Smart Lender Applicant Credibility Prediction for Loan Approval

IBM-Project-10223-1659114439

Project Report

Team Members

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Chapter 1: INTRODUCTION

1.1 Project Overview

The credit system governed by the banks is one of the most important factors which affect our country's economy and financial condition. Also, 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. This problem occurs when the banks need to provide loans to the customers who are in need of the money. But by forecasting the loan defaulters, the banks definitely may reduce their loss by reducing their non-profit assets.

1.2 Purpose

People who need loan and want to check whether they are eligible for loan or not

Chapter 2: LITERATURE SURVEY

2.1 References

S. No	Paper	Year	Citation	Methodologies used
1	**Machine Learning Based Model for Prediction of Loan Approval**	2022	B. P. Lohani, M. Trivedi, R. J. Singh, V. Bibhu, S. Ranjan and P. K. Kushwaha, "Machine Learning Based Model for Prediction of Loan Approval," *2022 3rd International Conference on Intelligent Engineering and Management (ICIEM)* , 2022, pp. 465-470, doi: 10.1109/ICIEM54221.2022.9853160.	In this paper, they have applied logistic regression as a tool to predict whether an applicant is eligible for the loan or not
2	**Loan Approval Prediction**	2022	Shubham Nalawade, Suraj Andhe, Siddhesh Parab, Prof. Amruta Sankhe "Loan Approval Prediction" ,International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 , Volume: 09 Issue: 04 , April 2022	They have compared the accuracy of different machine learning algorithms. They got a percentage of accuracy ranging from 75-85% but the best accuracy they got was from Logistic Regression i.e.88.70%

3	**Bank Loan Approval Prediction Using Data Science Technique (ML)**	2022	Subhiksha R, Vaishnavi L, Shalini B, Mr. N. Manikandan,"Bank Loan Approval Prediction Using Data Science Technique (ML)",International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321- 9653, Volume 10 Issue V May 2022	In this paper, four algorithms are used such as Random Forest algorithm, Decision Tree algorithm, Naive Bayes algorithm, Logistic Regression algorithm to predict the loan approval of customers. All the four algorithms are going to be used on the same dataset and going to find the algorithm with maximum accuracy to deploy the model.
4	**Algorithm For the Loan Credibility Prediction System**	2019	Soni P M, Varghese Paul, "Algorithm For the Loan Credibility Prediction System", International Journal of Recent Technology and Engineering (IJRTE)ISSN:2277-3878, Volume-, Issue-1S4, June 2019	In this research work a novel hybrid feature selection algorithm using wrapper model and fisher score is introduced. The main objective of this paper is to prove that new hybrid model produces better accuracy than the traditional random forest algorithm

5	**An Approach for Prediction of Loan Approval using Machine Learning Algorithm**	2020	M. A. Sheikh, A. K. Goel and T. Kumar, "An Approach for Prediction of Loan Approval using Machine Learning Algorithm," *2020 International Conference on Electronics and Sustainable Communication Systems (ICESC)* , 2020, pp. 490- 494, doi: 10.1109/ICESC48915.2020.9155614.	The data is collected from the Kaggle for studying and prediction. Logistic Regression models have been performed and the different measures of performances are computed

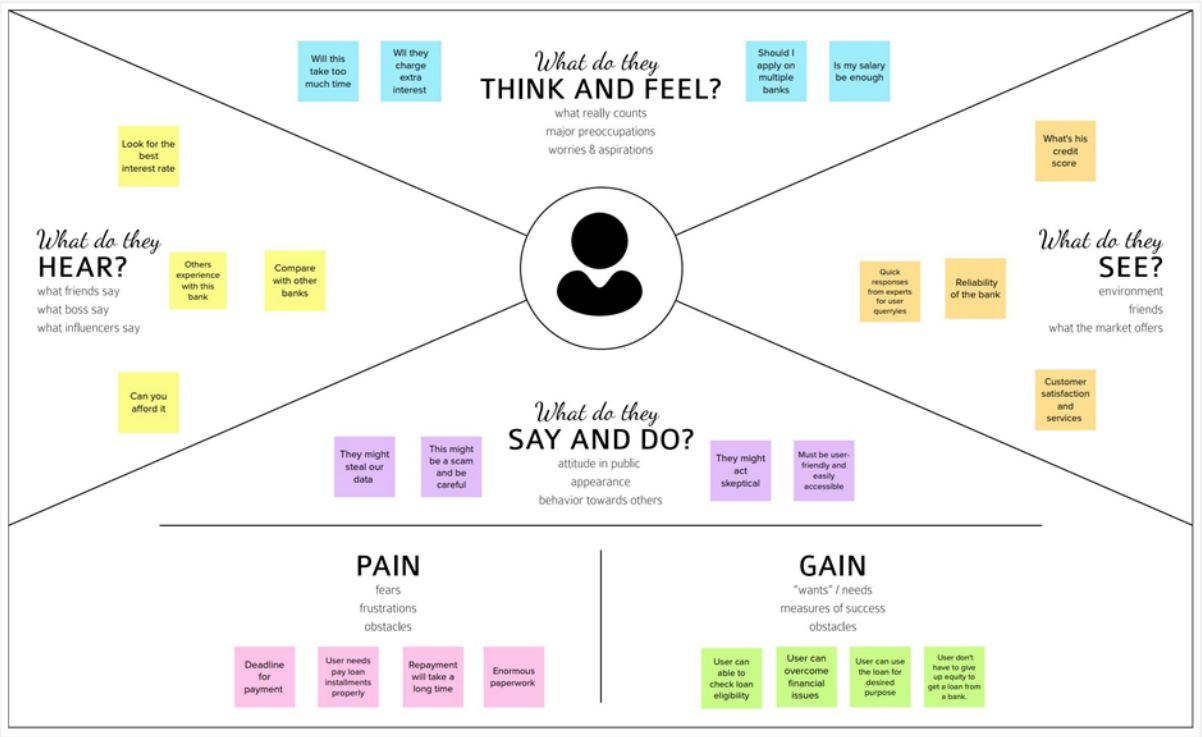
2.2 Problem Statement Definition

The credit system governed by the banks is one of the most important factors which affect our country's economy and financial condition. Also, 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. This problem occurs when the banks need to provide loans to the customers who are in need of the money. But by forecasting the loan defaulters, the banks definitely may reduce their loss by reducing their non-profit assets.

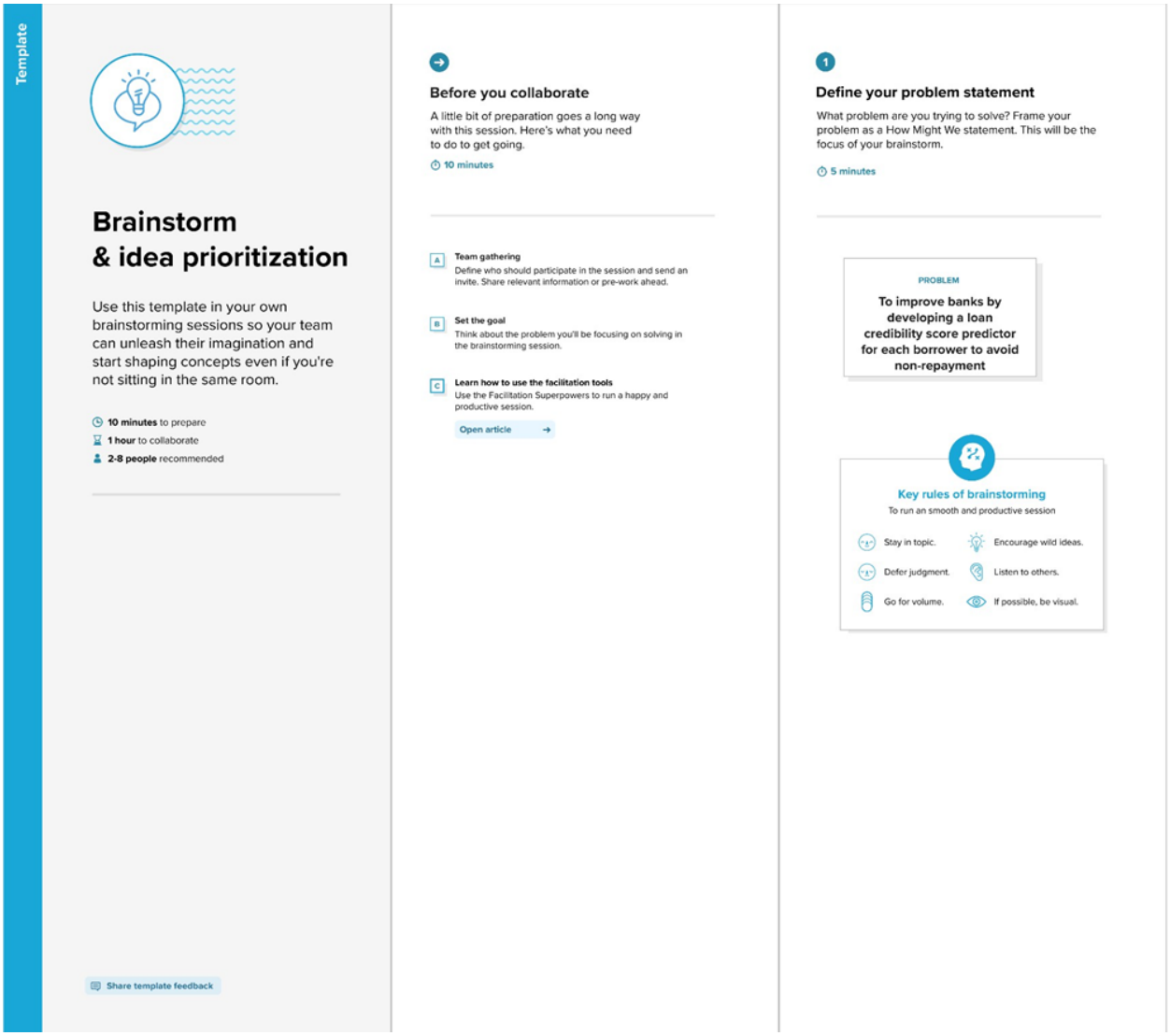
Chapter 3: IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes. It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



