PROJECT REPORT

Smart Lender:

Applicant Credibility Prediction for Loan Approval

submitted by

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CHAPTER 1 INTRODUCTION

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.

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.

1.2 PURPOSE

Loan prediction analysis uses specific parameters about a loan application to determine whether or not the loan should get approved. Approved loans usually have a good credit history, decent applicant income, and reliability in other factors. Banks use statistical and manual methods to verify these factors and decide about the applicant's loan status.

This is proactive credit risk management. It enables to intervene at the earliest opportunity so that you have more options for remedying the situation and avoiding losses.

CHAPTER 2 LITERATURE SURVEY

2.1 EXISTING PROBLEM

Machine Learning implementation is a very complex part in terms of Data analytics. Working on the data which deals with prediction and making the code to predict the future of our comes from the customer is challenging part. The current system has some fundamental issues, such as excessive paper use, task overload, and file maintenance.

2.2 REFERENCES

Title: Prediction of Modernized Loan Approval System Based on Machine Learning Approach

Author: Vishal Singh, Ayushman Yadav, Rajat Awasthi

Technology has boosted the existence of humankind the quality of life they live. Every day we are planning to create something new and different. We have a solution for every other problem we have machines to support our lives and make us somewhat complete in the banking sector candidate gets proofs/ backup before approval of the loan amount.

The application approved or not approved depends upon the historical data of the candidate by the system. Every day lots of people applying for the loan in the banking sector but Bank would have limited funds. 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. Considering the papers imitation, in some situations like client going through some disaster so here the algorithm cannot predict the appropriate result.

Title: Predictive And Probabilistic Approach Using Logistic Regression :Application To Prediction Of Loan Approval

Author: Ashlesha Vaidya

This paper represents Decision taking is attained by probabilistic and predictive approaches developed by various machine learning algorithms. This paper discusses about logistic regression ad its

mathematical representation. This paper adheres to logistic regression as a machine learning tool in order to actualize the predictive and probabilistic approaches to a given problem of loan approval prediction. Using logistic regression as a tool, this paper specifically delineates about whether or not loan for a set of records of an applicant will be approved. Furthermore, it also discusses about other real-world applications of this machine learning mode. The basic methodology insists that this paper adheres to logistic regression as a machine learning tool in order to actualize the predictive and probabilistic approaches to a given problem of loan approval prediction. The limitations include the applications for the logistic regression modelling is not restrictive to the applications stated.

Title: Bank Loan Prediction System using Machine Learning

Author: Anshika Gupta , Vinay Pant , Sudhanshu Kumar, Pravesh Kumar Bansal

With the advancement in technology, there are so many enhancements in the banking sector also. The number of applications is increasing every day for loan approval. There are some bank policies that they have to consider while selecting an applicant for loan approval. Based on some parameters, the bank has to decide which one is best for approval. It is tough and risky to check out manually every person and then recommended for loan approval. In this work, we 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. Basic methodology include 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. Limitations of this paper states that this prediction module is not much integrated.

Title: Tree-Based Methods for Loan Approval

Author: Mohamed Alaradi, Sawsan Hilal

This study shows Loan approval is one of the most important processes that any banking organization owns. The acceptance or rejection of any loan application has a direct impact on the bank revenue and the profitability in quarterly issued financial statements. Though loan approval is a critical process, the actual decision made is not a straightforward procedure and comes with a lot of uncertainties This work aimed at developing a high performance predictive model for loan approval prediction using decision trees boosting came in superior in terms of performance, relevance and interpretation via the

importance chart scoring accuracy on testing dataset [98.75%] specificity [100%], Minority class prediction accuracy [92.85%], and classification efficiency of [97.0%]. Therefore, boosting-based decision-tree predictive model was recommended to facilitate decision making regarding the eligibility of loan applicants based on their characteristics. The basic methodology provides This work aimed at developing a high performance predictive model for loan approval prediction using decision trees. Experiments were made in different varieties of tree methods ranging from the most simplified and comprehensible decision tree reaching up to the most complex random forests. The limitations include Results yielded inadequate performance with respect to simplified decision trees due to the highlight correlated and complex feature space, majority of critical parameters affecting loan approval was not reflected upon and yielded an impractically over-simplified tree.

Title: Credit Evaluation Ensemble Model with Self-Contained Shunt Author:
Wenyu Qiu, Siwen Li, Yumeng Cao, Hua Li

In the actual loan scenario, the proportion of “good” and “bad” samples is usually extremely imbalanced. Therefore, this paper constructs an ensemble model with a pre-judging mechanism for the imbalanced datasets of small enterprise. It can learn the structure of data set independently and adjust the structure spontaneously through the “data shunt”, which can improve the efficiency of model, simplify the complexity of model and optimize the indicators to achieve the goal of reducing bank operating costs and bad debt rates. (1) Supervised data splitter: In this paper, we select the densitybased outlier test algorithm Local Outlier Factor (LOF) as the main algorithm of the shunt and the raw data will be reduced and clustered by Principal Component Analysis (PCA) and K-Means++ clustering algorithm, and the outlier test pipeline will be constructed for each cluster data. The methodology includes constructs an ensemble model with a pre-judging mechanism for the imbalanced datasets of small enterprise.

(1) Supervised data splitter

(2) Construction of the two-channel model

The paper cites limitations such as the FRP increases, there will be no retracement in the ROC curve. Thus, choosing an appropriate threshold will be more difficult for models in such condition.

Title: Loan default prediction using decision trees and random forest Author:
Golak Bihari Rath, DebasishDas, BiswaRanjan Acharya.

The methodology includes it describes about the comprehensive and comparative analysis between two algorithms. Both the algorithms have been used on the same dataset. The limitations include the main limitation of random forest is that a large number of trees can make the algorithm too slow and ineffective for real-time predictions. These algorithms are fast to train, but quite slow to create predictions once they are trained.

2.3 PROBLEM STATEMENT DEFINITION

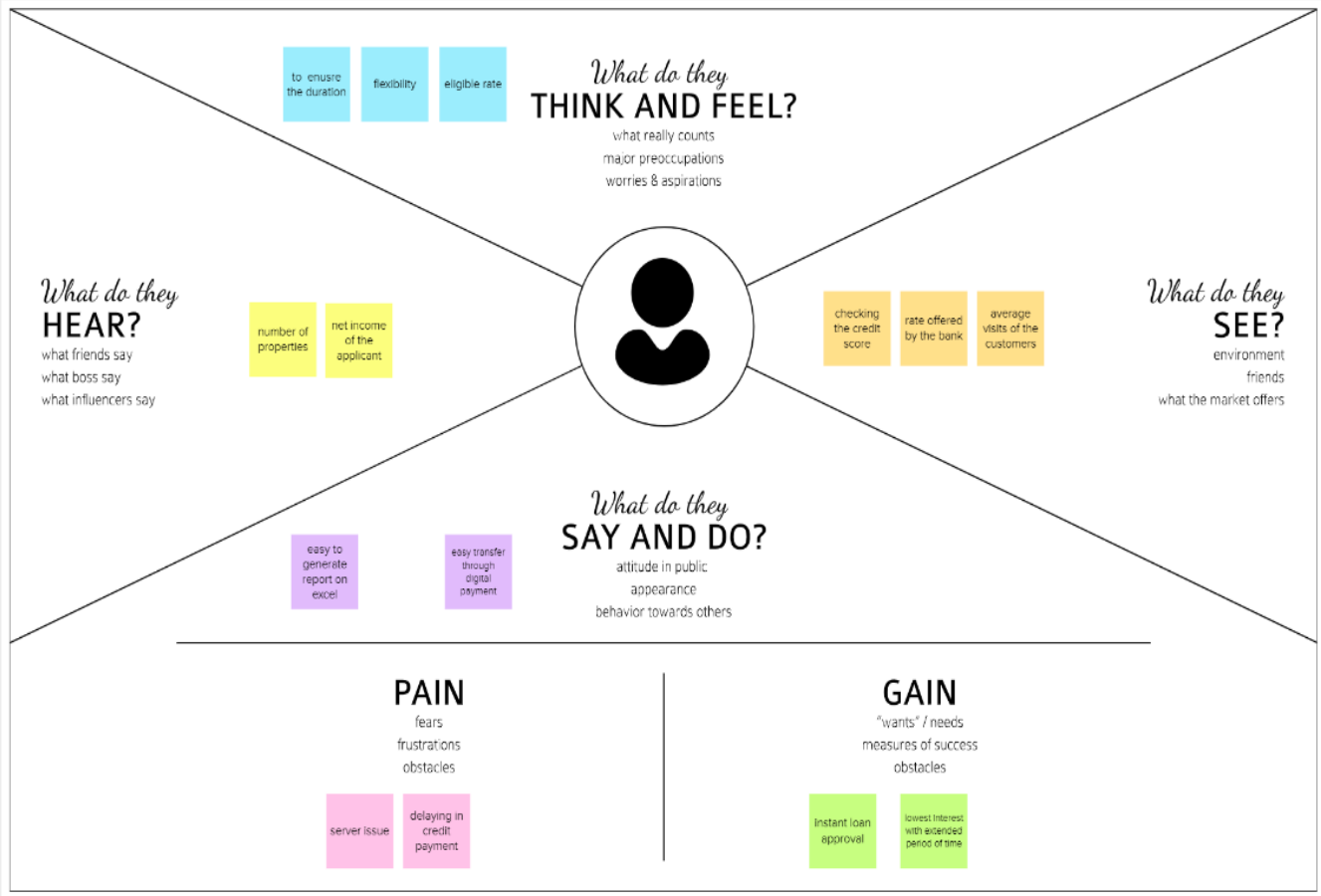
A problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love. A well-articulated customer problem statement allows you and your team to find the ideal solution for the challenges your customers face. Throughout the process, you'll also be able to empathize with your customers, which helps you better understand how they perceive your product or service.

