Project Report

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1. INTRODUCTION:

A loan is the core business part of banks. The main portion the bank's profit is directly come from the profit earned from the loans. Though bank approves loan after a regress process of verification and testimonial but still there's no surety whether the chosen hopeful is the right hopeful or not. This process takes fresh time while doing it manually. We can prophesy whether that particular hopeful is safe or not and the whole process of testimonial is automated by machine literacy style. Loan Prognostic is really helpful for retainer of banks as well as for the hopeful also.

1.1.   Project overview :

One of the most important factors which affect our country's economy and financial condition is the credit system governed by the banks. The process of bank credit risk evaluation is recognized at banks across the globe. "As we know credit risk evaluation is very crucial, there is a variety of techniques are used for risk level calculation. In addition, credit risk is one of the main functions of the banking community. The prediction of credit defaulters is one of the difficult tasks for any bank. But by forecasting the loan defaulters, the banks definitely may reduce their loss by reducing their non-profit assets, so that recovery of approved loans can take place without any loss and it can play as the contributing parameter of the bank statement. This makes the study of this loan approval prediction important. Machine Learning techniques are very crucial and useful in the prediction of these types of data. We will be using classification algorithms such as Decision tree, Random forest, KNN, and xg boost. We will train and test the data with these algorithms. From this best model is selected and saved in pkl format. We will be doing flask integration and IBM deployment

Purpose:

With the enhancement in the banking sector lots of people are applying for bank loans but the bank has its limited assets which it has to grant to limited people only, so finding out to whom the loan can be granted which will be a safer option for the bank is a typical process. So in this paper we try to reduce this risk factor behind selecting the safe person so as to save lots of bank efforts and assets. This is done by mining the Big Data of the previous records of the people to whom the loan was granted before and on the basis of these records / experiences the machine was trained using the machine learning model which give the most accurate result. The main objective of this paper is to predict whether assigning the loan to particular person will be safe or not.

2. LITERATURE SURVEY:

Loan Approval Prediction using Machine Learning Models .Outlier detection and removal, as well as imputation removal processing, were done during the pre-processing stage. To predict the chances of current status regarding the loan approval process, SVM, DT, KNN, and gradient boosting models were used in this method. To divide the dataset into training and testing processes, the 80:20 rule was used. Experimentation concluded that the Decision Tree has significantly higher loan prediction accuracy than the other models. Data collection and pre-processing, applying machine learning models, training, and testing the data.

Accurate loan approval prediction based on machine learning approach. The framework acknowledges or won't have any significant bearing for a loan. Obligation reimbursement is a critical mark of bank funds. It is extremely challenging to foresee the capacity of clients to reimburse a loan. AI methods are extremely valuable in uncovering the aftereffects of many sources. This paper utilizes three AI calculations: Logistic Regression (LR), Decision Tree (DT) and Random Forest (RF) to distinguish client advances. Studies have shown that the respectability of AI calculations is more noteworthy than the backwardness and technique of learning AI. Logistic Regression , Decision Tree and Random Forest.

Bank Loan Prediction System using Machine Learning. In this paper, they use a machine learning technique that will predict the person who is reliable for a loan, based on the previous record of the person whom the loan amount is accredited before. This work's primary objective is to predict whether the loan approval to a specific individual is safe or not. . Fraud detection and credit risk applications are particularly well suited to classification technique. This approach frequently employs Decision tree based classification Algorithm. In classification, a training set is used to build the model as the classifier which can classify the data items into its appropriate classes. A testset is used to validate the model. Loan Dataset, Logistic Regression, Random Forest, Django.

Loan Sanctioning Prediction Procedure based on NB approach. The seven parameters considered were income, age, profession, existing loan with its tenure, amount and approval status. The sub-processes include, Pre-processing (handling the missing values with KNN and data refinement using binning algorithm), Classification using NB approach and updating the dataset frequently results in appropriate improvement in the loan prediction process. Experimentation put-forth the conclusion that, integration of KNN and binning algorithm with NB resulted in improved prediction of loan sanctioning process. NB approach integrated with K-Nearest Neighbour (KNN) and binning algorithms.

Prediction of Modernized Loan Approval System Based on Machine Learning Approach. This model uses logistic regression as a machine learning tool. This paper uses a statistical model (Logistic Regression) to predict whether the loan should be approved or not for a set of records of an applicant. Logistic regression can even work with power terms and nonlinear effect. The historical data of candidates was used to build a machine learning model using different classification algorithms. The main objective of this paper is to predict whether a new applicant granted the loan or not using machine learning models trained on the historical data set. Logistic regression, XGBoost.

2.1. Existing problem:

Bank employees check the details of applicant manually and give the loan to eligible applicant. Checking the details of all applicants takes lot of time. The artificial neural network model for predict the credit risk of a bank. The Feed-forward back propagation neural network is used to forecast the credit default. The method in which two or more classifiers are combined together to produce a ensemble model for the better prediction. They used the bagging and boosting techniques and then used random forest technique. The process of classifiers is to improve the performance of the data and it gives better efficiency. In this work, the authors describe various ensemble techniques for binary classification and also for multi class classification. The new technique that is described by the authors for ensemble is COB which gives effective performance of classification but it also compromised with noise and outlier data of classification. Finally they concluded that the ensemble based algorithm improves the results for training data set.

2.2. REFERENCES:

[1] Kumar Arun, Garg Ishan, Kaur Sanmeet, May-Jun. 2016. Loan Approval Prediction based on Machine Learning Approach, IOSR Journal of Computer Engineering (IOSR-JCE)

[2] Wei Li, Shuai Ding, Yi Chen, and Shanlin Yang, Heterogeneous Ensemble for Default Prediction of Peer-to-Peer Lending in China, Key Laboratory of Process Optimization and Intelligent Decision- Making, Ministry of Education, Hefei University of Technology, Hefei 2009, China.

[3] Short-term prediction of Mortgage default using ensembled machine learning models, Jesse C.Sealand on july 20, 2018.

[4] Clustering Loan Applicants based on Risk Percentage using K-Means Clustering Techniques,Dr. K.Kavitha, International Journal of Advanced Research in

Computer Science and Software Engineering.

2.3.Problem Statement:

If a model can identify credit-worthy customers that were not recognized by traditional credit scores, while minimizing their risk of default on the loans, this can be a lucrative niche market or micro-market, pushing higher the profit margin of the financial institution or investor. Although the prospect of more customers seems positive, it is important to be careful as to not lend to people that will default on the loan. Thus, a conservative approach and strict evaluation metrics were kept in mind throughout the project. The loan default prediction is a problem of binary classification (should the investor lend or not). Logistic Regression is a good model for this problem.

