Smart Lender - Applicant Credibility Prediction for Loan Approval

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GitHub & Project Demo Link

Introduction

1.1 Overview

Big Data's main advantage is its ability to analyse a set of data in order to draw out valuable information. Volume, Velocity, and Variety are the attributes used to describe the data collected by various organisations and businesses. Sometimes, the precision and accuracy of the data depend not only on how accurate the data is but also on when it is delivered. Big data has the greatest potential in the financial industry. These data can be quickly transformed into decision-making tools with added value by using efficient analysis techniques.

The answer to the query of how to analyse this data is machine learning. Artificial intelligence offers features that cost less in terms of both time and resources when used. Additionally, it provides novel classification methods and new insights into data. Machine learning is currently being actively used in banking and financial institutions for a variety of purposes, including trading, portfolio management, fraud detection, and loan approval. Artificial intelligence is used in the financial industry to create "robo-advisors," intelligent portfolio systems that can adjust to the risks and objectives of the user. To make decisions very quickly, decision trading support systems, also known as algorithmic trading, are used. Machine learning has brought promising new approaches to analyse user behaviour and spot fraudulent transactions for fraud detection. Loan providers, especially big

businesses like banks and insurance companies, train machine learning algorithms using a tonne of consumer data and financial lending outcomes. which can be used to decide wisely when it comes to insurance and lending. In this study, we focus on the latter: the decision-making process for loan approval.

According to a data analysis perspective, determining whether to approve a loan is a "good" or "bad" risk depends on the analysis and classification of a set of loan applicant data. A set of data is divided into two classes using the binary classification method, which is a straightforward classification case. When we want to predict a specific outcome that can only take two distinct values, we typically use this type of classification. Typical examples include detecting spam, diagnosing illnesses, looking for credit card fraud, or in our case, approving loans. Binary classification is a very basic problem, despite being fairly straightforward. Different paradigms are applied when learning binary classifiers, such as: Support Vector Machines, Decision Trees, K-nearest neighbourhood, Bayesian Classification, Logistic regression, Neural Networks, and more recently, deep learning.

1.2 Purpose

To develop a smart lending loan approval or rejection application that can automatically approve or reject a loan based on the user's credit score. This increases the efficiency of the loan approval process and makes it less cumbersome and more economical.

LITERATURE SURVEY

2.1 Existing Problem

Currently the process is performed manually by dedicated experts who review credit history and application and manually approve or reject a loan. This is inefficient for a multitude of reasons. It makes the whole process cumbersome, complex and prone to mistakes. It is also not very economical or convenient. By automating this process with the help of Data Science and Machine Learning, all the existing problems can be easily overcome.

2.2 References

[1] V. Singh, A. Yadav, R. Awasthi and G. N. Partheeban, "Prediction of Modernized Loan Approval System Based on Machine Learning Approach," 2021 International Conference on Intelligent Technologies (CONIT), 2021, pp. 1-4, doi: 10.1109/CONIT51480.2021.9498475.

[2] H. Ramachandra, G. Balaraju, R. Divyashree and H. Patil, "Design and Simulation of Loan Approval Prediction Model using AWS Platform," 2021 International Conference on Emerging Smart Computing and Informatics (ESCI), 2021, pp. 53-56, doi: 10.1109/ESCI50559.2021.9397049.

[3] P. Tumuluru, L. R. Burra, M. Loukya, S. Bhavana, H. M. H. CSaiBaba and N. Sunanda, "Comparative Analysis of Customer Loan Approval Prediction using Machine Learning Algorithms," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), 2022, pp. 349-353, doi: 10.1109/ICAIS53314.2022.9742800.

[4] S. Barua, D. Gavandi, P. Sangle, L. Shinde and J. Ramteke, "Swindle: Predicting the Probability of Loan Defaults using CatBoost Algorithm," 2021 5th International Conference on Computing Methodologies and Communication (ICCMC), 2021, pp. 1710-1715, doi: 10.1109/ICCMC51019.2021.9418277.

[5] V. Singh, A. Yadav, R. Awasthi and G. N. Partheeban, "Prediction of Modernized Loan Approval System Based on Machine Learning Approach," 2021 International Conference on Intelligent Technologies (CONIT), 2021, pp. 1-4, doi: 10.1109/CONIT51480.2021.9498475.

[6] M. Alaradi and S. Hilal, "Tree-Based Methods for Loan Approval," 2020 International Conference on Data Analytics for Business and Industry: Way Towards a Sustainable Economy (ICDABI), 2020, pp. 1-6, doi: 10.1109/ICDABI51230.2020.9325614.

[7] D. P. Rajesh, M. Alam, M. Tahernezhadi, C. Vikram and P. N. Phaneendra, "Real Time Data Science Decision Tree Approach to Approve Bank Loan from Lawyer's Perspective," 2020 19th IEEE International Conference on Machine Learning and Applications (ICMLA), 2020, pp. 921-929, doi: 10.1109/ICMLA51294.2020.00150.

[8] K. Sirisong, P. Palangsantikul, P. Arpasat, S. Intarasema and S. Tumswadi, "Analysis of a Bank's Lending Approval System using Process Mining," 2021 19th International Conference on ICT and Knowledge Engineering (ICT&KE), 2021, pp. 1-4, doi: 10.1109/ICTKE52386.2021.9665411.

2.3 PROBLEM STATEMENT DEFINITION

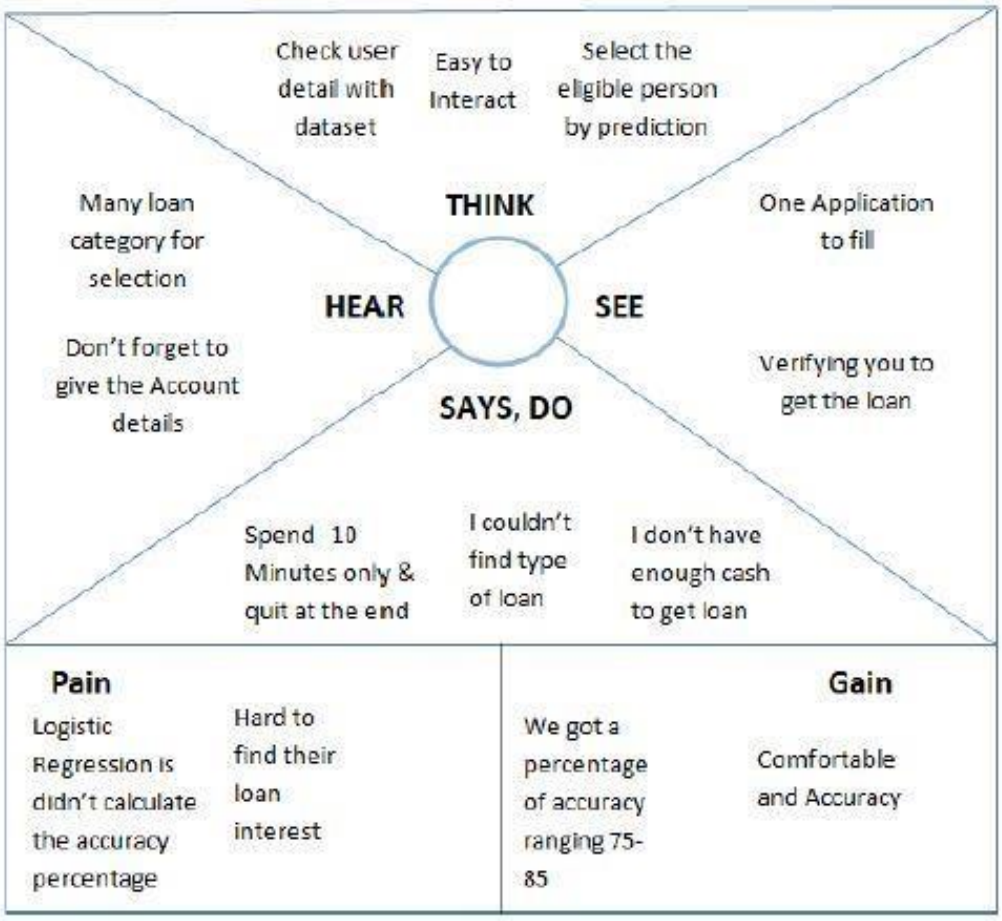
- To accurately predict the credibility of a candidate for loan approval.
- Developing a loan approval system that can provide a possible reason for rejection
- Develop a loan approval system that can predict loan approval based on expert data.

IDEATION AND PROPOSED SOLUTION

3.1 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.

EMPATHY MAP:


Check user detail with dataset
Easy to Interact
Select the eligible person by prediction
Many loan category for selection
THINK
One Application to fill
HEAR
SEE
Don't forget to give the Account details
Verifying you to get the loan
SAYS, DO
Spend 10 Minutes only & quit at the end
I couldn't find type of loan
I don't have enough cash to get loan
Pain
Logistic Regression is didn't calculate the accuracy percentage
Hard to find their loan interest
Gain
We got a percentage of accuracy ranging 75-85
Comfortable and Accuracy

3.2 IDEATION AND BRAINSTORMING

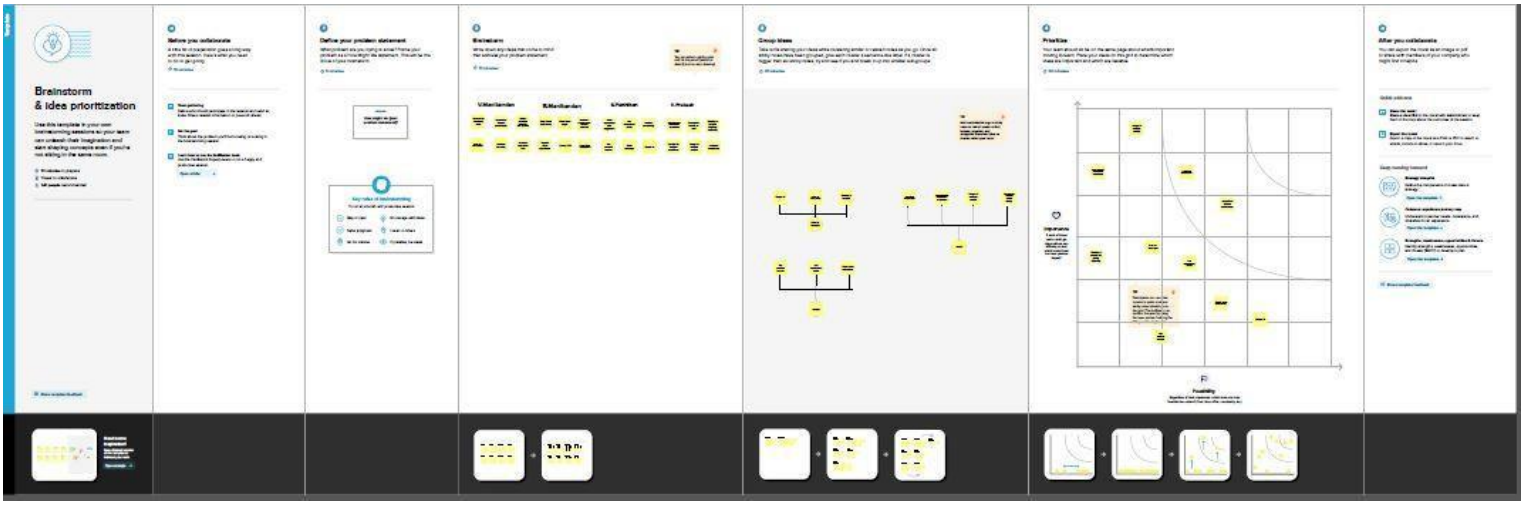


Fig. 2 Brainstorming Ideas

3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To accurately predict the credibility of a candidate for loan approval.
2.	Idea / Solution description	Develop a machine learning model that can not only classify an applicant based on credibility but also provide further details regarding the decision or applicant.
3.	Novelty / Uniqueness	The model will perform multi-label classification and provide additional parameters supporting the loan approval decision that it will give.
4.	Social Impact / Customer Satisfaction	The product will help predict and automate loan approvals reliably and understand the decision as well. It will also account for uncommon circumstances and diverse situations.
5.	Business Model (Revenue Model)	Freemium Model
6.	Scalability of the Solution	The model can be adapted by any banking organization with ease. Classification will be generalized as much as possible but the

		process can be very customized.

