26>Portland</option>**

**<option value=27>watsonia</option>**

**<option value=28>Dartmoor</option>**

**<option value=29>Brisbane</option>**

**<option value=30>Cairns</option>**

**<option value=31>GoldCoast</option>**

**<option value=32>Townsville</option>**

**<option value=33>Adelaide</option>**

**<option value=34>MountGambier</option>**

**<option value=35>Nuriootpa</option>**

**<option value=36>Woomera</option>**

**<option value=37>Albany</option>**

**<option value=38>Witchcliffe</option>**

**<option value=39>PearceRAAF</option>**

**<option value=40>PerthAirport</option>**

**<option value=41>Perth</option>**

**<option value=42>SalmonGums</option>**

**<option value=43>Walpole</option>**

**<option value=44>Hobart</option>**

**<option value=45>Launceston</option>**

**<option value=46>AliceSprings</option>**

**<option value=47>Darwin</option>**

**<option value=48>Katherine</option>**

**<option value=49>Uluru</option>**

**<option value=50>PerthAirport</option>**

**</select>&nbsp;&nbsp;&nbsp;**

**<input type="number" name="MinTemp" step="any" placeholder="MinTemp"/>&nbsp;&nbsp;&nbsp;**

**<input type="number" name="MaxTemp" step="any" placeholder="MaxTemp" />&nbsp;&nbsp;&nbsp;**

**<input type="number" name="Rainfall" step="any" placeholder="Rainfall"/>&nbsp;&nbsp;&nbsp;<br/><br/><br/><br/>**

**<input type="number" name="Evaporation" step="any" placeholder="Evaporation" />&nbsp;&nbsp;&nbsp;**

**<input type="number" name="sunshine" step="any" placeholder="Sunshine"/>&nbsp;&nbsp;&nbsp;**

**<label for="WindGustDir">WindGustDir:</label>**

**<select id="WindGustDir" name="WindGustDir">**

**<option value=1>W</option>**

**<option value=2>WNW</option>**

**<option value=3>WSW</option>**

**<option value=4>NE</option>**

**<option value=5>NNW</option>**

**<option value=6>N</option>**

**<option value=7>NNE</option>**

**<option value=8>SW</option>**

**<option value=9>ENE</option>**

**<option value=10>SSE</option>**

**<option value=11>S</option>**

**<option value=12>SSW</option>**

**<option value=13>NW</option>**

**<option value=14>SE</option>**

**<option value=15>ESE</option>**

**<option value=16>E</option>**

**</select>&nbsp;&nbsp;&nbsp;**

**<input type="number" name="WindGustSpeed" step="any" placeholder="WindGustSpeed"/>&nbsp;&nbsp;&nbsp;<br/><br/><br/><br/>**

**<label for="WindDir9am">WindDir9am:</label>**

**<select id="WindDir9am" name="WindDir9am">**

**<option value=1>W</option>**

**<option value=2>WNW</option>**

**<option value=3>WSW</option>**

**<option value=4>NE</option>**

**<option value=5>NNW</option>**

**<option value=6>N</option>**

**<option value=7>NNE</option>**

**<option value=8>SW</option>**

**<option value=9>ENE</option>**

**<option value=10>SSE</option>**

**<option value=11>S</option>**

**<option value=12>SSW</option>**

**<option value=13>NW</option>**

**<option value=14>SE</option>**

**<option value=15>ESE</option>**

**<option value=16>E</option>**

**</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;**

**<label for="WindDir3pm">WindDir3pm:</label>**

**<select id="WindDir3pm" name="WindDir3pm">**

**<option value=1>W</option>**

**<option value=2>WNW</option>**

**<option value=3>WSW</option>**

**<option value=4>NE</option>**

**<option value=5>NNW</option>**

**<option value=6>N</option>**

**<option value=7>NNE</option>**

**<option value=8>SW</option>**

**<option value=9>ENE</option>**

**<option value=10>SSE</option>**

**<option value=11>S</option>**

**<option value=12>SSW</option>**

**<option value=13>NW</option>**

**<option value=14>SE</option>**

**<option value=15>ESE</option>**

**<option value=16>E</option>**

**</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;**

**<input type="number" name="WindSpeed9am" step="any" placeholder="WindSpeed9am"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp**

**;&nbsp;<br/><br/><br/>**

**<input type="number" name="WindSpeed3pm" step="any" placeholder="WindSpeed3pm"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp**

**;&nbsp;<br/><br/><br/><br/>**

**<input type="number" name="Humidity9am" step="any" placeholder="Humidity9am"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp; &nbsp;**

**<input type="number" name="Humidity3pm" step="any" placeholder="Humidity3pm"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp; &nbsp;**

**<input type="number" name="Pressure9am" step="any" placeholder="Pressure9am"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;& nbsp;**

**<input type="number" name="Pressure3pm" step="any" placeholder="Pressure3pm"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;& nbsp;<br/><br/><br/><br/>**