3. IDEATION & PROPOSED SOLUTION:

3.1. EMPATHY MAP CANVAS:

3.2. IDEATION & BRAINSTORMING:

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

Step-1: Team Gathering, Collaboration and Select the Problem Statement

Step-2: Brainstorm, Idea Listing and Grouping

Step-3: Idea Prioritization
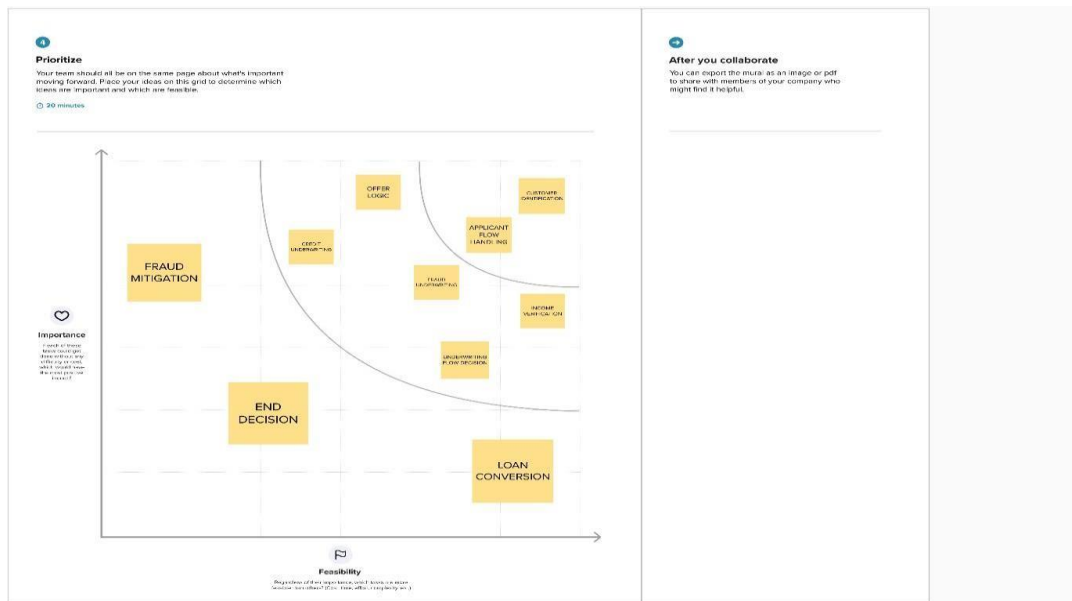
3.3. Proposed Solution:

1. LOGISTIC REGRESSION - LOAN DEFAULTERS: A very important approach in predictive analytics is used to study the problem of predicting loan defaulters using "The Logistic regression model". Here the data is collected from the Kaggle for studying and prediction. The models are compared on the basis of the performance measures such as sensitivity and specificity.

2. RANDOM FOREST - LOAN APPROVAL: To decrease the approval time and the risk associated with the loan many loan prediction models were introduced. Here we are comparing those models and it was found that the Random Forest proved to be the most accurate and fitting where it uses a Supervised Machine Learning Algorithm that is used widely in Classification and Regression problems. It builds decision trees on different samples and takes their majority vote for classification and average in case of regression.

3. DECISION TREE – CREDIT RISK ASSESSMENT: Here an effective prediction model is used for the bankers that help them predict the credible customers who have

applied for loan. Decision Tree Induction Data Mining Algorithm is applied to predict the attributes relevant for credibility. This can be used by the organizations to screen or filter the pool of requests by the customers and it has highest accuracy results.

3.4. Problem Solution fit:

Project Title: Smart Lender – Applicant Credibility Prediction for Loan Approval

Project Design Phase-I - Solution Fit

Team ID: PNT2022TMID27294

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) — CS
- The applicant must be above 20 years
- Loan lenders like banking firms or small financial firms.
- Bank account users.
- Credit/debit card holders.

6. CUSTOMER CONSTRAINTS — CC
Not clear in finding out his eligibility criteria for different schemas and There is an increasing rate of loan defaults. Banks identify the loan defaulters for much reduced credit risk as large portions of a bank's assets directly come from the interest earned on loans given.

5. AVAILABLE SOLUTIONS — AS
- Random forest, Logistic regression, Decision tree and Naive bayes algorithm are used
- Using data pre-processing data mining and data filtering
- Algorithms such as naïve bayes, k-nearest neighbors are used.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS — J&P
To find an applicant which can give best interest. Needs to find a loan applicant with good credit score. Accuracy of data should be precise so that it won't mislead the loan to ineligible user.

9. PROBLEM ROOT CAUSE — RC
Identifying the loan defaulters is a difficult task as credit risk evaluation is a very crucial process where it lies as a major factor in the trend of banking sector that affect country's economy which is credit system handled by banks.

7. BEHAVIOUR — BE
The small finance sector that deals with middle class and poor class people seek to find the credibility.
The user can select the loan repayment time and can know the interest rates, credit score and available of loan in nearby location of the consumer.

Focus on J&P, tap into BE, understand RC

3. TRIGGERS

TR

The slow process of loan approval is affecting the business of our customer and it also decline the revenue of our customers. Due to the sudden surge in the number of loan defaulters our customers business is highly affected like Financial situation of the user, Credit score rates, Low interest rates.

4. EMOTIONS: BEFORE / AFTER

EM

If the data is not secure it shows the insecurity of the user towards the app, it indicates emotion of fear and the vulnerability of the app towards attackers.

10. YOUR SOLUTION

SL

• There is an increasing rate of loan defaulters and banks are not able to correctly handle the loan request. To avoid this problem a machine learning algorithm is developed.

• The system automatically selects the credible candidates to approve the loan and it will improve the speed, efficacy, and accuracy of loan approval processes.

• This help the user(Lender) to accurately identify whom to lend the loan and also help the banks to identify the loan defaulter for much-reduced credit risk.

Decision tree, Random forest and logistic regression can be used to detect the credit risk evaluation. We use classification algorithms such as KNN and XGBOOST algorithms that forecast the loan defaulters and predict loan approval.

8. CHANNELS of BEHAVIOUR

CH

8.1 ONLINE

Customers can easily predict their eligibility through a user interface.

8.2 OFFLINE

• Submission of documents.
• Avail loan manager
• Apply credit/Debit card and also installing the Machine Learning algorithm in their system to work efficiently.

4. REQUIREMENT ANALYSIS:

4.1. Functional Requirement:

| User Registration	1. Applicant Credibility description. 2. Information about Credibility details required for loan approval. 3. if new user, REGISTER . 4. if already exists, SIGNIN.
User Registration	Enter Email Id ,phone number and other personal information to register in the application
User Confirmation	Confirm users via sending OTP to their Email address 0r their phone number.
User Login	Enter the user Email Id and the password to login.
Loan Approval	Credibility details with their documents have to be submitted for prediction.
Result	• If Approved - It displays the credit score and the information about what is done to be next. • If Not Approved - It displays the reason why you are rejected and not eligible for the loan.

4.2.Non-functional requirements:

1	**Availability**	The loan will be easily available for those who have high income and to those who assure to repay the high sum within short period of time.
2	**Scalability**	The customer should be above the age of 21.And also based on customer's capacity to handle this.

3	**Usability**	If the customer is eligible ,he/she should be able to receive the acknowledgement receipt for loan application within 7 days from the bank. If not, then he/she should be intimated with the reason for rejection.
4	**Security**	Checks if the consumer has any fraudulent history and no data theft to any third party apps.
5	**Reliability**	Consumer should have good credit scores and stable source of income.
6	**Performance**	By training the model using different Machine Learning algorithms ,the performance of the system can be increased.