I am	Describe customer with 3-4 key characteristics - *who are they?*	Describe the customer and their attributes here
I'm trying to	*List their outcome or "job" the care about - what are they trying to achieve?*	List the thing they are trying to achieve here
but	Describe what problems or barriers stand in the way – *what bothers them most?*	Describe the problems or barriers that get in the way here
because	Enter the "root cause" of why the problem or barrier exists – *what needs to be solved?*	Describe the reason the problems or barriers exist
which makes me feel	Describe the emotions from the customer's point of view – *how does it impact them emotionally?*	Describe the emotions the result from experiencing the problems or barriers

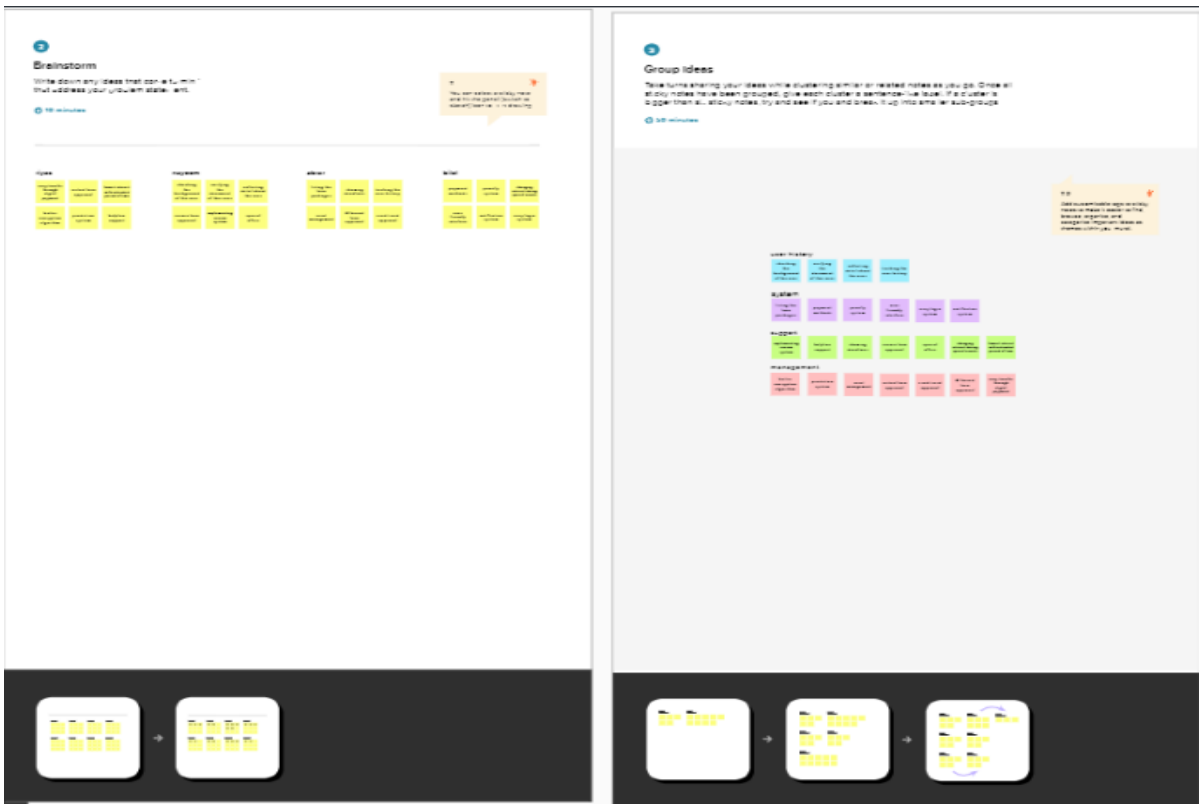
CHAPTER 3

IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



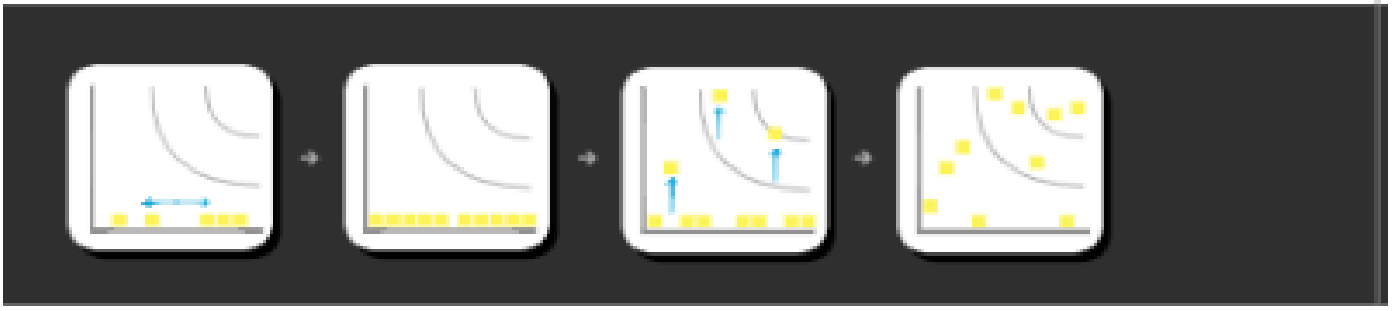
3.1 IDEATION & BRAINSTORMING



Prioritize

Importance

Feasibility

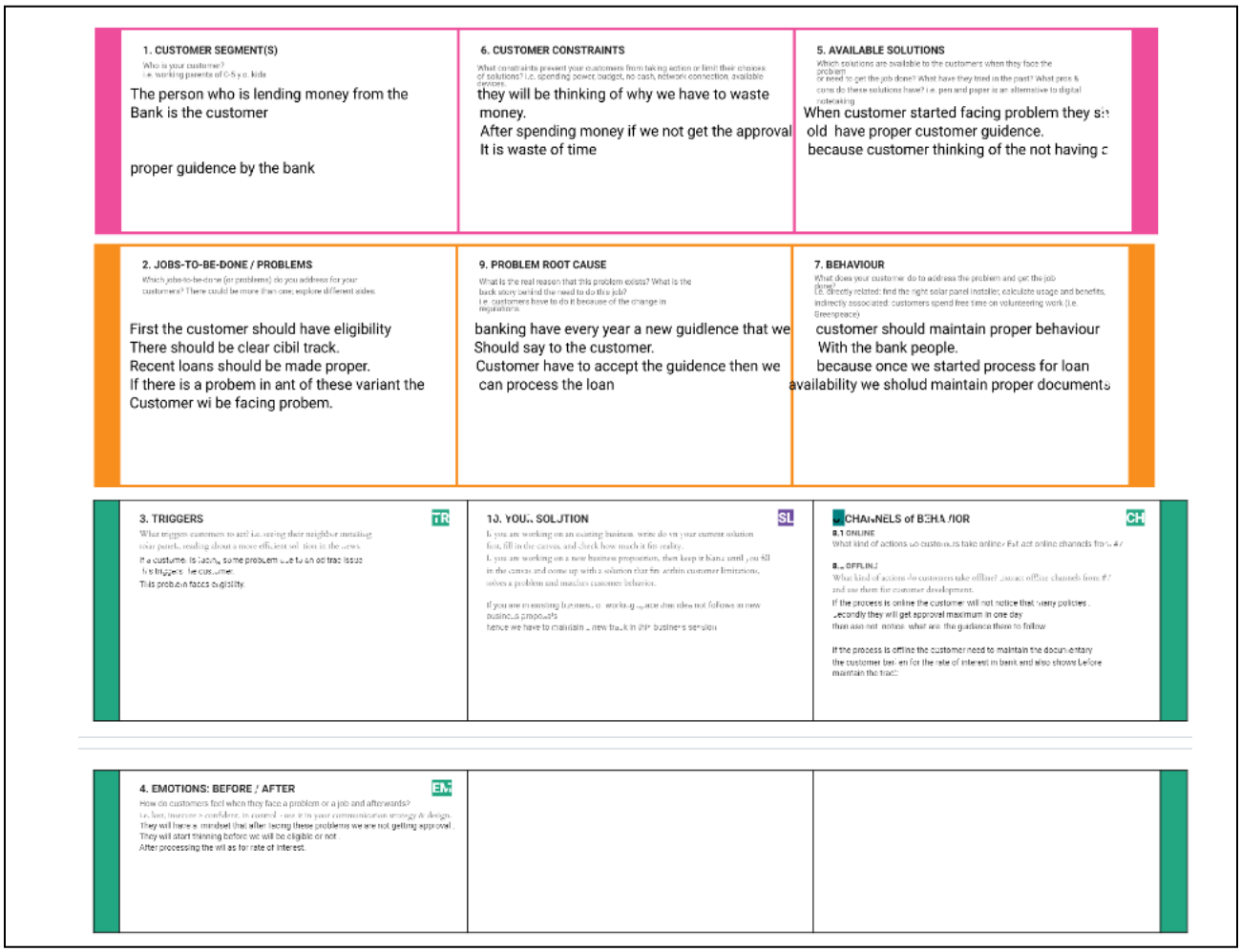


3.2 PROPOSED SOLUTION

S. No.	Parameter	Description
1	Problem Statement (Problem to be solved)	As we know that now-a-days there is a rapid growth in banking sector, resulting lots of people are applying for bank loans. Finding out the applicant to whom the loan will be approved is a difficult process. The process of bank credit risk evaluation is recognized at banks across the globe. As we know credit risk evaluation is very crucial, there are a variety of techniques 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
2	Idea/Solution description	We aim to make use of machine learning to make better financial predictions and understand the banking sector's lending applications and the creditworthiness of individuals and organizations.