3.4 PROBLEM SOLUTION FIT

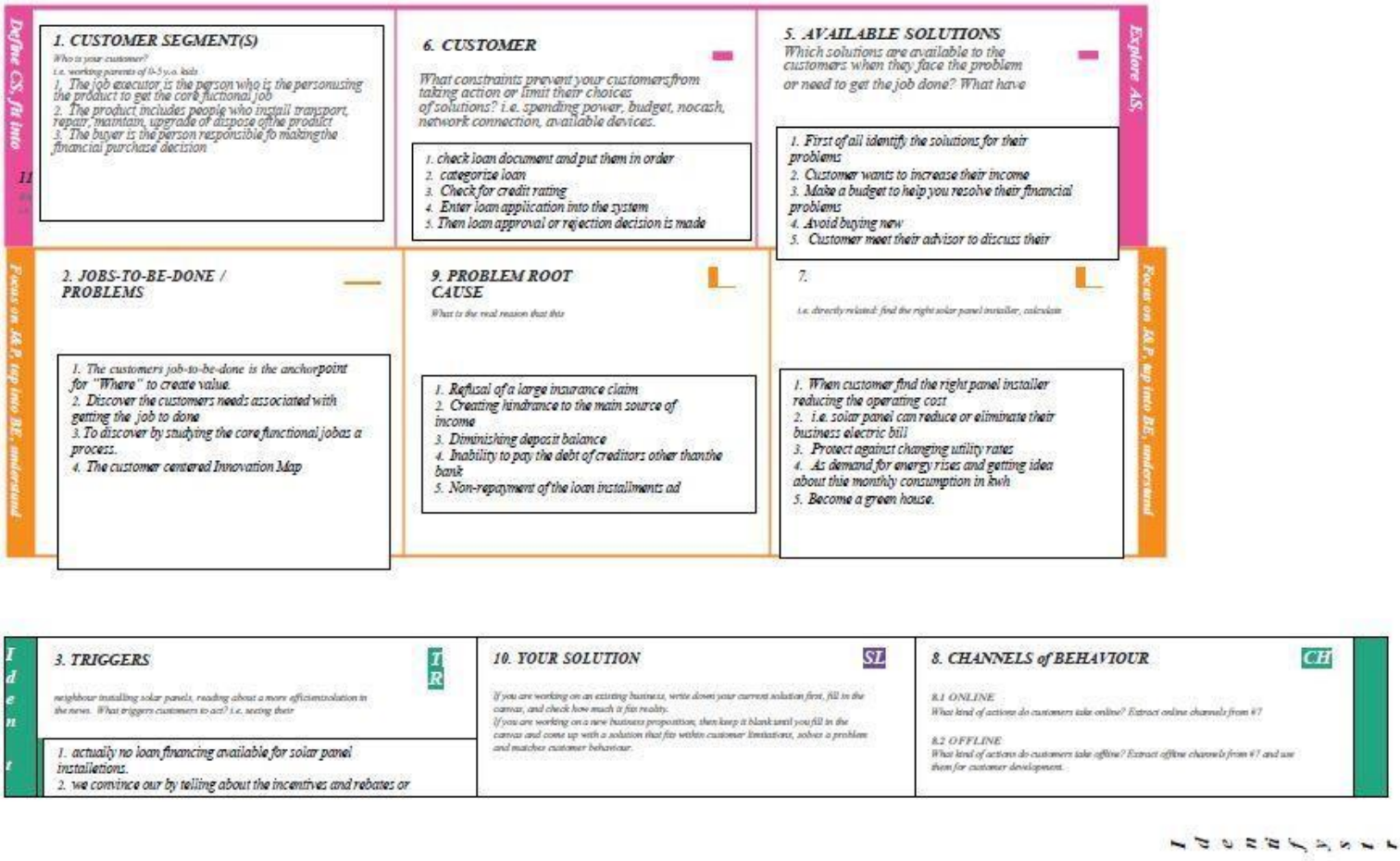


Fig. 3 Problem Solution Fit

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

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	User Application	Filling of application Modification of application Verification of application
FR-4	Loan Issuance	Checking status of loan Loan Approval Loan Rejection
FR-5	Credit history analysis	Credit score auditing Income auditing
FR-6	User management	Choosing appropriate loan program for users Categorising users according to credit history.

4.2 NON- FUNCTIONAL REQUIREMENTS

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Simple and understandable UI. Easy to navigate Smooth and seamless Easy to comprehend
NFR-2	**Security**	Restricted access to data. Login verification Registration verification Upholding privacy of user
NFR-3	**Reliability**	Backup to prevent data loss Negation of data loss due to lag.
NFR-4	**Performance**	Web based application. Requires minimum Intel Pentium 4 processor, 4 GB RAM, 1280x1024 screen with application window size 1024x680
NFR-5	**Availability**	Platform independent support.
NFR-6	**Scalability**	Can operate efficiently across multiple devices with varying hardware and software

		specifications.

PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

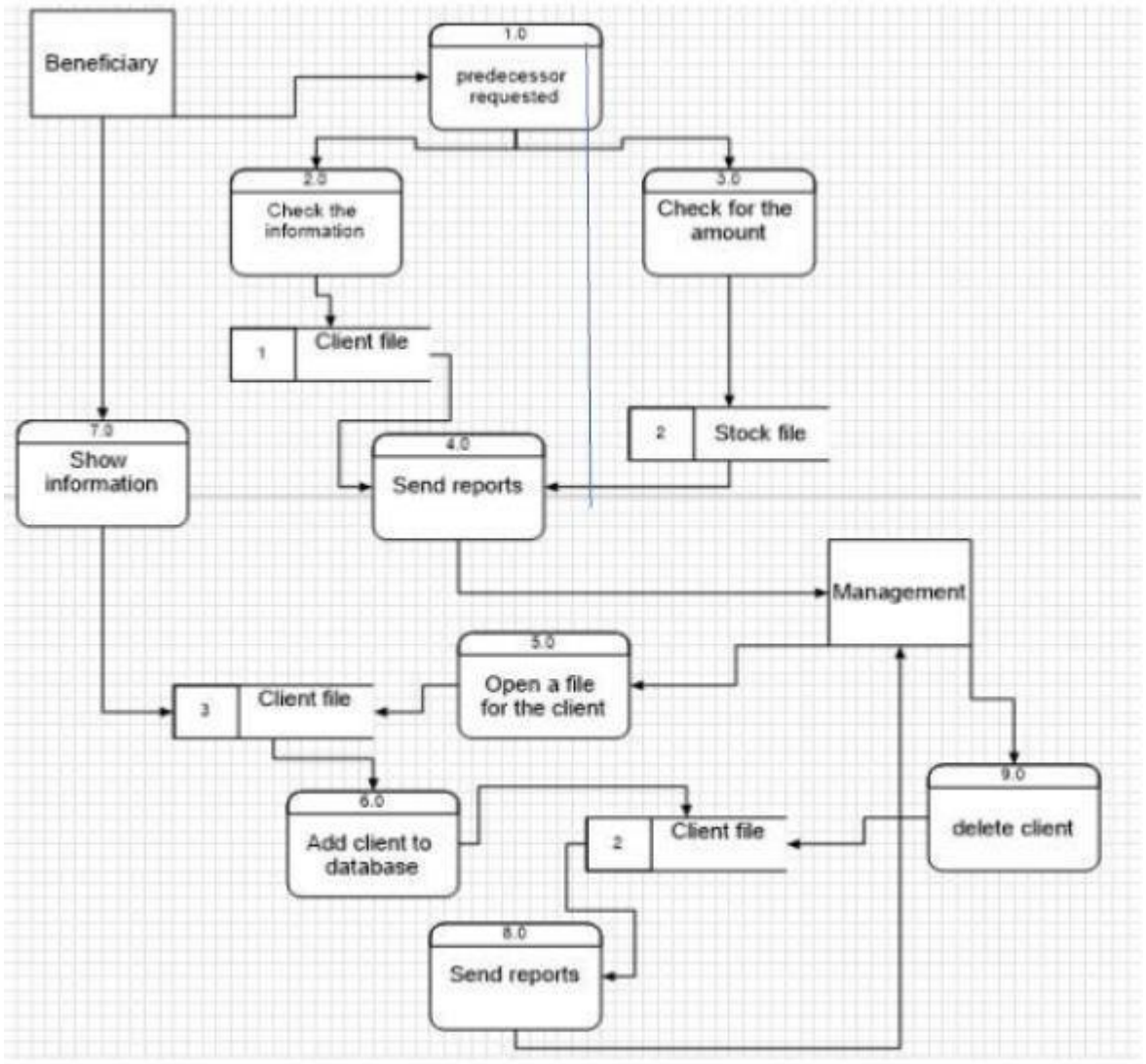


Fig. 4 Data Flow DIagram

5.2 SOLUTION AND TECHNICAL ARCHITECTURE

An application should be developed which is able to take the details of the loan applicant, store them and utilize a machine learning model to predict the eligibility for loan approval based on the user application details and credit history. The user should be able to know his/her eligibility upon giving the required details to the application.

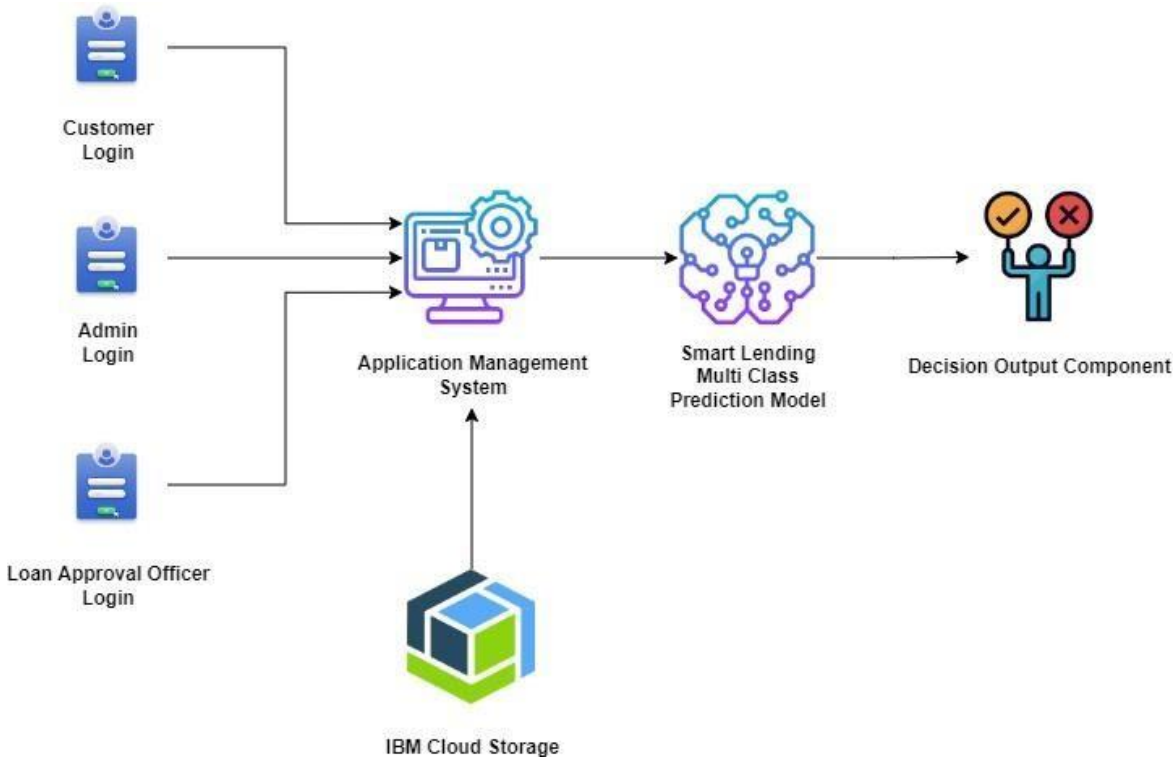


Fig. 5 Solution Architecture

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-1
		USN-4	As a user, I can register for the application through Gmail	I can receive confirmation email & click confirm	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	Able to login	High	Sprint-1
	Dashboard	USN-6	As a user, I should be able to access the dashboard with everything I am allowed to use.	Access the dashboard	Medium	Sprint-1
Customer (Web user)	Registration	USN-7	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-8	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-9	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-1
		USN-10	As a user, I can register for the application through Gmail	I can receive confirmation email & click confirm	Medium	Sprint-1
	Login	USN-11	As a user, I can log into the application by entering email & password	Able to login	High	Sprint-1
	Dashboard	USN-12	As a user, I should be able to access the dashboard with everything I am allowed to use.	Access the dashboard	Medium	Sprint-1