5. PROJECT DESIGN:

### 5.1. Data Flow Diagrams:

Borrowing Process
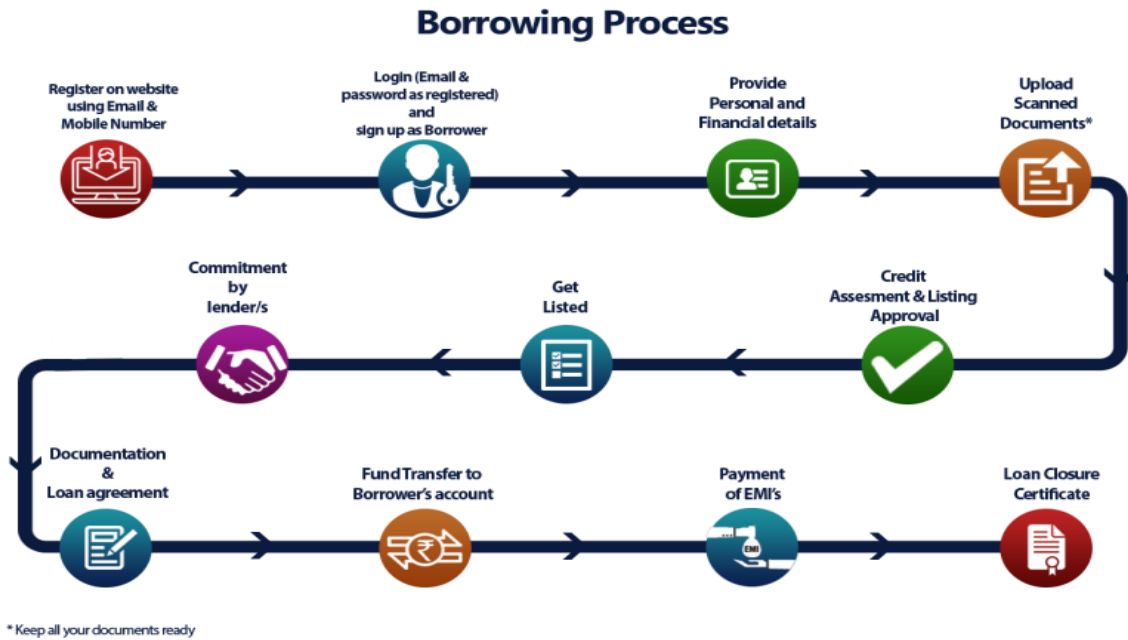
LOAN MANAGEMENT SYSTEM
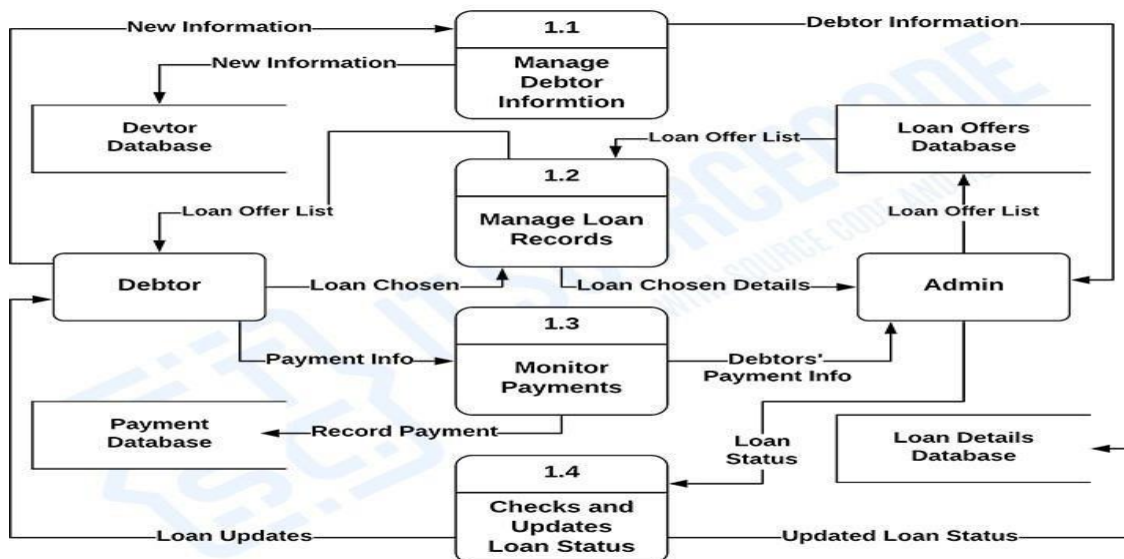
DATA FLOW DIAGRAM LEVEL 2

5.2. Solution & Technical Architecture:

- The primary goal in the banking industry is to place their funds in safe hands. So, the system needs to verify the documents effectively and should ensure that only capable people get the loan.

- The model should be trained to produce results with satisfactory accuracy, after which it produces accurate results without any tedious manual work.

- The users can get the results.

- The system should reduce risk to both the bank and the customer.

- The model can anticipate outcomes and is quickly adaptable to a wide range of inputs. Also, this strategy saves the banking industry and its staff a significant amount of time.
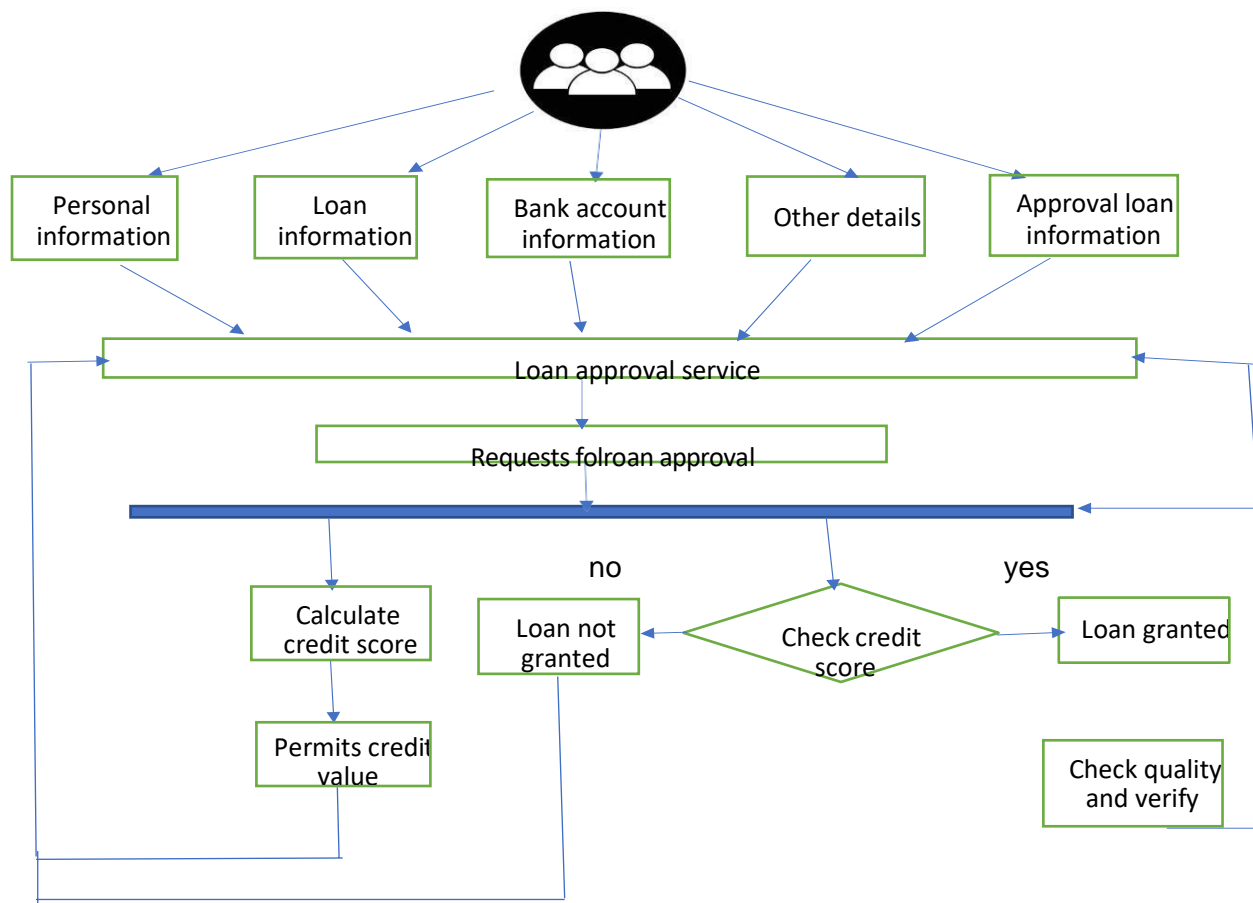
5.3. User Stories:

Use the below template to list all the user stories for the product.