**<label for="Cloud9pm">Cloud9pm:</label>**

**<select id="Cloud9am" name="Cloud9am">**

**<option value=1>0</option>**

**<option value=2>1</option>**

**<option value=3>2</option>**

**<option value=4>3</option>**

**<option value=5>4</option>**

**<option value=6>5</option>**

**<option value=7>6</option>**

**<option value=8>7</option>**

**<option value=9>8</option>**

**<option value=9>NA</option>**

**</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;**

**<label for="Cloud3pm">Cloud3pm:</label>**

**<select id="Cloud3pm" name="Cloud3pm">**

**<option value=1>0</option>**

**<option value=2>1</option>**

**<option value=3>2</option>**

**<option value=4>3</option>**

**<option value=5>4</option>**

**<option value=6>5</option>**

**<option value=7>6</option>**

**<option value=8>7</option>**

**<option value=9>8</option>**

**<option value=9>NA</option>**

**</select>&nbsp;&nbsp;&nbsp; &nbsp;&nbsp;&nbsp;&nbsp;**

**<input type="number" name="Temp9am" step="any" placeholder="Temp9am"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbs p;**

**<input type="number" name="Temp3pm" step="any" placeholder="Temp3pm"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nb sp;<br/><br/><br/><br/>**

**<label for="RainToday">Rain Today:</label>**

**<select id="RainToday" name="RainToday">**

**<option value=1>Yes</option>**

**<option value=2>No</option>**

**<option value=2>NA</option>**

**</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;**

**<label for="RainTomorrow">Rain Tomorrow:</label>**

**<select id="RainTomorrow" name="RainTomorrow">**

**<option value=1>Yes</option>**

**<option value=2>No</option>**

**<option value=2>NA</option>**

**</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;**

**<br>**

**Feature 2: Predicting Possibility of RainFall**

This web app utilizes the Machine Learning Modelling deployed on IBM Watson to predict if there is a chance of rain or not. The data is dumped into a pickled file titled “model.pkl”. The project is integrated with python flask.

* If the entered atmospheric data indicates possibility of rain ( like high humidity ) then we will land into the page titled as “chance.html”

***Code Snippet* :**

**<body background="https://wallpaperaccess.com/full/164299.jpg" text="black">**

**<div class="login">**

**<center><h1>Chances of rain today</h1></center>**

**<center><h2>Pack your raincoat and umbrella !!</h2></center>**

* If the entered atmospheric data indicates possibility of no rain ( like clear sky and less clouds ) then we will land into the page titled as “nochance.html”.

***Code Snippet* :**

**<body class="background-image" text="black">**

**<div class="login">**

**<center><h1>No chances of rain today , enjoy your outing</h1></center>**

**</body>**

* Spyder IDE for Python was used to code Server Side Scripting. Using POST and GET Method we are rendering the templates of index.html , chance.html , nochance.html.

***Code Snippet* :**

**app = Flask( name )**

**model = pickle.load(open(r'C:\Users\Sreshta B\OneDrive\Desktop\Project Rainfall\model.pkl','rb'))**

**@app.route('/') def home():**

return render\_template('index.html') @app.route('/predict',methods=["POST","GET"]) def predict():

**input\_features=[x for x in request.form.values() ] features\_values=[np.array(input\_features)]**

**names = [['Location','MinTemp','MaxTemp','Rainfall','WindGustSpeed', 'WindSpeed9am','WindSpeed3pm','Humidity9am','Humidity3pm', 'Pressure9am','Pressure3pm','Temp9am','Temp3pm','RainToday', 'WindGustDir','WindDir9am','WindDir3pm','year','month','day']]**

**print(features\_values) print(len(features\_values))**

**data = pandas.DataFrame(features\_values,columns=names)**

**prediction=model.predict(data) print(prediction)**

**if prediction == "Yes":**

**return render\_template("chance.html") else:**

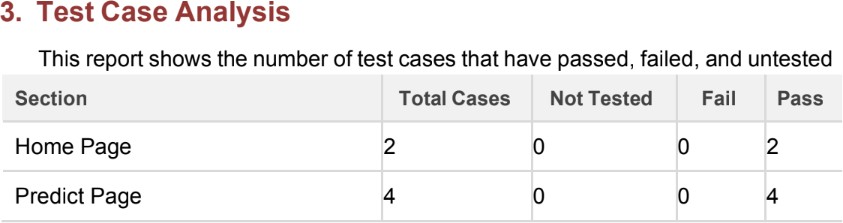
**return render\_template("nochance.html") if name == ' main ':**