3.2 Ideation & Brainstorming



2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

Allen Manoj

- A pay stub from your employer may occasionally be required by the bank or creditor in order for your loan application to be accepted.
- Credit ratings can be built up by doing things like keeping your credit card balance low
- The legal right to repossess the collateral minimizes losses, allowing them to approve more applicants
- make sure you have enough spare money in your following paycheck to repay the obligation right away while covering your regular bills at the same time.
- personal loans via apps are faster in terms of application and approval process.
- You can take a loan from an online loan app for medical emergencies or buy any large asset.
- Call the customer service numbers on the back of your credit cards and ask for an increase.
- Boosting your income and lowering your debt improves your debt-to-income ratio, which is the percentage of your monthly debt payments divided by monthly income.
- Perks like financial advising and flexible payments.

Janani

- Retirement loans allow you to borrow money from yourself.
- your name in all legal records has to be the same, else, there would be complete chaos. This is why your Aadhaar number is unique and remains the same always.
- CIBIL score is an important parameter for evaluating Loan applications. If your CIBIL score is low, your loan application can be rejected by banks or NBFCs.
- In order to qualify for a consolidation loan, you must have a good credit score and enough income to handle the combined monthly payment to the new lender (after meeting your other living expenses such as housing and transportation).
- In order to qualify for a settlement program, you must owe more than $10,000 in unsecured debt (credit cards, medical debt, personal loans) and have enough income to fund an escrow account with 1/3 of the amount owed.
- Shorter repayment terms pose lower default risks
- Have these documents ready in advance: Monthly bank statements Recent tax returns Pay stubs dating back three months or more A signed letter from your employer
- Sometimes if you are getting a loan from a bank or creditor that is different from your own, providing them with a bank statement can help to improve the speed at which you can attain your loan.
- Be sure to do some additional research, as every bank and creditor has different policies regarding this.

Allen Manoj

- Credit scores are major considerations on personal loan applications. The higher your score, the better your approval chances
- Understanding credit score One person has one identity.
- Lower APR than other types of personal loan lenders.
- Both approaches work very differently and have unique pros and cons.
- A debt consolidation loan means that one new lender pays off what you owe to multiple old creditors.
- Be prepared to verify employment and earnings when seeking a personal loan based on income only rather than credit score.
- If you don't have good credit, it's hard to get approved through a bank. Also, few banks let you pre- qualify to preview the loan's rate and term. This option is more common with online lenders
- Peer-to-peer lending enables persons to borrow and lend money without the use of an official financial institution as a mediator.
- Loan applications ask for your annual income, and you can include money earned from part-time work.

Janani

- Sometimes these statements must be official and sent from your bank to another bank, but in other cases, you may simply print off a screenshot of your bank
- Requesting more money than what you need to reach your financial goal can be seen as risky by lenders and may make it harder to get approved.
- You don't have to visit any bank or branch when you deal with online loan app
- Unsecured loans do not require collateral or put you in jeopardy of losing your house to foreclosure.
- never missing payments, and staying in good financial standing with your bank.
- One of the best ways to get easily approved for any kind of loan is to have an extremely good credit rating.
- People with terrific job security have the best approval odds because the lender can count on your income continuing through the end of the loan term.
- Many types available including secured personal loans.
- Pay close attention to the three primary eligibility criteria: credit scores, income and affordability, and the documentation needed to verify your identity online.

Benita Majo

- taking out and then repaying an installment loan on time should improve your score in the future, allowing you to borrow money at better rates.
- Such apps provide instant personal loan starting from INR 10,000 to INR 2 lakh. You can get a loan as per your requirement and eligibility
- Income-based auto loans are often easier to obtain without a credit score because the lenders hold the title to a valuable asset.
- his is one of the major benefits offered by online loan app. Once your personal loan is approved, the cash amount is directly transferred into your personal savings account.
- Lenders also typically require minutes and/or resolutions that document Board approval of the loan
- Get on top of payments. If you're not already, be vigilant about making monthly payments toward all your debts, paying more than the minimums when you can.
- "Buy now, pay later" plans let you purchase items now and pay for them over a series of installments, usually without interest or fees
- If you're already a customer with the bank, you may receive an additional APR discount
- a lower credit score is also welcome on P2P lending platforms. In fact, the P2P industry is fast becoming a reliable hub for loans for people with no cibil score

Kumaran

- A credit card is technically a loan that is referred to as a revolving line of credit. Every time you use your card, your card's issuing bank lends you the money to pay for your purchase
- Explore each alternative to decide which is best for your needs before taking the plunge.
- As these are unsecured short-term loans the interest rates are normally low compared to the bank loans. The interest rates on loan app start from as low
- Beware of the high origination fees associated with payday cash advances
- Consumers are easily confused about how debt consolidation works because the industry uses interchangeable terms.
- Depending on your eligibility you can avail a loan amount of your own choice.
- If you ask the lender to disregard a critical underwriting factor, you must shine in this area.
- Bear in mind that installment loans have fixed monthly payments over a predefined period and many contract types with lower borrowing costs fit the broad definition.
- Personal loans based on income and not a credit score can help borrowers with weak credentials obtain quick funding for a vacation, or Emergency cash etc.,

Benita Majo

- First, unpaid doctor or hospital bills can sometimes inflate your debt to income ratio
- Smaller principal amounts help minimize losses
- in order to get a proper pay stub to prove your income and employment
- Before shopping around for loan offers, community associations must first determine if they have authority to borrow funds.
- They are best suited to emergencies, such as medical bills, car repair, and other urgent needs due to the high borrowing costs.
- Missed payment does not hurt your credit score.
- The lender will ask and will require documentation to confirm you have the finances in order to repay the loan.
- Specific guidelines issued by different agencies determine how medical collections appearing on your credit report will affect a mortgage approval and interest rate.
- Meanwhile, contracts secured by the equity (if you have enough) in your property have more affordable payments.

