ESTIMATE THE CROP YIELD USING DATA ANALYTICS

A PROJECT REPORT

SUBMITTED BY

ANANTHI K

BRAGADESSWARI S

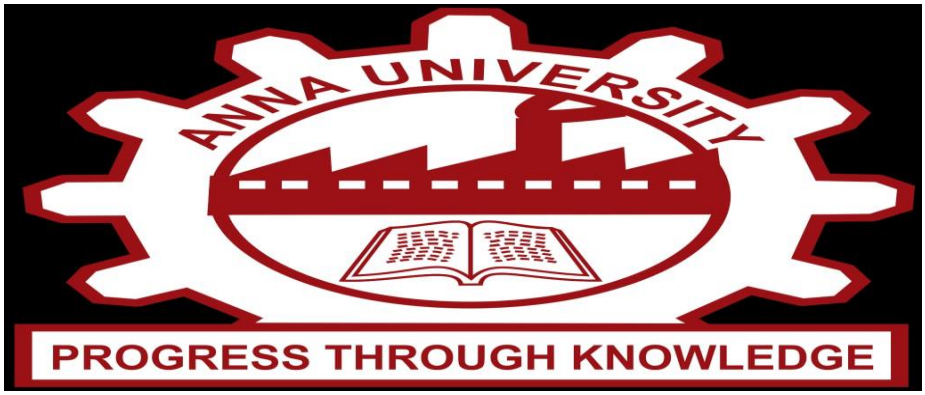
UDAYA GEETHA A

VIJAYALAKSHMI P

In partial fullfillment for the award of the degree of

Bachelor of Engineering(B.E.) in

COMPUTER SCIENCE AND ENGINEERING



Commented [BS1]:

ACKNOWLEDGEMENT

We would like to express our special thanks of gratitude to our **Faculty Mentor** and **Industry Mentor** for their support and guidance in completing our project on Estimate the Crop Yield

We would like to extend our gratitude to the **IBM** for **Nalaiya Thiran** project for providing us with all the facility that was required.

It was a great learning experience. We would like to take this opportunity to express our gratitude.

DATE:

19/11/2022

TEAM MEMBERS:

ANANTHI K

BRAGADEESWARI S

UDAYA GEETHA A

VIJAYALAKSHMI P

PROJECT REPORT FORMAT

1. INTRODUCTION
- 1.1 Project Overview
- 1.2 Purpose

2. LITERATURE SURVEY
- 2.1 Existing Problem
- 2.2 References
- 2.3 Problem Statement Definition

3. IDEATION & PROPOSED SOLUTION
- 3.1 Empathy Map Canvas
- 3.2 Ideation & Brainstorming
- 3.3 Proposed Solution
- 3.4 Problem Solution Fit

4. REQUIREMENT ANALYSIS
- 4.1 Functional Requirement
- 4.2 Non-Functional Requirements

5. PROJECT DESIGN
- 5.1 Data Flow Diagrams
- 5.2 Solution & Technical Architecture
- 5.3 User Stories

6. PROJECT PLANNING & SCHEDULING
- 6.1 Sprint Planning & Estimation
- 6.2 Sprint Delivery Schedule
- 6.3 Reports from JIRA

7. CODING & SOLUTIONING
- 7.1 Feature 1
- 7.2 Feature 2
- 7.3 Database Schema(if Applicable)

8. TESTING
8.1 Test Cases
8.2 User Acceptance Testing
9. RESULTS
9.1 Performance Metrices

10. ADVANTAGES & DISADVANTAGES
11. CONCLUSION
12. FUTURE SCOPE
13. APPENDIX
Source Code
GitHub & Project Demo

1.INTRODUCTION

1.1 Project Overview

In the world, data can be available from web logs, sensor network, Internet texts and Documents, internet search indexing, mobile devices, social networking. Everyday 2.5 quintillion bytes of data are created according to the estimation done by IBM and it is very large amount so the 90% of data in the world has been created in last 2 years .

Data Science is the extraction of knowledge from data. Hal Varian, Google's Chief Economist, NYT, 2009 define Data Science is "The ability to take data, to be able to understand it, to process it, to extract value from it, to visualize it, to communicate it - that's going to be a hugely important skill". Jeffrey Staton, Syracuse University School of Information Studies define data science is "Data Science refers to an emerging area of work concerned with the collection, preparation, analysis, visualization, management and preservation of large collection of information".

Data analytics is the process of transforming raw data into usable information, often presented in the form of a published analytical article, in order to add value to the statistical output. Big data analytics is the process of examining big data to discover hidden patterns, unknown correlations and other useful information that can be used to make better decisions. With big data analytics, data scientists and others can analyze huge volumes of data. Analyzing big data allows analysts, researchers, and business users to make better and faster decisions using data that was previously inaccessible or unusable. Using advanced analytics techniques such as text analytics, machine learning, predictive analytics, data mining, statistics, and natural language processing, businesses can analyze previously untapped data

sources independent or together with their existing enterprise data to gain new insights resulting in significantly better and faster decisions.

. There are mainly three types of data analytics their specification is discussed below.

A. Predictive Analytics

Predictive analytics use data to identify historical patterns to predict the future. Predictive analytics provide estimates about the likelihood of a future outcome. For example, some companies are using predictive analytics for sales lead scoring. Some companies have gone one step further use predictive analytics for the entire sales process, analyzing lead source, number of communications, types of communications, social media, documents, CRM data, etc. Properly tuned predictive analytics can be used to support sales, marketing, or for other types of complex forecasts.

B. Descriptive Analytics

Descriptive analytics or statistics does exactly what the name implies them "Describe", or summarize raw data and make it something that is interpretable by humans. Descriptive statistics are useful to show things like, total stock in inventory, average dollars spent per customer and Year over year change in sales. Common examples of descriptive analytics are reports that provide historical insights regarding the company's production, financials, operations, sales, finance, inventory and customers.

C. Prescriptive Analytics

Prescriptive analytics allows users to "prescribe" a number of different possible actions to and guide them towards a solution. Prescriptive analytics automatically synthesizes big data, mathematical sciences, business rules, and machine learning to

make predictions and then suggests decision options to take advantage of the predictions. For example, in the health care industry, you can better manage the patient population by using prescriptive analytics to measure the number of patients who are clinically obese, then add filters for factors like diabetes and LDL cholesterol levels to determine where to focus treatment. The same prescriptive model can be applied to almost any industry target group or problem.

1.2 Purpose

- The purpose of this project is to know about the fundamental concepts of IBM Cognos on cloud, the working with IBM Cognos, to work with various graph and charts and to create meaningful dashboard.
- It can be used to estimate crop prediction in long and short term.
- Canvas maps are available.

2.LITERATURE SURVEY

2.1 EXISTING PROBLEM

- With the changing of climate, agriculture faces increasing problems with extreme weather events leading to considerable yield losses of crops. Most often, crop plants are sensitive to stresses. since they were mostly selected for high yield, and not for stress tolerance.
- In most areas where crop production is dependent on rainfall there is always risk of **crop failure or yield loss due to moisture stress**. In the semi-arid tropic areas, moisture is always inadequate for crop growth because of low precipitation and erratic distribution and poor soil moisture storage capacity of soils.

2.2 References

https://www.noble.org/news/publications/ag-news-and
views/2001/september/soil-and-water-
relationships/
https://www.jagranjosh.com/general-knowledge/list-of-major-crops-of-india-
temperature-
rainfall-soil-1473918924-1
https://mail.google.com/mail/u/0/?tab=rm&ogbl#inbox/KtbxLthVdScFrqFwSlJwm
jlwtMJQTcW
mgq?
projector=1&messagePartId=0.1
https://mail.google.com/mail/u/0/?tab=rm&ogbl#inbox/QgrcJHsbjCZLbpXskSwG
kvRhRHVGT

sGPvPL
https://mail.google.com/mail/u/0/?tab=rm&ogbl#inbox/KtbxLwgswrWrQzWGcQ
HRxtBcTlFjsc
DQkL
https://mail.google.com/mail/u/0/?tab=rm&ogbl#inbox/QgrcJHrhstxRbjhJHJDSd
MNfnwnvWlZ
WCFq
https://mail.google.com/mail/u/0/?tab=rm&ogbl#inbox/KtbxLxGkKJkBgvprKljM
gRBVdhcHrw
qTsB
https://mail.google.com/mail/u/0/?tab=rm&ogbl#inbox/KtbxLvGzbQQwnqswfJL
mlmFHXMCk
ZHmXGB
https://mail.google.com/mail/u/0/?tab=rm&ogbl#inbox/KtbxLthlvfCQjzgCHDCM
kPXNRcswNJ