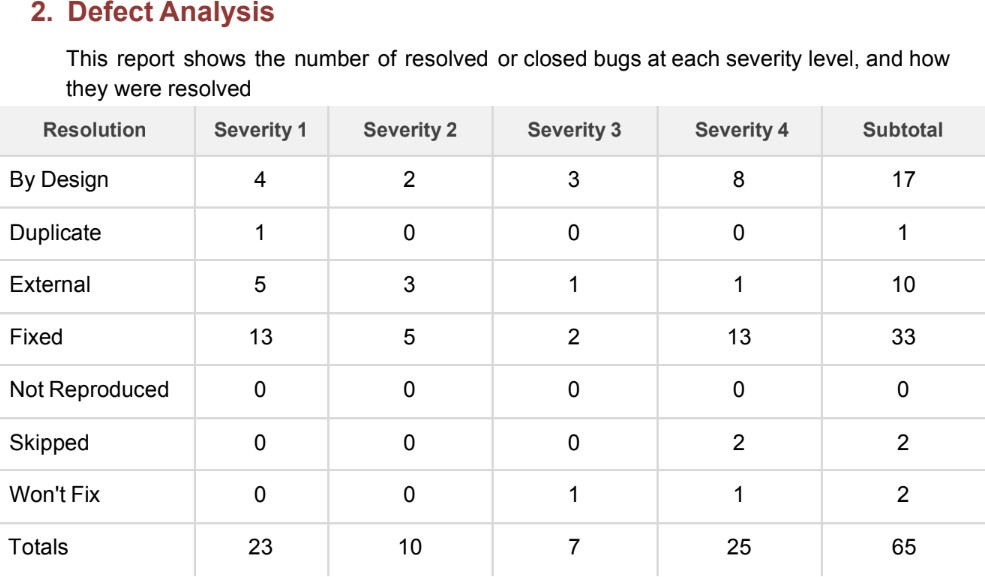
**# run() method of Flask class runs the application # on the local development server.**

**app.run()**

# Testing

* 1. **Test Cases**
* TC 1 - Index/Prediction Page
* TC 2 - Chance Page
* TC 3 - No chance Page
  1. **User Acceptance Testing**

User acceptance testing (UAT), also called application testing or end-user testing, is a phase of software development in which the software is tested in the real world by its intended audience.



# 9.Results

**9.1 Performance Metrics**

Performance testing is a non-functional [software testing](https://www.microfocus.com/products/performance-engineering/overview) technique that determines how the stability, speed, scalability, and responsiveness of an application holds up under a given workload. It’s a key step in ensuring software quality

The classifier used for this model is RandomForest Classifier

**Classification Model: Random Forest Confusion Matrix –**

**[[21393 1324]**

**[ 2855 3520]]**

**Accuracy Score-** 0.8563522617901829

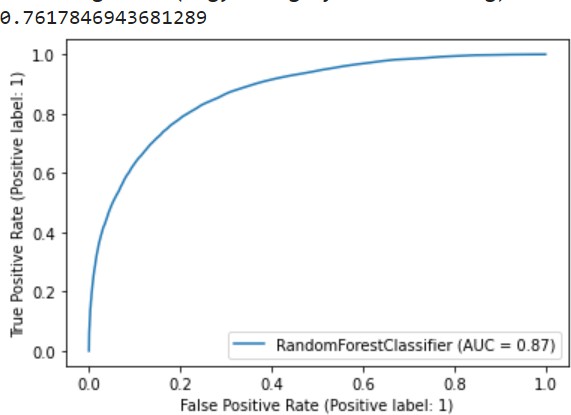
**Classification Report –** Accuracy: 0.8563522617901829

Precision: 0.7641309659553673

Recall: 0.49814165870234683

F1-score: 0.6031113396760092

ROC-ACU CURVE

****

# Advantages and Disadvantages

* 1. **Advantages**

Crop growth is highly dependent on the weather. Some crops require specific high or low temperatures to initiate germination and continue development. Temperature and humidity, on the other hand, are frequently used to forecast the occurrence of various insect pests and diseases. Farmers can plant sowing, protection, harvesting, and other field activities based on this data to avoid negative weather effects and yield losses. is the sole determinant of crop yields. It includes weather observations from each field to provide information on crop growing conditions at the time.

Weather monitoring provides a variety of measurement options for providing useful information about soil and crop conditions, including:

* + - Temperatures of the air and soil
    - humidity relative
    - Moisture in the soil
    - Rainfall
    - Wind speed and direction
    - Evapotranspiration

All measured parameters can be used for specific field operations such as a schedule of irrigation events, pest alarm models, and determining the best time for crop fertilization and protection. Farming with weather data is essential for successful farm management. More importantly, it promotes sustainable agriculture, thereby protecting the environment. Farmers nowadays use weather stations to precisely measure environmental conditions. There are several types available based on a number of measured parameters, work precision, and work range. Farming is the most important industry because it provides us with food that we need to live. Despite the numerous effects of climate change, farming must be more productive and sustainable than ever. As a result, our app provides comprehensive guidance in rainfall analysis and prediction, making it simple for farmers to continue farming.

* 1. **Disadvantages :**
     + Despite having a good hardware system , i.e sensors detecting rainfall based on parameters like Humidity and Temperature , lacks any GSM Module or Frontend to give real time notifications and messages to users about the weather conditions or rainfall.
     + Disadvantages of MLP include too many parameters because it is fully connected. Parameter number = width x depth x height. Each node is connected to another in a very dense web — resulting in redundancy and inefficiency.
     + Fluctuations or variations in climatic parameters is a recurring phenomena in the studied districts. The effects of climate variability exacerbate existing social and economic encounters across the area, because people here are mainly reliant on resources that are sensitive to climate variability and rainfed agriculture.
     + Most of the studies on rainfall trend/analysis were only limited to seasonal monsoon rainfall only.
     + The absorption and dispersion of the electromagnetic wave are the main physical phenomena responsible for the attenuation caused by rain. However, due to the random nature of this meteorological phenomenon, in an Earth-space link, it is only possible to predict the long-term statistical behavior deadline.
     + There was a need for development of a more homogeneous (spatially and temporally) rainfall time series for the Indian region using the latest data. The newly constructed rainfall series is uniformly distributed throughout the country and it represents almost all the existing administrative districts.