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.	As a user I can enter Gmail and set a password	High	Sprint-1
Customer (Mobile user)	Confirmation email	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
Customer (Mobile user)	Verification	USN-3	Registration as a user can be confirmed using OTP or verification code.	As a user can get OTP or verification code	Low	Sprint-2
Customer (Mobile user)	Login	USN-4	Users can log into the web/mobile interface by storing or using the registered login credentials.	Able to login	Medium	Sprint-1
Customer (Mobile user)	Login	USN-5	As a user, I can log into the application by entering email & password	Can be able to login using Gmail	High	Sprint-1
Customer (Mobile user)	Dashboard	USN-6	As a user, I should be able to login the profile or status dashboard	Able to access dashboard account	Medium	Sprint-2
Customer care executive	Feedback Analysis	USN-7	Checks the user feedbacks and provide essential technical support	Access the account/ able to access the dashboard	Medium	Sprint-2
Customer Care Executive	Automated analysis of cibil- score	USN-8	As a loan approval officer I can make decisions by checking and monitoring all the feeded applications and getting to a prediction.	Get a decision for loan prediction based on the details provided in the loan application	High	Sprint-3
Administrator	Admin information	USN-9	As a admin cibil score which represents credit history plays major role in analysis	Cibil score /credit history plays major role	High	Sprint-3
Administrator	Login/Register	USN-10	As an admin I should be able to login with	Able to get logged in	High	Sprint-4

6. PROJECT PLANNING & SCHEDULING

6.1. Sprint Planning & Estimation:

Phrase 1: Information Collection and Requirement Analysis

Phrase 2: Project Planning and Developing Modules

Phrase 3: Implementing the High Accuracy Deep Learning Algorithm to Perform

Phrase 4: Deploying the Model on Cloud and Testing the Model and UI Performance

6.2. Sprint Delivery Schedule:

7.	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	Aravind,Dhanushan, Gunalan,harish
Sprint -1		USN-2	As a user, I will receive confirmation email once I have registered for the application	3	High	Aravind Dhanushan Gunalan Harish

Sprint-1		USN-3	As a user, I can register for the application through Facebook	1	Low	Aravind Dhanushan Gunalan Harish
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	Aravind Dhanushan Gunalan harish

Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	3	High	Aravind Dhanushan Gunalan Harish
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	Aravind Dhanushan Gunalan Harish

Sprint-2	Register	USN-7	As a loan approval officer, I should be able to register myself as one using unique email and password.	5	Medium	Aravind Dhanushan Gunalan Harish
Sprint-2	Login	USN-8	As a loan approval officer I should be able to login myself as one using unique email and password.	5	Medium	Aravind Dhanushan Gunalan Harish
Sprint-3	Automated analysis of credit history	USN-9	As a loan approval officer, I can access the dashboard where I feed application for loan prediction.	10	High	Aravind Dhanushan Gunalan Harish

Sprint		USN				
Sprint-3		USN-10	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	Aravind Dhanushan Gunalan Harish
Sprint-4	Register	USN-11	As an admin, I should be able to register myself as one using unique email and password.	2	Medium	Aravind Dhanushan Gunalan Harish
Sprint-4	Login	USN-12	As an admin I should be able to login myself as one using unique email and password.	2	Medium	Aravind Dhanushan Gunalan Harish
Sprint-4	Dashboard	USN-13	As an admin, I should be able to access the dashboard with everything I am allowed to use.	2	Medium	Aravind Dhanushan Gunalan Harish

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

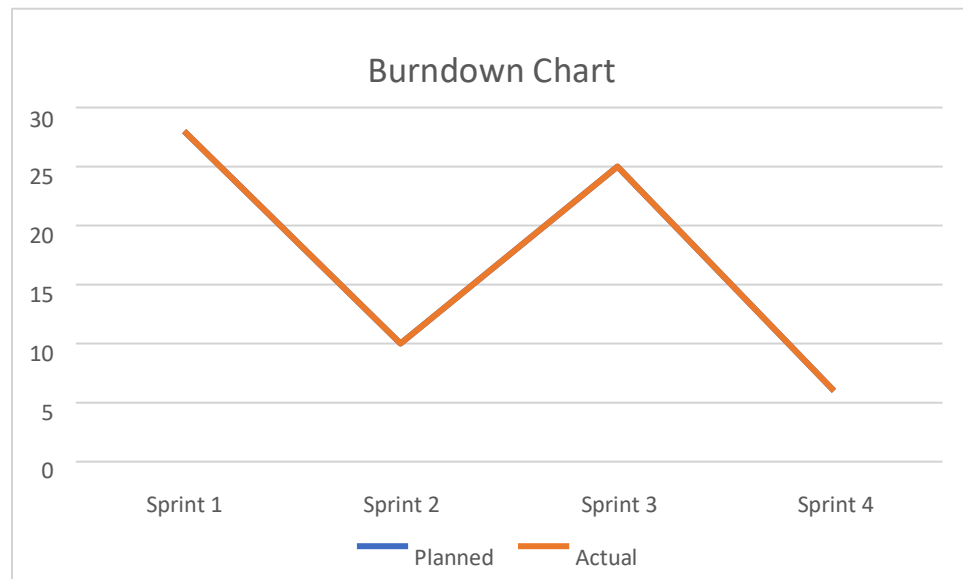| Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	26 Oct 2022	01 Nov 2022	28	01 Nov 2022
Sprint-2	20	6 Days	02 Nov 2022	07 Nov 2022	10	07 Nov 2022
Sprint-3	20	6 Days	08 Nov 2022	13 Nov 2022	25	13 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	6	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)

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

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.

7.1Reports from JIRA

Gunalan JIRA WORKSPACE:

Dhanushan JIRA WORKSPACE:
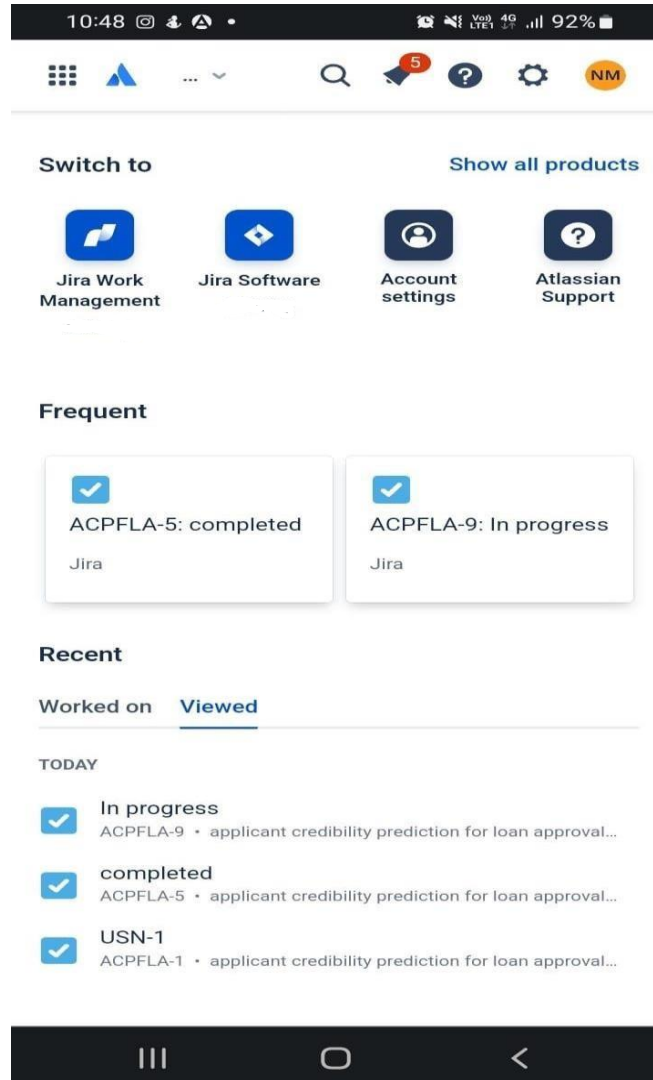
Aravind JIRA WORKSPACE:

Harish JIRA WORKSPACE:

7. CODING & SOLUTIONING

7.1Features:

Index.html:

```
<!DOCTY
PE 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>SMART LENDER</title>
              <style>
                @import
            url("https://fonts.googleapis.com/css2?family=Aref+Ruqaa+Ink:wght@700
            &display=swap");
                @import
            url("https://fonts.googleapis.com/css2?family=EB+Garamond&display=sw
            ap");
                @import
            url("https://fonts.googleapis.com/css2?family=Antic+Slab&display=swap")
            ;

                html {
                  user-select: none;
                }

                body {
                  margin-top: 5%;
                  color: white;
                }

                html {
                  background: linear-gradient(rgba(0, 0, 0, 0.5), rgba(0, 0, 0, 0.5)),
            url(static/loan.jpeg);
                  height: 100%;
                  background-position: center;
                  background-repeat: no-repeat;
```

```css
    background-size: cover;
    object-fit: cover;
}

h1 {
    font-size: 45px;
    font-family: "Aref Ruqaa Ink", serif;
}

h3 {
    font-size: 20px;
    font-family: "Antic Slab", serif;
}

h6 {
    font-size: 20px;
    font-family: "Antic Slab", serif;
}

/* ~~~~~~~ BUTTON ~~~~~~~ */

.container,
.container:before,
.container:after {
    box-sizing: border-box;
    padding: 0;
    margin: 0;
    font: 300 1em/1.5 "Open Sans", "Helvetica Neue", Arial, sans-serif;
    text-decoration: none;
    color: #111;
}

.btn {
    background: rgba(236, 240, 241, 0.425);
}

.container {
    min-width: 500px;
    margin: 5% auto;
    text-align: center;
}

button:hover {
```

```css
    cursor: pointer;
}

button {
    background: transparent;
    outline: none;
    position: relative;
    border: 3px solid #FCDDB0;
    padding: 15px 50px;
    overflow: hidden;
}

/*button:before (attr data-hover)*/
button:hover:before {
    opacity: 1;
    transform: translate(0, 0);
}

button:before {
    content: attr(data-hover);
    position: absolute;
    top: 1.1em;
    left: 0;
    width: 100%;
    text-transform: uppercase;
    letter-spacing: 3px;
    font-weight: 800;
    font-size: 0.8em;
    opacity: 0;
    transform: translate(-100%, 0);
    transition: all 0.3s ease-in-out;
}

/*button div (button text before hover)*/
button:hover div {
    opacity: 0;
    transform: translate(100%, 0);
}

button div {
    text-transform: uppercase;
    letter-spacing: 3px;
    font-weight: 800;
```

```css
    font-size: 0.8em;
    transition: all 0.3s ease-in-out;
}

/*--- Footer ---*/

.footer {
    margin-top: 10px;
}

.nav-link {
    font-weight: bold;
    font-size: 14px;
    text-transform: uppercase;
    text-decoration: none;
    color: #ffffff;
    padding: 20px 0px;


    display: inline-block;
    position: relative;
    opacity: 0.75;
}

#d {
    margin-top: -40px;
    font-family: "EB Garamond", serif;
    letter-spacing: 0.5px;
}

#p {
    margin-top: -50px;
    font-family: "EB Garamond", serif;
    letter-spacing: 0.5px;
}

.nav-link:hover {
    opacity: 1;
}

.nav-link::before {
    transition: 300ms;
    height: 3px;
```

```css
    content: "";
    position: absolute;
    background-color: #FCDDB0;
}

.nav-link-fade-up::before {
    width: 100%;
    bottom: 5px;
    opacity: 0;
}

.nav-link-fade-up:hover::before {
    bottom: 10px;
    opacity: 1;
}

p {
    color: white;
    font-family: "Aref Ruqaa Ink", serif;
    letter-spacing: 0.5px;
}

.tooltip {
    position: relative;
    display: inline-block;
    /* If you want dots under the hoverable text */
}

/* Tooltip text */
.tooltip .tooltiptext {
    border-radius: 10px;
    visibility: hidden;
    width: 100px;
    color: #fff;
    right: 28vh;
    /* Position the tooltip text - see examples below! */
    position: absolute;
    z-index: 1;
}


/* Show the tooltip text when you mouse over the tooltip container */
```

```css
.tooltip:hover .tooltiptext {
    visibility: visible;
}

.tooltip1 {
    position: relative;
    display: inline-block;
    /* If you want dots under the hoverable text */
}

/* Tooltip text */
.tooltip1 .tooltiptext1 {
    border-radius: 10px;
    visibility: hidden;
    width: 100px;
    color: #fff;
    text-align: center;
    left: 28vh;
    /* Position the tooltip text - see examples below! */
    position: absolute;
    z-index: 1;
}



/* Show the tooltip text when you mouse over the tooltip container */
.tooltip1:hover .tooltiptext1 {
    visibility: visible;
}


@media only screen and (max-width: 600px) {

    html {
        width: 100% !important;
    }

    body {
        margin-top: 110px;
    }

    h1 {
        font-size: 40px;
```

```
        }

        h3 {
           font-size: 15px;
        }

        .container {
           min-width: 200px;
        }

        .btn {
           margin-right: 2vh;
        }

        #d {
           letter-spacing: 0px;
           font-size: 14px;
        }

        #p {
           letter-spacing: 0px;
           font-size: 14px;
        }

        .footer {
           margin-top: 15vh;
        }

        .tooltip .tooltiptext {
           display: none;
        }

        .tooltip1 .tooltiptext1 {
           display: none;
        }

     }
   </style>
</head>

<body>
  <main>
     <center>
```

```html
        <h1>Smart Lender</h1>
        <h3>Get to know your applicant application will get accepted or
not</h3>
        <h6>
            Click the <em><b> Predict </b></em> button and update the
details to
            know the prediction for the applicant.
        </h6>

        <div class="container">
          <a href="predict.html">
            <button style="color: #ffffff ;" class="btn" data-hover="Loan
Predictor" onclick="predict.html">
                <div>Predict</div>
            </button>
          </a>
        </div>

      </center>
    </main>
  </body>

</html>
```