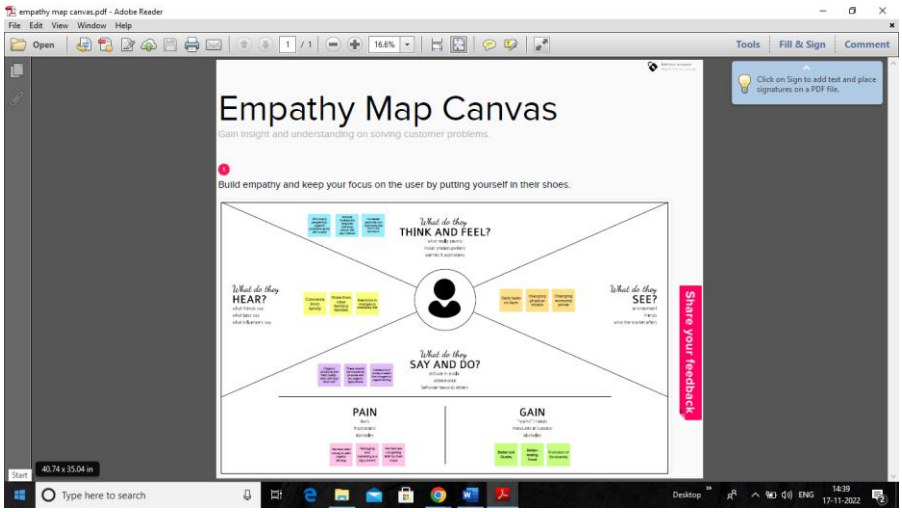
2.3 Problem Statement Definition

Farmers can improve their drought resilience by making different crop choices, enrolling in crop insurance. To prevent from flood they have to maintain Water distribution, Field water management, Ground water use, Agronomic practices, Multi-functional use, Internal governance

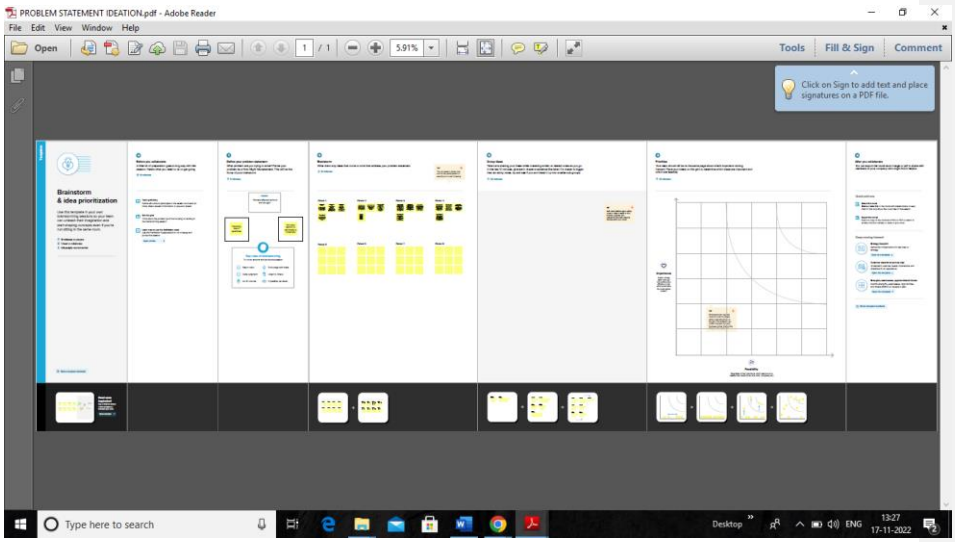
Now a days, India is to allow farmers to sell produce directly to bulk buyers such as trading companies, food processors and large retailers Farmers can directly sell their produce to cash and carry retailers.