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Loan Approval Officer	Register	USN-13	As a loan approval officer, I should be able to register myself as one using unique email and password.	I can access my account	Medium	Sprint-2
	Login	USN-14	As a loan approval officer I should be able to login myself as one using unique email and password.	Access loan approval dashboard	Medium	Sprint-2
	Automated analysis of credit history	USN-15	As a loan approval officer, I can access the dashboard where I feed application for loan prediction.	I can access the dashboard for loan application prediction.	High	Sprint-3
		USN-16	As a loan approval officer, I can get a decision followed by some details for the decision when I feed an application for loan prediction.	Get a decision for loan prediction with details regarding the decision.	High	Sprint-3
Admin	Register	USN-17	As an admin, I should be able to register myself as one using unique email and password.	I can access my account	Medium	Sprint-4
	Login	USN-18	As an admin I should be able to login myself as one using unique email and password.	Able to login	Medium	Sprint-4
	Dashboard	USN-19	As a admin, I should be able to access the dashboard with everything I am allowed to use.	Access the dashboard	Medium	Sprint-4

PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

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.	3	High	Manikandan Manikandan Parthiban prakash
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	3	High	Manikandan Manikandan Parthiban Prakash
Sprint-1		USN-3	As a user, I can register for the application through Facebook	1	Low	Manikandan Manikandan Parthiban Prakash
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	Manikandan Manikandan Parthiban Prakash
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	3	High	Manikandan Manikandan Parthiban Prakash
Sprint-1	Dashboard	USN-6	As a user, I should be able to access the dashboard with everything I am allowed to use.	2	Medium	Manikandan Manikandan Parthiban Prakash
Sprint-1	Registration	USN-7	As a user, I can register for the application by entering my email, password, and confirming my password.	3	High	Manikandan Manikandan Parthiban Prakash
Sprint-1		USN-8	As a user, I will receive confirmation email once I have registered for the application	3	High	Manikandan Manikandan Parthiban Prakash
Sprint-1		USN-9	As a user, I can register for the application through Facebook	1	Low	Manikandan Manikandan Parthiban Prakash
Sprint-1		USN-10	As a user, I can register for the application through Gmail	2	Medium	Manikandan Manikandan Parthiban Prakash
Sprint-1	Login	USN-11	As a user, I can log into the application by entering email & password	3	High	Manikandan Manikandan Parthiban Prakash

Sprint-1	Dashboard	USN-12	As a user, I should be able to access the dashboard with everything I am allowed to use.	2	Medium	Manikandan Manikandan Parthiban Prakash

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Register	USN-13	As a loan approval officer, I should be able to register myself as one using unique email and password.	5	Medium	Manikandan Manikandan Parthiban Prakash
Sprint-2	Login	USN-14	As a loan approval officer I should be able to login myself as one using unique email and password.	5	Medium	Manikandan Manikandan Parthiban Prakash
Sprint-3	Automated analysis of credit history	USN-15	As a loan approval officer, I can access the dashboard where I feed application for loan prediction.	10	High	Manikandan Manikandan Parthiban Prakash
Sprint-3		USN-16	As a loan approval officer, I can get a decision followed by some details for the decision when I feed an application for loan prediction.	15	High	Manikandan Manikandan Parthiban Prakash
Sprint-4	Register	USN-17	As an admin, I should be able to register myself as one using unique email and password.	2	Medium	Manikandan Manikandan Parthiban Prakash
Sprint-4	Login	USN-18	As an admin I should be able to login myself as one using unique email and password.	2	Medium	Manikandan Manikandan Parthiban Prakash
Sprint-4	Dashboard	USN-19	As a admin, I should be able to access the dashboard with everything I am allowed to use.	2	Medium	Manikandan Manikandan Parthiban Prakash

6.1 SPRINT DELIVERY SCHEDULE

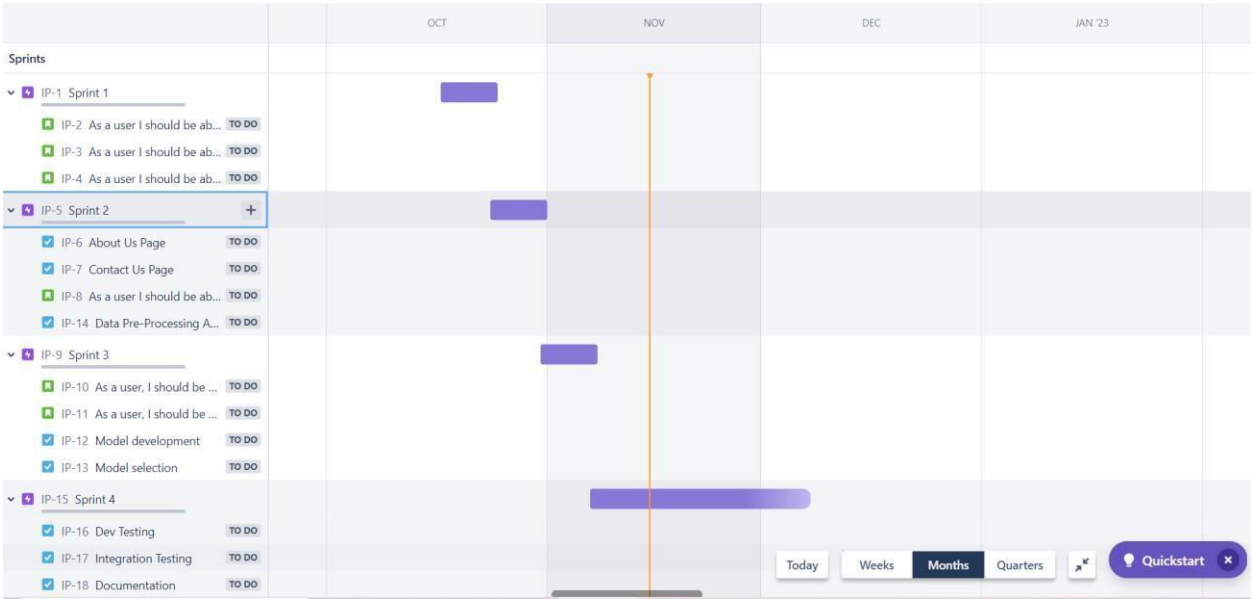


Fig. 6 Sprint Delivery Schedule

6.2 REPORTS FROM JIRA

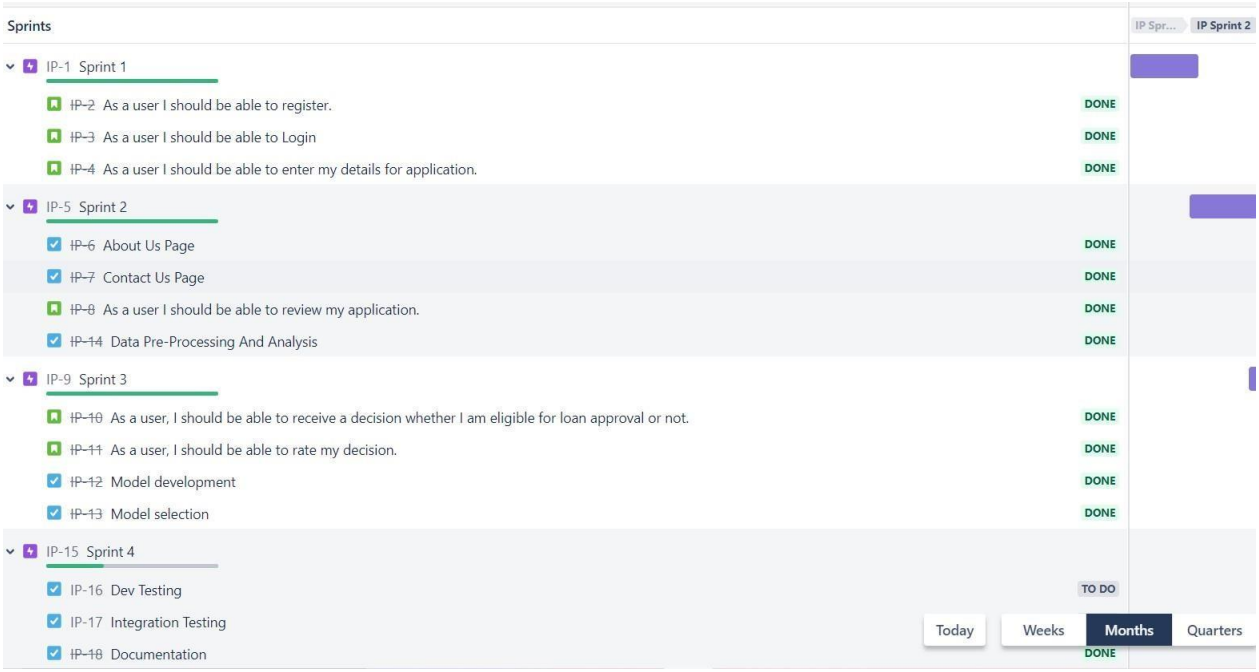


Fig. 7 Project Report

CODING AND SOLUTIONING

7.1 FEATURE 1-SIGN UP

Register.html

```
<!DOCTYPE html>

<html lang="en">

<head>

   <title>Register</title>

   <link rel="stylesheet" type="text/css"
href="https://stackpath.bootstrapcdn.com/bootstrap/4.4.1/css/bootstrap.min.css">

   <link rel="stylesheet" type="text/css" href="static/register.css">

   <script >

function check(x)

{
```

```
  var number=/^([0-9]{10})+$/;
   if(x.value.match(number)){
      alert("Valid email address!");
      document.myform.mon.focus();
      return true;

   }
   else{
      alert("Please enter only your 10 digit mobile number");
      document.myform.mon.focus();
      return false;

   }

}
function ValidateEmail(input) {
```

```
var validRegex = /^[a-zA-Z0-9.!#$%&'*+/=?^_`{|}~-]+@[a-zA-Z0-9-]+(?:\.[a-zA-Z0-9-]+)*$/;

if (input.value.match(validRegex)) {

alert("Valid email address!");

document.myform.email.focus();

return true;

} else {

alert("Invalid email address!");

document.myform.email.focus();
```

```
return false;



}

 }



   </script>



</head>

<body>



   <div class="container">

      <form name="myform" method="post" class="form-signup" onsubmit="return
check(document.myform.mon)" onsubmit="return
ValidateEmail(document.myform.email)">

         <h1 class="reg">Register</h1>

         <p>Create your account</p>
```

```
<div class="form-group">
    <input type="text" class="form-control" name="name" placeholder="Enter your name" required >
</div>

<div class="form-group">
    <input type="email" class="form-control" name="email" placeholder="Enter your emailID" required>
</div>

<div class="form-group">
    <input type="user name" class="form-control" name="username" placeholder="Enter your username" required>

</div>
<div class="form-group">
```

```
        <input type="password" class="form-control" name="password"
placeholder="Enter your password" required>


    </div>


    <div class="form-group">
        <input type="text" class="form-control" name="mon" placeholder="Enter your
mobile number" required >


    </div>
    <div class="form-group">
      <label>
      <input type="checkbox">
      I accept the <a href="terms.html">Terms and conditions</a>
      </label>


    </div>
```

```
        <input type="submit" class="btn btn-success btn-block" name="" value="submit">




      </form>

   </div>



</body>

</html>
```