Predict.html:

```html
<!DOCTY
PE 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>SMART LENDER</title>
  <style>
    @import
url("https://fonts.googleapis.com/css2?family=Aref+Ruqaa+Ink:wght@700
&display=swap");
```

```css
@import
url("https://fonts.googleapis.com/css2?family=Albert+Sans&display=swap
");
@import
url("https://fonts.googleapis.com/css2?family=EB+Garamond&display=sw
ap");

html {
    height: 100%;
}

body {
    margin: 0;
    margin-bottom: 50%;
    padding: 0;
    font-family: sans-serif;
    /* background: linear-gradient(#141e30, #243b55);*/
    background-image: linear-gradient(rgba(0, 0, 0, 0.5),
        rgba(0, 0, 0, 0.5)),
      url(static/loan1.jpeg);
    height: 10%;
    background-position: center;
    background-repeat: no-repeat;
    background-size: cover;
    background-attachment: fixed;
    object-fit: fill;
}

.login-box {
    position: absolute;
    top: 100%;
    left: 50%;
    width: 400px;
    padding: 40px;
    transform: translate(-50%, -50%);
    background: rgba(0, 0, 0, 0.5);
    box-sizing: border-box;
    box-shadow: 0 15px 25px rgba(0, 0, 0, 0.6);
    border-radius: 10px;
}

::placeholder {
    color: aliceblue;
```

```css
}

.login-box h2 {
    margin: 0 0 30px;
    padding: 0;
    color: #fff;
    text-align: center;
}

.fon {
    color: #fff;
    text-align: center;
    font-family: "Albert Sans", sans-serif;
}

.login-box .user-box {
    position: relative;
}

.login-box .user-box input {
    width: 100%;
    padding: 10px 0;
    font-size: 16px;
    color: #fff;
    margin-bottom: 30px;
    border: none;
    border-bottom: 1px solid #fff;
    outline: none;
    background: transparent;
}

.login-box .user-box label {
    position: absolute;
    top: 0;
    left: 0;
    padding: 10px 0;
    font-size: 16px;
    color: #fff;
    pointer-events: none;
    transition: 0.5s;
}

.login-box .user-box input:focus~label,
```

```css
.login-box .user-box input:valid~label {
    top: -20px;
    left: 0;
    color: #FCDDB0;
    font-size: 12px;
}

/*--- Button */

.container,
.container:before,
.container:after {
    box-sizing: border-box;
    padding: 0;
    margin: 0;
    font: 300 1em/1.5 "Open Sans", "Helvetica Neue", Arial, sans-serif;
    text-decoration: none;
    color: #111;
}

.btn {
    background: rgba(236, 240, 241, 0.425);
}

.container {
    min-width: 500px;
    margin: 5% auto;
    text-align: center;
}

button:hover {
    cursor: pointer;
}

button {
    background: transparent;
    outline: none;
    position: relative;
    border: 3px solid #FCDDB0;
    padding: 15px 50px;
    overflow: hidden;
}
```

```css
/*button:before (attr data-hover)*/
button:hover:before {
    opacity: 1;
    transform: translate(0, 0);
}

button:before {
    content: attr(data-hover);
    position: absolute;
    top: 1.1em;
    left: 0;
    width: 100%;
    text-transform: uppercase;
    letter-spacing: 3px;
    font-weight: 800;
    font-size: 0.8em;
    opacity: 0;
    transform: translate(-100%, 0);
    transition: all 0.3s ease-in-out;
}

/*button div (button text before hover)*/
button:hover div {
    opacity: 0;
    transform: translate(100%, 0);
}

button div {
    text-transform: uppercase;
    letter-spacing: 3px;
    font-weight: 800;
    font-size: 0.8em;
    transition: all 0.3s ease-in-out;
}

/*--- Footer ---*/

.footer {
    margin-top: 200vh;
    margin-bottom: 10px;
}

.nav-link {
```

```css
    font-weight: bold;
    font-size: 14px;
    text-transform: uppercase;
    text-decoration: none;
    color: #ffffff;
    padding: 20px 0px;
    /* margin: 0px 20px;*/

    display: inline-block;
    position: relative;
    opacity: 0.75;
}

#d {
    margin-top: -40px;
    font-family: "EB Garamond", serif;
    letter-spacing: 0.5px;
}

#p {
    margin-top: -50px;
    font-family: "EB Garamond", serif;
    letter-spacing: 0.5px;
}

.nav-link:hover {
    opacity: 1;
}

.nav-link::before {
    transition: 300ms;
    height: 3px;
    content: "";
    position: absolute;
    background-color: #FCDDB0;
}

.nav-link-fade-up::before {
    width: 100%;
    bottom: 5px;
    opacity: 0;
}
```

```css
.nav-link-fade-up:hover::before {
    bottom: 10px;
    opacity: 1;
}

p {
    color: white;
    font-family: "Aref Ruqaa Ink", serif;
    letter-spacing: 0.5px;
}

.tooltip {
    position: relative;
    display: inline-block;
    /* If you want dots under the hoverable text */
}

/* Tooltip text */
.tooltip .tooltiptext {
    border-radius: 10px;
    visibility: hidden;
    width: 100px;
    right: 28vh;
    /* Position the tooltip text - see examples below! */
    position: absolute;
    z-index: 1;
}

/* Show the tooltip text when you mouse over the tooltip container */
.tooltip:hover .tooltiptext {
    visibility: visible;
}

.tooltip1 {
    position: relative;
    display: inline-block;
    /* If you want dots under the hoverable text */
}

/* Tooltip text */
.tooltip1 .tooltiptext1 {
    border-radius: 10px;
    visibility: hidden;
```

```css
    width: 100px;
    left: 28vh;
    /* Position the tooltip text - see examples below! */
    position: absolute;
    z-index: 1;
}

/* Show the tooltip text when you mouse over the tooltip container */
.tooltip1:hover .tooltiptext1 {
    visibility: visible;
}

@media only screen and (max-width: 600px) {
    .login-box {
        width: 300px;
    }

    .container {
        min-width: 200px;
    }

    .footer {
        position: sticky;
        margin-top: 198vh;
        font-size: 20px;
    }

    #d {
        letter-spacing: 0px;
        font-size: 14px;
    }

    #p {
        letter-spacing: 0px;
        font-size: 14px;
    }

    .fon {
        font-size: 15px;
    }

    .tooltip .tooltiptext {
        display: none;
```

```
        }

      .tooltip1 .tooltiptext1 {
        display: none;
      }
    }
  </style>
</head>

<body>
  <div class="login-box">
    <h2 style="text-transform: uppercase; font-family: 'Aref Ruqaa Ink',
serif">
      Smart lender - <br />
      <span style="font-size: 14px; color: azure">Know your
Loan eligibility</span>
    </h2>
    <p class="fon" style="font-size: 14px">
      Let's begin by entering your deatils below
    </p>
    <br />
    <form action="/submit" method="post">
      <div class="user-box">
        <input type="text" name="" required=""
onfocus="this.placeholder='Enter your name'"
          onblur="this.placeholder=''" />
        <label>Name</label>
      </div>
      <div class="user-box">
        <input type="text" name="Loan_ID" required=""
onfocus="this.placeholder='Enter your Loan ID'"
          onblur="this.placeholder=''" />
        <label>Loan ID</label>
      </div>
      <div class="user-box">
        <input list="gender" type="data-list" name="Gender" required=""
onchange="resetIfInvalid(this);"
          onfocus="this.placeholder='Enter your Gender'"
onblur="this.placeholder=''" />
        <label>Gender</label>
        <datalist id="gender" name="gender">
          <option value="Male"></option>
          <option value="female"></option>
```

```html
        </datalist>
      </div>
      <div class="user-box">
        <input list="married" type="text" name="Married" required=""
onchange="resetIfInvalid(this);"
          onfocus="this.placeholder='Enter your Marital Status'"
onblur="this.placeholder='' />
        <label>Married</label>
        <datalist id="married" name="married">
          <option value="yes"></option>
          <option value="no"></option>
        </datalist>
      </div>
      <div class="user-box">
        <input list="dep" type="text" name="Dependents" required=""
onchange="resetIfInvalid(this);"
          onfocus="this.placeholder='Enter your Dependents'"
onblur="this.placeholder='' />
        <label>Dependents</label>
        <datalist id="dep" name="dep">
          <option value="0"></option>
          <option value="1"></option>
          <option value="2"></option>
          <option value="3+"></option>
        </datalist>
      </div>
      <div class="user-box">
        <input list="edu" type="text" name="Education" required=""
onchange="resetIfInvalid(this);"
          onfocus="this.placeholder='Enter your Educational
Qualification'" onblur="this.placeholder='' />
        <label>Education</label>
        <datalist name="edu" id="edu">
          <option value="Graduate"></option>
          <option value="Non-Graduate"></option>
        </datalist>
      </div>
      <div class="user-box">
        <input list="emp" type="text" name="Self_Employes" required=""
onchange="resetIfInvalid(this);"
          onfocus="this.placeholder='Are you self employed?'"
onblur="this.placeholder='' />
        <label>Self Employed</label>
```

```html
      <datalist name="emp" id="emp">
        <option value="yes"></option>
        <option value="no"></option>
      </datalist>
    </div>
    <div class="user-box">
      <input type="number" name="ApplicantIncome" required=""
        onfocus="this.placeholder='Enter your Income in Dollars'"
onblur="this.placeholder='' />
      <label>Applicant Income</label>
    </div>
    <div class="user-box">
      <input type="number" name="CoaaplicantIncome" required=""
        onfocus="this.placeholder='Enter your CO Applicant Income in
Dollars'"
        onblur="this.placeholder='' />
      <label>CO Applicant Income</label>
    </div>
    <div class="user-box">
      <input type="number" name="LoanAmount" required=""
        onfocus="this.placeholder='Enter your Loan Amount in Dollars'"
onblur="this.placeholder='' />
      <label>Loan Amount</label>
    </div>
    <div class="user-box">
      <input list="term" type="text" name="Loan_Amount_Term"
required="" onchange="resetIfInvalid(this);"
        onfocus="this.placeholder='Enter the loan amount term'"
onblur="this.placeholder='' />
      <label>Loan Amount Term</label>
      <datalist name="term" id="term">
        <option value="480"></option>
        <option value="360"></option>
        <option value="300"></option>
        <option value="240"></option>
        <option value="180"></option>
        <option value="120"></option>
        <option value="84"></option>
        <option value="60"></option>
        <option value="36"></option>
        <option value="12"></option>
      </datalist>
    </div>
```

```html
        <div class="user-box">
          <input list="credit" type="text" name="Credit_History" required=""
onchange="resetIfInvalid(this);"
            onfocus="this.placeholder='Enter your Credit History'"
onblur="this.placeholder=''" />
          <label>Credit History</label>
          <datalist name="credit" id="credit">
            <option value="yes"></option>
            <option value="no"></option>
          </datalist>
        </div>
        <div class="user-box">
          <input list="prop" type="text" name="Property_Area" required=""
onchange="resetIfInvalid(this);"
            onfocus="this.placeholder='Enter your area of the property'"
onblur="this.placeholder=''" />
          <label>Property Area</label>
          <datalist name="prop" id="prop">
            <option value="Urban"></option>
            <option value="Rural"></option>
            <option value="Semi-Rural"></option>
          </datalist>
        </div>

        <div class="container">
          <a href="submit.html">
            <button style="color: #ffffff ;" class="btn" data-hover="PREDICT"
onclick="submit.html">
              <div>SUBMIT</div>
            </button>
          </a>
        </div>
      </form>
    </div>
</body>
<script>
  function resetIfInvalid(el) {
    //just for beeing sure that nothing is done if no value selected
    if (el.value == "") return;
    var options = el.list.options;
    for (var i = 0; i < options.length; i++) {
      if (el.value == options[i].value)
        //option matches: work is done
```

```
                return;
            }
            //no match was found: reset the value
            el.value = "";
        }
    </script>

</html>
```