Kumaran

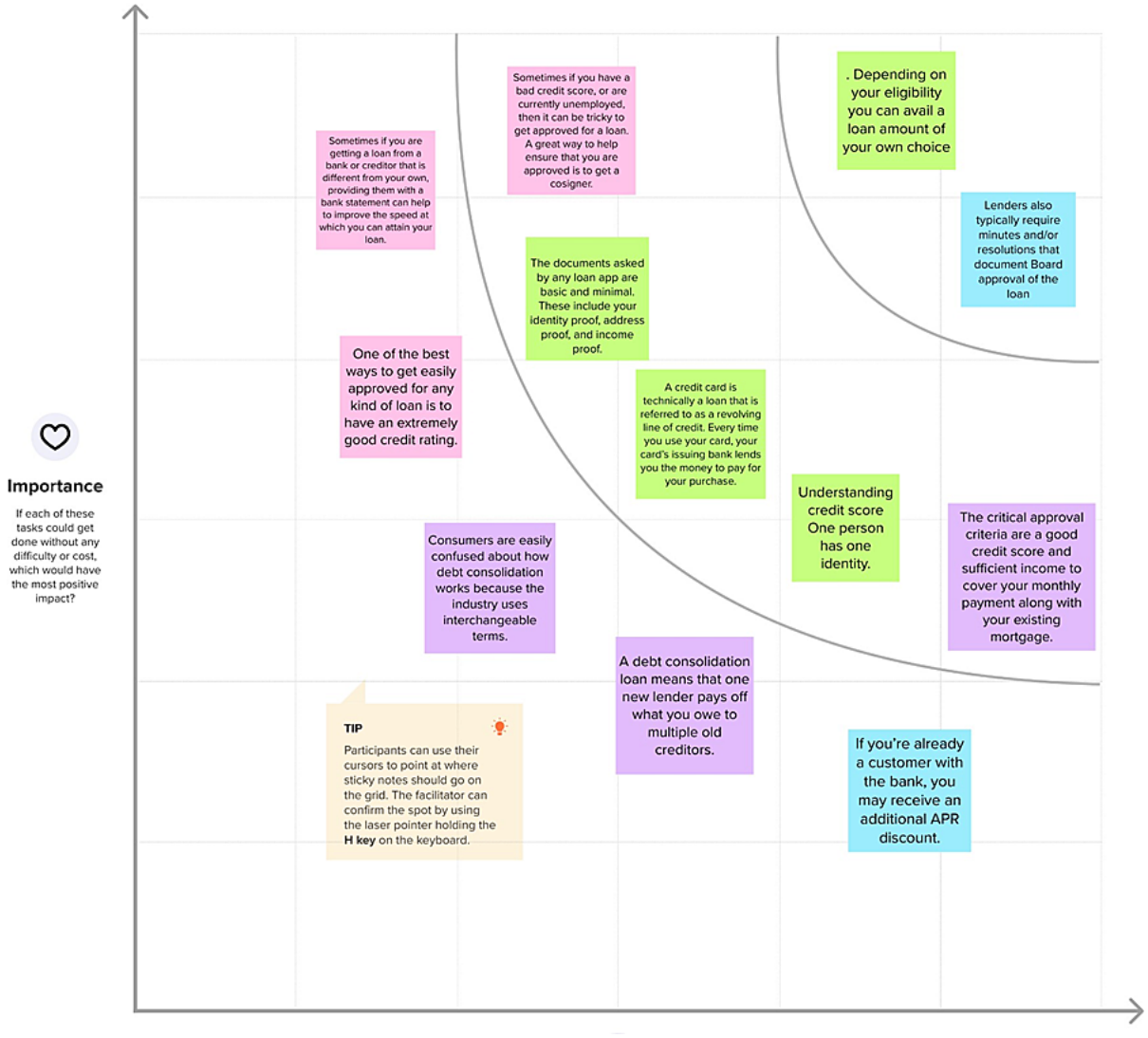
- All the required documents can be submitted by uploading on the loan app from your smartphone itself.
- Sometimes if you have a bad credit score, or are currently unemployed, then it can be tricky to get approved for a loan. A great way to help ensure that you are approved is to get a cosigner.
- The documents asked by any loan app are basic and minimal. These include your identity proof, address proof, and income proof.
- Borrow money from yourself instead of a third party.
- income-based installment loans allow you to quickly get small sums of cash, often without a credit check.
- Second, medical debt can appear on your consumer report. When it does, it can hurt your credit score – depending on the version used.
- Most online lenders disclose their minimum requirements for credit scores and annual income and whether they offer options like co-signers.
- The critical approval criteria are a good credit score and sufficient income to cover your monthly payment along with your existing mortgage.
- If you meet a lender's minimum qualifications and want to see estimated rates and terms, you can pre- qualify for a personal loan.

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes



3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

[=

3.3 Proposed Solution

S.No.	Parameter	Description
1	Problem Statement (Problem to be solved)	To accurately predict the credibility of a candidate for loan approval.
2.	Idea / Solution description	Our solution includes developing an ML model that can classify an applicant based on credibility and provide further details regarding the approval of the loan. Algorithms such as KNN, decision trees, SVM are used
3.	Novelty / Uniqueness	The model will do multiple label classification and provide extra inputs to assist in its determination of whether to approve a loan.
.4.	Social Impact / Customer Satisfaction	The model will carry out multi-label categorization and offer extra inputs to assist the decision to approve the loan.
5.	Business Model (Revenue Model)	Freemium model. Once we reach a particular usage rate, we can monetize features like the ability to see several banks or to apply for numerous banks. We can even provide subscription services.
6.	Scalability of the Solution	Any financial firm may quickly and easily adapt the model. The procedure of classification can be very customizable, but it will be as broad as feasible.

3.4 Problem Solution fit

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

Team ID: PNT2022TMID53311

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Who is your customer?
i.e. working parents of 0-5 y.o. kids

1. People with a bank account
2. Stakeholders & Customers
3. People who need loan & people who approve the loan
4. Bankers & Loan officers

6. CUSTOMER CONSTRAINTS CC

What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.

1. Slow process due to manual checking.
2. Complicated Process
3. Plenty of formalities and requirement for documentation.
4. Lack of awareness.

5. AVAILABLE SOLUTIONS AS

Which solutions are available to the customers when they face the problem
or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking

1. Existing loan apps that are available online.
2. Loan agents
3. Online websites to check the credit score of the individual.

Explore AS, differentiate

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

2. JOBS-TO-BE-DONE / PROBLEMS J&P

Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.

1. Availability of Data.
2. To predict and provide accurate information.
3. To provide a detailed classification for the customers.
4. Defaulting of the loan.

9. PROBLEM ROOT CAUSE RC

What is the real reason that this problem exists?
What is the back story behind the need to do this job?
i.e. customers have to do it because of the change in regulations.

1. We need to verify the borrower before sanctioning the loan.
2. Lack of accountability & Failure of models.
3. Individual/Organization's creditworthiness is highly important before sanctioning the loan for them.

7. BEHAVIOUR BE

What does your customer do to address the problem and get the job done?
i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)

1. Customer should know about the repayments and choose the plan according to their affordability.
2. Hastens the approval process.

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

Identify strong TR & EM

3. TRIGGERS TR

What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.

1. Communication gap between the customers and bank.
2. Borrowers can easily apply for the correct amount by knowing the maximum eligible amount and get their loan approved.

4. EMOTIONS: BEFORE / AFTER EM

How do customers feel when they face a problem or a job and afterwards?
i.e. lost, insecure > confident, in control - use it in your communication strategy & design.

1. Before:
- Borrowers are doubtful about the process.
- Tired and Frustrated

2. After:
- Lenders are confident to lend money to borrowers.
- Easy & Scalable process.

10. YOUR SOLUTION SL

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

Using several machine learning models to predict the possibility of loan approval.

Automated customer support to help the user and guide them through the process.
Users can gain knowledge and apply for loans through the app/portal.

various parameters to be collected from the borrowers like their income, personal details and credit score, etc.

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE
What kind of actions do customers take online? Extract online channels from #7

8.2 OFFLINE
What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

Online:
- apply and track the process online.
- physical interaction can be avoided.
- borrowers can submit proof online and lenders can verify.

Offline:
- Submission of documents in person.
- meet with officers to know about their eligibility.
- To wait in the bank for a long period of time.

Identify strong TR & EM

Chapter 4: REQUIREMENT ANALYSIS

4.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Input	● Selecting the type of loan ● Filing the necessary details
FR-2	Eligibility of Loan	● Loan Approval ● Loan Rejection
FR-3	Check for approvable amount of loan	● Maximum Eligible loan Prediction
FR-4	Chatbot	● Clarifying user's doubts.

4.2 Non-Functional requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	● Easy to use and self-explaining website. ● Easy navigation between pages. ● Simple structure for faster access.
NFR-2	**Reliability**	● Ensembling the outputs of various ML models.
NFR-3	**Performance**	● Web Based Application. ● Ability to indicate user inputs of erroneous data types.

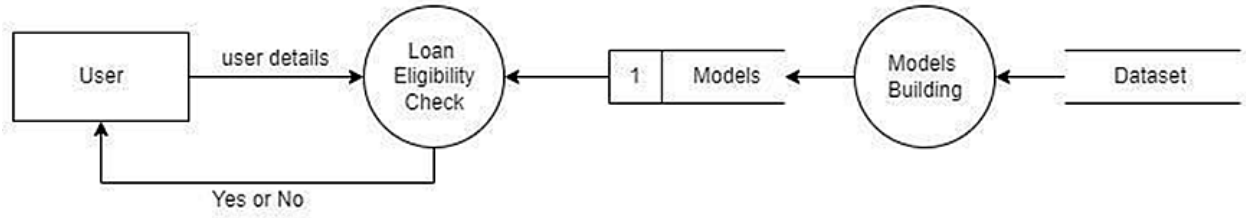
NFR-4	**Availability**	● Application is available 24 / 7 as it is hosted on IBM cloud. ● Simple web browser is enough to access the website.
NFR-5	**Scalability**	● Can be extended for other types of loans. ● Aadhar and PAN verification can also be implemented.

Chapter 5: PROJECT DESIGN

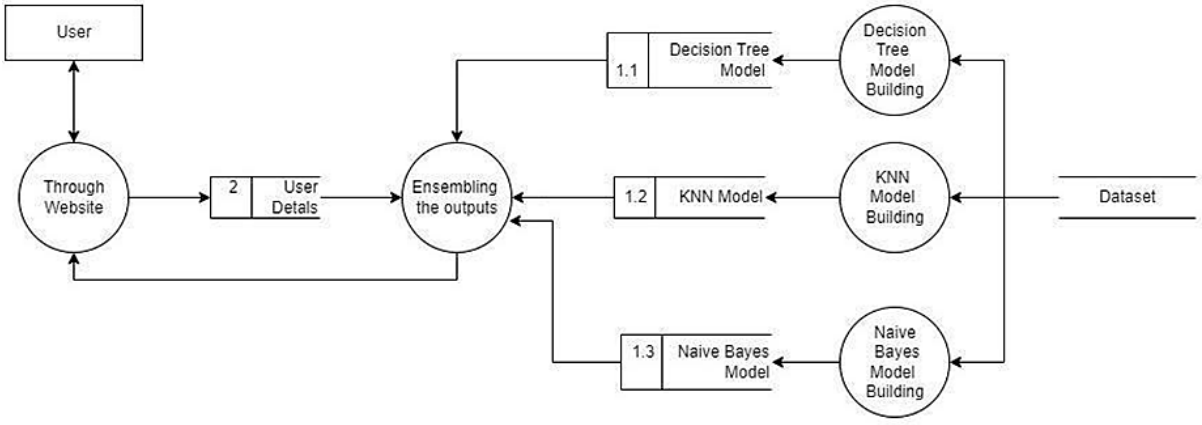
5.1 Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