3	Novelty/ Uniqueness	This system automatically selects the eligible candidates. This is helpful to both bank staff and applicant. The time period for the sanction of loan will be drastically reduced. Performance and accuracy of thealgorithms can be calculated and compared and Class imbalance can be dealt with machine learning approaches.
4	Socia Impact/ Customer Satisfaction	Using this system would significantly improve the banking ecosystem and reduce the loan defaulting rates that banks currently see. This would also allow the clients to borrow based on their past records and better understand their borrowing capacity.

5	Business Model (Revenue Model)	• Finance application: Example, BOB World. • Our system could prove to be useful for both banks as well as their customers.
6	Scalability of the Solution	The system, being dynamically and modularly developed, allows for much modification and large scalable operations. More data when made available can be processed and produce efficient results. This system is easily and efficiently scalable.

3.4. PROBLEM STATEMENT



CHAPTER 4
REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

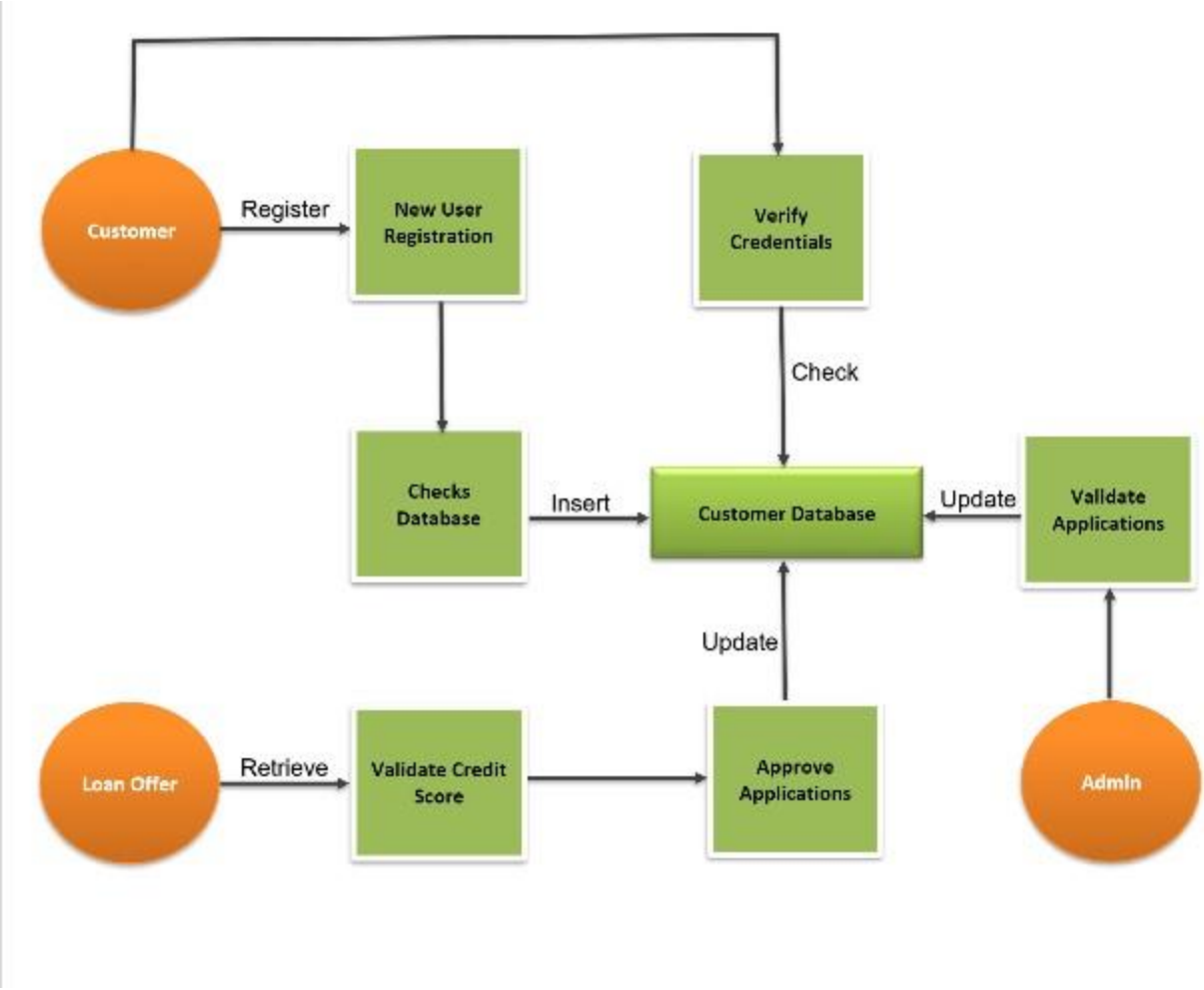
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1		Registration through Bank Website Registration through Gmail Registration through mobile Application
FR-2	User Confirmation	Confirmation via Email Confirmation
FR-3	Loan type	Personal Loan Education
FR-4	User Details	Name, Address, Income, Occupation.
FR-5	Assets Proof	Agricultural land, Gold
FR-6	Verification	Verification of user Details which are provided above