Submit.html:

```html
<!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>SMART LENDER</title>
  <style>
    @import
url('https://fonts.googleapis.com/css2?family=Aref+Ruqaa+Ink:wght@700&display=swap');
    @import
url('https://fonts.googleapis.com/css2?family=EB+Garamond&display=swap');

    body {
      color: white;
      font-family: 'Aref Ruqaa Ink', serif;
      background-image: linear-gradient(rgba(0, 0, 0, 0.5),
          rgba(0, 0, 0, 0.5)),
        url(static/loan.jpeg);
      height: 10%;
      background-position: center;
      background-repeat: no-repeat;
      background-size: cover;
      background-attachment: fixed;
      object-fit: fill;
```

```css
}

.output {
    margin-top: 15%;
}


/*--- Footer ---*/

.footer {
    margin-top: 21vh;
}

.nav-link {
    font-weight: bold;
    font-size: 14px;
    text-transform: uppercase;
    text-decoration: none;
    color: #ffffff;
    padding: 20px 0px;
    /* margin: 0px 20px;*/

    display: inline-block;
    position: relative;
    opacity: 0.75;
}

#d {
    margin-top: -40px;
    font-family: 'EB Garamond', serif;
    letter-spacing: 0.5px;
}

#p {
    /* margin-top: -50px;*/
    font-family: 'EB Garamond', serif;
    letter-spacing: 0.5px;
}

.nav-link:hover {
    opacity: 1;
}
```

```css
.nav-link::before {
   transition: 300ms;
   height: 3px;
   content: "";
   position: absolute;
   background-color: #FCDDB0;
}

.nav-link-fade-up::before {
   width: 100%;
   bottom: 5px;
   opacity: 0;
}

.nav-link-fade-up:hover::before {
   bottom: 10px;
   opacity: 1;
}

p {
   color: white;
   font-family: 'Aref Ruqaa Ink', serif;
   letter-spacing: 0.5px;
}

.tooltip {
   position: relative;
   display: inline-block;
   /* If you want dots under the hoverable text */
}

/* Tooltip text */
.tooltip .tooltiptext {
   border-radius: 10px;
   visibility: hidden;
   width: 100px;
   right: 28vh;
   /* Position the tooltip text - see examples below! */
   position: absolute;
   z-index: 1;
}

/* Show the tooltip text when you mouse over the tooltip container */
```

```css
.tooltip:hover .tooltiptext {
    visibility: visible;
}

.tooltip1 {
    position: relative;
    display: inline-block;
    /* If you want dots under the hoverable text */
}

/* Tooltip text */
.tooltip1 .tooltiptext1 {
    border-radius: 10px;
    visibility: hidden;
    width: 100px;
    top: 3vh;
    left: 28vh;
    /* Position the tooltip text - see examples below! */
    position: absolute;
    z-index: 1;
}

/* Show the tooltip text when you mouse over the tooltip container */
.tooltip1:hover .tooltiptext1 {
    visibility: visible;
}

@media only screen and (max-width: 600px) {

    body {
        margin-top: 30vh;
    }

    .footer {
        margin-top: 30vh;
    }

    .tooltip .tooltiptext {
        display: none;
    }

    .tooltip1 .tooltiptext1 {
        display: none;
```

```
                }
              }
          </style>
        </head>

        <body>
          <main class="output">
            <center>
              <h1>SMART LENDER</h1>
              <h3>{{prediction_text}}</h3>
            </center>
          </main>
        </body>

      </html>
```