7.2 FEATURE 2-LOGIN

Login.html

```
<!DOCTYPE html>

<html>

<head>

        <title>LogIn Page</title>

        <link rel="stylesheet"
href="https://cdn.jsdelivr.net/npm/bootstrap@4.5.3/dist/css/bootstrap.min.css"
integrity="sha384-
```

```
TX8t27EcRE3e/ihU7zmQxVncDAy5uIKz4rEkgIXeMed4M0jlfIDPvg6uqKI2xXr2"
crossorigin="anonymous">
</head>
<style>
  .group{
     padding-top: 100px;
  }
</style>
<body>
  <div class="container">
       <div class="row">
            <div style="width: 40%; margin: 25px auto;">
       <div class="group">
            <h3 style="text-align: center;">Login Page</h3>
            <form action="login1.php" method="POST" >
                 <div class="form-group">
```

```
                    <label>UserName:</label><input type="text"
name="username" class="form-control" autofocus placeholder="Enter your username or
gmail ID" required="">
                </div>
                <div class="form-group">
                    <label>Password:</label><input type="Password"
name="password" class="form-control" autofocus placeholder="Password" required="">
                </div>

    <label>Enter Captcha:</label>
    <div class="form-row">
     <div class="form-group col-md-6">
      <input type="text" class="form-control" readonly id="capt" required="">
     </div>
     <div class="form-group col-md-6">
      <input type="text" class="form-control" id="textinput" required="">
     </div>
```

```
    </div>


        <div class="form-group">
<button onclick="validcap()" name="save" class="btn btn-lg btn-success btn-block"
>Submit</button>
                        </div>
                </form>
   <h6>Captcha not visible <img src="refresh.png" width="40px" onclick="cap()"></h6>
   <p>New Here?<a href="register.html">Register</a> </p>
        </div>
        </div>
</div>
</div>
<script type="text/javascript">
 function cap(){
   var alpha = ['A','B','C','D','E','F','G','H','I','J','K','L','M','N','O','P','Q','R','S','T','U','V'
          ,'W','X','Y','Z','1','2','3','4','5','6','7','8','9','0','a','b','c','d','e','f','g','h','i',
```

```
 'j','k','l','m','n','o','p','q','r','s','t','u','v','w','x','y','z', '!','@','#','$','%','^','&','*','+'];

 var a = alpha[Math.floor(Math.random()*71)];

 var b = alpha[Math.floor(Math.random()*71)];

 var c = alpha[Math.floor(Math.random()*71)];

 var d = alpha[Math.floor(Math.random()*71)];

 var e = alpha[Math.floor(Math.random()*71)];

 var f = alpha[Math.floor(Math.random()*71)];


 var final = a+b+c+d+e+f;

 document.getElementById("capt").value=final;

}

function validcap(){

 var stg1 = document.getElementById('capt').value;

 var stg2 = document.getElementById('textinput').value;

 if(stg1==stg2){

 // alert("Form is validated Succesfully");
```

```
            return true;
          }else{
            alert("Please enter a valid captcha");
            return false;
          }
        }
</script>
</body>
<script src="https://code.jquery.com/jquery-3.5.1.slim.min.js" integrity="sha384-DfXdz2htPH0lsSSs5nCTpuj/zy4C+OGpamoFVy38MVBnE+IbbVYUew+OrCXaRkfj" crossorigin="anonymous"></script>
<script src="https://cdn.jsdelivr.net/npm/bootstrap@4.5.3/dist/js/bootstrap.bundle.min.js" integrity="sha384-ho+j7jyWK8fNQe+A12Hb8AhRq26LrZ/JpcUGGOn+Y7RsweNrtN/tE3MoK7ZeZDyx" crossorigin="anonymous"></script>
</html>
```

7.3 FEATURE 3 – BANK LOGIN

Bank login.html

```
<!DOCTYPE html>

<html>

<head>

        <title>LogIn Page</title>

        <link rel="stylesheet"
href="https://cdn.jsdelivr.net/npm/bootstrap@4.5.3/dist/css/bootstrap.min.css"
integrity="sha384-
TX8t27EcRE3e/ihU7zmQxVncDAy5uIKz4rEkgIXeMed4M0jlfIDPvg6uqKI2xXr2"
crossorigin="anonymous">

</head>

<style>

   .group{

      padding-top: 100px;

   }

</style>
```

```
<body>

<div class="container">
        <div class="row">
                <div style="width: 40%; margin: 25px auto;">
        <div class="group">
                <h3 style="text-align: center;">Bank Login Page</h3>
                <form method="POST" action="bank1.php">
                        <div class="form-group">
                                <label>Bank user ID:</label><input type="text"
name="BankUserName" class="form-control" autofocus placeholder="Enter the Bank User
ID" required>
                        </div>
                        <div class="form-group">
```

<label>Bank Email ID:</label><input type="email" name="bankemail" class="form-control" autofocus placeholder="Enter the Bank Email ID" required>

<label>Password:</label><input type="Password" name="Password" class="form-control" autofocus placeholder="Password" required>

<label>Enter Captcha:</label>

<input type="text" class="form-control" readonly id="capt" required>

<input type="text" class="form-control" id="textinput" required>

```
    </div>


        <div class="form-group">

                                    <button onclick="validcap()" name="Submit" class="btn btn-lg
btn-success btn-block">Submit</button>

                            </div>

                    </form>

   <h6>Captcha not visible <img src="refresh.png" width="40px" onclick="cap()"></h6>



        </div>

        </div>

</div>

</div>

<script type="text/javascript">

  function cap(){

    var alpha = ['A','B','C','D','E','F','G','H','I','J','K','L','M','N','O','P','Q','R','S','T','U','V'

            ,'W','X','Y','Z','1','2','3','4','5','6','7','8','9','0','a','b','c','d','e','f','g','h','i',
```

```
 'j','k','l','m','n','o','p','q','r','s','t','u','v','w','x','y','z', '!','@','#','$','%','^','&','*','+'];

 var a = alpha[Math.floor(Math.random()*71)];

 var b = alpha[Math.floor(Math.random()*71)];

 var c = alpha[Math.floor(Math.random()*71)];

 var d = alpha[Math.floor(Math.random()*71)];

 var e = alpha[Math.floor(Math.random()*71)];

 var f = alpha[Math.floor(Math.random()*71)];


 var final = a+b+c+d+e+f;

 document.getElementById("capt").value=final;

}

function validcap(){

 var stg1 = document.getElementById('capt').value;

 var stg2 = document.getElementById('textinput').value;

 if(stg1==stg2){

  alert("Form is validated Succesfully");
```

```
            return true;
          }else{
            alert("Please enter a valid captcha");
            return false;
          }
        }
</script>
</body>
<script src="https://code.jquery.com/jquery-3.5.1.slim.min.js" integrity="sha384-DfXdz2htPH0lsSSs5nCTpuj/zy4C+OGpamoFVy38MVBnE+IbbVYUew+OrCXaRkfj" crossorigin="anonymous"></script>
<script src="https://cdn.jsdelivr.net/npm/bootstrap@4.5.3/dist/js/bootstrap.bundle.min.js" integrity="sha384-ho+j7jyWK8fNQe+A12Hb8AhRq26LrZ/JpcUGGOn+Y7RsweNrtN/tE3MoK7ZeZDyx" crossorigin="anonymous"></script>
</html>
```

7.4 FEATURE 4 – LOAN APPROVAL OR REJECTION

Approve.html

```
<!DOCTYPE html>

<html lang="en" dir="ltr">

 <head>

  <meta charset="utf-8">

  <title>Loan approva status</title>

  <link rel="stylesheet" href="static/approve.css">

  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/5.15.3/css/all.min.css"/>

 </head>

 <body>

  <h1>LOAN APPROVAL STATUS</h1>

  <h2>{{prediction_text}}</h2>

  <img src="static/approve.jpg" width="150px" height="150px">

  <h3>Please provide your feedback</h3>

  <div class="container">
```

```
<div class="post">
  <div class="text">Thanks for rating us!</div>
  <div class="edit">EDIT</div>
</div>
<div class="star-widget">
  <input type="radio" name="rate" id="rate-5">
  <label for="rate-5" class="fas fa-star"></label>
  <input type="radio" name="rate" id="rate-4">
  <label for="rate-4" class="fas fa-star"></label>
  <input type="radio" name="rate" id="rate-3">
  <label for="rate-3" class="fas fa-star"></label>
  <input type="radio" name="rate" id="rate-2">
  <label for="rate-2" class="fas fa-star"></label>
  <input type="radio" name="rate" id="rate-1">
  <label for="rate-1" class="fas fa-star"></label>
```

```
  <form action="#">
    <header></header>
    <div class="textarea">
      <textarea cols="30" placeholder="Describe your experience.."></textarea>
    </div>
    <div class="btn">
      <button type="submit">Post</button>
    </div>
  </form>
 </div>
</div>
<script>
 const btn = document.querySelector("button");
 const post = document.querySelector(".post");
 const widget = document.querySelector(".star-widget");
 const editBtn = document.querySelector(".edit");
```

```
    btn.onclick = ()=>{
      widget.style.display = "none";
      post.style.display = "block";
      editBtn.onclick = ()=>{
      widget.style.display = "block";
      post.style.display = "none";
      }
      return false;
    }
  </script>
 </body>
</html>
```

Reject.html

```
<!DOCTYPE html>
<html lang="en" dir="ltr">
 <head>
```

```
    <meta charset="utf-8">
    <title>Loan approval status</title>
    <link rel="stylesheet" href="static/reject.css">
    <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.15.3/css/all.min.css"/>
  </head>
  <body>
    <h1>LOAN APPROVAL STATUS</h1>
    <h2>{{prediction_text}}</h2>
    <img src="static/reject.jpg" width="200px" height="200px">
    <h3>Please provide your feedback</h3>
    <div class="container">

      <div class="post">
        <div class="text">Thanks for rating us!</div>
        <div class="edit">EDIT</div>
      </div>
```

```
<div class="star-widget">
 <input type="radio" name="rate" id="rate-5">
 <label for="rate-5" class="fas fa-star"></label>
 <input type="radio" name="rate" id="rate-4">
 <label for="rate-4" class="fas fa-star"></label>
 <input type="radio" name="rate" id="rate-3">
 <label for="rate-3" class="fas fa-star"></label>
 <input type="radio" name="rate" id="rate-2">
 <label for="rate-2" class="fas fa-star"></label>
 <input type="radio" name="rate" id="rate-1">
 <label for="rate-1" class="fas fa-star"></label>
 <form action="#">
  <header></header>
  <div class="textarea">
   <textarea cols="30" placeholder="Describe your experience.."></textarea>
  </div>
```

```
    <div class="btn">
      <button type="submit">Post</button>
    </div>
   </form>
  </div>
</div>
<script>
  const btn = document.querySelector("button");
  const post = document.querySelector(".post");
  const widget = document.querySelector(".star-widget");
  const editBtn = document.querySelector(".edit");
  btn.onclick = ()=>{
    widget.style.display = "none";
    post.style.display = "block";
    editBtn.onclick = ()=>{
    widget.style.display = "block";
```

```
        post.style.display = "none";
      }
      return false;
    }
  </script>
 </body>
</html>
```