4.2 NON-FUNCTIONAL REQUIREMENTS

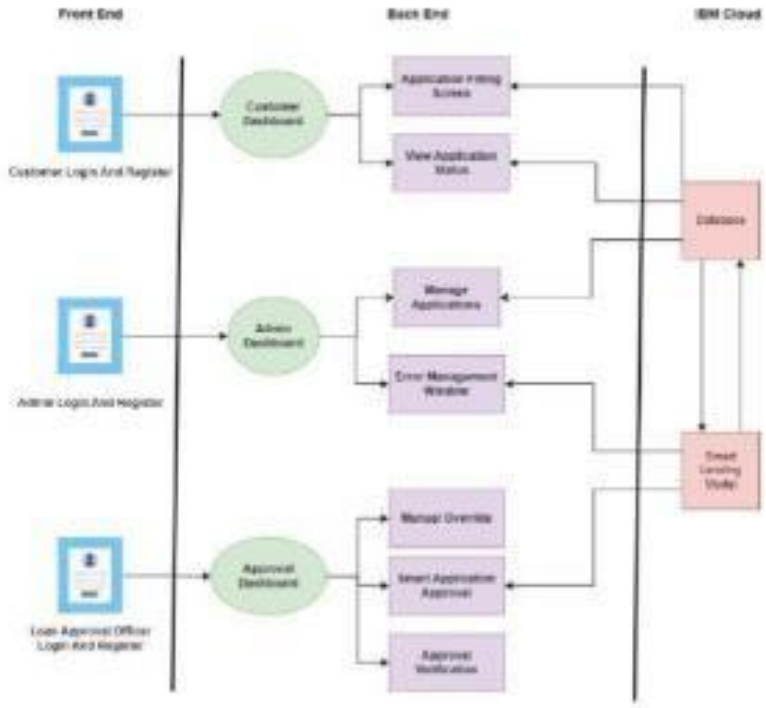
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Easy to access
NFR-2	**Security**	User proofs
NFR-3	**Reliability**	Based on the customer Income
NFR-4	**Performance**	Previous history of the user bank account
NFR-5	**Availability**	Based on the customer Address
NFR-6	**Scalability**	Based on the customer Assets proofs

CHAPTER 5
PROJECT DESIGN

5.1 DATA FLOW DIAGRAM



5.2 SOLUTION & TECHNICAL ARCHITECTURE



Guidelines:

1. Include all the processes (As an application logic / Technology Block)
2. Provide infrastructural demarcation (Local / Cloud)
3. Indicate external interfaces (third party API's etc.)
4. Indicate Data Storage components / services
5. Indicate interface to machine learning models (if applicable)

5.3. USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1

		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
		USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
		USN-6	As a user, I can log into the application by entering email & password	I can check my score by providing PAN	High	Sprint-1
Customer (Web user)		USN-7	As a user, I can interact with financial institutions		High	Sprint-2
Customer Care Executive		USN-8	As a user, I can solve my queries by interacting with helpline		Medium	Sprint-2
Administrator		USN-9	As a user, I can avail loans and credit from financial institutions	Credit score	High	Sprint-1

CHAPTER 6

PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

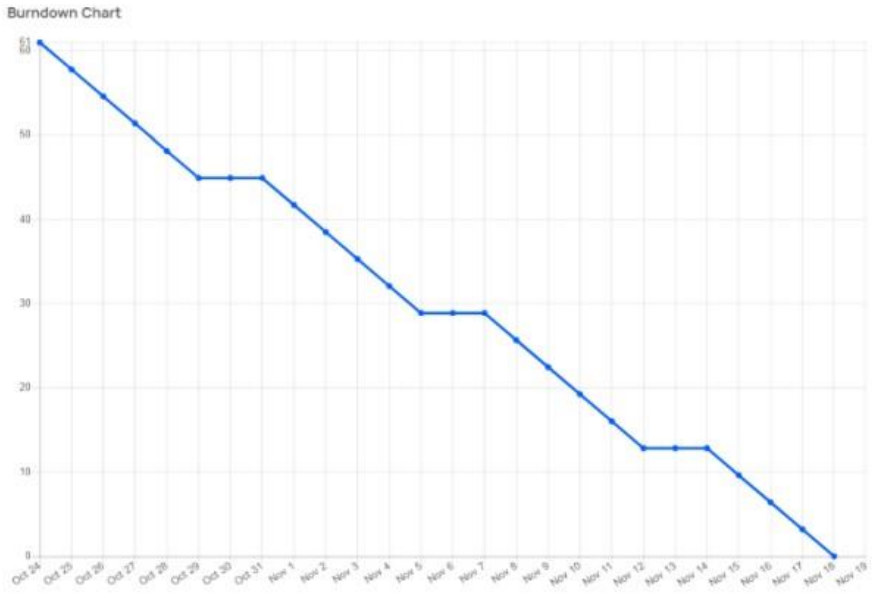
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint – 1	Forms	USN – 1	As a user, I can enter the data which I have and also the data which the website asks to me	6	Very High	Riyas, Nayeem, Abrar, Bilal
Sprint – 3	Prediction	USN – 2	As I have given the data into the webpage, now the data can be predicted for the loan avail	4	Medium	Riyas, Nayeem, Abrar, Bilal
Sprint – 4	Deployment of the Webpage in Cloud	USN – 3	As a user, I require global access to the web page as a user	3	Low	Riyas, Nayeem, Abrar, Bilal
Sprint – 4	Deployment of AI model in the cloud	USN – 4	Model would be running on the Cloud	3	Low	Riyas, Nayeem, Abrar, Bilal
Sprint – 2	Model building	USN – 5	I require an ML model that can categorise Credit defaulters	5	High	Riyas, Nayeem, Abrar, Bilal

Sprint – 3	User Interface building	USN – 6	As a User, I need a medium to enter my data	4	Medium	Riyas, Nayeem, Abrar, Bilal

6.2 SPRINT DELIVERY SCHEDULE

Sprint	**Total Story Points**	**Duration**	**Sprint Start Date**	**Sprint End Date (Planned)**	**Story Points Completed (as on Planned End Date)**	**Sprint Release Date (Actual)**
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	6	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	6	6 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	6	13 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	6	19 Nov 2022

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.