8. TESTING:

8.1 Test Cases

For checking the loan application, We have two testcase
- Eligible
- Not Eligible

This is based on the training and testing the model we used in our application.
This eligibility can be checked by using the details entered by the users. This
includes the details like
- Gender
- Status
- Dependants
- Education
- Employ
- Income
- Co-income(additional income)
- Loan amount
- Loan amount term(in days)
- Credit history
- Property area(type of location)

8.2 User Acceptance Testing:

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Smart Lender – Applicant Credibility Prediction for Loan Approval 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	7	3	2	3	11
Duplicate	1	0	3	0	3
External	3	2	0	1	6
Fixed	0	2	4	16	17
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	2	2	1	8
Totals	11	9	13	22	48

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	13	0	0	15
Security	2	0	0	3
Outsource Shipping	3	0	0	4
Exception Reporting	6	0	0	9
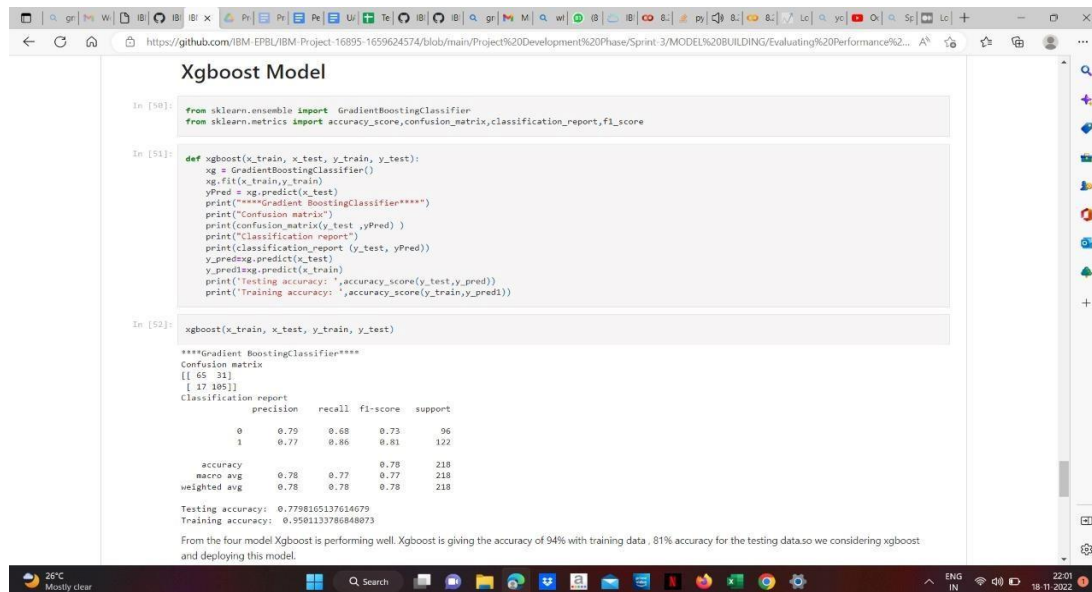
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9. RESULTS

9.1. Performance Metrics

S.No.	Parameter	Values	Screenshot
1.	Metrics	**Regression Model:** MAE - , MSE - , RMSE - , R2 score - **Classification Model:** Confusion Matrix - , Accuracy Score- & Classification Report -	FIGURE-1
2.	Tune the Model	Hyper parameter Tuning - Validation Method -	FIGURE-2

FIGURE-1

FIGURE-2

10. ADVANTAGES & DISADVANTAGES:
ADVANTAGES
- Fast and highly accurate result

- Easy handling of the problem

- Less risk and more convenient to use

- Reliablity is pretty high

- Better choice for responsive result

- Better user interface

   DISADVANTAGES

- Machine Learning model in general is little complex

- Prediction sometime not reliable because the model is build on the old data.

- The prediction result is more depend on the model.

11. CONCLUSION:

Today's fast-growing IT industry needs to discover new technology and update the old technology that helps us to reduce human intervention and increase the efficiency of the work. This model is used for the banking system or anyone who wants to apply for a loan. It will be very helpful in bank management. From the analysis of the data, it is very clear that it reduces all the frauds done at the time of loan approval. Time is also very precious for everyone through this not only the bank but also the waiting time of the applicant will also reduce. As it seems, it will not deal with some special cases when only one parameter is enough for the decision, but it is quite efficient and reliable in some instant.

12. FUTURE SCOPE

In the future, this prediction module can be more improved and integrated. The system is prepared on the previous training data but in the future, it is possible to make changes to software, which can accept new testing data and should also take part in training data and predict accordingly.

13. APPENDIX:

Source Code:

```python
from flask import render_template,Flask,request

import numpy as np

import pickle

import requests

API_KEY = "hmIOFhnjuvRGrJaKtFnyvNKEQTINuL4eRrcnbp6K7c8R"

token_response = requests.post('https://iam.cloud.ibm.com/identity/token',
data={"apikey":API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-
type:apikey'})

mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}

app= Flask(__name__, template_folder='templates')

scale = pickle.load(open('scale.pkl','rb'))

@app.route('/')

def home():
    return render_template('index.html')

@app.route('/predict.html')

def formpg():
    return render_template('predict.html')

@app.route('/submit',methods = ['POST'])

def predict():
loan_num,gender,married,depend,education,self_emp,applicant_income,co_inco
```

```python
me,loan_amount,loan_term,credit_history,property_area = [x for x in
request.form.values()]
    if gender == 'Male':
        gender = 1
    else:
        gender = 0
    if married == 'Yes':
        married = 1
    else:
        married = 0
    if education == 'Graduate':
        education = 0
    else:
        education = 1
    if self_emp == 'Yes':
        self_emp = 1
    else:
        self_emp = 0
    if depend == '3+':
        depend = 3
    applicant_income = int(applicant_income)
    applicant_income = np.log(applicant_income)
    loan_amount = int(loan_amount)
    loan_amount = np.log(loan_amount)
```

```python
    if credit_history == 'Yes':

        credit_history = 1

    else:

        credit_history = 0

    if property_area == 'Urban':

        property_area = 2

  elif property_area == 'Rural':

        property_area = 0

    else:

        property_area = 1

    features =
[[gender,married,depend,education,self_emp,applicant_income,co_income,loan_
amount,loan_term,credit_history,property_area]]

    #con_features = [np.array(features)]

    scale_features = scale.fit_transform(features)

    sf = scale_features.tolist()

    payload_scoring = {"input_data": [{"fields":
['gender','married','depend','education','self_emp','applicant_income','co_income
','loan_amount','loan_term','credit_history','property_area'], "values": sf}]}

    response_scoring = requests.post('https://us-
south.ml.cloud.ibm.com/ml/v4/deployments/5108313c-f101-4c06-8f87-
151aa0d1c3ff/predictions?version=2022-10-26',
json=payload_scoring,headers={'Authorization': 'Bearer ' + mltoken})

    print("response_scoring")

    prediction = response_scoring.json()
```

```python
    predict = prediction['predictions'][0]['values'][0][0]

    #prediction = model.predict(scale_features)

    if predict == 0:

        return render_template('submit.html', prediction_text ='You are eligible for
loan')

    else:

        return render_template('submit.html',prediction_text = 'Sorry you are not
eligible for loan')

if__name__== "__main__":

  app.run(debug=True)
```

GitHub & Project Demo Link:

https://github.com/IBM-EPBL/IBM-Project-14385-1659585004#ibm-project-14385-1659585004

https://drive.google.com/file/d/1EiwSXL9FTB5lA-1plX28QbH6LDGpQe57/view?usp=share_link