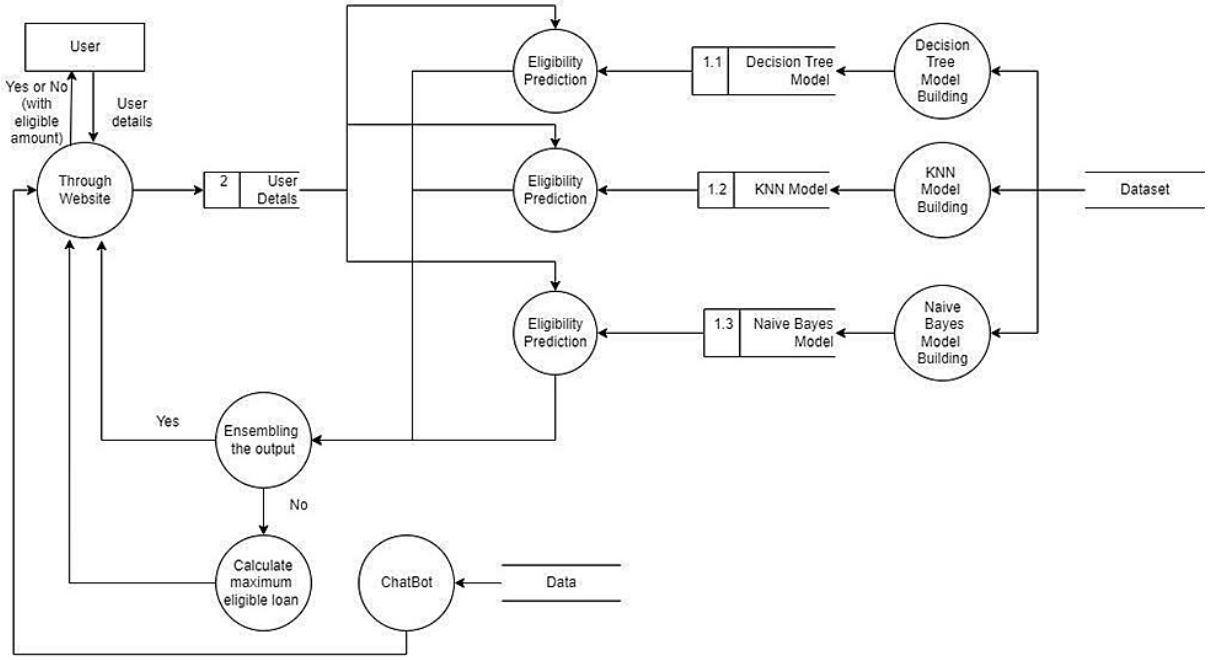
DFD - LEVEL 0



DFD - LEVEL 1



DFD - LEVEL 2



5.2 Solution & Technical Architecture

Solution Architecture:

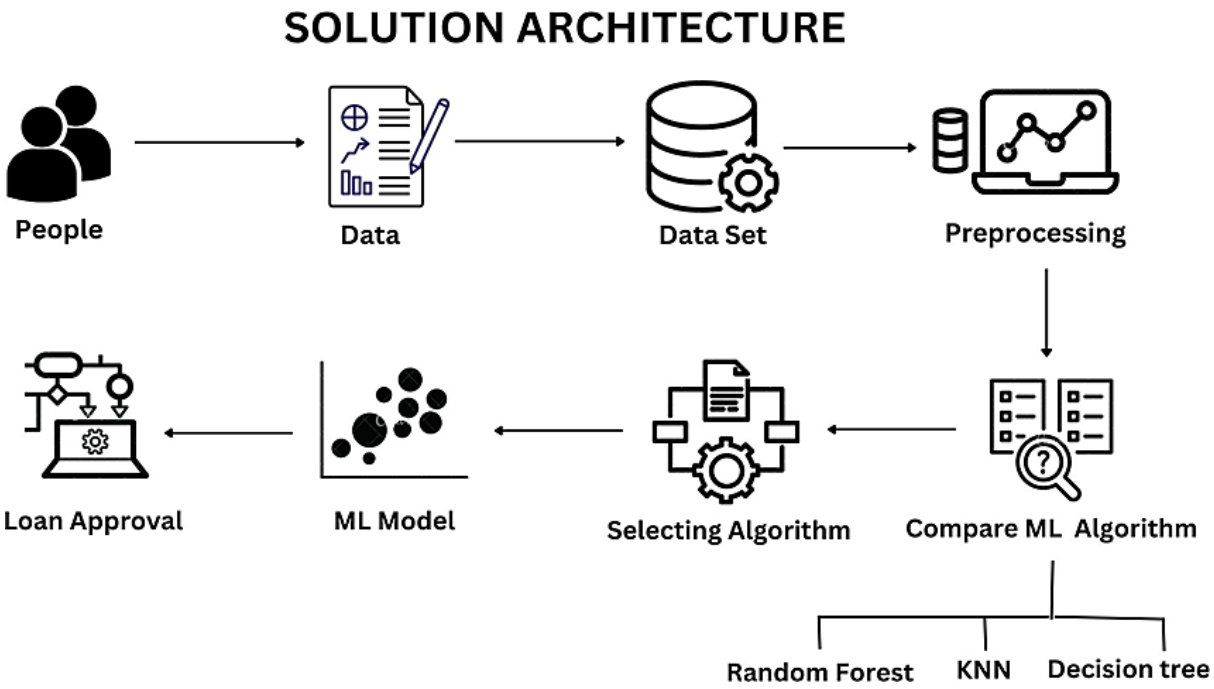
Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

● Find the best tech solution to solve existing business problems

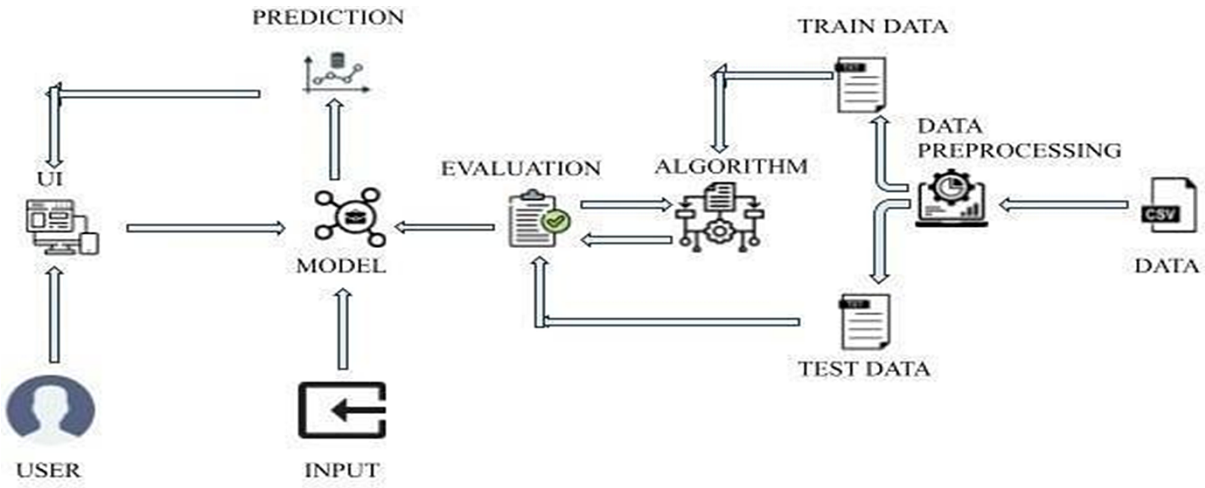
. ● Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders

. ● Define features, development phases, and solution requirements

. ● Provide specifications according to which the solution is defined, managed, and delivered.