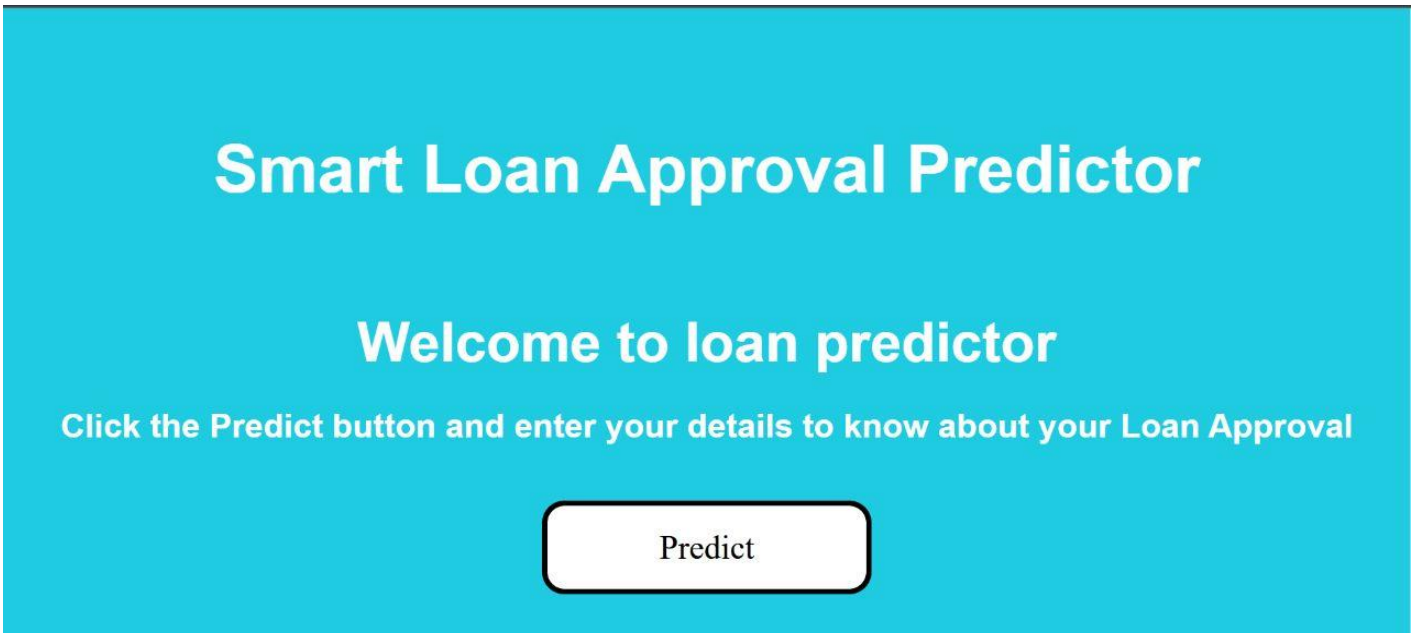


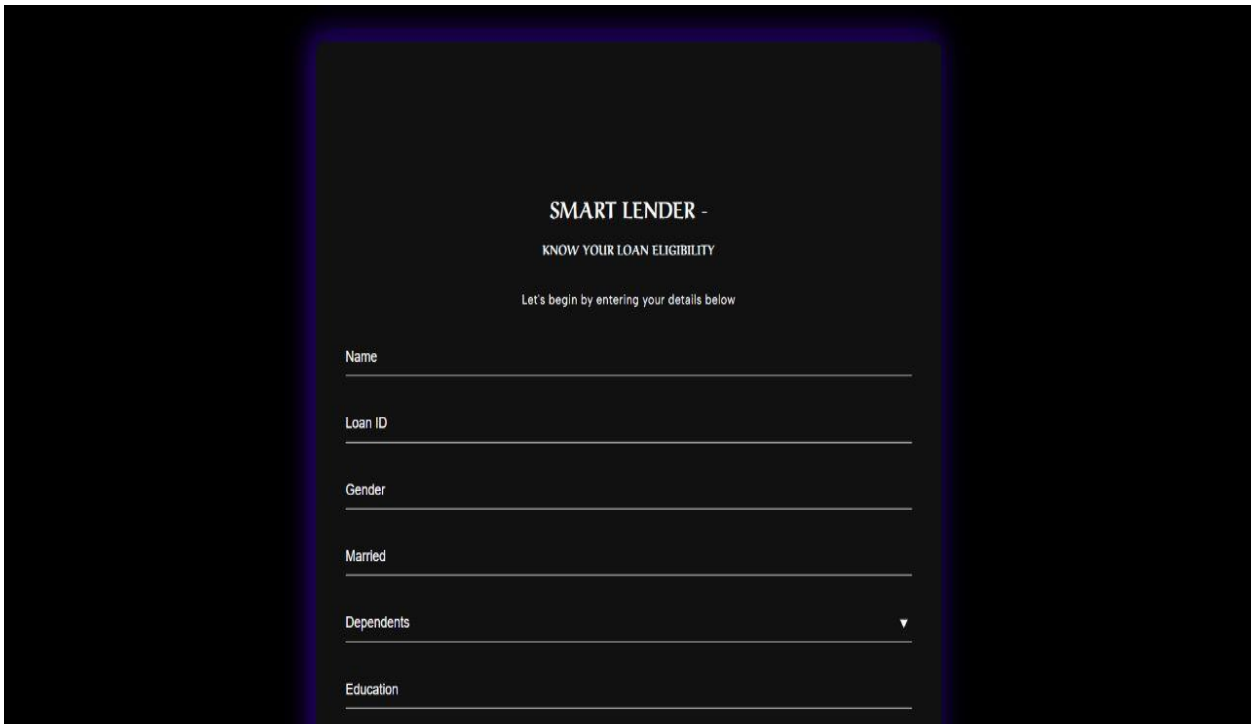
CHAPTER 7

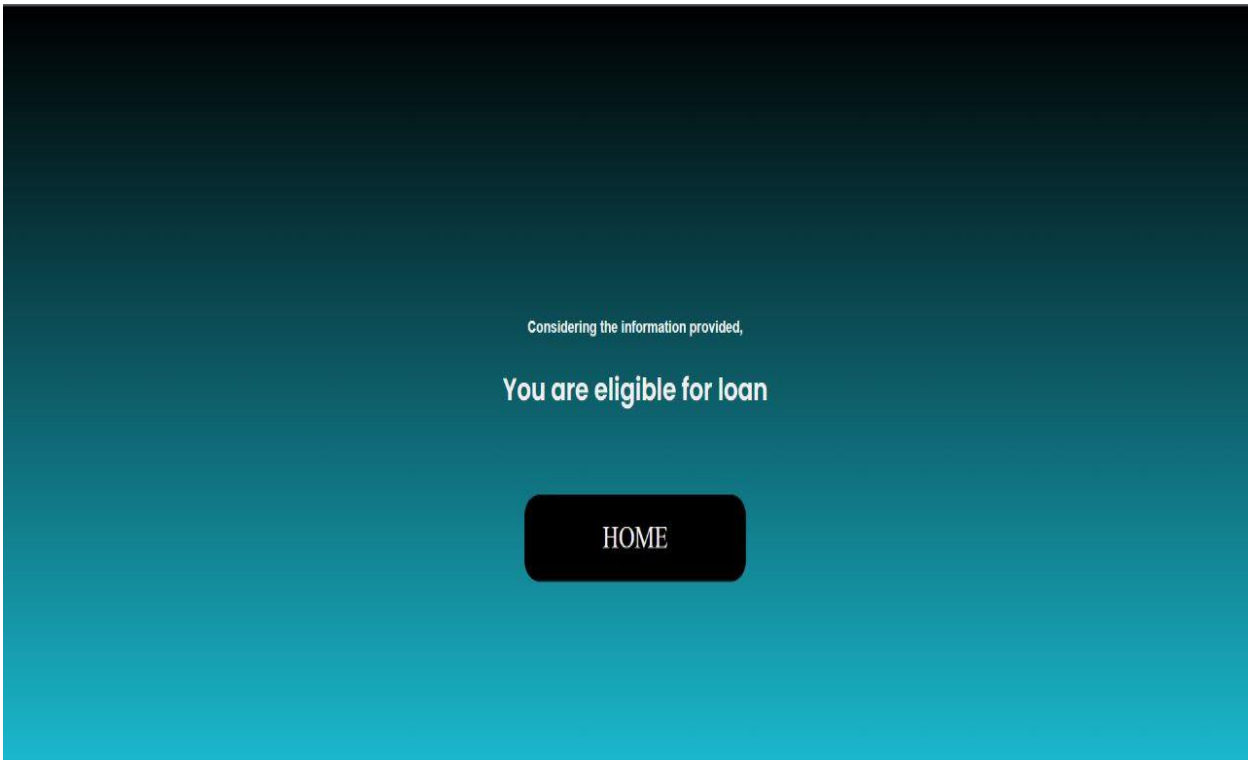
CODING & SOLUTIONING

```
from flask import render_template,Flask,request
import numpy as np import pickle

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

model = pickle.load(open("rdf.pkl",'rb')) 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_income,loan_a
mount,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)

   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(con_features)    prediction =
model.predict(scale_features)    print(prediction)    if prediction == 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)
```




SMART LENDER -
KNOW YOUR LOAN ELIGIBILITY
Let's begin by entering your details below
Name
Loan ID
Gender
Married
Dependents
Education