# Conclusion

Exploration of the spatiotemporal distribution and changing pattern of rainfall in any location is a basic and necessary requirement for the management and planning of water resources, sustainable agricultural development, and other sectors. As a result, using years of long-term annual and seasonal rainfall data from thirty-four meteorological subdivisions, the current study investigated the variability and trend analysis of annual rainfall in several ways, including overall data. The current study found that the overall annual and seasonal variability of rainfall was greatest in Western India's sub-divisions, while Eastern and North India had the lowest variability.Rainfall variability increased significantly in the majority of meteorological subdivisions after the post change point, and similar results were found when the rainfall trend was analyzed for the post change point.

Innovative trend analysis was used to improve trend analysis results. The results show that the majority of the sub-divisions had a significant negative trend. Even though the MK test detected no trend in some of the sub-divisions, the trend was detected using innovative trend analysis. However, in the current study, the micro level change rate analysis was used, and the results show that after 1960, most meteorological subdivisions recorded more than 500mm rainfall departure from the long-term average rainfall in many years.

However, in the current study, thirty-four meteorological subdivisions were considered for the research, but to be more accurate, micro level data such as district-level data should be incorporated. The very high precision micro level management plan will then be realized. Even the grid-wide rainfall study using cutting-edge microwave remote sensing technology will be extremely beneficial to planners. To achieve very high quality forecasting data, ensemble machine learning techniques and deep learning techniques such as the long-short-term memory (LSTM) network can be used.

Consequently, these in-depth details about historical data for the entire nation are very helpful for planning. One of the most striking features of recent development planning is the forecasting of incoming events, which can be found in any sector such as finance, water resources, and, most importantly, climatology. As a result, in this study, rainfalls for all meteorological subdivisions were forecasted using advanced AI models such as artificial neural networks. The rainfall forecasting findings show that 15% of rainfall will be reduced in 2030, indicating that alarming situations will emerge for both the environment and the living world.

# Future Scope

We are all concerned about the weather. Not only do we wish for warm, sunny weather so that we can swim, enjoy nature, or carry out important farm tasks, but we also wish for rain so that we can water the plants or dance with an umbrella on the wet street. However, unlike in other industries, the weather is the most important factor influencing farm production. It can have an impact on crop growth, total yield, pest occurrence, water and fertilizer requirements, and all farm activities performed during the growing season. In other words, farming under the open sky is highly dependent on the weather and is vulnerable to its mood swings, especially now that climate change is causing unpredictable weather that is beyond human control.

A farmer cannot control the weather. He can, however, adapt to the situation and implement additional farm management practices to reduce crop losses. As a result, accurate weather information is critical for planning farm activity without adverse events.

The best way to protect crops and ensure a high and healthy yield is to be aware of real-time weather conditions such as air and dew temperature, precipitation, and

humidity. Drought, flood, hail, or frost can all cause immediate plant stress, resulting in failed production and increased costs.

13.Appendix

Source code

Index.html

<!doctype html>

<html>

<section>

<head>

<meta charset="utf-8">

<style>

\* { margin:0; padding:0;

}

.background-image{

background-image: url('https://wallpaperaccess.com/full/490844.jpg'); background-size: cover;

background-repeat: no-repeat; height: 120vh;

}

input[type=text], select { width: 50%;

padding: 12px 20px; margin: 8px 0; display: inline-block;

border: 1px solid rgb(246, 238, 238); border-radius: 4px;

box-sizing:border-box;

}

input[type=number], select { width: 17%;

padding: 12px 20px; margin: 8px 0; display: inline-block;

border: 1px solid rgb(246, 238, 238); border-radius: 4px;

box-sizing: border-box;

}

input[type=submit] { width: 100%;

background-color: #4CAF50; color: white;

padding: 14px 20px; margin: 8px 0; border: none;

border-radius: 4px; cursor: pointer;

}

input[type=submit]:hover { background-color: #45a049;