3 IDEATION & PROPOSED SOLUTION

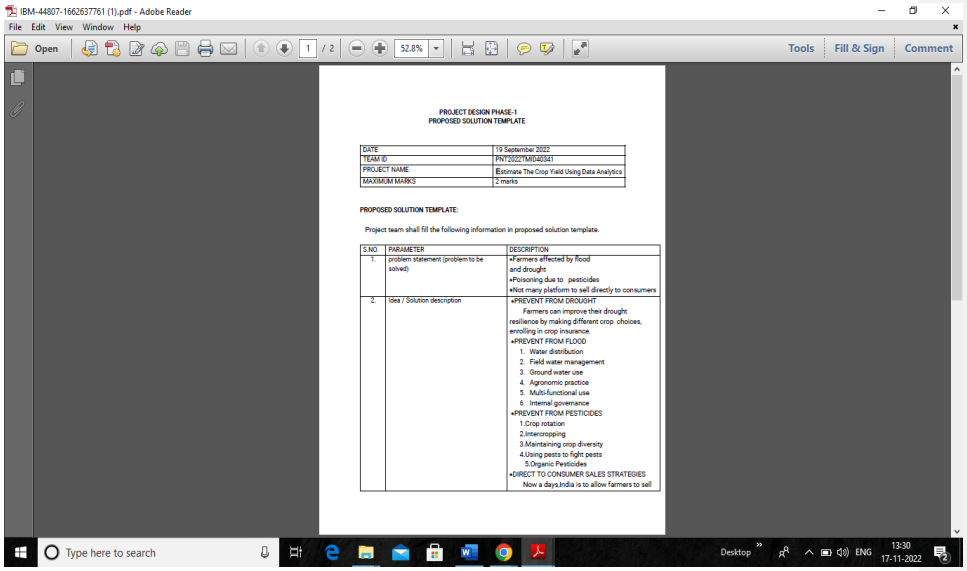
3.1 Empathy Map Canvas

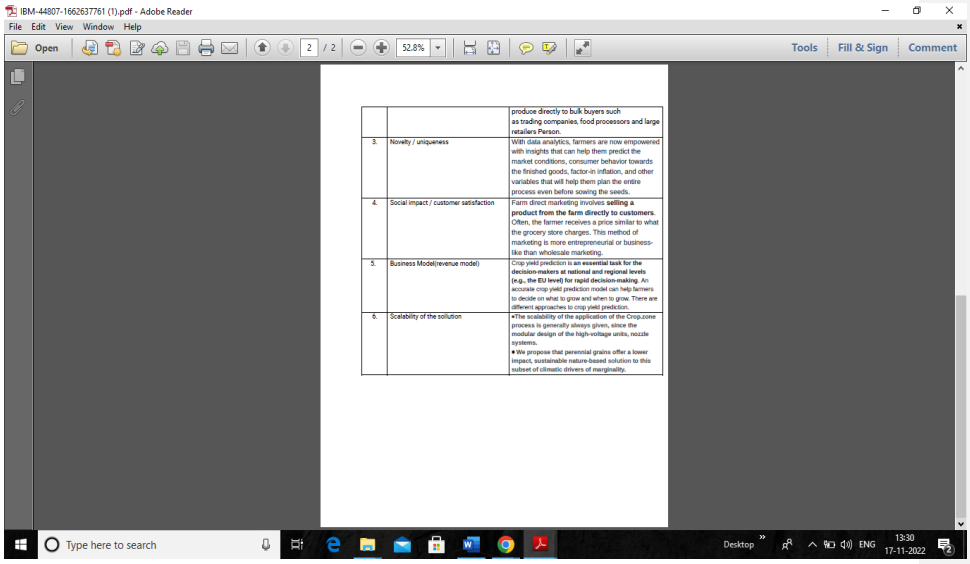


3.2 Ideation & Brainstorming

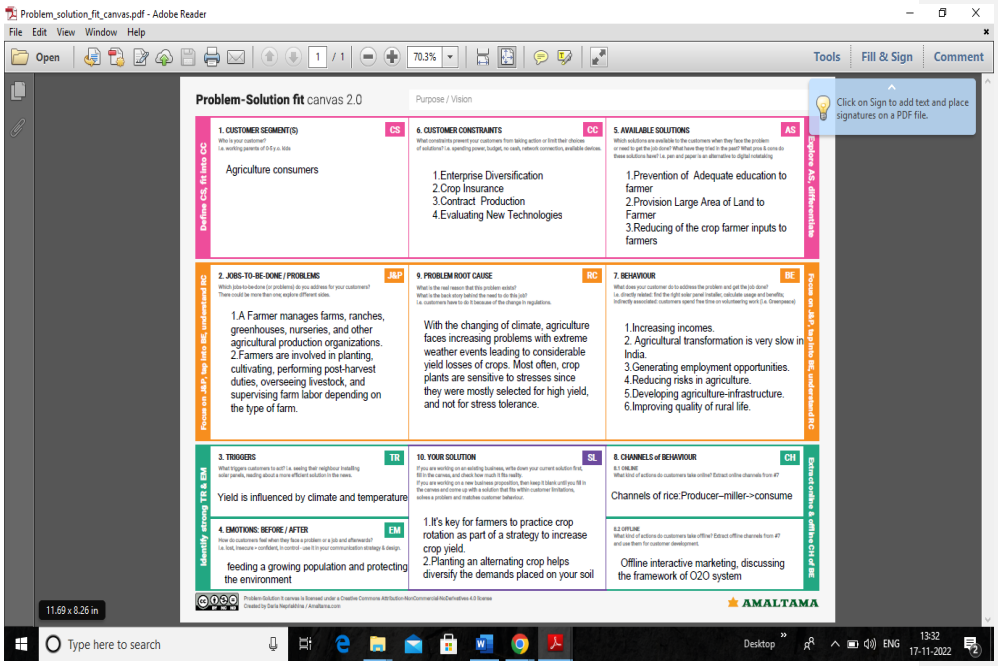


3.3 Proposed Solution



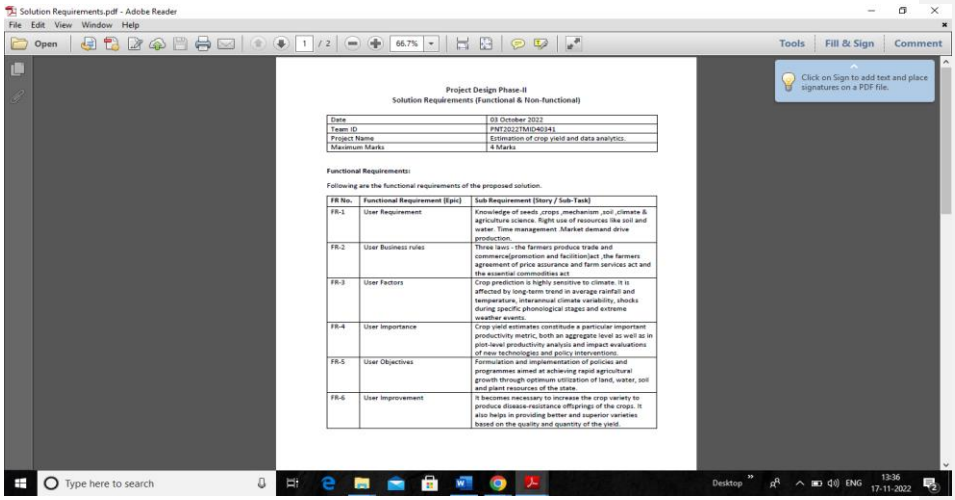


3.4 Problem Solution



4.REQUIREMENT ANALYSIS

4.1 Functional requirement



Solution Requirements.pdf - Adobe Reader

File Edit View Window Help

Open | 1 / 2 | 66.7% | Tools | Fill & Sign | Comment

Click on Sign to add text and place signatures on a PDF file.

Project Design Phase-II
Solution Requirements (Functional & Non-functional)

Date	03 October 2022
Team ID	PNT2022TMID40341
Project Name	Estimation of crop yield and data analytics.
Maximum Marks	4 Marks

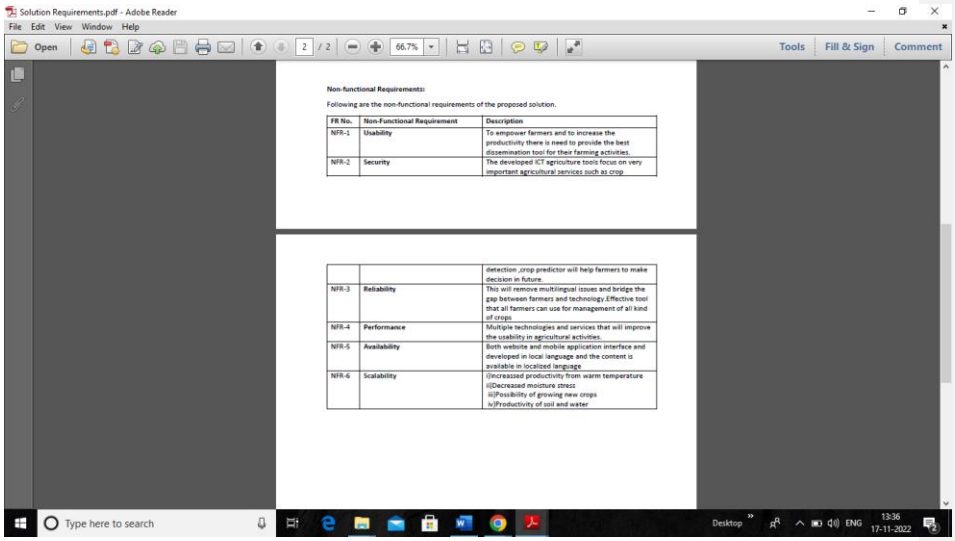
Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Requirement	Knowledge of seeds ,crops ,mechanism ,soil ,climate & agriculture science. Right use of resources like soil and water. Time management .Market demand drive production.
FR-2	User Business rules	Three laws - the farmers produce trade and commerce(promotion and facilition)act ,the farmers agreement of price assurance and farm services act and the essential commodities act.
FR-3	User Factors	Crop prediction is highly sensitive to climate. It is affected by long-term trend in average rainfall and temperature, interannual climate variability, shocks during specific phonological stages and extreme weather events.
FR-4	User Importance	Crop yield estimates constitude a particular important productivity metric, both an aggregate level as well as in plot-level productivity analysis and impact evaluations of new technologies and policy interventions.
FR-5	User Objectives	Formulation and implementation of policies and programmes aimed at achieving rapid agricultural growth through optimum utilization of land, water, soil and plant resources of the state.
FR-6	User Improvement	It becomes necessary to increase the crop variety to produce disease-resistance offsprings of the crops. It also helps in providing better and superior varieties based on the quality and quantity of the yield.

Type here to search | Desktop | ENG | 13:36 17-11-2022

4.2 Non-Functional Requirement



Solution Requirements.pdf - Adobe Reader

File Edit View Window Help

Open | 2 / 2 | 66.7% | Tools | Fill & Sign | Comment

Non-functional Requirements:

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

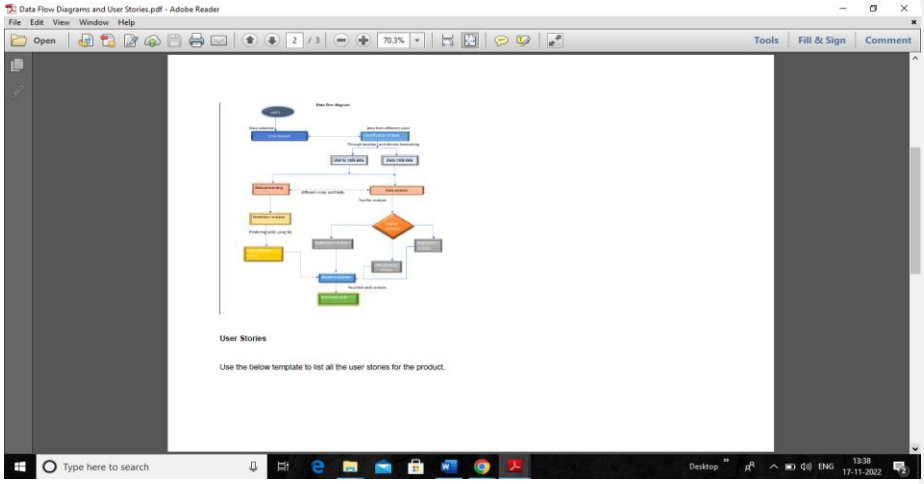
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	To empower farmers and to increase the productivity there is need to provide the best dissemination tool for their farming activities.
NFR-2	Security	The developed ICT agriculture tools focus on very important agricultural services such as crop

		detection ,crop predictor will help farmers to make decision in future.
NFR-3	Reliability	This will remove multilingual issues and bridge the gap between farmers and technology.Effective tool that all farmers can use for management of all kind of crops
NFR-4	Performance	Multiple technologies and services that will improve the usability in agricultural activities.
NFR-5	Availability	Both website and mobile application interface and developed in local language and the content is available in localized language
NFR-6	Scalability	i)Increased productivity from warm temperature ii)Decreased moisture stress iii)Possibility of growing new crops iv)Productivity of soil and water