Technical Architecture:



5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Money lender (Web user)	Dashboard	USN-1	As a user, I should be able to access the dashboard.	Access the dashboard	Low	Sprint 3
		USN-2	Select the type of loan	Select the type of loan	Medium	Sprint 3
	Check for loan eligibility	USN-3	Fill the application with the details of the borrower.	Check the eligibility of the borrower.	High	Sprint 4
Borrower	Dashboard	USN-4	Should be able to access the dashboard.	Access the dashboard.	Low	Sprint 3
		USN-5	Choose the type of loan	Choose the type of loan	Medium	Sprint 3

Chapter 6: PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Product Backlog, Sprint Schedule, and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	ser Story / Task	Story Points	Priority	Team Members
Sprint-1	Dataset	USN-4	Download the dataset	1	High	Allen Manoj Benita Majo Janani K Kumaran
Sprint-1		USN-5	isualize the dataset	2	Low	Allen Manoj Benita Majo Janani K Kumaran
Sprint-1		USN-6	re-process the dataset	3	Medium	Allen Manoj Benita Majo Janani K Kumaran
Sprint-1	Machine Learning Model	USN-7	NN model building	5	High	Allen Manoj Benita Majo

						Janani K Kumaran
Sprint-2		USN-8	Decision Tree model building	5	High	Allen Manoj Benita Majo Janani K Kumaran

Sprint	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Story Points**	**Priority**	**Team Members**
Sprint-2		USN-9	Naive Bayes model building	5	High	Allen Manoj Benita Majo Janani K Kumaran
Sprint-2		USN-10	Fine Tuning of the model	3	Low	Allen Manoj Benita Majo Janani K Kumaran
Sprint-2		USN-11	Evaluation and saving of the model	5	High	Allen Manoj Benita Majo Janani K Kumar

						an
Sprint-3	Customer User Interface	USN-12	Model Integration with flask	5	High	Allen Manoj Benita Majo Janani K Kumaran
Sprint-3		USN-1	As a user, I should be able to access the dashboard.	3	Medium	Allen Manoj Benita Majo Janani K Kumaran
Sprint-3		USN-2	Selecting the loan type	3	Low	Allen Manoj Benita Majo Janani K Kumaran
Sprint-3		USN-3	Fill the application and check the eligibility for loan approval	5	High	Allen Manoj Benita Majo Janani K Kumaran

Sprint-4	Deployed the website	USN-13	Register on IBM Cloud	3	Low	Allen Manoj Benita Majo Janani K Kumaran
Sprint-4		USN-14	Train the ML model on IBM Cloud	5	Medium	Allen Manoj Benita Majo Janani K Kumaran

Sprint	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Story Points**	**Priority**	**Team Members**
Sprint-4		USN-15	Deploy the website on IBM Cloud	8	High	Allen Manoj Benita Majo Janani K Kumaran

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	11	6 Days	24 Oct 2022	29 Oct 2022	11	29 Oct 2022
Sprint-2	18	6 Days	31 Oct 2022	05 Nov 2022	18	05 Nov 2022
Sprint-3	16	6 Days	07 Nov 2022	12 Nov 2022	16	12 Nov 2022
Sprint-4	16	6 Days	14 Nov 2022	19 Nov 2022	16	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)