}

label { color: rgb(250, 246, 246); } label span { color: green; }

</style>

<title> Rainfall Prediction</title>

<base href="/">

<meta name="viewport" content="width=device-width, initial-scale=1">

<link rel="icon" type="image/x-icon" href="favicon.ico">

<body class="background-image">

<div class="login"><center><br><br><br>

<center><h1>Rainfall Prediction</h1></center><br><br>

<h2>Please enter the following details...</h2><br><br>

<center><form action="{{ url\_for('predict')}}"method="post">

</style></head>

<label for="Location">Location:</label>

<select id="Location" name="Location">

<option value=1>Albury</option>

<option value=2>BadgerysCreek</option>

<option value=3>Cobar</option>

<option value=4>CoffsHarbour</option>

<option value=5>Moree</option>

<option value=6>Newcastle</option>

<option value=7>NorahHarbour</option>

<option value=8>NorfolkIsland</option>

<option value=9>Penrith</option>

<option value=10>Richmond</option>

<option value=12>Sydney</option>

<option value=13>SydneyAirport</option>

<option value=11>WAggaWagga</option>

<option value=18>Williamtown</option>

<option value=14>Wollongong</option>

<option value=16>Canberra</option>

<option value=15>Tuggeranong</option>

<option value=17>MountGinini</option>

<option value=20>Ballarat</option>

<option value=19>Bendigo</option>

<option value=21>Sale</option>

<option value=22>MelbourneAirport</option>

<option value=23>Melbourne</option>

<option value=24>Mildura</option>

<option value=25>Nhil</option>

<option value=26>Portland</option>

<option value=27>watsonia</option>

<option value=28>Dartmoor</option>

<option value=29>Brisbane</option>

<option value=30>Cairns</option>

<option value=31>GoldCoast</option>

<option value=32>Townsville</option>

<option value=33>Adelaide</option>

<option value=34>MountGambier</option>

<option value=35>Nuriootpa</option>

<option value=36>Woomera</option>

<option value=37>Albany</option>

<option value=38>Witchcliffe</option>

<option value=39>PearceRAAF</option>

<option value=40>PerthAirport</option>

<option value=41>Perth</option>

<option value=42>SalmonGums</option>

<option value=43>Walpole</option>

<option value=44>Hobart</option>

<option value=45>Launceston</option>

<option value=46>AliceSprings</option>

<option value=47>Darwin</option>

<option value=48>Katherine</option>

<option value=49>Uluru</option>

<option value=50>PerthAirport</option>

</select>&nbsp;&nbsp;&nbsp;

<input type="number" name="MinTemp" step="any" placeholder="MinTemp"/>&nbsp;&nbsp;&nbsp;

<input type="number" name="MaxTemp" step="any" placeholder="MaxTemp"

/>&nbsp;&nbsp;&nbsp;

<input type="number" name="Rainfall" step="any" placeholder="Rainfall"/>&nbsp;&nbsp;&nbsp;<br/><br/><br/><br/>

<input type="number" name="Evaporation" step="any" placeholder="Evaporation"

/>&nbsp;&nbsp;&nbsp;

<input type="number" name="sunshine" step="any" placeholder="Sunshine"/>&nbsp;&nbsp;&nbsp;

<label for="WindGustDir">WindGustDir:</label>

<select id="WindGustDir" name="WindGustDir">

<option value=1>W</option>

<option value=2>WNW</option>

<option value=3>WSW</option>

<option value=4>NE</option>

<option value=5>NNW</option>

<option value=6>N</option>

<option value=7>NNE</option>

<option value=8>SW</option>

<option value=9>ENE</option>

<option value=10>SSE</option>

<option value=11>S</option>

<option value=12>SSW</option>

<option value=13>NW</option>

<option value=14>SE</option>

<option value=15>ESE</option>

<option value=16>E</option>

</select>&nbsp;&nbsp;&nbsp;

<input type="number" name="WindGustSpeed" step="any" placeholder="WindGustSpeed"/>&nbsp;&nbsp;&nbsp;<br/><br/><br/><br/>

<label for="WindDir9am">WindDir9am:</label>

<select id="WindDir9am" name="WindDir9am">

<option value=1>W</option>

<option value=2>WNW</option>

<option value=3>WSW</option>

<option value=4>NE</option>

<option value=5>NNW</option>

<option value=6>N</option>

<option value=7>NNE</option>

<option value=8>SW</option>

<option value=9>ENE</option>

<option value=10>SSE</option>

<option value=11>S</option>

<option value=12>SSW</option>

<option value=13>NW</option>

<option value=14>SE</option>

<option value=15>ESE</option>

<option value=16>E</option>

</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;

<label for="WindDir3pm">WindDir3pm:</label>

<select id="WindDir3pm" name="WindDir3pm">

<option value=1>W</option>

<option value=2>WNW</option>

<option value=3>WSW</option>

<option value=4>NE</option>

<option value=5>NNW</option>

<option value=6>N</option>

<option value=7>NNE</option>

<option value=8>SW</option>

<option value=9>ENE</option>

<option value=10>SSE</option>

<option value=11>S</option>

<option value=12>SSW</option>

<option value=13>NW</option>

<option value=14>SE</option>

<option value=15>ESE</option>

<option value=16>E</option>

</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;

<input type="number" name="WindSpeed9am" step="any" placeholder="WindSpeed9am"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;<br/

><br/><br/>

<input type="number" name="WindSpeed3pm" step="any" placeholder="WindSpeed3pm"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;<br/

><br/><br/><br/>

<input type="number" name="Humidity9am" step="any" placeholder="Humidity9am"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;

<input type="number" name="Humidity3pm" step="any" placeholder="Humidity3pm"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;

<input type="number" name="Pressure9am" step="any" placeholder="Pressure9am"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;

<input type="number" name="Pressure3pm" step="any" placeholder="Pressure3pm"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;<br/><b r/><br/><br/>

<label for="Cloud9pm">Cloud9pm:</label>

<select id="Cloud9am" name="Cloud9am">

<option value=1>0</option>

<option value=2>1</option>

<option value=3>2</option>

<option value=4>3</option>

<option value=5>4</option>

<option value=6>5</option>

<option value=7>6</option>

<option value=8>7</option>

<option value=9>8</option>

<option value=9>NA</option>

</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;