Prediction.html

```
<!doctype html>
<html lang="en">
 <head>
  <!-- Required meta tags -->
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
```

```
    <!-- Bootstrap CSS -->

    <link rel="stylesheet" href="static/prediction.css">

    <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.0.0-
beta3/dist/css/bootstrap.min.css" rel="stylesheet" integrity="sha384-
eOJMYsd53ii+scO/bJGFsiCZc+5NDVN2yr8+0RDqr0Ql0h+rP48ckxlpbzKgwra6"
crossorigin="anonymous">

    <link href="https://unpkg.com/tailwindcss@^2/dist/tailwind.min.css" rel="stylesheet">



    <title>prediction</title>

  </head>

  <body>

    <script>

      function valid(){

      var Ai=document.getElementById("ApplicantIncome").value;

      var Co=document.getElementById("CoapplicantIncome").value;

      var LA=document.getElementById("LoanAmount").value;

      var LT=document.getElementById("Loan_Amount_Term").value;
```

```
if(Ai > 10000000000000000000000000000000000000){
  alert("Applicant income is too large enter a valid number")
  return false;
}
if(Co > 10000000000000000000000000000000000000){
  alert("Coapplicant income is too large enter a valid number")
  return false;
}
if(LA > 10000000000000000000000000000000000000){
  alert("Loan Amount is too large enter a valid number")
  return false;
}
if(LT > 10000000000000000000000000000000000000){
  alert("loan amount term is too large enter a valid number")
  return false;
}
```

```
var name=document.getElementById("Name").value;

var letters=/^[a-zA-Z]*$/;

if(!name.match(letters)){

  alert("Name must contain only alphabets")

  return false;

}

var num=/^[0-9]+$/;

if(!Ai.match(num)){

  alert("Enter only valid numbers alphabets are not allowed ")

  return false;

}

if(!Co.match(num)){

  alert("Enter only valid numbers alphabets are not allowed ")

  return false;

}

if(!LA.match(num)){
```

```
  alert("Enter only valid numbers alphabets are not allowed ")
  return false;
 }
 if(!LT.match(num)){
  alert("Enter only valid numbers alphabets are not allowed ")
  return false;
 }
 var mo=document.getElementById("mon").value;
 var mn=/^[0-9]{10}$/;
 if(!mo.match(mn)){
  alert("Please enter only 10 digit mobile number")
  return false;
 }

}
</script>
```

```
<section class="text-gray-600 body-font">

<div class="container px-5 py-24 mx-auto">

 <div class="flex flex-col text-center w-full mb-20">



  <h1 class="Heading">LOAN ELIGIBILITY PREDICTION</h1><br>

  <p class="fill">Fill the form for prediction</p>

 </div>

 <div>



 </div>

 <div class="mb-3">

 <a class="btn btn-primary" href="./" id="back" role="button">Back</a></div>



<form action='/prediction.html' method="post" onsubmit="return valid()">

 <div class="mb-3">

  <label for="exampleFormControlInput1" class="form-label">Name</label>
```

```
      <input type="text" class="form-control" id="Name" name="Name" placeholder="Enter your Name" required >
   </div>
   <div class="mb-3">
     <label for="exampleFormControlInput1" class="form-label"> Email ID</label>
     <input type="email" class="form-control" id="email" name="email" placeholder="Enter your Email ID" required >
  </div>
  <div class="mb-3">
    <label for="exampleFormControlInput1" class="form-label">Mobile Number</label>
    <input type="text" class="form-control" id="mon" name="mon" placeholder="Enter your Mobile number" required>
</div>
<div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label"> Gender</label>
  <select class="form-select" id="gender" name="gender" aria-label="Default select example" required >
```

```
  <option selected>-- select gender --</option>
  <option value="Male">Male</option>
  <option value="Female">Female</option>
</select>
</div>
<div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label"> Married status</label>
  <select class="form-select" id="married" name="married" aria-label="Default select
example" required >
  <option selected>-- select married status --</option>
  <option value="Yes">Yes</option>
  <option value="No">No</option>
</select>
</div>
<div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Dependents</label>
```

```
 <select class="form-select" id="dependents" name="dependents" aria-label="Default
select example" required>
 <option selected>-- select dependents --</option>
 <option value="0">0</option>
 <option value="1">1</option>
 <option value="2">2</option>
 <option value="3+">3+</option>
</select>
</div>
<div class="mb-3">
 <label for="exampleFormControlInput1" class="form-label">Education</label>
 <select class="form-select" id="education" name="education" aria-label="Default select
example" required>
 <option selected>-- select education --</option>
 <option value="Graduate">Graduate</option>
 <option value="Not Graduate">Not Graduate</option>
</select>
```

```
</div>

<div class="mb-3">

 <label for="exampleFormControlInput1" class="form-label">Self_Employed</label>

 <select class="form-select" id="employed" name="employed" aria-label="Default select example" required>

 <option selected>-- select Self_Employed --</option>

 <option value="Yes">Yes</option>

 <option value="No">No</option>

</select>

</div>

<div class="mb-3">

 <label for="exampleFormControlInput1" class="form-label">Credit_History</label>

 <select class="form-select" id="credit" name="credit" aria-label="Default select example" required >

 <option selected >-- select Credit_History --</option>

 <option value="Yes">Yes</option>

 <option value="No">No</option>
```

```
</select>

</div>

<div class="mb-3">

  <label for="exampleFormControlInput1" class="form-label">Property_Area</label>

  <select class="form-select" id="proparea" name="proparea" aria-label="Default select example" required>

  <option selected>-- select Property_Area --</option>

  <option value="Semiurban">Semiurban</option>

  <option value="Urban">Urban</option>

  <option value="Rural">Rural</option>

</select>

</div>

<div class="mb-3">

  <label for="exampleFormControlInput1" class="form-label">Enter ApplicantIncome</label>
```

```
 <input type="text" class="form-control" id="ApplicantIncome" name="ApplicantIncome"
placeholder="ApplicantIncome" required>



</div>

<div class="mb-3">

 <label for="exampleFormControlInput1" class="form-label">Enter
CoapplicantIncome</label>

 <input type="text" class="form-control" id="CoapplicantIncome"
name="CoapplicantIncome" placeholder="CoapplicantIncome" required>

</div>

<div class="mb-3">

 <label for="exampleFormControlInput1" class="form-label">Purpose of loan</label>

 <select class="form-select" id="pur" name="pur" aria-label="Default select example"
required>

 <option selected>-- select the purpose of loan --</option>

 <option value="person">Personal loan</option>

 <option value="Bussiness">Bussiness loan</option>
```

```
 <option value="Education">Education loan</option>
 <option value="Home">Home loan</option>
 <option value="Other">other</option>
</select>
</div>
<div class="mb-3">
 <label for="exampleFormControlInput1" class="form-label">Enter LoanAmount</label>
 <input type="text" class="form-control" id="LoanAmount" name="LoanAmount"
placeholder="LoanAmount" required>
</div>
<div class="mb-3">
 <label for="exampleFormControlInput1" class="form-label">Enter
Loan_Amount_Term</label>
 <input type="text" class="form-control" id="Loan_Amount_Term"
name="Loan_Amount_Term" placeholder="Loan_Amount_Term" required>
</div>
<div class="mb-3">
```

```
 <label for="exampleFormControlInput1" class="form-label">Enter Adhar
Number</label>

 <input type="text" class="form-control" id="Adhar" name="Adhar" placeholder="Adhar
Number" required >

</div>

<div class="mb-3">

 <label for="exampleFormControlInput1" class="form-label">Enter PAN card ID</label>

 <input type="text" class="form-control" id="PAN " name="PAN " placeholder="PAN card
ID" required>

</div>

<div class="mb-3">

<label for="property document" class="form-label">Property
Document</label><br><input type="file" required >

</div>

<div class="mb-3">

<label for="Govt ID proof" class="form-label">Govet ID proof</label><br><input
type="file" required>

</div>
```

```
<div class="mb-3">
  <input type="checkbox" required>
  I accept the <a href="terms.html">Terms and conditions</a>
  </div>
<br><br>
<div class="mb-3">
<input type="submit" class="but" value="PREDICT">
</div>
    </form>




  </div>
</section>
    <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.0.0-
beta3/dist/js/bootstrap.bundle.min.js" integrity="sha384-
JEW9xMcG8R+pH31jmWH6WWP0WintQrMb4s7ZOdauHnUtxwoG2vI5DkLtS3qm9Ekf"
crossorigin="anonymous"></script>
```

```
 </body>

</html>
```

Model.ipynb

```
import numpy as np

import pandas as pd

import pickle

import seaborn as sns

import matplotlib.pyplot as plt

%matplotlib inline

import sklearn

from sklearn.preprocessing import LabelEncoder

from sklearn.tree import DecisionTreeClassifier

from sklearn.ensemble import RandomForestClassifier

from sklearn.neighbors import KNeighborsClassifier

from xgboost import XGBClassifier
```

```
from sklearn.ensemble import RandomForestClassifier

import imblearn

from imblearn.under_sampling import RandomUnderSampler

from sklearn.model_selection import train_test_split

from sklearn.preprocessing import scale

from sklearn.preprocessing import  MaxAbsScaler

from sklearn.metrics import accuracy_score,classification_report,confusion_matrix,f1_score



## Reading The Dataset

df=pd.read_csv('Loan_dataset.csv')

df

df.head()

df.info()

df.shape

df=df.drop(columns=["Loan_ID"],axis=1)

## Uni-Variate Analysis
```

```
sns.distplot(df.ApplicantIncome)

sns.countplot(df.Property_Area)

sns.countplot(df.Gender)

sns.countplot(df.Education)

sns.countplot(df.Self_Employed)

sns.countplot(df.Married)

sns.histplot(df.LoanAmount)

sns.displot(df.CoapplicantIncome)

plt.pie(df.Property_Area.value_counts(),[0,0,0],labels=['Semi urban','Urban','Rural'])

## Bivariate Analysis

sns.countplot(df['Married'],hue=df['Gender'])

sns.countplot(df['ApplicantIncome'],hue=df['CoapplicantIncome'])

sns.countplot(df['LoanAmount'],hue=df['Property_Area'])

sns.countplot(df['Education'],hue=df['Self_Employed'])

sns.barplot(df.ApplicantIncome,df.CoapplicantIncome)

sns.countplot(df['LoanAmount'],hue=df['Loan_Amount_Term'])
```

```
plt.scatter(df.ApplicantIncome,df.LoanAmount)

sns.countplot(df['Dependents'],hue=df['Gender'])

## Multi variate Analysis

sns.heatmap(df.corr(),annot=True)

plt.plot(df.LoanAmount,df.Loan_Amount_Term,df.ApplicantIncome)

df.plot.line()

df.hist()

plt.plot(df.LoanAmount,df.ApplicantIncome,df.CoapplicantIncome)

plt.plot(df.Loan_Amount_Term,df.ApplicantIncome,df.CoapplicantIncome)

## Descriptive Analysis

df.describe()

df.std()

df.mean()

df.mode()

## Data Pre-Processing

## Check for Null Values
```

```
df.isnull().any()

df.isnull().sum()

df['LoanAmount']=df['LoanAmount'].fillna(df['LoanAmount'].mean())

df['Loan_Amount_Term']=df['Loan_Amount_Term'].fillna(df['Loan_Amount_Term'].mean())

df['Credit_History']=df['Credit_History'].fillna(df['Credit_History'].mean())

df['Gender']=df['Gender'].fillna(df['Gender'].mode()[0])

df['Married']=df['Married'].fillna(df['Married'].mode()[0])

df['Dependents']=df['Dependents'].fillna(df['Dependents'].mode()[0])

df['Self_Employed']=df['Self_Employed'].fillna(df['Self_Employed'].mode()[0])

df.isnull().any()

df.isnull().sum()

## Handling Categorical Values

df.head()

le=LabelEncoder()

df.Gender=le.fit_transform(df.Gender)

df.Married=le.fit_transform(df.Married)
```

```
df.Education=le.fit_transform(df.Education)

df.Self_Employed=le.fit_transform(df.Self_Employed)

df.Property_Area=le.fit_transform(df.Property_Area)

df.Loan_Status=le.fit_transform(df.Loan_Status)

df.Dependents=le.fit_transform(df.Dependents)

df.head()

## Spliting into dependent and independent data

df.head()

x=df.iloc[:,:-1]

y=df.Loan_Status

x.head()

y.head()

## Scaling The Data

scaler = MaxAbsScaler()

x_sc=scaler.fit_transform(x)

x_sc
```

```
## Balancing The Dataset

sns.countplot(df.Loan_Status)

rus=RandomUnderSampler(sampling_strategy=1)

x_res,y_res=rus.fit_resample(x,y)

ax=y_res.value_counts().plot.pie(autopct='%.2f')

_=ax.set_title("under-sampling")

## Splitting Data Into Train and Test

xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.3,random_state=10)

xtrain.head()

xtest.head()

ytrain.head()

ytest.head()

xtrain.shape

xtest.shape

ytrain.shape

ytest.shape
```

```
## Model Building

## Decision Tree Model

dmodel=DecisionTreeClassifier(random_state=100)

dmodel.fit(x_res,y_res)

ypredd=dmodel.predict(xtest)

ypred2d=dmodel.predict(xtrain)

## Random Forest Model

Rmodel=RandomForestClassifier(n_estimators=100,max_depth=12,max_features=3)

Rmodel.fit(x_res,y_res)

ypredR=Rmodel.predict(xtest)

ypred2R=Rmodel.predict(xtrain)

## KNN Model

kmodel=KNeighborsClassifier()

kmodel.fit(x_res,y_res)

ypredk=kmodel.predict(xtest)

ypred2k=kmodel.predict(xtrain)
```

```
## Xgboost Model

xmodel=XGBClassifier(eval_metric='mlogloss',n_estimators=100,random_state=100)

xmodel.fit(x_res,y_res)

ypredx=xmodel.predict(xtest)

ypred2x=xmodel.predict(xtrain)

## Compare The Model

print("Decision Tree Model Testing Accuracy")

print(accuracy_score(ytest,ypredd))

print("Decision Tree Model Training Accuracy")

print(accuracy_score(ytrain,ypred2d))

print("Random Forest Model Testing Accuracy")

print(accuracy_score(ytest,ypredR))

print("Random Forest Model Training Accuracy")

print(accuracy_score(ytrain,ypred2R))

print("KNN Model Testing Accuracy")

print(accuracy_score(ytest,ypredk))
```

```
print("KNN Model Training Accuracy")

print(accuracy_score(ytrain,ypred2k))

print("Xgboost Model Testing Accuracy")

print(accuracy_score(ytest,ypredx))

print("Xgboost Model Training Accuracy")

print(accuracy_score(ytrain,ypred2x))

## Evaluating Performance Of The Model And Saving The Model

## Random Forest Model is Selected

print("Random Forest Model Testing Accuracy")

print(accuracy_score(ytest,ypredR))

print("Random Forest Model Training Accuracy")

print(accuracy_score(ytrain,ypred2R))

y=Rmodel.predict([[1,1,1,1,0,4583.0,1508.0,128.0,360.0,1.0,0]])

print(y)

y1=Rmodel.predict([[1,0,0,0,0,5849,0.0,146.412162,360.0,1.0,2]])

print(y1)
```

```
y2=Rmodel.predict([[1,0,0,1,0,678,987,90,24,1.0,2]])

print(y2)

f1_score(ypredR,ytest,average='weighted')

pd.crosstab(ytest,ypredR)

print(classification_report(ypredR,ytest))
```