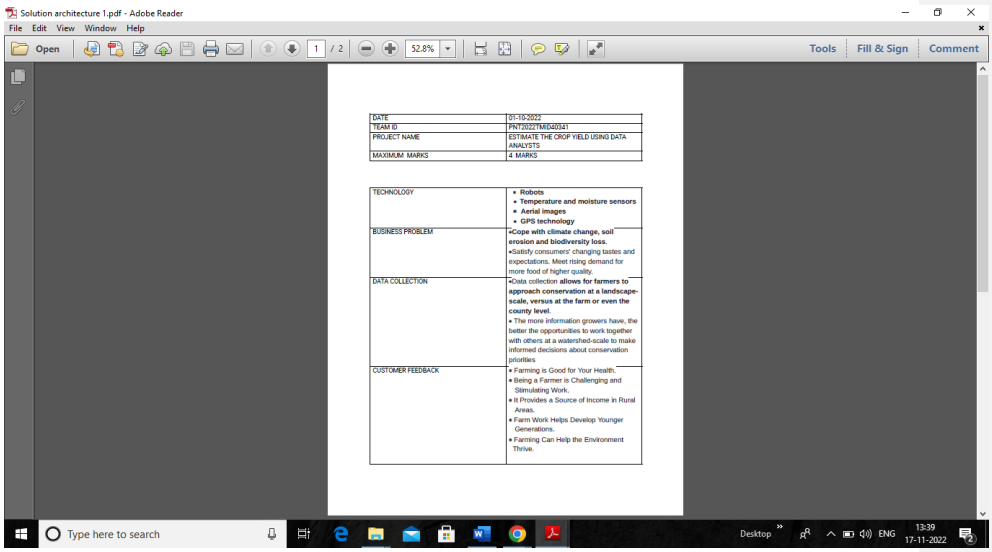
Type here to search | Desktop | ENG | 13:36 17-11-2022

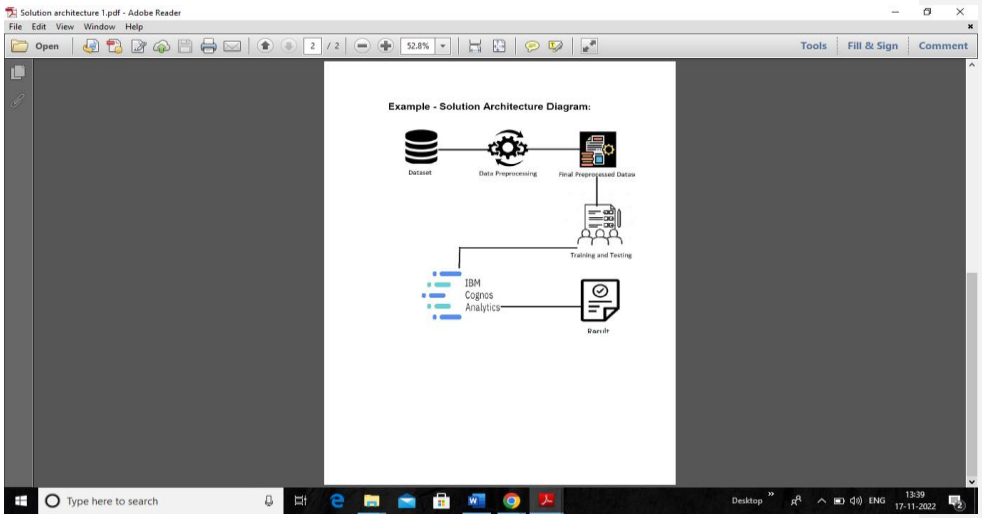
5. Project Design

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture





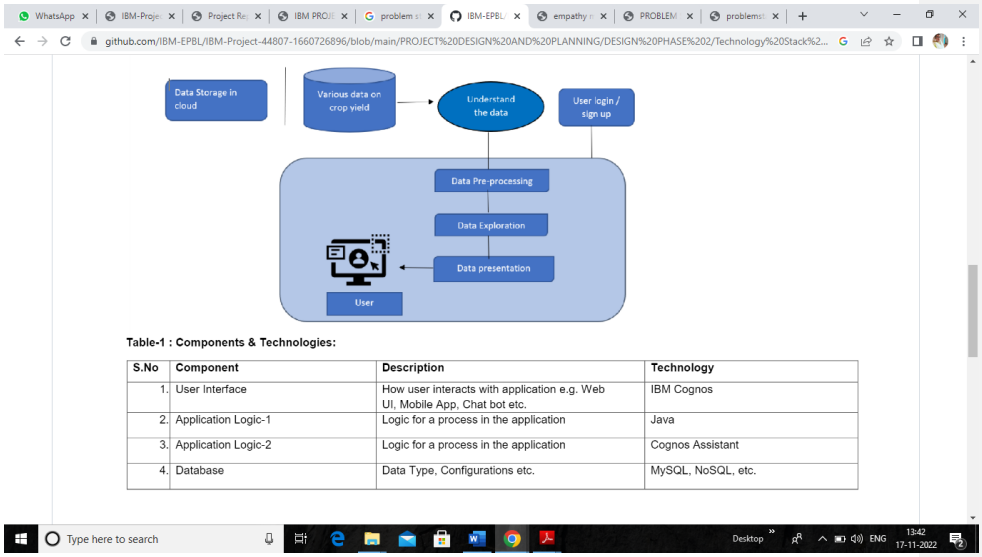
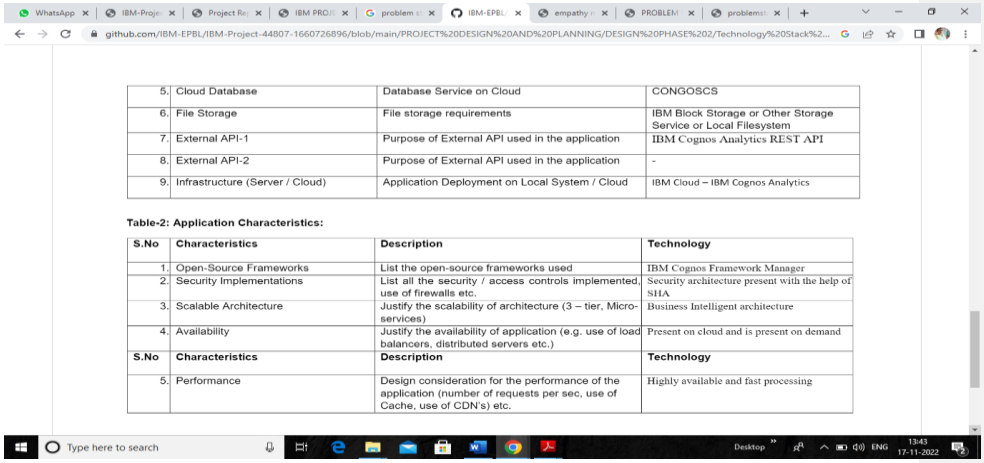


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chat bot etc.	IBM Cognos
2.	Application Logic-1	Logic for a process in the application	Java
3.	Application Logic-2	Logic for a process in the application	Cognos Assistant
4.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.

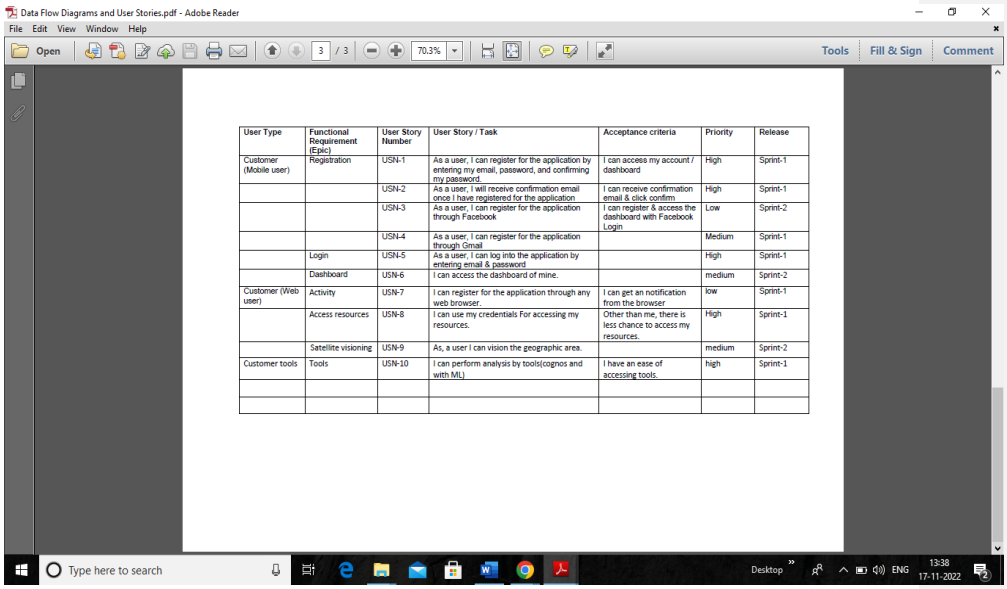


5.	Cloud Database	Database Service on Cloud	CONGOSCS
6.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
7.	External API-1	Purpose of External API used in the application	IBM Cognos Analytics REST API
8.	External API-2	Purpose of External API used in the application	-
9.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud	IBM Cloud – IBM Cognos Analytics

Table-2: Application Characteristics:

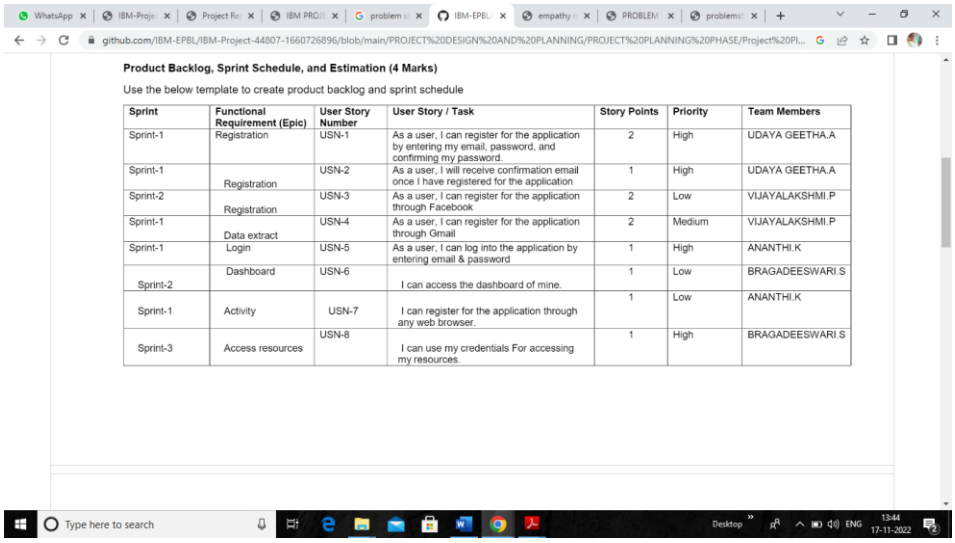
S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	IBM Cognos Framework Manager
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	Security architecture present with the help of SHA
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Business Intelligent architecture
4.	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	Present on cloud and is present on demand
S.No	**Characteristics**	**Description**	**Technology**
5.	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Highly available and fast processing

5.3 User Stories



User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard	USN-6	I can access the dashboard of mine.		medium	Sprint-2
Customer (Web user)	Activity	USN-7	I can register for the application through any web browser.	I can get an notification from the browser	low	Sprint-1
	Access resources	USN-8	I can use my credentials For accessing my resources.	Other than me, there is less chance to access my resources.	High	Sprint-1
	Satellite visioning	USN-9	As, a user I can vision the geographic area.		medium	Sprint-2
Customer tools	Tools	USN-10	I can perform analysis by tools(cognos and with ML)	I have an ease of accessing tools.	high	Sprint-1

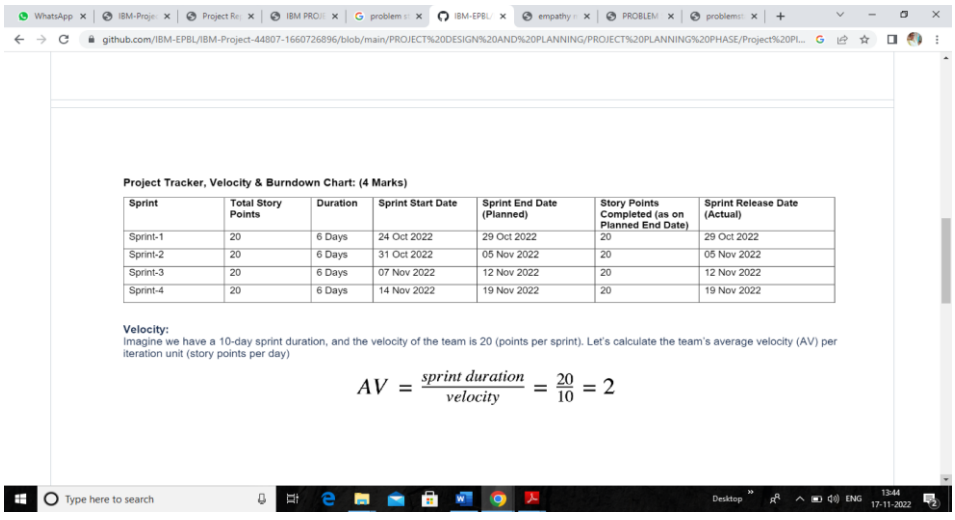
6.PROJECT PLANNING AND SCHEDULING



Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	UDAYA GEETHA.A
Sprint-1	Registration	USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	UDAYA GEETHA.A
Sprint-2	Registration	USN-3	As a user, I can register for the application through Facebook	2	Low	VIJAYALAKSHMI.P
Sprint-1	Data extract	USN-4	As a user, I can register for the application through Gmail	2	Medium	VIJAYALAKSHMI.P
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	ANANTHI.K
Sprint-2	Dashboard	USN-6	I can access the dashboard of mine.	1	Low	BRAGADEESWARI.S
Sprint-1	Activity	USN-7	I can register for the application through any web browser.	1	Low	ANANTHI.K
Sprint-3	Access resources	USN-8	I can use my credentials For accessing my resources.	1	High	BRAGADEESWARI.S



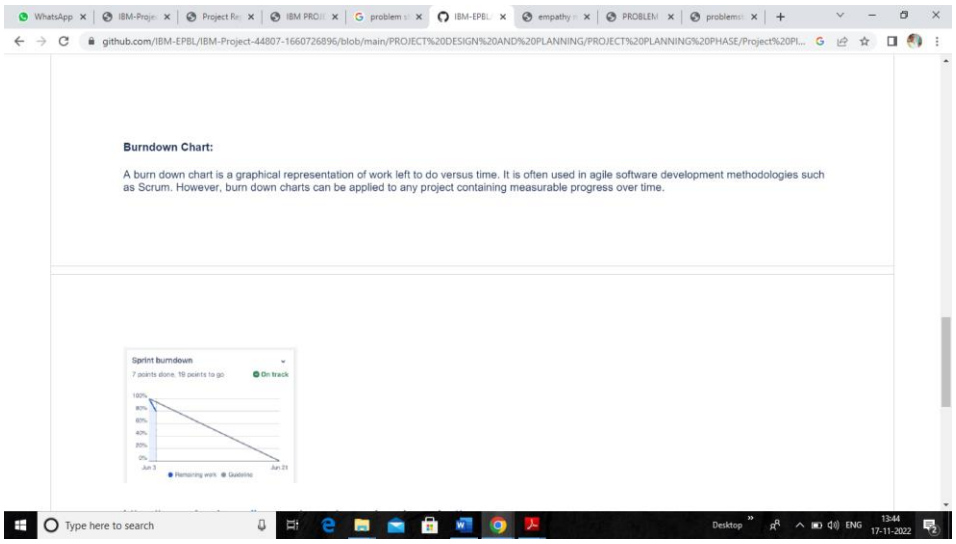
Project Tracker, Velocity & Burndown Chart: (4 Marks)

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

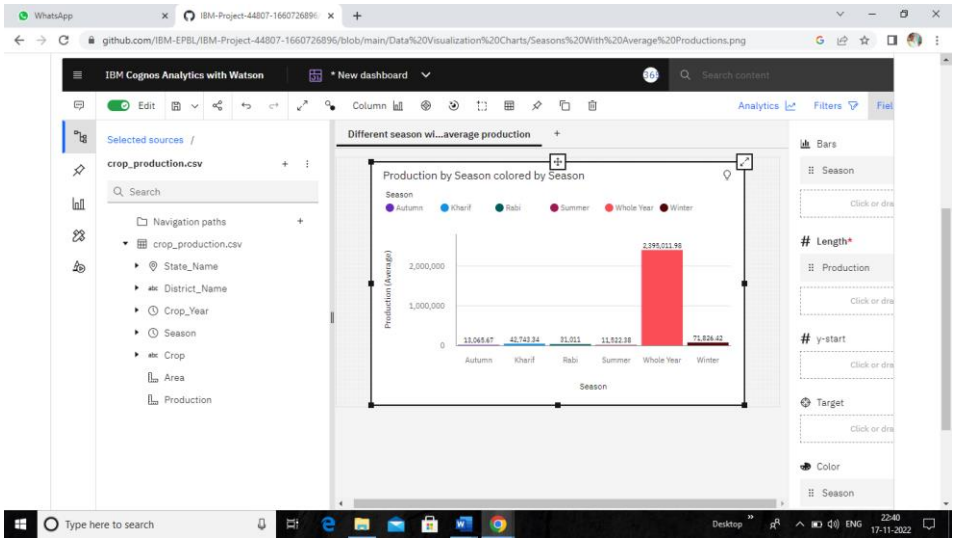
Velocity:

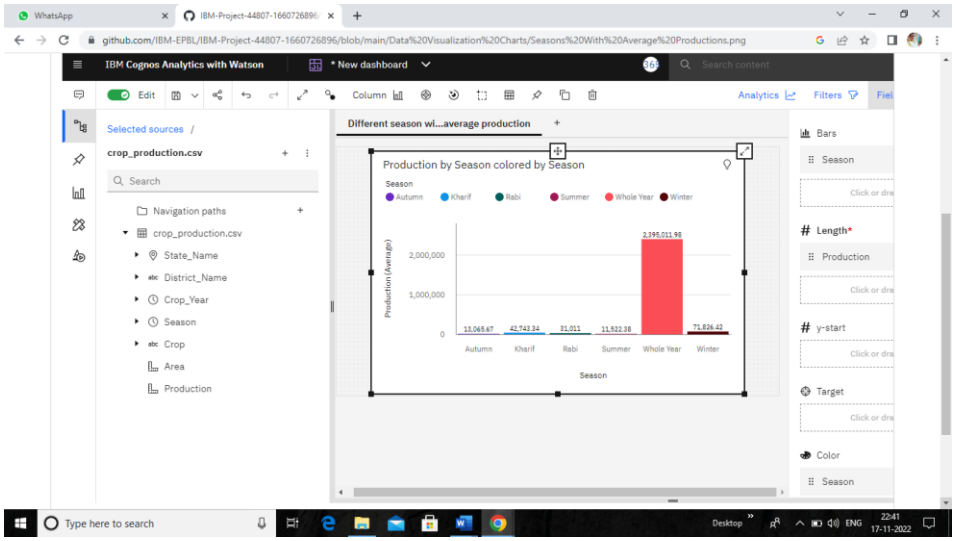
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

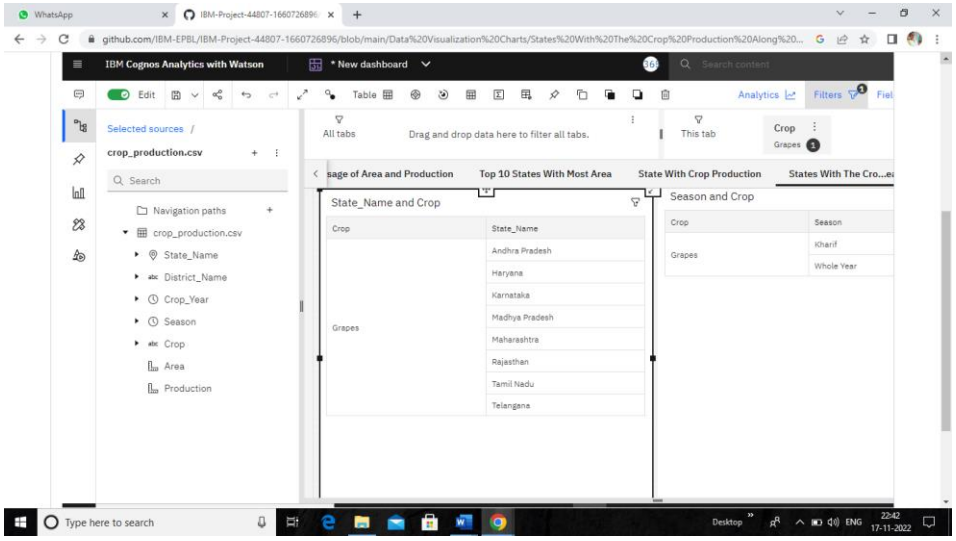
$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

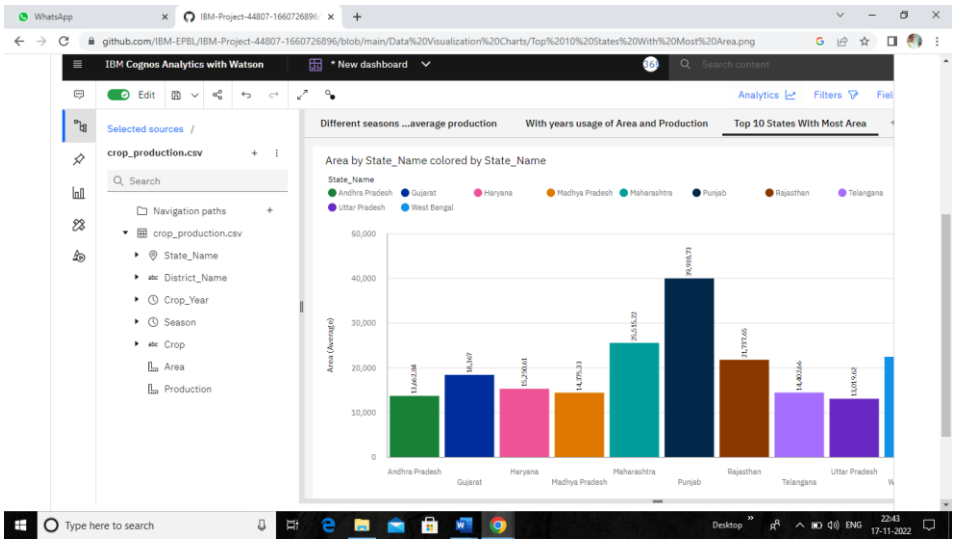

github.com/IBM-EPBL/IBM-Project-44807-1660726896/blob/main/PROJECT%20DESIGN%20AND%20PLANNING/PROJECT%20PLANNING%20PHASE/Project%20Pl...
Burndown Chart:
A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.
Sprint burndown
7 points done, 19 points to go
On track
Type here to search
Desktop
ENG
13:44
17-11-2022

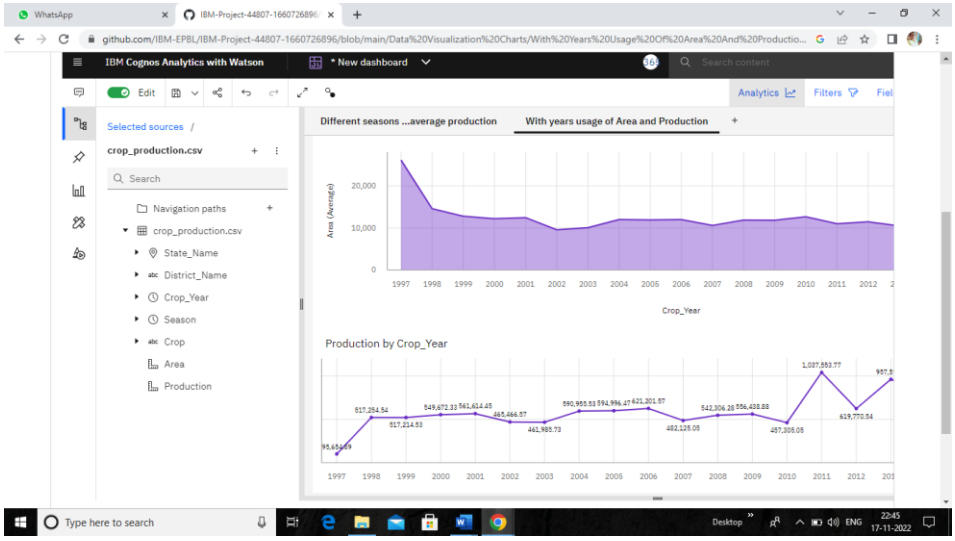
7. CODING & SOLUTIONING





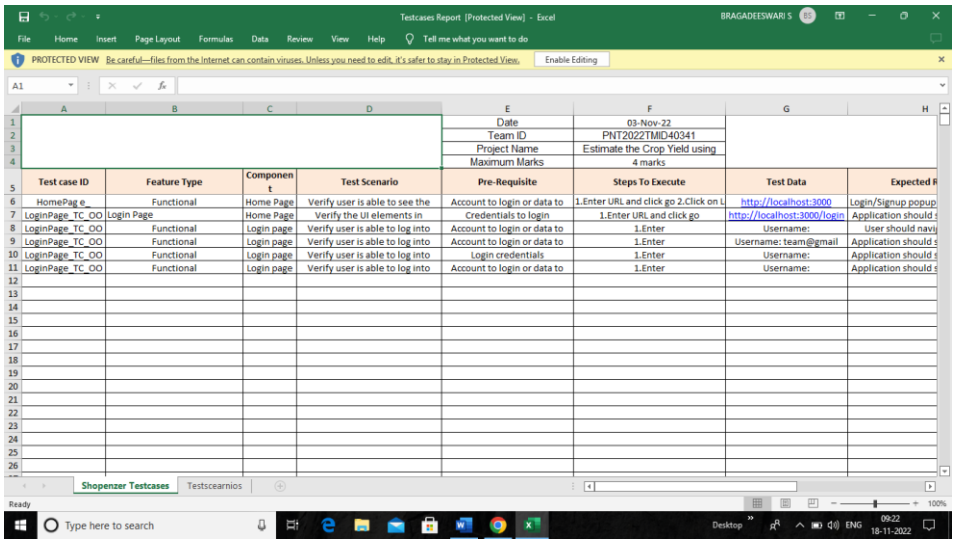

IBM Cognos Analytics with Watson
* New dashboard
Selected sources
crop_production.csv
Navigation paths
State_Name
District_Name
Crop_Year
Season
Crop
Area
Production
All tabs
Drag and drop data here to filter all tabs.
This tab
Crop
Grapes
Top 10 States With Most Area
State With Crop Production
State_Name and Crop
Season and Crop
Andhra Pradesh
Haryana
Karnataka
Madhya Pradesh
Maharashtra
Rajasthan
Tamil Nadu
Telangana
Kharif
Whole Year