<label for="Cloud3pm">Cloud3pm:</label>

<select id="Cloud3pm" name="Cloud3pm">

<option value=1>0</option>

<option value=2>1</option>

<option value=3>2</option>

<option value=4>3</option>

<option value=5>4</option>

<option value=6>5</option>

<option value=7>6</option>

<option value=8>7</option>

<option value=9>8</option>

<option value=9>NA</option>

</select>&nbsp;&nbsp;&nbsp; &nbsp;&nbsp;&nbsp;&nbsp;

<input type="number" name="Temp9am" step="any" placeholder="Temp9am"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;

<input type="number" name="Temp3pm" step="any" placeholder="Temp3pm"/>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;<br/><br/

><br/><br/>

<label for="RainToday">Rain Today:</label>

<select id="RainToday" name="RainToday">

<option value=1>Yes</option>

<option value=2>No</option>

<option value=2>NA</option>

</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;

<label for="RainTomorrow">Rain Tomorrow:</label>

<select id="RainTomorrow" name="RainTomorrow">

<option value=1>Yes</option>

<option value=2>No</option>

<option value=2>NA</option>

</select>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;

<br>

<br><br>

<style>

.button {

display: inline-block; border-radius: 4px; background-color: #058a2d; border: none;

color: #FFFFFF; text-align: center; font-size: 28px; padding: 20px; width: 200px; transition: all 0.5s; cursor: pointer; margin: 5px;

}

.button span { cursor: pointer;

display: inline-block; position: relative; transition: 0.5s;

}

.button span:after { content: '\00bb'; position: absolute; opacity: 0;

top: 0;

right: -20px; transition: 0.5s;

}

.button:hover span { padding-right: 25px;

}

.button:hover span:after { opacity: 1;

right: 0;

}</style>

<center><button type="submit" class="button"

style="vertical-align:middle"><span>Predict</span></button></center>

</form></center>

<br>

<p style="color:rgb(245, 241, 241)">{{Predict\_Text}}</p>

<br>

<br>

<img src="data:image/png;base64,{{url\_3}}" alt="Submit Form" height="180" width="233" onerror="this.style.display='none'"/>

<img src="data:image/png;base64,{{url\_1}}" alt="Submit Form" height="180" width="233" onerror="this.style.display='none'"/>

<img src="data:image/png;base64,{{url\_4}}" alt="Submit Form" height="180" width="233" onerror="this.style.display='none'"/>

<br>

<br>

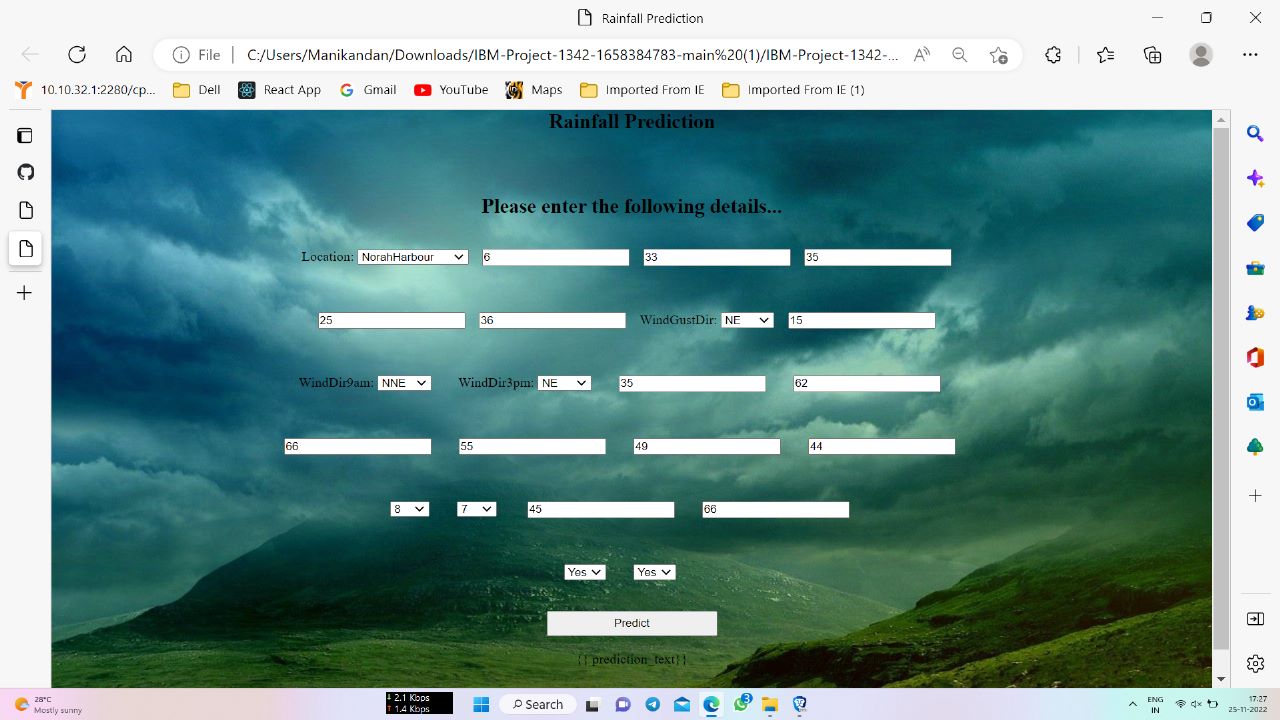
<img src="data:image/png;base64,{{url\_2}}" alt="Submit Form" height="150" width="711" onerror="this.style.display='none'"/>