TESTING

8.1 TEST CASES

Test Case	Result
Verify user is able to see sign up page when user clicks sign up button from the navigation bar	Positive
Verify UI elements in sign up page	Positive
Verify user is able to register with valid details	Positive
Verify user is able to login with valid details	Positive
Verify user is able to provide application details	Positive
Verify UI elements in log in page	Positive
Verify UI elements in application page	Positive
Verify eligible user is getting loan approved	Positive
Verify ineligible user is getting loan rejected	Positive
Verify UI elements of predict page	Positive
Verify user is able to rate the decision	Positive
Verify user is able to submit feedback	Positive
Verify user is able to fill contact us details	Positive
Verify UI elements of feedback page	Positive
Verify UI elements of contact page	Positive
Verify UI elements of feedback page	Positive

8.2 USER ACCEPTANCE TESTING

Test Case ID	Feature Type	Component	Test Scenario	Steps To Execute
SignUpPage_TC_001	Feature	Sign up page	Verify user is able to see sign up page	1. Enter Url 2. Click sign up 3. Fill details
SignUpPage_TC_002	UI	Sign up page	Verify sign up page UI elements	1. Enter Url 2. Click sign up 3. Check UI elements match requirements.
LoginPage_TC_001	Feature	Login page	Verify user is able to see login page	1. Enter Url 2. Click login up 3. Fill details
LoginPage_TC_002	UI	Login page	Verify login page UI elements	1. Enter Url 2. Click login up 3. Check UI elements match requirements.
ApplicationPage_TC_001	Feature	Application page	Verify user is able to see application page	1. Enter Url 2. Click application 3. Fill details
ApplicationPage_TC_002	UI	Application page	Verify application page UI elements	1. Enter Url 2. Click application 3. Check UI elements match requirements.
PredictionPage_TC_001	Feature	Approve page	Verify user is able to see prediction approval page	1. Enter Url 2. Prediction 3. Check prediction
PredictionPage_TC_002	Feature	Reject page	Verify user is able to see prediction rejection page	1. Enter Url 2. Prediction 3. Check prediction
PredictionPage_TC_003	UI	Prediction page	Verify prediction page UI elements	1. Enter Url 2. Click predict 3. Check UI elements match requirements.
RatingPage_TC_001	Feature	Rating page	Verify user is able to see rating page	1. Enter Url 2. Prediction 3. Check prediction 4. Give Rating

RatingPage_TC_002	UI	Rating page	Verify rating page UI elements	1. Enter Url 2. Click predict 3. Check UI elements match requirements.
FeedbackPage_TC_001	Feature	Feedback page	Verify user is able to see feedback page	1. Enter Url 2. Go to feedback page 3. Fill details
FeedbackPage_TC_002	UI	Feedback page	Verify feedback page UI elements	1. Enter Url 2. Click feedback 3. Check UI elements match requirements.
ContactUsPage_TC_001	Feature	Contact us page	Verify user is able to see contact us page	1. Enter Url 2. Go to contact us page 3. Fill details
ContactUsPage_TC_002	UI	Contact us page	Verify contact us page UI elements	1. Enter Url 2. Click contact us 3. Check UI elements match requirements.

RESULTS

9.1 PERFORMANCE METRICS

There are numerous metrics used to assess the capability of a machine learning model. Precision, recall, fi-score, support, accuracy, macro average and weighted average have been used to assess the performance of the machine learning application.

Precision is one indicator of a machine learning model's performance – the quality of a positive prediction made by the model. Precision refers to the number of true

positives divided by the total number of positive predictions (i.e., the number of true positives plus the number of false positives). The recall is calculated as the ratio between the numbers of Positive samples correctly classified as Positive to the total number of Positive samples. The F1 score is defined as the harmonic mean of precision and recall.

Support may be defined as the number of samples of the true response that lies in each class of target values. Accuracy is one metric for evaluating classification models. It is the fraction of predictions our model got right. Macro average is the simple mean of scores of all classes. Weighted average or weighted sum ensemble is an ensemble machine learning approach that combines the predictions from multiple models, where the contribution of each model is weighted proportionally to its capability or skill.

```
print(classification_report(ypredR,ytest))
```

	precision	recall	f1-score	support
0	0.98	0.80	0.88	64
1	0.90	0.99	0.94	121
accuracy			0.92	185
macro avg	0.94	0.89	0.91	185
weighted avg	0.93	0.92	0.92	185

Fig. 8 Performance Metrics

ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES

- The process is now entirely automated.
- Process is streamlined and efficient.
- Prediction have a high degree of accuracy, avoiding errors.
- Predictions are swift and almost instant, reducing time taken to perform the eligibility process.
- Process is decentralized and economical.

10.2 DISADVANTAGES

- May give unexpected result for anomalous credit history.

CONCLUSION

Loan eligibility determination is a sensitive, vital yet cumbersome process. A lot of resources are drained to ensure the process is continuous without any interruption or error when done manually. With the help of machine learning, the entire process has been fully automated and made more resourceful, economical, convenient and efficient.

FUTURE SCOPE

- Decentralized integration with banks as an API service.
- Detection of loan frauds.

APPENDIX

13.1 SOURCE CODE

Register.html

```
<!DOCTYPE html>

<html lang="en">

<head>

   <title>Register</title>

   <link rel="stylesheet" type="text/css"
href="https://stackpath.bootstrapcdn.com/bootstrap/4.4.1/css/bootstrap.min.css">

   <link rel="stylesheet" type="text/css" href="static/register.css">

   <script >

function check(x)

{
```

```
  var number=/^([0-9]{10})+$/;
   if(x.value.match(number)){
      alert("Valid email address!");
      document.myform.mon.focus();
      return true;

   }
   else{
      alert("Please enter only your 10 digit mobile number");
      document.myform.mon.focus();
      return false;

   }

}
function ValidateEmail(input) {
```

```
var validRegex = /^[a-zA-Z0-9.!#$%&'*+/=?^_`{|}~-]+@[a-zA-Z0-9-]+(?:\.[a-zA-Z0-9-
]+)*$/;

if (input.value.match(validRegex)) {

alert("Valid email address!");

document.myform.email.focus();

return true;

} else {

alert("Invalid email address!");

document.myform.email.focus();
```

```
return false;



}

 }



   </script>



</head>

<body>



   <div class="container">

      <form name="myform" method="post" class="form-signup" onsubmit="return
check(document.myform.mon)" onsubmit="return
ValidateEmail(document.myform.email)">

         <h1 class="reg">Register</h1>

         <p>Create your account</p>
```

```
<div class="form-group">
    <input type="text" class="form-control" name="name" placeholder="Enter your name" required >
</div>

<div class="form-group">
    <input type="email" class="form-control" name="email" placeholder="Enter your emailID" required>
</div>

<div class="form-group">
    <input type="user name" class="form-control" name="username" placeholder="Enter your username" required>

</div>
<div class="form-group">
```

```
        <input type="password" class="form-control" name="password"
placeholder="Enter your password" required>


    </div>


    <div class="form-group">
        <input type="text" class="form-control" name="mon" placeholder="Enter your
mobile number" required >


    </div>
    <div class="form-group">
      <label>
      <input type="checkbox">
      I accept the <a href="terms.html">Terms and conditions</a>
      </label>


    </div>
```

```
        <input type="submit" class="btn btn-success btn-block" name="" value="submit">




      </form>

   </div>



</body>

</html>
```

Login.html

```
<!DOCTYPE html>

<html>

<head>

        <title>LogIn Page</title>

        <link rel="stylesheet"

href="https://cdn.jsdelivr.net/npm/bootstrap@4.5.3/dist/css/bootstrap.min.css"

integrity="sha384-
```

```
TX8t27EcRE3e/ihU7zmQxVncDAy5uIKz4rEkgIXeMed4M0jlfIDPvg6uqKI2xXr2"
crossorigin="anonymous">
</head>
<style>
  .group{
     padding-top: 100px;
  }
</style>
<body>
  <div class="container">
       <div class="row">
            <div style="width: 40%; margin: 25px auto;">
       <div class="group">
            <h3 style="text-align: center;">Login Page</h3>
            <form action="login1.php" method="POST" >
                 <div class="form-group">
```

```
                    <label>UserName:</label><input type="text"
name="username" class="form-control" autofocus placeholder="Enter your username or
gmail ID" required="">

                </div>

                <div class="form-group">

                    <label>Password:</label><input type="Password"
name="password" class="form-control" autofocus placeholder="Password" required="">

                </div>


    <label>Enter Captcha:</label>

    <div class="form-row">

     <div class="form-group col-md-6">

      <input type="text" class="form-control" readonly id="capt" required="">

     </div>

     <div class="form-group col-md-6">

      <input type="text" class="form-control" id="textinput" required="">

     </div>
```

```
    </div>


        <div class="form-group">
<button onclick="validcap()" name="save" class="btn btn-lg btn-success btn-block"
>Submit</button>
                        </div>
                </form>
   <h6>Captcha not visible <img src="refresh.png" width="40px" onclick="cap()"></h6>
   <p>New Here?<a href="register.html">Register</a> </p>
        </div>
        </div>
</div>
</div>
<script type="text/javascript">
 function cap(){
   var alpha = ['A','B','C','D','E','F','G','H','I','J','K','L','M','N','O','P','Q','R','S','T','U','V'
          ,'W','X','Y','Z','1','2','3','4','5','6','7','8','9','0','a','b','c','d','e','f','g','h','i',
```

```
 'j','k','l','m','n','o','p','q','r','s','t','u','v','w','x','y','z', '!','@','#','$','%','^','&','*','+'];

 var a = alpha[Math.floor(Math.random()*71)];

 var b = alpha[Math.floor(Math.random()*71)];

 var c = alpha[Math.floor(Math.random()*71)];

 var d = alpha[Math.floor(Math.random()*71)];

 var e = alpha[Math.floor(Math.random()*71)];

 var f = alpha[Math.floor(Math.random()*71)];


 var final = a+b+c+d+e+f;

 document.getElementById("capt").value=final;

}

function validcap(){

 var stg1 = document.getElementById('capt').value;

 var stg2 = document.getElementById('textinput').value;

 if(stg1==stg2){

 // alert("Form is validated Succesfully");
```

```
            return true;
          }else{
            alert("Please enter a valid captcha");
            return false;
          }
        }
</script>
</body>
<script src="https://code.jquery.com/jquery-3.5.1.slim.min.js" integrity="sha384-DfXdz2htPH0lsSSs5nCTpuj/zy4C+OGpamoFVy38MVBnE+IbbVYUew+OrCXaRkfj" crossorigin="anonymous"></script>
<script src="https://cdn.jsdelivr.net/npm/bootstrap@4.5.3/dist/js/bootstrap.bundle.min.js" integrity="sha384-ho+j7jyWK8fNQe+A12Hb8AhRq26LrZ/JpcUGGOn+Y7RsweNrtN/tE3MoK7ZeZDyx" crossorigin="anonymous"></script>
</html>
```