IBM Cognos Analytics with Watson
* New dashboard
Selected sources
crop_production.csv
Different seasons ...average production
With years usage of Area and Production
Top 10 States With Most Area
Area by State_Name colored by State_Name
State_Name
Andhra Pradesh
Gujarat
Haryana
Madhya Pradesh
Maharashtra
Punjab
Rajasthan
Telangana
Uttar Pradesh
West Bengal
50,000
40,000
30,000
20,000
10,000
0
Area (Average)
Andhra Pradesh
Gujarat
Haryana
Madhya Pradesh
Maharashtra
Punjab
Rajasthan
Telangana
Uttar Pradesh

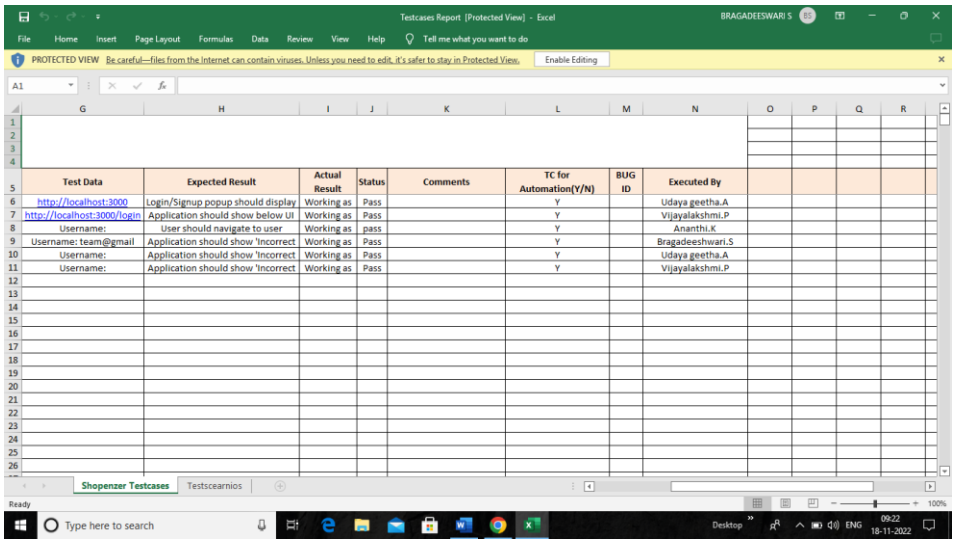

IBM Cognos Analytics with Watson
* New dashboard
Edit
Analytics
Filters
Selected sources
crop_production.csv
Search
Navigation paths
crop_production.csv
State_Name
District_Name
Crop_Year
Season
Crop
Area
Production
Different seasons ...average production
With years usage of Area and Production
Area (Average)
20,000
10,000
0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Crop_Year
Production by Crop_Year
95,654.69
517,254.54
517,214.53
549,672.33
561,414.45
465,666.97
461,965.73
590,955.53
594,996.47
621,201.97
482,125.05
542,306.26
556,438.88
457,305.05
1,037,553.77
619,770.54
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Type here to search
Desktop
ENG
22:45
17-11-2022

8. TESTING

8.1 Test Cases

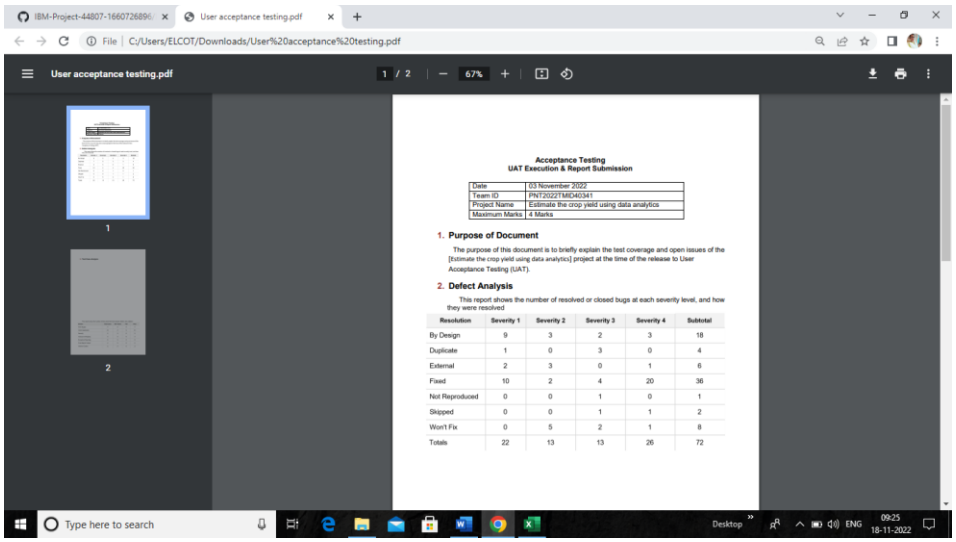


				Date	03-Nov-22		
				Team ID	PNT2022TMID40341		
				Project Name	Estimate the Crop Yield using		
				Maximum Marks	4 marks		
Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected R
HomePag e_	Functional	Home Page	Verify user is able to see the	Account to login or data to	1.Enter URL and click go 2.Click on L	http://localhost:3000	Login/Signup popup
LoginPage_TC_OO	Login Page	Home Page	Verify the UI elements in	Credentials to login	1.Enter URL and click go	http://localhost:3000/login	Application should s
LoginPage_TC_OO	Functional	Login page	Verify user is able to log into	Account to login or data to	1.Enter	Username:	User should navi
LoginPage_TC_OO	Functional	Login page	Verify user is able to log into	Account to login or data to	1.Enter	Username: team@gmail	Application should s
LoginPage_TC_OO	Functional	Login page	Verify user is able to log into	Login credentials	1.Enter	Username:	Application should s
LoginPage_TC_OO	Functional	Login page	Verify user is able to log into	Account to login or data to	1.Enter	Username:	Application should s



Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	BUG ID	Executed By
http://localhost:3000	Login/Signup popup should display	Working as	Pass		Y		Udaya geetha.A
http://localhost:3000/login	Application should show below UI	Working as	Pass		Y		Vijayalakshmi.P
Username:	User should navigate to user	Working as	pass		Y		Ananthi.K
Username: team@gmail	Application should show 'Incorrect	Working as	Pass		Y		Bragadeeshwari.S
Username:	Application should show 'Incorrect	Working as	Pass		Y		Udaya geetha.A
Username:	Application should show 'Incorrect	Working as	Pass		Y		Vijayalakshmi.P

8.2 User Acceptance Testing



Acceptance Testing
UAT Execution & Report Submission

Date	03 November 2022
Team ID	PNT2022TMID40341
Project Name	Estimate the crop yield using data analytics
Maximum Marks	4 Marks

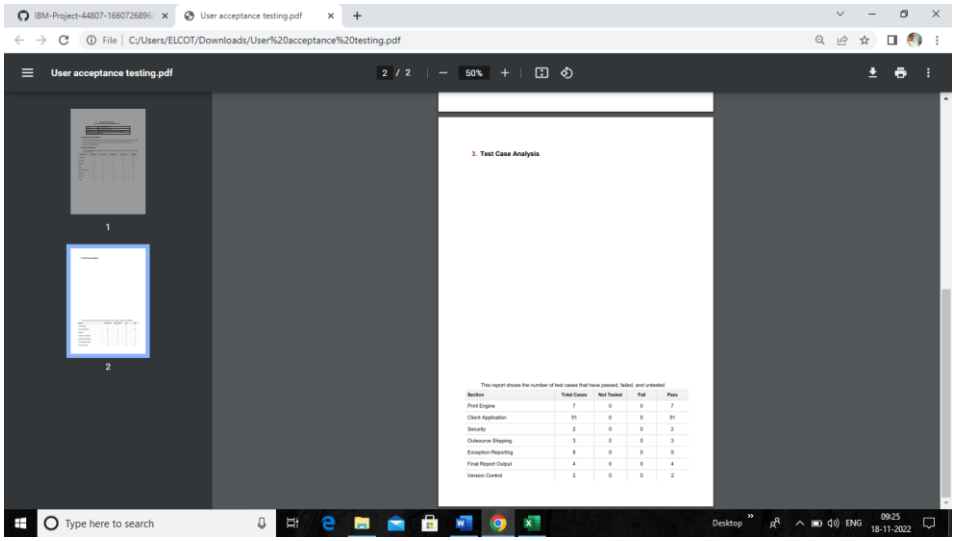
1. Purpose of Document

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

2. Defect Analysis

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	9	3	2	3	18
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	10	2	4	20	36
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	22	13	13	26	72



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

9. RESULTS

9.1Performance Metrics

- Crop Performance analytics quantify the yield potential and environmental impact of food production at field, farm and catchment scales.
- Crop Performance works with growers, food companies and retailers to improve productivity, conserve resources, and monitor the environmental impact of food production.