</div></center>

</body>

</section>

</html>



**chance.html**

<!DOCTYPE html>

<html>

<head>

<meta charset="UTF-8">

<title>Rainfall Prediction</title>

</head>

<body background="https://wallpaperaccess.com/full/164299.jpg" text="black">

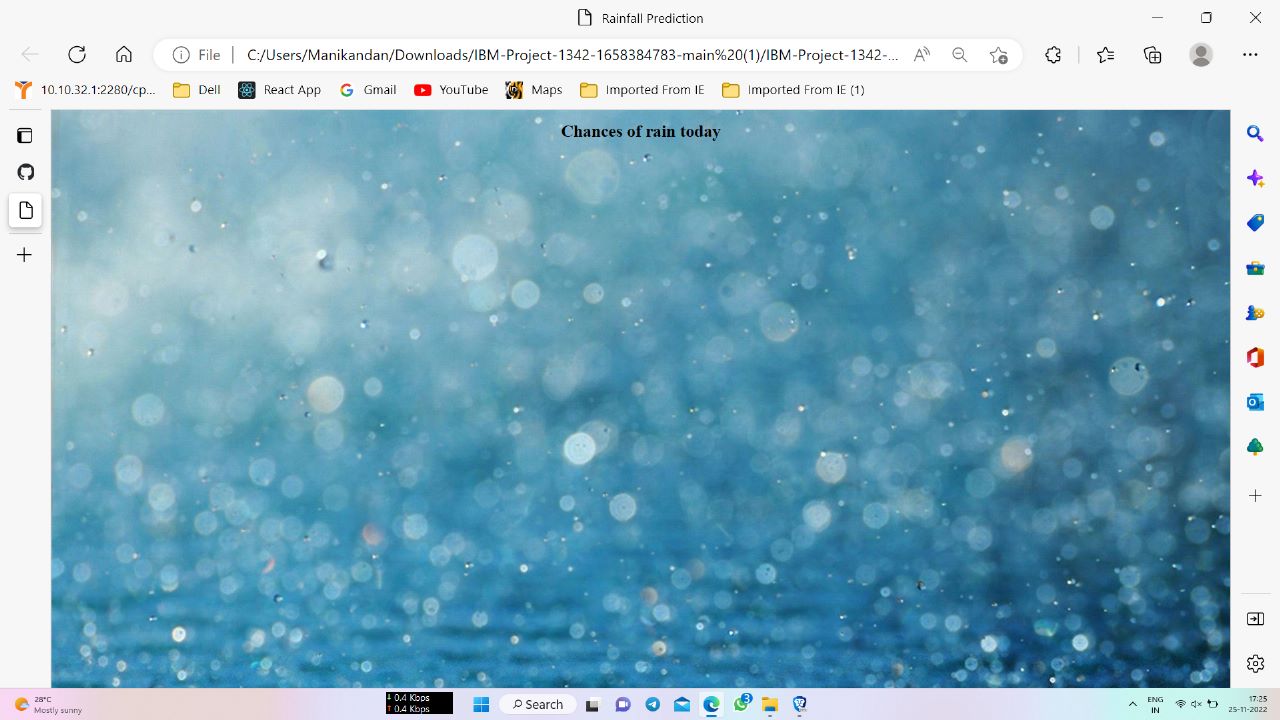
<div class="login">

<center><h1>Chances of rain today</h1></center>

<center><h2>Pack your raincoat and umbrella !!</h2></center>

</body>

</html>



**Nochance.html**

<!DOCTYPE html>

<html>

<head>

<meta charset="UTF-8">

<style>

\* { margin:0; padding:0;

}

.background-image{

background-image: url('https://wallpaperaccess.com/thumb/4880221.jpg'); background-size:cover;

background-repeat: no-repeat;

height: 80vh; width:auto;