Bank login.html

```
<!DOCTYPE html>

<html>

<head>

        <title>LogIn Page</title>

        <link rel="stylesheet"
href="https://cdn.jsdelivr.net/npm/bootstrap@4.5.3/dist/css/bootstrap.min.css"
integrity="sha384-
TX8t27EcRE3e/ihU7zmQxVncDAy5uIKz4rEkgIXeMed4M0jlfIDPvg6uqKI2xXr2"
crossorigin="anonymous">

</head>

<style>

   .group{

      padding-top: 100px;

   }

</style>

<body>
```

```
<div class="container">
        <div class="row">
                <div style="width: 40%; margin: 25px auto;">
        <div class="group">
                <h3 style="text-align: center;">Bank Login Page</h3>
                <form method="POST" action="bank1.php">
                        <div class="form-group">
                                <label>Bank user ID:</label><input type="text"
name="BankUserName" class="form-control" autofocus placeholder="Enter the Bank User
ID" required>
                        </div>
                        <div class="form-group">
```

<label>Bank Email ID:</label><input type="email" name="bankemail" class="form-control" autofocus placeholder="Enter the Bank Email ID" required>

<label>Password:</label><input type="Password" name="Password" class="form-control" autofocus placeholder="Password" required>

<label>Enter Captcha:</label>

<input type="text" class="form-control" readonly id="capt" required>

<input type="text" class="form-control" id="textinput" required>

```
    </div>


        <div class="form-group">

                                <button onclick="validcap()" name="Submit" class="btn btn-lg
btn-success btn-block">Submit</button>

                        </div>

                </form>

   <h6>Captcha not visible <img src="refresh.png" width="40px" onclick="cap()"></h6>



        </div>

        </div>

</div>

</div>

<script type="text/javascript">

  function cap(){

    var alpha = ['A','B','C','D','E','F','G','H','I','J','K','L','M','N','O','P','Q','R','S','T','U','V'

          ,'W','X','Y','Z','1','2','3','4','5','6','7','8','9','0','a','b','c','d','e','f','g','h','i',
```

```
 'j','k','l','m','n','o','p','q','r','s','t','u','v','w','x','y','z', '!','@','#','$','%','^','&','*','+'];

 var a = alpha[Math.floor(Math.random()*71)];

 var b = alpha[Math.floor(Math.random()*71)];

 var c = alpha[Math.floor(Math.random()*71)];

 var d = alpha[Math.floor(Math.random()*71)];

 var e = alpha[Math.floor(Math.random()*71)];

 var f = alpha[Math.floor(Math.random()*71)];


 var final = a+b+c+d+e+f;

 document.getElementById("capt").value=final;

}

function validcap(){

 var stg1 = document.getElementById('capt').value;

 var stg2 = document.getElementById('textinput').value;

 if(stg1==stg2){

  alert("Form is validated Succesfully");
```

```
            return true;
          }else{
            alert("Please enter a valid captcha");
            return false;
          }
        }
</script>
</body>
<script src="https://code.jquery.com/jquery-3.5.1.slim.min.js" integrity="sha384-DfXdz2htPH0lsSSs5nCTpuj/zy4C+OGpamoFVy38MVBnE+IbbVYUew+OrCXaRkfj" crossorigin="anonymous"></script>
<script src="https://cdn.jsdelivr.net/npm/bootstrap@4.5.3/dist/js/bootstrap.bundle.min.js" integrity="sha384-ho+j7jyWK8fNQe+A12Hb8AhRq26LrZ/JpcUGGOn+Y7RsweNrtN/tE3MoK7ZeZDyx" crossorigin="anonymous"></script>
</html>
```

Approve.html

```
<!DOCTYPE html>

<html lang="en" dir="ltr">

 <head>

  <meta charset="utf-8">

  <title>Loan approva status</title>

  <link rel="stylesheet" href="static/approve.css">

  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/5.15.3/css/all.min.css"/>

 </head>

 <body>

  <h1>LOAN APPROVAL STATUS</h1>

  <h2>{{prediction_text}}</h2>

  <img src="static/approve.jpg" width="150px" height="150px">

  <h3>Please provide your feedback</h3>

  <div class="container">
```

```
<div class="post">
  <div class="text">Thanks for rating us!</div>
  <div class="edit">EDIT</div>
</div>
<div class="star-widget">
  <input type="radio" name="rate" id="rate-5">
  <label for="rate-5" class="fas fa-star"></label>
  <input type="radio" name="rate" id="rate-4">
  <label for="rate-4" class="fas fa-star"></label>
  <input type="radio" name="rate" id="rate-3">
  <label for="rate-3" class="fas fa-star"></label>
  <input type="radio" name="rate" id="rate-2">
  <label for="rate-2" class="fas fa-star"></label>
  <input type="radio" name="rate" id="rate-1">
  <label for="rate-1" class="fas fa-star"></label>
  <form action="#">
```

```
    <header></header>
    <div class="textarea">
      <textarea cols="30" placeholder="Describe your experience.."></textarea>
    </div>
    <div class="btn">
      <button type="submit">Post</button>
    </div>
   </form>
  </div>
</div>
<script>
  const btn = document.querySelector("button");
  const post = document.querySelector(".post");
  const widget = document.querySelector(".star-widget");
  const editBtn = document.querySelector(".edit");
  btn.onclick = ()=>{
```

```
      widget.style.display = "none";
      post.style.display = "block";
      editBtn.onclick = ()=>{
      widget.style.display = "block";
      post.style.display = "none";
      }
      return false;
    }
  </script>
 </body>
</html>
```

Reject.html

```
<!DOCTYPE html>
<html lang="en" dir="ltr">
 <head>
  <meta charset="utf-8">
```

```
  <title>Loan approval status</title>
  <link rel="stylesheet" href="static/reject.css">
  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.15.3/css/all.min.css"/>
 </head>
 <body>
  <h1>LOAN APPROVAL STATUS</h1>
  <h2>{{prediction_text}}</h2>
  <img src="static/reject.jpg" width="200px" height="200px">
  <h3>Please provide your feedback</h3>
  <div class="container">

   <div class="post">
    <div class="text">Thanks for rating us!</div>
    <div class="edit">EDIT</div>
   </div>
   <div class="star-widget">
```

```
<input type="radio" name="rate" id="rate-5">
<label for="rate-5" class="fas fa-star"></label>
<input type="radio" name="rate" id="rate-4">
<label for="rate-4" class="fas fa-star"></label>
<input type="radio" name="rate" id="rate-3">
<label for="rate-3" class="fas fa-star"></label>
<input type="radio" name="rate" id="rate-2">
<label for="rate-2" class="fas fa-star"></label>
<input type="radio" name="rate" id="rate-1">
<label for="rate-1" class="fas fa-star"></label>
<form action="#">
 <header></header>
 <div class="textarea">
  <textarea cols="30" placeholder="Describe your experience.."></textarea>
 </div>
 <div class="btn">
```

```
      <button type="submit">Post</button>
    </div>
   </form>
  </div>
</div>
<script>
  const btn = document.querySelector("button");
  const post = document.querySelector(".post");
  const widget = document.querySelector(".star-widget");
  const editBtn = document.querySelector(".edit");
  btn.onclick = ()=>{
    widget.style.display = "none";
    post.style.display = "block";
    editBtn.onclick = ()=>{
    widget.style.display = "block";
    post.style.display = "none";
```

```
      }

      return false;

    }

  </script>

 </body>

</html>
```