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

Our Project velocity

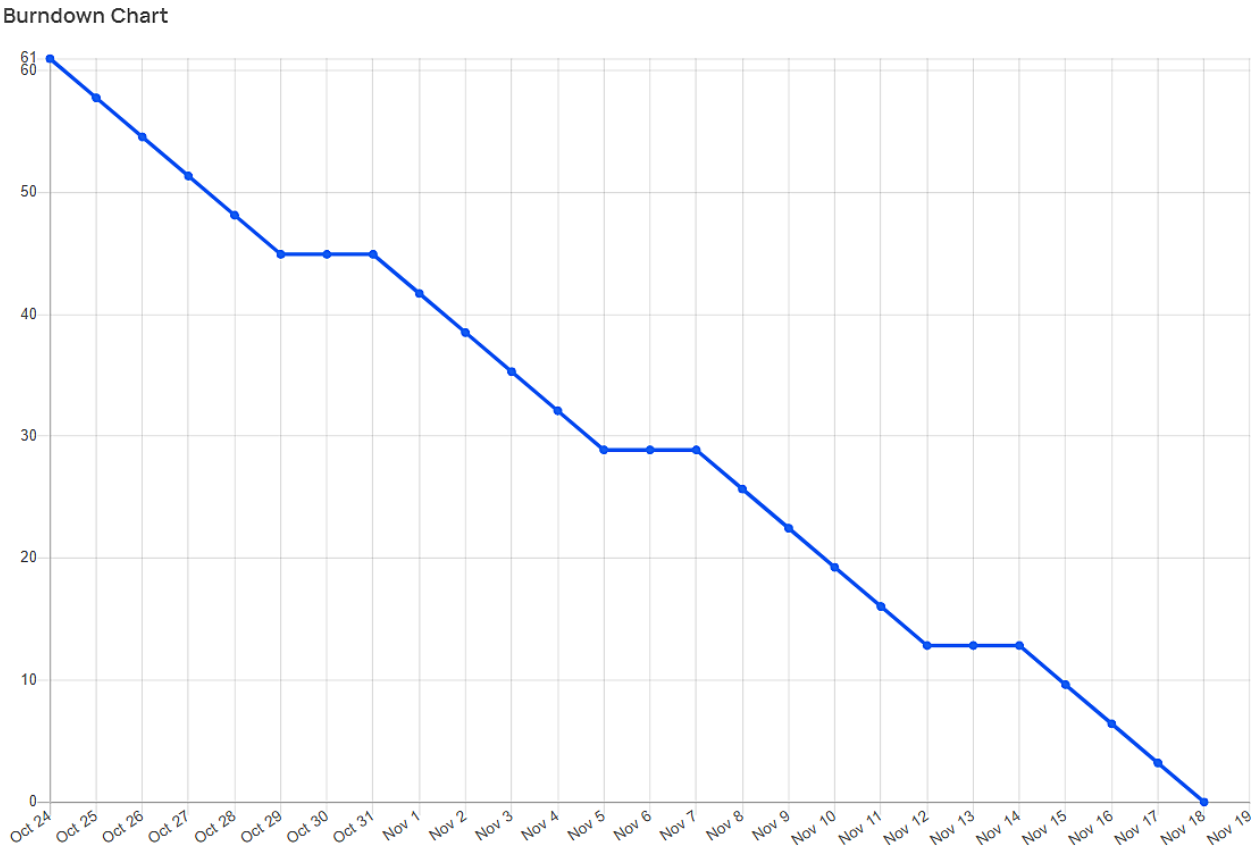
Sprint - 1 = 11/6 = 1.833

Sprint - 2 = 18/6 = 3

Sprint - 3 = 16/6 = 2.67

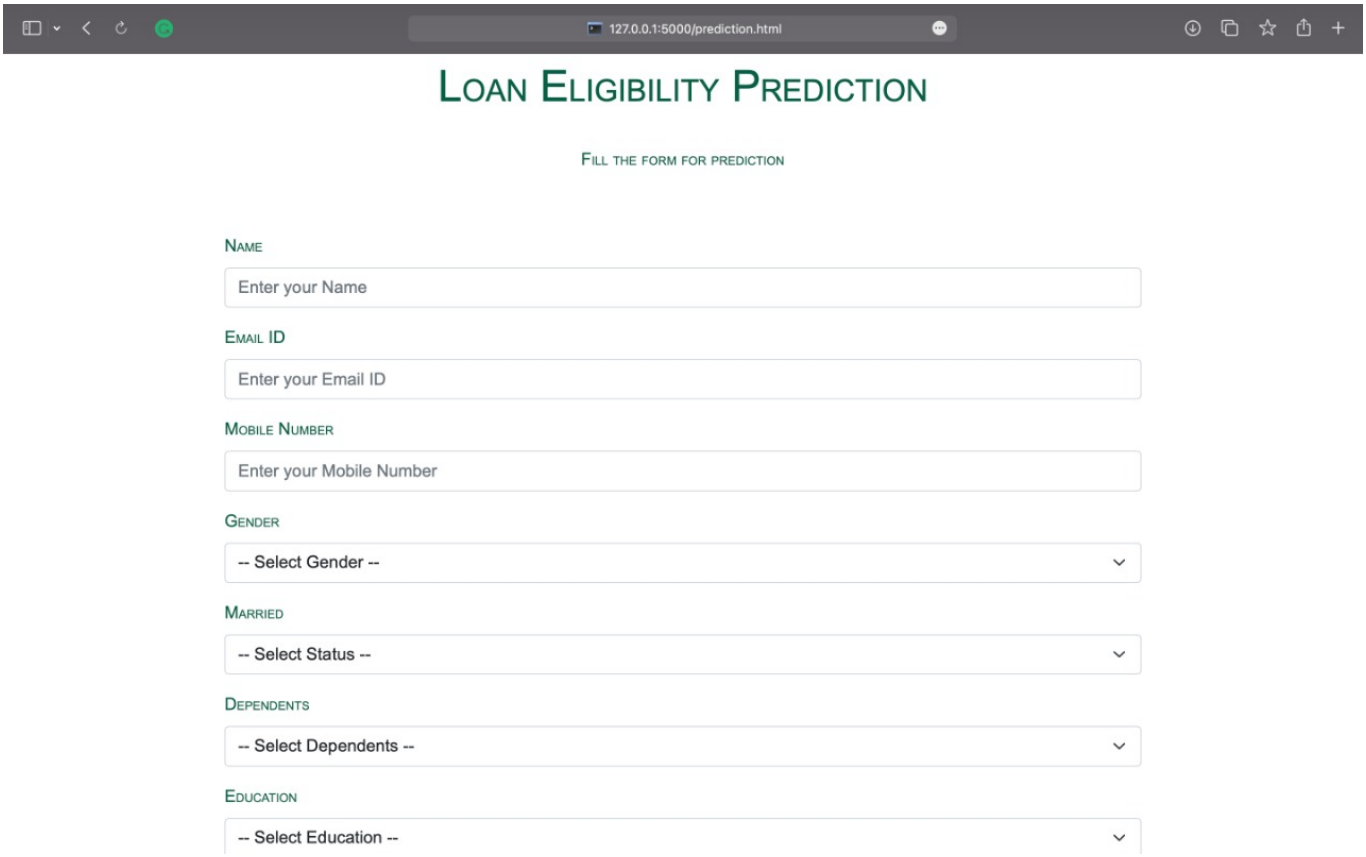
Sprint - 4 = 16/6 = 2.67

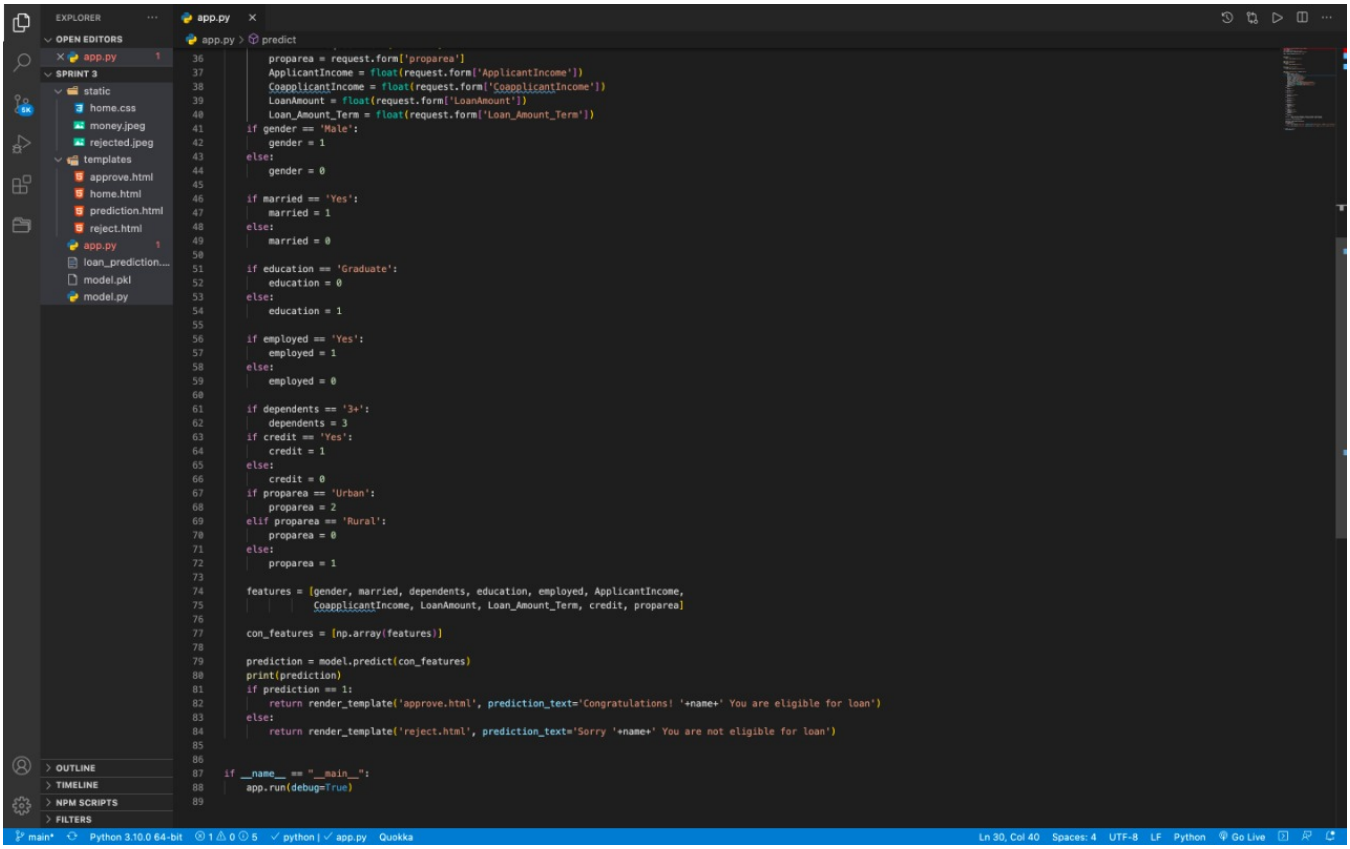
Total Velocity = 61/24 = 2.54



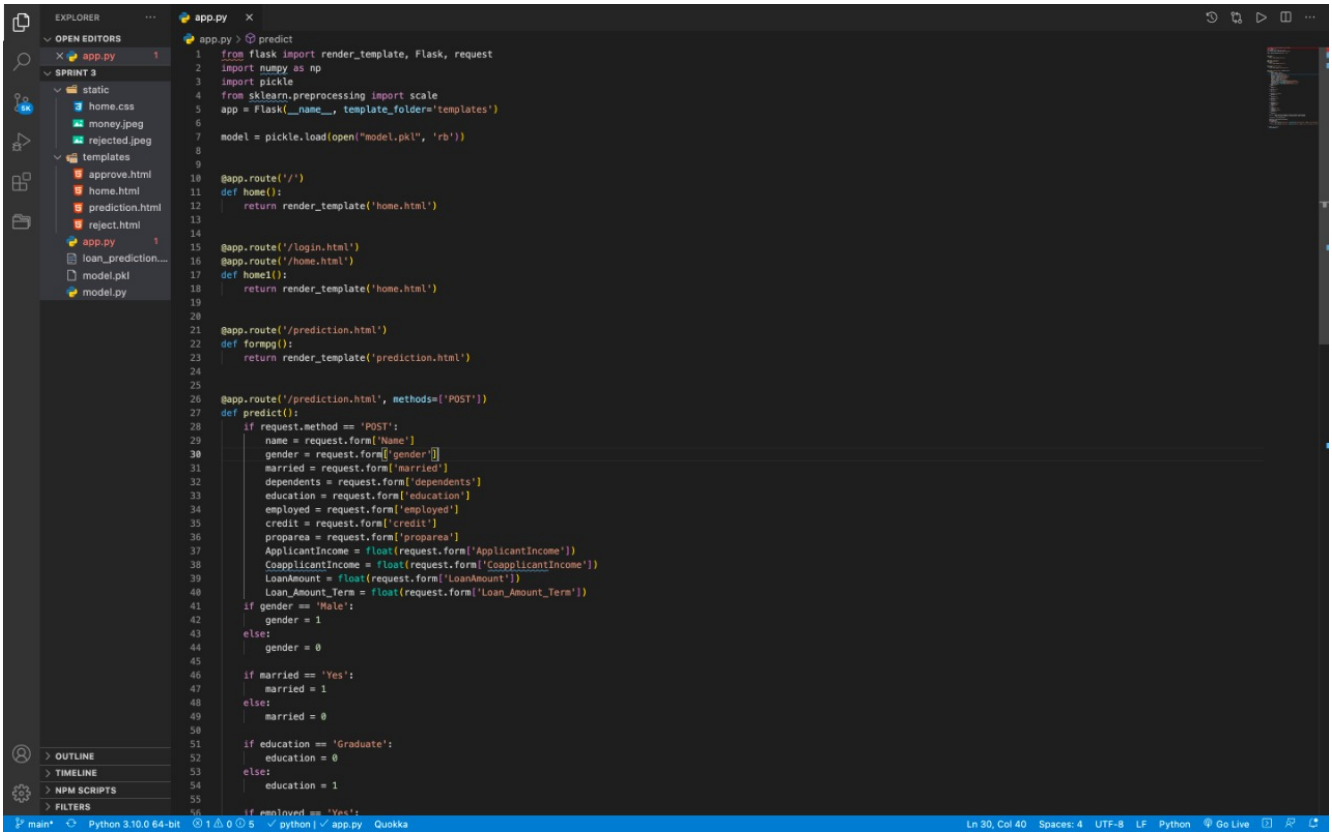
Chapter 7: CODING & SOLUTIONING

7.1 Feature 1



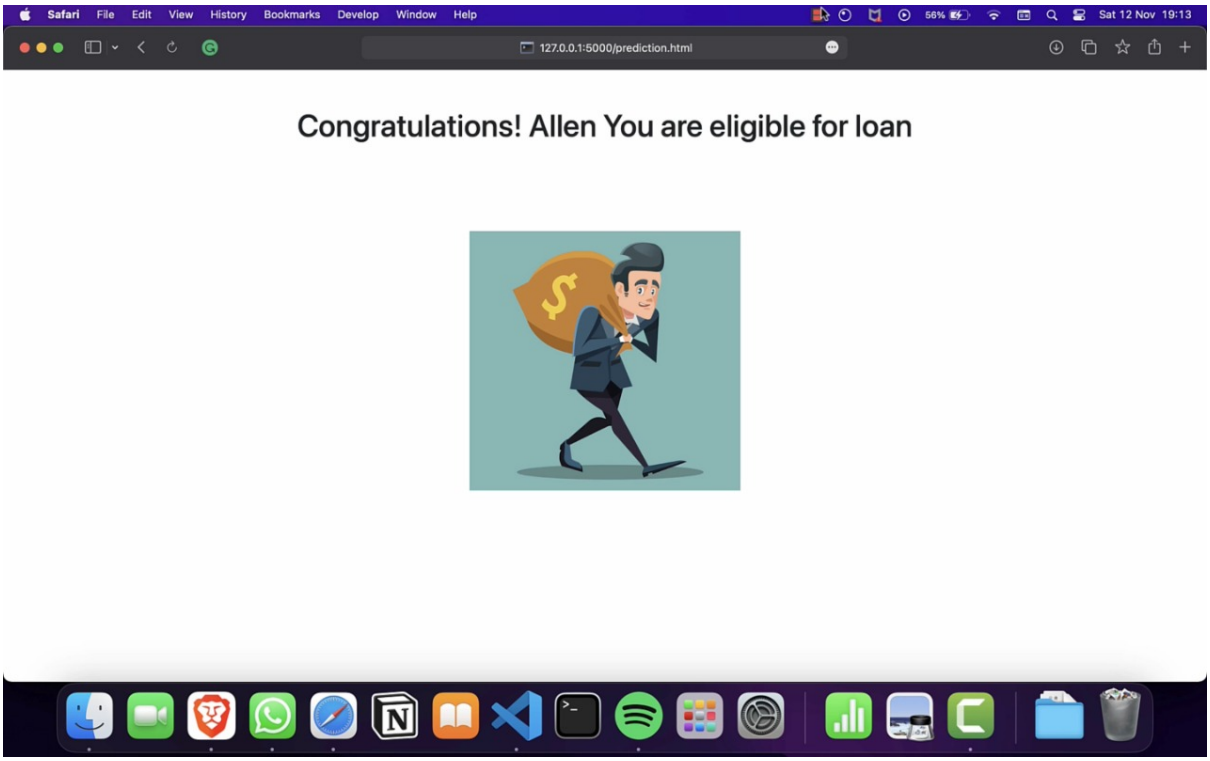


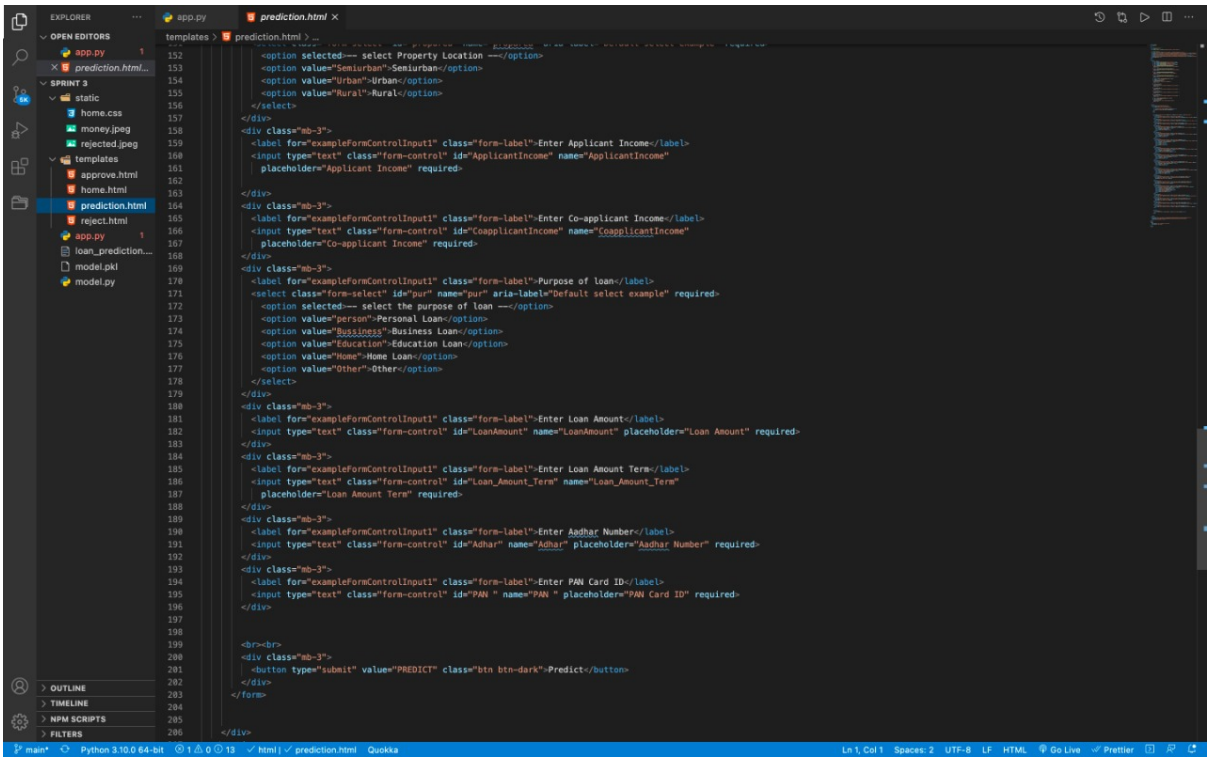
```
        proparea = request.form['proparea']
        ApplicantIncome = float(request.form['ApplicantIncome'])
        CoapplicantIncome = float(request.form['CoapplicantIncome'])
        LoanAmount = float(request.form['LoanAmount'])
        Loan_Amount_Term = float(request.form['Loan_Amount_Term'])
    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 employed == 'Yes':
        employed = 1
    else:
        employed = 0

    if dependents == '3+':
        dependents = 3
    if credit == 'Yes':
        credit = 1
    else:
        credit = 0
    if proparea == 'Urban':
        proparea = 2
    elif proparea == 'Rural':
        proparea = 0
    else:
        proparea = 1

    features = [gender, married, dependents, education, employed, ApplicantIncome,
                CoapplicantIncome, LoanAmount, Loan_Amount_Term, credit, proparea]

    con_features = [np.array(features)]

    prediction = model.predict(con_features)
    print(prediction)
    if prediction == 1:
        return render_template('approve.html', prediction_text='Congratulations! '+name+' You are eligible for loan')
    else:
        return render_template('reject.html', prediction_text='Sorry '+name+' You are not eligible for loan')


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



```
from flask import render_template, Flask, request
import numpy as np
import pickle
from sklearn.preprocessing import scale
app = Flask(__name__, template_folder='templates')

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


@app.route('/')
def home():
    return render_template('home.html')


@app.route('/login.html')
@app.route('/home.html')
def home1():
    return render_template('home.html')


@app.route('/prediction.html')
def formpg():
    return render_template('prediction.html')


@app.route('/prediction.html', methods=['POST'])
def predict():
    if request.method == 'POST':
        name = request.form['Name']
        gender = request.form['gender']
        married = request.form['married']
        dependents = request.form['dependents']
        education = request.form['education']
        employed = request.form['employed']
        credit = request.form['credit']
        proparea = request.form['proparea']
        ApplicantIncome = float(request.form['ApplicantIncome'])
        CoapplicantIncome = float(request.form['CoapplicantIncome'])
        LoanAmount = float(request.form['LoanAmount'])
        Loan_Amount_Term = float(request.form['Loan_Amount_Term'])
    if gender == 'Male':
        gender = 1
    else:
        gender = 0