}

</style>

<title>Rainfall Prediction</title>

</head>

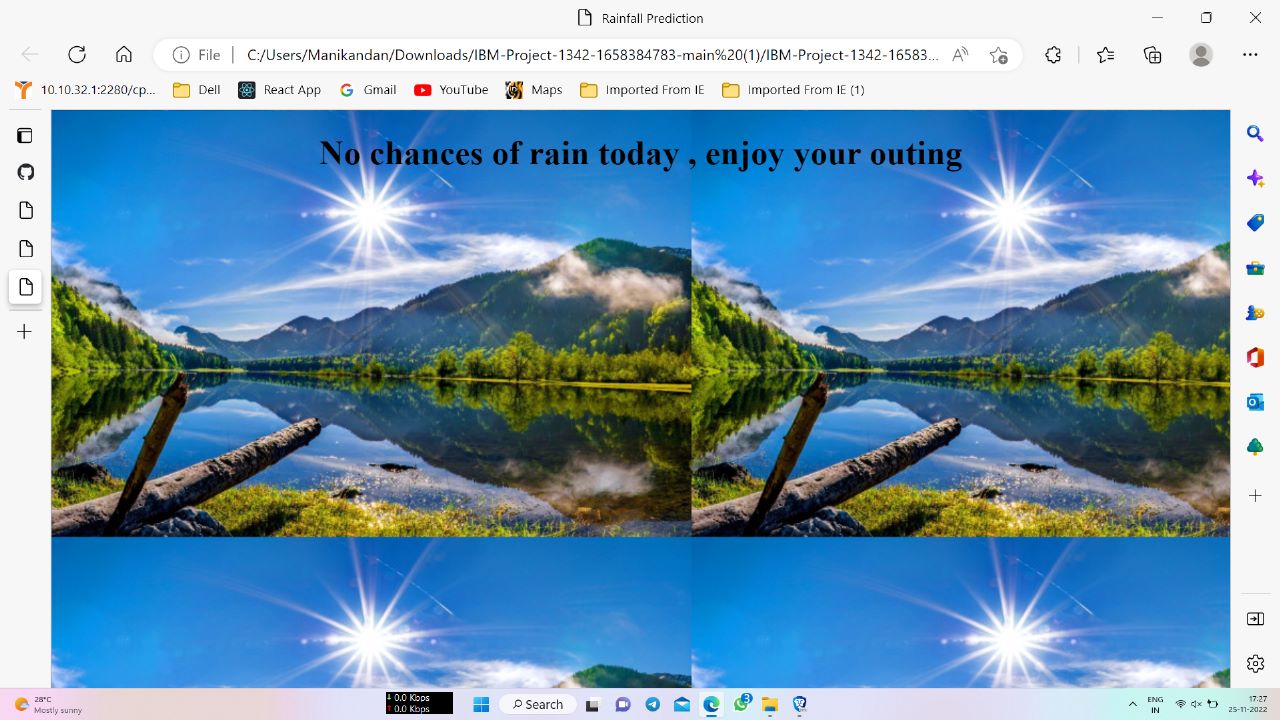
<body class="background-image" text="black">

<div class="login">

<center><h1>No chances of rain today , enjoy your outing</h1></center>

</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 flask import Flask, request, jsonify, render\_template

app = Flask( name )

model = pickle.load(open(r'C:\Users\Sreshta B\OneDrive\Desktop\Project Rainfall\model.pkl','rb'))

@app.route('/') def home():

return render\_template('index.html') @app.route('/predict',methods=["POST","GET"]) def predict():

input\_features=[x for x in request.form.values() ] features\_values=[np.array(input\_features)]

names = [['Location','MinTemp','MaxTemp','Rainfall','WindGustSpeed', 'WindSpeed9am','WindSpeed3pm','Humidity9am','Humidity3pm', 'Pressure9am','Pressure3pm','Temp9am','Temp3pm','RainToday', 'WindGustDir','WindDir9am','WindDir3pm','year','month','day']]

print(features\_values) print(len(features\_values))

data = pandas.DataFrame(features\_values,columns=names)

prediction=model.predict(data)

print(prediction)

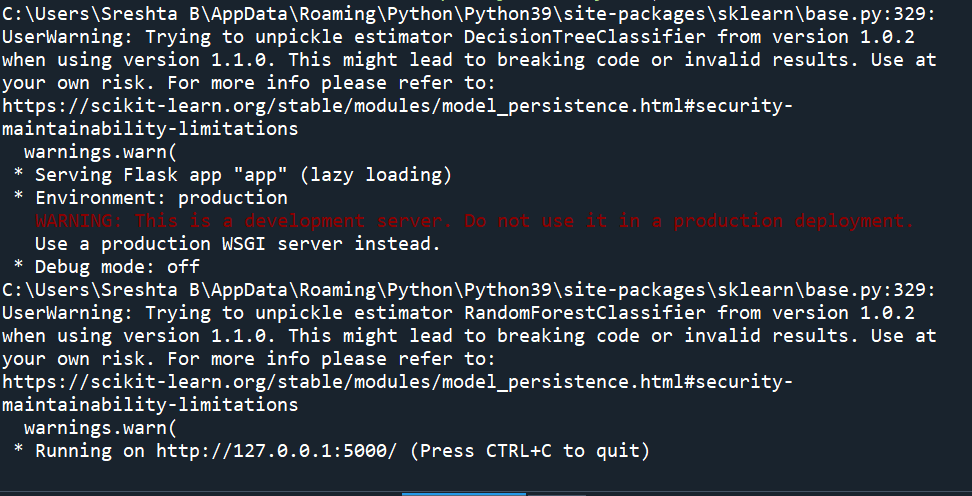
if prediction == "Yes":

return render\_template("chance.html") else:

return render\_template("nochance.html") if name == ' main ':

# run() method of Flask class runs the application # on the local development server.

app.run()



**Links**

**Link to Github Repository link:** <https://github.com/IBM-EPBL/IBM-Project-33552-1660222589>

**Link to Project Demo Video link:** [**https://drive.google.com/file/d/1txmFlxpIExvPmpDBveMxbYwa4Sh4O-Ln/view?usp=share\_link**](https://drive.google.com/file/d/1txmFlxpIExvPmpDBveMxbYwa4Sh4O-Ln/view?usp=share_link)