Prediction.html

```
<!doctype html>

<html lang="en">

 <head>

  <!-- Required meta tags -->

  <meta charset="utf-8">

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



  <!-- Bootstrap CSS -->
```

```
    <link rel="stylesheet" href="static/prediction.css">

    <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.0.0-
beta3/dist/css/bootstrap.min.css" rel="stylesheet" integrity="sha384-
eOJMYsd53ii+scO/bJGFsiCZc+5NDVN2yr8+0RDqr0Ql0h+rP48ckxlpbzKgwra6"
crossorigin="anonymous">

    <link href="https://unpkg.com/tailwindcss@^2/dist/tailwind.min.css" rel="stylesheet">



    <title>prediction</title>

  </head>

  <body>

    <script>

      function valid(){

      var Ai=document.getElementById("ApplicantIncome").value;

      var Co=document.getElementById("CoapplicantIncome").value;

      var LA=document.getElementById("LoanAmount").value;

      var LT=document.getElementById("Loan_Amount_Term").value;

      if(Ai > 10000000000000000000000000000000000000000){
```

```
  alert("Applicant income is too large enter a valid number")
  return false;
}
if(Co > 10000000000000000000000000000000000000){
  alert("Coapplicant income is too large enter a valid number")
  return false;
}
if(LA > 10000000000000000000000000000000000000){
  alert("Loan Amount is too large enter a valid number")
  return false;
}
if(LT > 10000000000000000000000000000000000000){
  alert("loan amount term is too large enter a valid number")
  return false;
}
var name=document.getElementById("Name").value;
```

```
var letters=/^[a-zA-Z]*$/;
if(!name.match(letters)){
  alert("Name must contain only alphabets")
  return false;
}
var num=/^[0-9]+$/;
if(!Ai.match(num)){
  alert("Enter only valid numbers alphabets are not allowed ")
  return false;
}
if(!Co.match(num)){
  alert("Enter only valid numbers alphabets are not allowed ")
  return false;
}
if(!LA.match(num)){
  alert("Enter only valid numbers alphabets are not allowed  ")
```

```
    return false;
   }
   if(!LT.match(num)){
    alert("Enter only valid numbers alphabets are not allowed ")
    return false;
   }
   var mo=document.getElementById("mon").value;
   var mn=/^[0-9]{10}$/;
   if(!mo.match(mn)){
    alert("Please enter only 10 digit mobile number")
    return false;
   }


  }
  </script>
<section class="text-gray-600 body-font">
```

```
 <div class="container px-5 py-24 mx-auto">
  <div class="flex flex-col text-center w-full mb-20">

   <h1 class="Heading">LOAN ELIGIBILITY PREDICTION</h1><br>
   <p class="fill">Fill the form for prediction</p>
  </div>
  <div>

  </div>
  <div class="mb-3">
  <a class="btn btn-primary" href="./" id="back" role="button">Back</a></div>

<form action='/prediction.html' method="post" onsubmit="return valid()">
  <div class="mb-3">
    <label for="exampleFormControlInput1" class="form-label">Name</label>
    <input type="text" class="form-control" id="Name" name="Name" placeholder="Enter
your Name" required >
```

```
  </div>
  <div class="mb-3">
    <label for="exampleFormControlInput1" class="form-label"> Email ID</label>
    <input type="email" class="form-control" id="email" name="email" placeholder="Enter your Email ID" required >
  </div>
  <div class="mb-3">
    <label for="exampleFormControlInput1" class="form-label">Mobile Number</label>
    <input type="text" class="form-control" id="mon" name="mon" placeholder="Enter your Mobile number" required>
</div>
<div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label"> Gender</label>
  <select class="form-select" id="gender" name="gender" aria-label="Default select example" required >
  <option selected>-- select gender --</option>
  <option value="Male">Male</option>
```

```
 <option value="Female">Female</option>
</select>
</div>
<div class="mb-3">
 <label for="exampleFormControlInput1" class="form-label"> Married status</label>
 <select class="form-select" id="married" name="married" aria-label="Default select
example" required >
 <option selected>-- select married status --</option>
 <option value="Yes">Yes</option>
 <option value="No">No</option>
</select>
</div>
<div class="mb-3">
 <label for="exampleFormControlInput1" class="form-label">Dependents</label>
 <select class="form-select" id="dependents" name="dependents" aria-label="Default
select example" required>
 <option selected>-- select dependents --</option>
```

```
  <option value="0">0</option>

  <option value="1">1</option>

  <option value="2">2</option>

  <option value="3+">3+</option>

</select>

</div>

<div class="mb-3">

  <label for="exampleFormControlInput1" class="form-label">Education</label>

  <select class="form-select" id="education" name="education" aria-label="Default select
example" required>

  <option selected>-- select education --</option>

  <option value="Graduate">Graduate</option>

  <option value="Not Graduate">Not Graduate</option>

</select>

</div>

<div class="mb-3">

  <label for="exampleFormControlInput1" class="form-label">Self_Employed</label>
```

```
 <select class="form-select" id="employed" name="employed" aria-label="Default select
example" required>
 <option selected>-- select Self_Employed --</option>
 <option value="Yes">Yes</option>
 <option value="No">No</option>
</select>
</div>
<div class="mb-3">
 <label for="exampleFormControlInput1" class="form-label">Credit_History</label>
 <select class="form-select" id="credit" name="credit" aria-label="Default select example"
required >
 <option selected >-- select Credit_History --</option>
 <option value="Yes">Yes</option>
 <option value="No">No</option>


</select>
</div>
```

```
<div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Property_Area</label>
  <select class="form-select" id="proparea" name="proparea" aria-label="Default select example" required>
  <option selected>-- select Property_Area --</option>
  <option value="Semiurban">Semiurban</option>
  <option value="Urban">Urban</option>
  <option value="Rural">Rural</option>
</select>
</div>
<div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Enter ApplicantIncome</label>
  <input type="text" class="form-control" id="ApplicantIncome" name="ApplicantIncome" placeholder="ApplicantIncome" required>

</div>
```

```
<div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Enter
CoapplicantIncome</label>
  <input type="text" class="form-control" id="CoapplicantIncome"
name="CoapplicantIncome" placeholder="CoapplicantIncome" required>
</div>
<div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Purpose of loan</label>
  <select class="form-select" id="pur" name="pur" aria-label="Default select example"
required>
  <option selected>-- select the purpose of loan --</option>
  <option value="person">Personal loan</option>
  <option value="Bussiness">Bussiness loan</option>
  <option value="Education">Education loan</option>
  <option value="Home">Home loan</option>
  <option value="Other">other</option>
</select>
```

```
</div>

<div class="mb-3">

 <label for="exampleFormControlInput1" class="form-label">Enter LoanAmount</label>

 <input type="text" class="form-control" id="LoanAmount" name="LoanAmount"
placeholder="LoanAmount" required>

</div>

<div class="mb-3">

 <label for="exampleFormControlInput1" class="form-label">Enter
Loan_Amount_Term</label>

 <input type="text" class="form-control" id="Loan_Amount_Term"
name="Loan_Amount_Term" placeholder="Loan_Amount_Term" required>

</div>

<div class="mb-3">

 <label for="exampleFormControlInput1" class="form-label">Enter Adhar
Number</label>

 <input type="text" class="form-control" id="Adhar" name="Adhar" placeholder="Adhar
Number" required >

</div>
```

```
<div class="mb-3">

 <label for="exampleFormControlInput1" class="form-label">Enter PAN card ID</label>

 <input type="text" class="form-control" id="PAN " name="PAN " placeholder="PAN card
ID" required>

</div>

<div class="mb-3">

<label for="property document" class="form-label">Property
Document</label><br><input type="file" required >

</div>

<div class="mb-3">

<label for="Govt ID proof" class="form-label">Govet ID proof</label><br><input
type="file" required>

</div>

<div class="mb-3">

 <input type="checkbox" required>

 I accept the <a href="terms.html">Terms and conditions</a>

 </div>
```

```
<br><br>

<div class="mb-3">

<input type="submit" class="but" value="PREDICT">

</div>

   </form>




  </div>

</section>

   <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.0.0-
beta3/dist/js/bootstrap.bundle.min.js" integrity="sha384-
JEW9xMcG8R+pH31jmWH6WWP0WintQrMb4s7ZOdauHnUtxwoG2vI5DkLtS3qm9Ekf"
crossorigin="anonymous"></script>



  </body>

</html>
```

Model.ipynb

```
import numpy as np

import pandas as pd

import pickle

import seaborn as sns

import matplotlib.pyplot as plt

%matplotlib inline

import sklearn

from sklearn.preprocessing import LabelEncoder

from sklearn.tree import DecisionTreeClassifier

from sklearn.ensemble import RandomForestClassifier

from sklearn.neighbors import KNeighborsClassifier

from xgboost import XGBClassifier

from sklearn.ensemble import RandomForestClassifier

import imblearn

from imblearn.under_sampling import RandomUnderSampler

from sklearn.model_selection import train_test_split
```

```
from sklearn.preprocessing import scale

from sklearn.preprocessing import  MaxAbsScaler

from sklearn.metrics import accuracy_score,classification_report,confusion_matrix,f1_score



## Reading The Dataset

df=pd.read_csv('Loan_dataset.csv')

df

df.head()

df.info()

df.shape

df=df.drop(columns=["Loan_ID"],axis=1)

## Uni-Variate Analysis

sns.distplot(df.ApplicantIncome)

sns.countplot(df.Property_Area)

sns.countplot(df.Gender)

sns.countplot(df.Education)
```

```
sns.countplot(df.Self_Employed)

sns.countplot(df.Married)

sns.histplot(df.LoanAmount)

sns.displot(df.CoapplicantIncome)

plt.pie(df.Property_Area.value_counts(),[0,0,0],labels=['Semi urban','Urban','Rural'])

## Bivariate Analysis

sns.countplot(df['Married'],hue=df['Gender'])

sns.countplot(df['ApplicantIncome'],hue=df['CoapplicantIncome'])

sns.countplot(df['LoanAmount'],hue=df['Property_Area'])

sns.countplot(df['Education'],hue=df['Self_Employed'])

sns.barplot(df.ApplicantIncome,df.CoapplicantIncome)

sns.countplot(df['LoanAmount'],hue=df['Loan_Amount_Term'])

plt.scatter(df.ApplicantIncome,df.LoanAmount)

sns.countplot(df['Dependents'],hue=df['Gender'])

## Multi variate Analysis

sns.heatmap(df.corr(),annot=True)
```

```
plt.plot(df.LoanAmount,df.Loan_Amount_Term,df.ApplicantIncome)

df.plot.line()

df.hist()

plt.plot(df.LoanAmount,df.ApplicantIncome,df.CoapplicantIncome)

plt.plot(df.Loan_Amount_Term,df.ApplicantIncome,df.CoapplicantIncome)

## Descriptive Analysis

df.describe()

df.std()

df.mean()

df.mode()

## Data Pre-Processing

## Check for Null Values

df.isnull().any()

df.isnull().sum()

df['LoanAmount']=df['LoanAmount'].fillna(df['LoanAmount'].mean())

df['Loan_Amount_Term']=df['Loan_Amount_Term'].fillna(df['Loan_Amount_Term'].mean())
```

```
df['Credit_History']=df['Credit_History'].fillna(df['Credit_History'].mean())

df['Gender']=df['Gender'].fillna(df['Gender'].mode()[0])

df['Married']=df['Married'].fillna(df['Married'].mode()[0])

df['Dependents']=df['Dependents'].fillna(df['Dependents'].mode()[0])

df['Self_Employed']=df['Self_Employed'].fillna(df['Self_Employed'].mode()[0])

df.isnull().any()

df.isnull().sum()

## Handling Categorical Values

df.head()

le=LabelEncoder()

df.Gender=le.fit_transform(df.Gender)

df.Married=le.fit_transform(df.Married)

df.Education=le.fit_transform(df.Education)

df.Self_Employed=le.fit_transform(df.Self_Employed)

df.Property_Area=le.fit_transform(df.Property_Area)

df.Loan_Status=le.fit_transform(df.Loan_Status)
```

```
df.Dependents=le.fit_transform(df.Dependents)

df.head()

## Spliting into dependent and independent data

df.head()

x=df.iloc[:,:-1]

y=df.Loan_Status

x.head()

y.head()

## Scaling The Data

scaler = MaxAbsScaler()

x_sc=scaler.fit_transform(x)

x_sc

## Balancing The Dataset

sns.countplot(df.Loan_Status)

rus=RandomUnderSampler(sampling_strategy=1)

x_res,y_res=rus.fit_resample(x,y)
```

```
ax=y_res.value_counts().plot.pie(autopct='%.2f')

_=ax.set_title("under-sampling")

## Splitting Data Into Train and Test

xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.3,random_state=10)

xtrain.head()

xtest.head()

ytrain.head()

ytest.head()

xtrain.shape

xtest.shape

ytrain.shape

ytest.shape

## Model Building

## Decision Tree Model

dmodel=DecisionTreeClassifier(random_state=100)

dmodel.fit(x_res,y_res)
```

```
ypredd=dmodel.predict(xtest)

ypred2d=dmodel.predict(xtrain)

## Random Forest Model

Rmodel=RandomForestClassifier(n_estimators=100,max_depth=12,max_features=3)

Rmodel.fit(x_res,y_res)

ypredR=Rmodel.predict(xtest)

ypred2R=Rmodel.predict(xtrain)

## KNN Model

kmodel=KNeighborsClassifier()

kmodel.fit(x_res,y_res)

ypredk=kmodel.predict(xtest)

ypred2k=kmodel.predict(xtrain)

## Xgboost Model

xmodel=XGBClassifier(eval_metric='mlogloss',n_estimators=100,random_state=100)

xmodel.fit(x_res,y_res)

ypredx=xmodel.predict(xtest)
```

```
ypred2x=xmodel.predict(xtrain)

## Compare The Model

print("Decision Tree Model Testing Accuracy")

print(accuracy_score(ytest,ypredd))

print("Decision Tree Model Training Accuracy")

print(accuracy_score(ytrain,ypred2d))

print("Random Forest Model Testing Accuracy")

print(accuracy_score(ytest,ypredR))

print("Random Forest Model Training Accuracy")

print(accuracy_score(ytrain,ypred2R))

print("KNN Model Testing Accuracy")

print(accuracy_score(ytest,ypredk))

print("KNN Model Training Accuracy")

print(accuracy_score(ytrain,ypred2k))

print("Xgboost Model Testing Accuracy")

print(accuracy_score(ytest,ypredx))
```

```
print("Xgboost Model Training Accuracy")

print(accuracy_score(ytrain,ypred2x))

## Evaluating Performance Of The Model And Saving The Model

## Random Forest Model is Selected

print("Random Forest Model Testing Accuracy")

print(accuracy_score(ytest,ypredR))

print("Random Forest Model Training Accuracy")

print(accuracy_score(ytrain,ypred2R))

y=Rmodel.predict([[1,1,1,1,0,4583.0,1508.0,128.0,360.0,1.0,0]])

print(y)

y1=Rmodel.predict([[1,0,0,0,0,5849,0.0,146.412162,360.0,1.0,2]])

print(y1)

y2=Rmodel.predict([[1,0,0,1,0,678,987,90,24,1.0,2]])

print(y2)

f1_score(ypredR,ytest,average='weighted')

pd.crosstab(ytest,ypredR)
```

```
print(classification_report(ypredR,ytest))
```

13.2 GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project- 49074-1660815695

13.3 DEMO VIDEO LINK

https://drive.google.com/file/d/1DWgwvLWKwdMVEkR5klyliuLXjDIU98V/view?usp=drivesdk