Considering the information provided,
You are eligible for loan
HOME

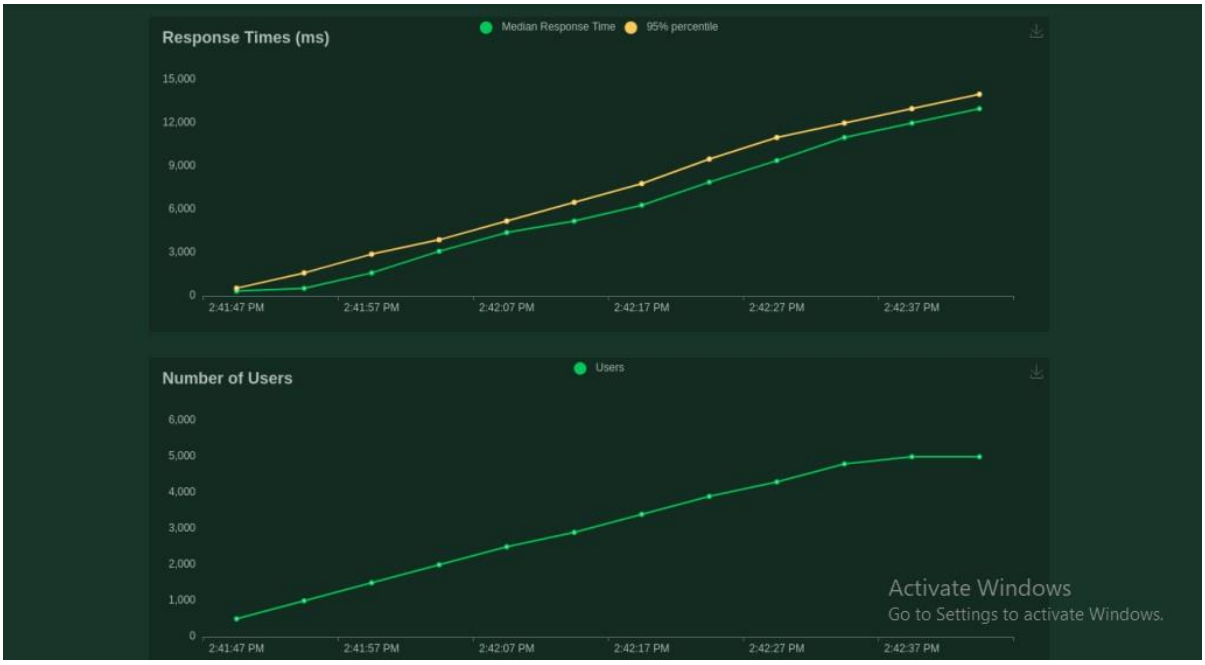
CHAPTER 8

TESTING

8.1 **TEST CASES**

Loan_ID	Gender	Married	Dependents	Education	Self-employed	Applicant Income	Coapplicant Income	Loan Amount	Loan Amount Term	Credit History	Property Area	Loan Status
LP001002	Male	No	0	Graduate	No	5849	0		360	1	Urban	Y
LP001003	Male	Yes	1	Graduate	No	4583	1508	128	360	1	Rural	N
LP001005	Male	Yes	0	Graduate	Yes	3000	0	66	360	1	Urban	Y
LP001006	Male	Yes	0	Not Graduate	No	2583	2358	120	360	1	Urban	Y
LP001008	Male	No	0	Graduate	No	6000	0	141	360	1	Urban	Y
LP001011	Male	Yes	2	Graduate	Yes	5417	4196	267	360	1	Urban	Y
LP001013	Male	Yes	0	Not Graduate	No	2333	1516	95	360	1	Urban	Y
LP001014	Male	Yes	3	Graduate	No	3036	2504	158	360	0	Semiurban	N
LP001018	Male	Yes	2	Graduate	No	4006	1526	168	360	1	Urban	Y

LP00102 0	Male	Yes	1	Graduate	No	12841	10968	349	360	1	Semiurban	N



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	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

3. Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7

Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

CHAPTER 9

RESULTS

For the purpose of predicting the loan approval status of the applied customer, we have chosen the machine learning approach to study the bank dataset. We have applied various machine learning algorithms to decide which one will be the best for applying on the dataset to get the result with the highest accuracy. Following this approach, we found that apart from the logistic regression, the rest of the algorithms performed satisfactory in terms of giving out the accuracy. The accuracy range of the rest of the algorithms were from 75% to 85%. Whereas the logistic regression gave us the best possible accuracy (88.70%) after the comparative study of all the algorithms.

We also determined the most important features that influence the loan approval status. These most important features are then used on some selected algorithms and their performance accuracy is compared with the instance of using all the features. This model can help the banks in figuring out which factors are important for the loan approval procedure. The comparative study makes us clear about which algorithm will be the best and ignores the rest, based on their accuracy.

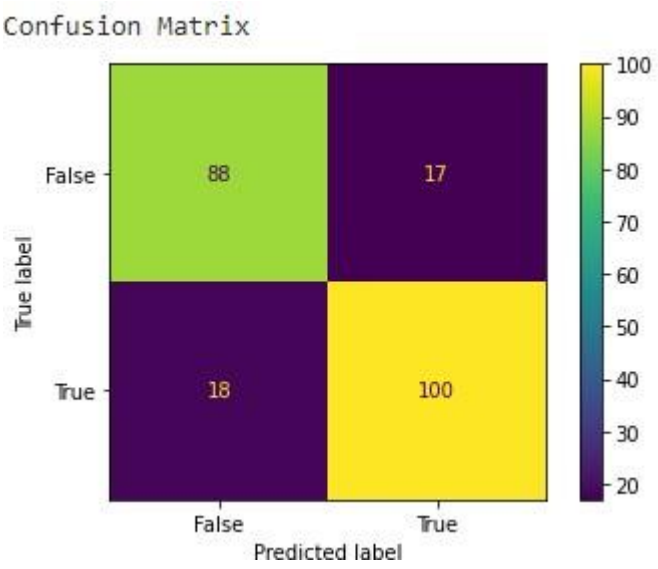
9.1 Performance Metrics:

Project team shall fill the following information in model performance testing template.

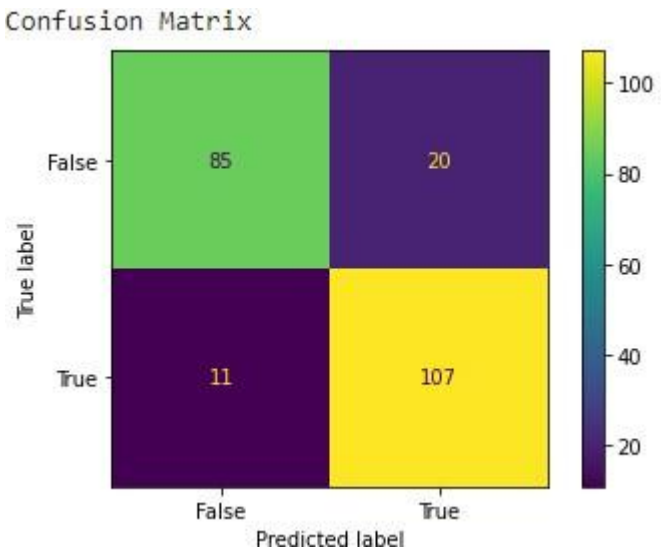
S.No.	Parameter	Values
1.	Metrics	**Classification Model: Decision Tree** Accuracy Score - 84% **Classification Report** precision recall f1-score 0 support 0.83 0.84 0.83 105 1 0.85 0.85 0.85 118
2.		**Classification Model: Rand om Forest** Accuracy Score - 84% **Classification Report** f1-score 0 support precision recall 0.85 0.89 0.81 0.87 105 118

		1 0.84 0.91
3.		**Classification Model: KNN** Accuracy Score - 78% **Classification Report** precision recall f1-score 0 support 0.82 0.70 0.76 105 1 0.77 0.86 0.81 118
4.		**Classification Model: XGB ost** Accuracy Score - 85% **Classification Report** precision recall f1-score 0 support 0.90 0.77 0.83 105 1 0.82 0.92 0.87 118