The food and agriculture industry benefits with more accurate supply forecasts, an enhanced visibility to source commodities, assess risk and monitor the impact of climate change on agriculture:

- Crop Performance analytics forecast crop yields with accuracy in advance of harvest.
- The data is used to inform in-season yield, water & nutrient status of crops at the field scale.
- Customers of growers in the supply chain benefit from an integrated view of supply to inform sourcing, harvest planning and logistics.

10. ADVANTAGES & DISADVANTAGES

Advantages:

1. Increases Soil Fertility

Prolonged planting of the same crop type leads to the depletion of specific nutrients in the soil. Each crop type has a different nutrient interaction with the soil, and each of them releases and absorbs different types of nutrients.

2. Increases Crop Yield

Crop rotation increases the harvest obtained from a single seasonal harvest. Because of the incorporation of different crop types, one gets not only a variety of crops after each season but also a general bounty harvest. Some scientific evidence proves a 10 to 25% increase in crop yield in crop rotation rather than monoculture.

2. Improper Implementation Can Cause Much More Harm Than Good

Improper implementation of this technique causes much more harm than good. If one lacks the technical know-how of crop rotation, there is no need experiment because there can be nutrient buildup that will take a longer time to correct.

3. Increases Soil Nutrients

As earlier stated, crop rotation allows the land to regenerate and rejuvenate its own nutrients without having to apply more nutrients through the use of fertilizers. Leaving the land bare for a season enables the land to restore the soil nutrients lost through absorption by plants harvested in the previous season.

4. Reduces Soil Erosion

Soil erosion is the carrying away of the most important topsoil layer by wind or water. When the soil is constantly covered by plants, the topsoil layer is not carried away by water during heavy rainfall.

5. Limits the Concentration of Pests and Diseases

Similar plants tend to have the same pathogens; therefore, crop rotation interrupts the pest life cycle and their habitat.

Disadvantages:

1. It Involves Risk

In crop rotation, investing in a season involves the input of a lot of money to buy different seedlings of the different types of crops to be planted.

2. Improper Implementation Can Cause Much More Harm Than Good

Improper implementation of this technique causes much more harm than good. If one lacks the technical know-how of crop rotation, there is no need to experiment because there can be nutrient buildup that will take a longer time to correct.

3. Obligatory Crop Diversification

For crop rotation to work, one has to plant different crops every time. Nonetheless, it does not allow a farmer to specialize in a single type of crop. The farmer is not able to produce a single crop on a large scale over a long period of time because of the damage it will do to the soil.

4. Requires More Knowledge and Skills

Crop rotation means a variety of crops; therefore, it requires a deeper set of skills and knowledge regarding each type of crop harvested. It also requires different types of machinery, and operating them also requires knowledge. This means farmers will have to invest more time and resources in learning and mastering this agricultural practice.

5. The Difference in Growing conditions

Certain locations and their climates are more favorable for monoculture, meaning a certain kind of crop. Other crops, other than that specific type of crop, cannot grow well in that specific type of temperature and soil conditions.

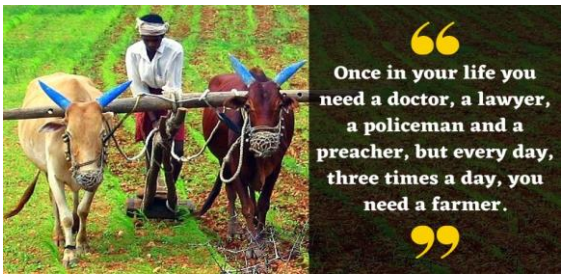
11. Conclusion

Based on these articles on the main crop yield changes in China due to climate change, this paper evaluates the level of consensus on the reliability of the results in space and time. The high-consensus conclusions are as follows:

The crop yield change in China will be negative from the 2020s. Take 2012 as the baseline, the yield will decrease by 5% in the 2030s, and the decrease will be greater than 25% in the 2070s. The decline in the second half of this century will be greater than that in the first half.

Different crops respond differently to climate change. Maize yield will decrease more than 10% in the 2050s and approximately 19% in the 2070s. Rice yield will decrease faster in the second half, with its yield change decreasing from 5% to 25% after the 2060s. The fluctuations in wheat yield in upcoming decades will be less volatile, and the yield decrease will be approximately 10% in the 2090s.

CO2 factors have a positive impact on yield changes. The crop yield will decrease by 6.6% in the 2040s, but it will be increased by 15% with CO2. In the 2090s, the yield decrease will be 22.8%, but it will be 17.8% with CO2. In addition, the central tendency of maize and rice yield change will be −3.4% and −2.7% per 10 years, but they will change to +1.4% and −0.6% per 10 years, respectively, under the impact of CO2.



12. FUTURE SCOPE

Crop yield prediction systems provide for better planning and decision-making to increase production. The proposed system involves a prediction module based on data mining classification algorithm namely Random Forest used to forecast the yield of major crops based on historical data.

Predicting encourages children to actively think ahead and ask questions. It also allows students to understand the story better, make connections to what they are reading, and interact with the text. Making predictions is also a valuable strategy to improve reading comprehension.

Diversification of crops reduces risk of financial loss due unfavorable conditions. Diversification of crops means variety of crops can be grown for meeting the domestic needs of farmers and livestock, to reduce risk of market fluctuations, mechanism of farming, growing expensive crops.

13 APPENDIX

SOURCE CODE

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <title>Estimate The Crop Yield Using  Data Analytics - IBM</title>
    <script src="https://cdn.tailwindcss.com"></script>
  </head>
  <body class="h-screen overflow-hidden scroll-smooth bg-gray-100">
    <header
      class="fixed top-0 p-5 bg-white border-b w-full shadow-md flex gap-10 justify-between
items-center"
    >
      <h1 class="font-bold text-lg">Estimate The Crop Yield Using  Data Analytics</h1>
      <nav class="flex gap-6 items-center">
        <a
          href="#dashboard"
          data-href="dashboard"
          class="link hover:underline bg-blue-600 text-white p-2 leading-none"
          >Dashboard</a
        >
        <a
```

```
      href="#report"
      data-href="report"
      class="link hover:underline p-2 leading-none"
      >Report</a
    >
    <a
      href="#story"
      data-href="story"
      class="link hover:underline p-2 leading-none"
      >Story</a
    >
  </nav>
</header>
<section id="dashboard" class="h-screen p-5 pt-24">
  <iframe
    src="C:\Users\Admin\Pictures\Screenshots\Screenshot (87).png"
    width="100%"
    height="100%"
    frameborder="0"
    gesture="media"
    allow="encrypted-media"
    allowfullscreen=""
    class="border"
  ></iframe>
</section>
<section id="report" class="h-screen p-5 pt-24">
  <iframe
    src="file:///C:/Users/Admin/Downloads/Screenshot%20(111).pdf"
```

```
      width="100%"
      height="100%"
      frameborder="0"
      gesture="media"
      allow="encrypted-media"
      allowfullscreen=""
      class="border"
    ></iframe>
  </section>
  <section id="story" class="h-screen p-5 pt-24">
    <iframe
      src="file:///C:/Users/Admin/Downloads/Screenshot%20(101).pdf"
      width="100%"
      height="100%"
      frameborder="0"
      gesture="media"
      allow="encrypted-media"
      allowfullscreen=""
      class="border"
    ></iframe>
  </section>
</body>
<script>
  const links = document.querySelectorAll("a.link");
  links.forEach((el) =>
    el.addEventListener("click", (e) => {
      e.preventDefault();
      document
```

```
        .getElementById(el.getAttribute("data-href"))
        .scrollIntoView({ behavior: "smooth" });
      const currActive = document.querySelector("a.link.active");
      currActive?.classList.remove("active");
      currActive?.classList.remove("bg-blue-600");
      currActive?.classList.remove("text-white");
      el.classList.add("active");
      el.classList.add("bg-blue-600");
      el.classList.add("text-white");
    })
  );
 </script>
</html>
```

GITHUB & PROJECT DEMO LINK

IBM-Project-44807-1660726896

https://youtu.be/e_kGVS7gaAc