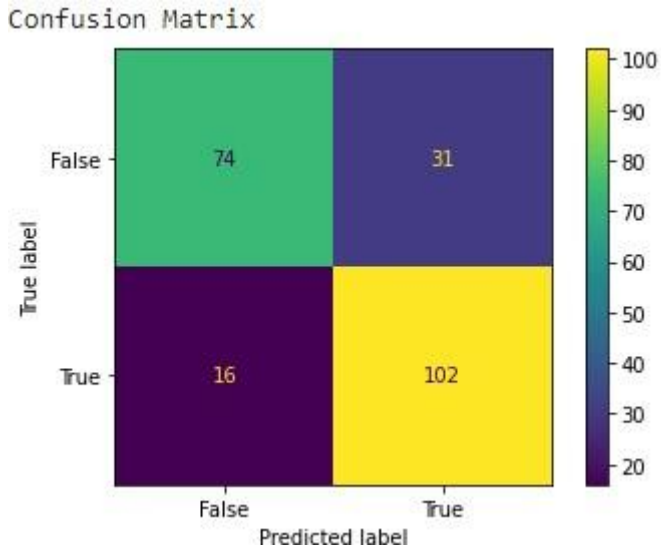
DECISION TREE CLASSIFIER



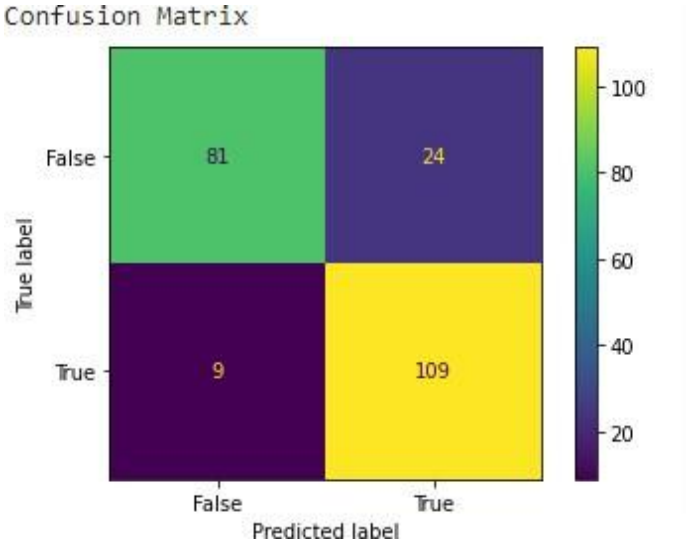
RANDOM FOREST CLASSIFIER



KNN



XG BOOST



CHAPTER 10

ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES

The benefits of loan tech servicing software for lenders include:

- **Eliminating human error**

It's no secret, that calculations are something that algorithms handle better than we, humans. In a lending system, there are just too many variables, which is why it is error-prone. The best loan servicing software, however, is created to completely rule out any errors, which is, undoubtedly, beneficial from every standpoint.

- **Preventing delays in payment**

Not being able to collect a debt is something that most lenders are especially wary of. However, if they leverage a traditional loan management approach, they may not see it coming. Loan servicing systems, on the other hand, integrate analytic modules capable of detecting even the most subtle fluctuations in clients' credibility and preventing payment delays in a timely manner.

- **Saving time**

Loan management requires a great level of meticulousness and attention to detail. As a rule, a full-fledged team is required to deal with every aspect of a loan process. Needless to say, loan management carried out manually and based on paperwork takes up a lot of time. A digital lending system, on the other hand, automates the routines and enables your team to dedicate time to other important tasks.

- **Automated reporting**

Automated report generation is another invaluable feature offered by a digital loan servicing platform. Accounting, tax reports, and invoices are often requested by regulatory bodies, borrowers and investors. These high urgency reports should be provided on demand, and contain information, which is 100% accurate. Loan tracking software enables lenders to quickly generate reports of different types and submit them urgently, in the required formats.

- **Increased revenue**

This stems from all of the above: an automated loan processing system enables lenders to process more applications, assign and manage more loans, and see them all the way through closing all while detecting scams and preventing delays. The staff is free to oversee the process and focus on client relationships and look for new business opportunities. This enables financial companies to gain a distinct competitive edge and increase revenue.

10.2 DISADVANTAGES

1. Accessibility

An organization looking to build loan software may not have enough on-premise infrastructure capacities to ensure its non-disruptive operation, updates, and support. Scaling during peak workloads and handling an increase in the number of users and subscriptions may

also be quite challenging. Using cloud infrastructure is best to ensure optimal scalability and availability.

2. Servicing different loan types

The more types of loans your money lending software is capable of servicing, the better. Lending applications that have a wide range of use cases, will surely attract more users than apps targeting only one specific loan type. A loan Tech software to create loan app estimation, for example, may have a broad range of applications from student loan tech calculations to estimating business loans and mortgages.

3. Centralized data storage

Every stage of the lending process involves working with customer data. The best loan servicing software stores this data in centralized storage accessible during every loan processing stage. A legacy loan management system, on the other hand, uses a siloed approach to data storage, which makes loan processing more laborious and lengthier.

4. Integrated credit assessment capabilities

Modern loan servicing software for private lenders should be able to instantly connect with credit bureaus and any other bodies responsible for credibility assessment. Such platforms should receive regular credit data updates and leverage big data analytics to assess the trustworthiness of applicants. The client's social media activity, for example, can be a valid source of alternative assessment of credibility.

5. Automation of routine processes

Using robotic process automation to streamline simple rule-based processes is another musthave feature of a loan management platform. Automation accelerates loan origination and processing and accounts for increasing client satisfaction. On top of that, it helps to avoid human error.

6. In-built analytic modules

Leveraging artificial intelligence (AI) and big data is another hallmark of excellent loan servicing software for lenders. Not only does it help to generate reports but also enables

companies to evaluate market trends, detect patterns in customer behavior and come up with new products and offerings.

7. Third-party integration

Another feature that most organizations find especially attractive in a loan processing system, is its capability to integrate with other enterprise software. ERP and CRM solutions are capable of enriching the lending system with data and insights. Systems integrating lending modules with software for remote sales personnel are also enjoying high popularity among lenders.

8. Security

Finance company software works with classified and highly sensitive data, and for both lenders and customers, security is a matter of paramount importance. An excellent lending system should possess advanced security capabilities, and ensure the highest level of customer, data, and network protection.

CHAPTER 11

CONCLUSION

In the debate over which supervised learning model to use for credit risk assessment, we have come to the conclusion that support vector machines can outperform other tree- based models or regression models if the setup of the experiment is similar to that of ours. Furthermore, in the debate over which dimensionality reduction technique to use, our model has shown us that recursive feature elimination with cross-validation can outperform models based on principal component analysis. For future improvements we would like to use more current data and from different sources for illustrating a better understanding of

the trends present in this field. Datasets similar to the above-mentioned experiments from previous works will be used to test this model for better comparison. It has been mentioned that in order to reduce computational cost and complexity we have omitted the idea of using neural networks. But as we are looking forward to work with even larger amount of data, we would like to make a comparative analysis using neural networks as well. It is a known fact that neural networks tend to perform better with large datasets and we would like to test this hypothesis in our future works. Again, as we are also discussing the contributions of feature selection/extraction techniques, we would like to implement other dimensionality reduction techniques such as genetic algorithm, univariate feature selection methods, tree-based feature selections etc. to gauge their performances and further improve the efficiency of the credit lending sector. Therefore, this paper can be concluded with the statement that this model illustrates an interesting approach in identifying loan defaulters in this ever-changing economy. Using the dataset from Lending Club our model has brought about remarkable results which in turn can play a major role in assessing the credit risk of borrowers, assist credit lending institutions and enable financial institutions to keep operating in a transparent and profitable way.

CHAPTER 12

FUTURE SCOPE

In this section, based on various performance metrics, a comparative analysis will be made of all the generated models. A precise classifier is the backbone of any machine learning model. Four supervised algorithms: Support vector machine (SVM), Logistic Regression (LR), Extreme Gradient Boosting (XGB) and Random Forest (RF) have been selected for the analysis. The hyperparameters of these algorithms will be tuned using GridSearchCV to select the best set of values for each model. The results will be discussed in two categories and will be illustrated in both a graphical and tabular manner. Firstly the models will be evaluated on a holdout test set using a train test split. Then another comparative analysis will be made of the same models but using a 5 fold cross- validation and GridSearchCV.

CHAPTER 13
APPENDIX

SOURCE CODE APK.PY

```
import pickle

import numpy as np
from flask import Flask, render_template, request

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

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

@app.route('/') def
home():
   return render_template('home.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_income,loan_a
mount,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)

    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,loa
n_term,credit_history,property_area]

    con_features = [np.array(features)]

    scale_features = scale.fit_transform(con_features)
prediction = model.predict(scale_features)
print(prediction)     if prediction == 0:
        return render_template('submit.html', prediction_text ='You are eligible for loan')
else:
        return render_template('submit.html',prediction_text = 'You are not eligible for loan')



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

HOME.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 Loan Approval Predictor</title>
    <link rel="stylesheet" href="home.css" />

    <style>
      @import
 url("https://fonts.googleapis.com/css2?family=Aref+Ruqaa+Ink:wght@700&display=swap");
      @import url("https://fonts.googleapis.com/css2?family=Albert+Sans&display=swap");
      @import url("https://fonts.googleapis.com/css2?family=EB+Garamond&display=swap");
```

```
    *{
      background-color:inherit;
font-family: 'Roboto', sans-serif;
margin:0;       padding: 0;
    }
    .container {
display: flex;       flex-
direction: column;
text-align: center;

    }

    .main1{       min-
height: 100vh;
width :100%;
      background-image: linear-gradient(
rgba(0, 0, 0, 0.925),          rgba(0, 203,
230, 0.884)
      ),url('pic.jpg');
background-size: cover;       color:
#f2f2f2;
    }
    .btn {
      border: 1px solid #fafafa;
       background: none; padding:
       20px 100px;
      font-size: 30px;       font-
family: "montserrat";
cursor: pointer;       margin:
50px;       transition: 0.8s;
position: relative;
overflow: hidden;
```

```
    }      .btn1 {        color:
black;        background:
white;        border-color:
black;        border-style:
groove;        border-
width: 5px;        border-
radius: 20px;

    }
    .btn1:hover {
color: antiquewhite;
background: grey;
    }
    .btn::before {
content: "Predict";
position: absolute;
left: 0;

      width: 100%;
height: 0%;
       background: #ffffff;
       z-index: 5;
transition: 0.8s;
    }
    .btn1::before {
top: 150;
       border-radius: 100% 100% 50% 50%;
    }
    .btn1:hover::before {
height: 180%;
    }
    html {
height: 100%;
```

```
    }

    h1 {        font-size: 60px;        font-
family: "Poppins", sans-serif;
    }

    h2 {        font-size: 50px;        font-
family: "Poppins", sans-serif;
    }      h3 {        margin-top: 30px;
font-size: 30px;        font-family:
"Poppins", sans-serif;
    }
    #footer {        margin-
bottom: 20px;
    }
    footer a {
      text-decoration: none; color:
      white;
      border-color: aquamarine;
background: rgb(138, 138, 249);
border-radius: 10px;        padding:
10px;}
  </style>
 </head>

 <body>
  <main>
   <center>

     <div class="main1">
      <br><br><br><br><br><br>
        <h1>Smart Loan Approval Predictor</h1>
        <br><br><br><br><br>
```

```
        <h2>Welcome to loan predictor</h2>
        <h3>
          Click the Predict button and enter your details to know about your
          Loan Approval
        </h3>

        <div class="container">
          <a href="predict.html">
            <button class="btn btn1" onclick="predict.html">Predict</button>
          </a>
        </div>
      </div>

      <footer>
        <div id="footer">

        </div>
      </footer>
    </center>
  </main>
 </body>
</html>
```

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

    html {       height:
100%;
background: black;
    }

    body {       margin: 0;
padding: 0;       font-
family: sans-serif;
      /* background: linear-gradient(#141e30, #243b55);*/
      background: grey; background:
      red;
    }

    .login-box {
position: absolute;
top: 100%;       left:
50%;       width: 50%;
padding: 40px;
      transform: translate(-50%, -50%);
background: rgba(35, 34, 36, 0.5);       box-sizing:
border-box;
      box-shadow: -5px -5px 30px 5px red, 5px 5px 30px 5px rgb(3, 3, 8);       border-
radius: 10px;
    }

    ::placeholder {
color: aliceblue;
    }
```

```
    .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,
    .login-box .user-box input:valid ~ label { top:
     -20px;
      left: 0; color:
      #03e9f4;
      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: rgb(236, 240, 241);
    }

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

```
    button:hover {
cursor: pointer;
    }

    button {
      background: transparent;
outline: none;       position:
relative;       border: 3px solid
#f50404;       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;        font-size: 0.8em;
transition: all 0.3s ease-in-out;
    }

    /*--- Footer ---*/

    .footer {
margin-top: 203vh;
    }

    .nav-link {        font-weight:
bold;        font-size: 14px;
text-transform: uppercase;
text-decoration: none;
color: #031d44;        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: #031d44;
    }

    .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;
    }
  </style>
 </head>
```

```
 <body>


  <div class="login-box">
   <h2
    style="text-transform: uppercase; font-family: 'Aref Ruqaa Ink', serif"
   >
    <br><br><br>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 details 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>
</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>
        <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>
       <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 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

```
<!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 Loan Predictor</title>
 </head>
 <style>
@import
url("https://fonts.googleapis.com/css2?family=Poppins:wght@400;500;600&display=swap") ;
   *{
      background-color:inherit;
font-family: 'Roboto', sans-serif;
margin:0;        padding: 0;
    }
    .container {
display: flex;        flex-
direction: column;
text-align: center;

    }

    .section-padding{        min-height:
70vh;        width :100vw;
background-image: linear-gradient(
        rgb(0, 0, 0),
rgba(0, 203, 230, 0.884)
      ),url('pic.jpg');
background-size: cover;
color: #f2f2f2;        padding-top:
40vh;
    }
    .btn {        border: 1px solid
#fafafa;        background:
none;        padding: 20px
100px;        font-size: 30px;
```

```
font-family: "montserrat";
cursor: pointer;
        margin: 50px;
       transition: 0.8s;
position: relative;
overflow: hidden;

    }
    .btn1 {        color: rgb(245,
238, 238);        background:
rgb(0, 0, 0);        border-color:
black;        border-style:
groove;        border-width:
5px;        border-radius: 20px;

    }


    html {
height: 100%;
    }

    h1 {        font-size: 60px;        font-
family: "Poppins", sans-serif;
    }

    h2 {        font-size: 50px;        font-
family: "Poppins", sans-serif;
    }      h3 {
margin-top: 30px;
font-size: 30px;
       font-family: "Poppins", sans-serif;
    }
```

```
   footer {
background: grey;
padding: 60px 0;
text-align: center;
   }
   footer img {      max-
width: 400px;
   }

 </style>

 <body>

   <section id="about" class="section-padding">
     <div class="container grid">
       <div class="left-content">
         <h4>Considering the information provided,<br><h3>{{prediction_text}}</h3></h4>
       </div>
     </div>
     <div class="container grid">
       <h3 class="heading"><center>{{result}}</center></h3>
     </div>

     <center><a href="http://127.0.0.1:5000/">
       <button class="btn btn1" onclick="home.html">HOME</button>
     </a></center>
   </section>
   <footer>
     <div class="container">
       <a href="#">
         <p>Designed by....</p><br>
```

```
        <p>Prateeksha</p>
        <p>hansika</p>
        <p>Saulathaa</p>
        <p>Bhuvanesh</p>
       </a>
      </div>
    </footer>
  </body>
</html>
```

GITHUB

https://github.com/IBM-EPBL/IBM-Project-16385-1659612590

PROJECT DEMO

https://drive.google.com/file/d/1xVw3y_1e_kNPXvixNpKKmji0sxk3u3n1/view