    if married == 'Yes':
        married = 1
    else:
        married = 0

    if education == 'Graduate':
        education = 0
    else:
        education = 1
```

7.2 Feature 2


Safari File Edit View History Bookmarks Develop Window Help
Sat 12 Nov 19:13
127.0.0.1:5000/prediction.html
Congratulations! Allen You are eligible for loan


EXPLORER
app.py
prediction.html
templates > prediction.html
OPEN EDITORS
app.py
prediction.html...
SPRINT 3
static
home.css
money.jpeg
rejected.jpeg
templates
approve.html
home.html
prediction.html
reject.html
app.py
loan_prediction....
model.pkl
model.py
OUTLINE
TIMELINE
NPM SCRIPTS
FILTERS
<option selected>-- select Property Location --</option>
<option value="Semiurban">Semiurban</option>
<option value="Urban">Urban</option>
<option value="Rural">Rural</option>
</select>

<label for="exampleFormControlInput1" class="form-label">Enter Applicant Income</label>
<input type="text" class="form-control" id="ApplicantIncome" name="ApplicantIncome"
placeholder="Applicant Income" required>

<label for="exampleFormControlInput1" class="form-label">Enter Co-applicant Income</label>
<input type="text" class="form-control" id="CoapplicantIncome" name="CoapplicantIncome"
placeholder="Co-applicant Income" required>

<label for="exampleFormControlInput1" class="form-label">Purpose of loan</label>
<select class="form-select" id="pur" name="pur" aria-label="Default select example" required>
<option selected>-- select the purpose of loan --</option>
<option value="person">Personal Loan</option>
<option value="Bussiness">Business Loan</option>
<option value="Education">Education Loan</option>
<option value="Home">Home Loan</option>
<option value="Other">Other</option>
</select>

<label for="exampleFormControlInput1" class="form-label">Enter Loan Amount</label>
<input type="text" class="form-control" id="LoanAmount" name="LoanAmount" placeholder="Loan Amount" required>

<label for="exampleFormControlInput1" class="form-label">Enter Loan Amount Term</label>
<input type="text" class="form-control" id="Loan_Amount_Term" name="Loan_Amount_Term"
placeholder="Loan Amount Term" required>

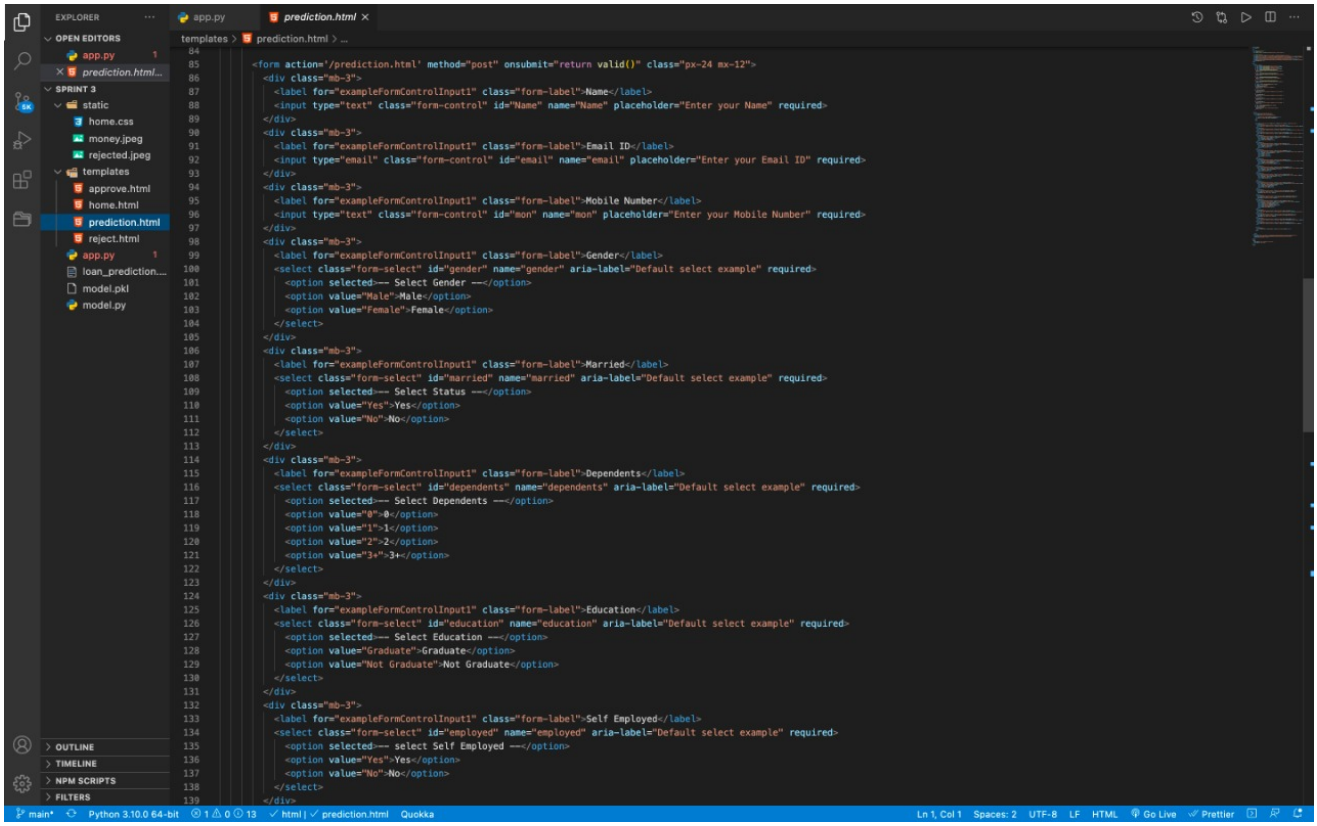
<label for="exampleFormControlInput1" class="form-label">Enter Aadhar Number</label>
<input type="text" class="form-control" id="Adhar" name="Adhar" placeholder="Aadhar Number" required>

<label for="exampleFormControlInput1" class="form-label">Enter PAN Card ID</label>
<input type="text" class="form-control" id="PAN " name="PAN " placeholder="PAN Card ID" required>

<button type="submit" value="PREDICT" class="btn btn-dark">Predict</button>

</form>

Python 3.10.0 64-bit
html | prediction.html
Quokka
Ln 1, Col 1
Spaces: 2
UTF-8
LF
HTML
Go Live
Prettier


EXPLORER
OPEN EDITORS
app.py
prediction.html...
SPRINT 3
static
home.css
money.jpeg
rejected.jpeg
templates
approve.html
home.html
prediction.html
reject.html
app.py
loan_prediction....
model.pkl
model.py
OUTLINE
TIMELINE
NPM SCRIPTS
FILTERS
app.py
prediction.html
templates > prediction.html > ...
<form action='/prediction.html' method="post" onsubmit="return valid()" class="px-24 mx-12">

<label for="exampleFormControlInput1" class="form-label">Name</label>
<input type="text" class="form-control" id="Name" name="Name" placeholder="Enter your Name" required>

<label for="exampleFormControlInput1" class="form-label">Email ID</label>
<input type="email" class="form-control" id="email" name="email" placeholder="Enter your Email ID" required>

<label for="exampleFormControlInput1" class="form-label">Mobile Number</label>
<input type="text" class="form-control" id="mon" name="mon" placeholder="Enter your Mobile Number" required>

<label for="exampleFormControlInput1" class="form-label">Gender</label>
<select class="form-select" id="gender" name="gender" aria-label="Default select example" required>
<option selected>-- Select Gender --</option>
<option value="Male">Male</option>
<option value="Female">Female</option>
</select>

<label for="exampleFormControlInput1" class="form-label">Married</label>
<select class="form-select" id="married" name="married" aria-label="Default select example" required>
<option selected>-- Select Status --</option>
<option value="Yes">Yes</option>
<option value="No">No</option>
</select>

<label for="exampleFormControlInput1" class="form-label">Dependents</label>
<select class="form-select" id="dependents" name="dependents" aria-label="Default select example" required>
<option selected>-- Select Dependents --</option>
<option value="0">0</option>
<option value="1">1</option>
<option value="2">2</option>
<option value="3+">3+</option>
</select>

<label for="exampleFormControlInput1" class="form-label">Education</label>
<select class="form-select" id="education" name="education" aria-label="Default select example" required>
<option selected>-- Select Education --</option>
<option value="Graduate">Graduate</option>
<option value="Not Graduate">Not Graduate</option>
</select>

<label for="exampleFormControlInput1" class="form-label">Self Employed</label>
<select class="form-select" id="employed" name="employed" aria-label="Default select example" required>
<option selected>-- select Self Employed --</option>
<option value="Yes">Yes</option>
<option value="No">No</option>
</select>

main*
Python 3.10.0 64-bit
1 0 13
html | prediction.html
Quokka
Ln 1, Col 1
Spaces: 2
UTF-8
LF
HTML
Go Live
Prettier

Chapter 8: TESTING

8.1 Test Cases

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	BUG ID	Executed By
tc01	Functional	e Page	Verify user is able to click on Predict button		1.Enter URL and fill the form 2.Click on Predict button		Loan form should display	Working as expected	Pass				
tc02	Functional	Home Page	The web page is getting refreshed		1.Automatic page reload		Loan form must appear automatically after page reload	Working as expected	Fail	No steps needed	Y	BUG-1234	
tc03	Functional	Home page	Field address validation		1. Double-click on the E-mail address field		User should navigate to E-mail address field	Working as expected	Pass				
tc04	Functional	Output page	Loan Credibility predicted output		1. Click on predict button 2. View the predicted results		User should access the Loan credibility predicted result	Working as expected	Pass				

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 [ProductName] project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	9	3	1	2	15
Duplicate	0	0	4	0	4
External	1	2	0	0	3
Fixed	10	5	4	21	40
Not Reproduced	0	0	0	0	0
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	20	9	9	23	64

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	5	0	0	5
Client Application	46	0	0	46
Security	4	0	0	4
Outsource Shipping	3	0	0	3
Exception Reporting	7	0	0	7
Final Report Output	4	0	0	4
Version Control	2	0	0	2

Chapter 9: RESULTS

9.1 Performance Metrics

Model Performance Testing:
Project team shall fill the following information in the model performance testing template.

S.No.	Parameter	Screenshot / Values
1	Data Responsiveness	The ML model takes about 0.3 seconds to process the dataset. The credibility result is predicted in approximately 0.9 seconds.
2	Utilisation of Data Filters	Sufficient data filters have been used for ideal model building
3	Effective User Story	No of Scene Added - 15
4	Descriptive Reports	No of Visualisations / Graphs - 13

Chapter 10: ADVANTAGES & DISADVANTAGES

Advantages:

Keep Control of the Company

A bank loans money to a business based on the value of the business and its perceived ability to service the loan by making payments on time and in full. Unlike with equity finance where the business issues shares, banks do not take any ownership position in businesses. Bank personnel also do not get involved in any aspect of running a business to which a bank grants a loan. This means you ghet to retain full management and control of your business with no external interference.

Bank Loan is Temporary

Once a business borrower has paid off a loan, there is no more obligation to or involvement with the bank lender unless the borrower wishes to take out a subsequent loan. Compare this with equity finance, where the company may be paying out dividends to shareholders for as along as the business exists.

Interest is Tax Deductible

The interest on business bank loans is tax-deductible. In addition, especially with fixed-rate loans, in which the interest rate does not change during the course of a loan, loan servicing payments remain the same throughout the life of the loan. This makes it easy for businesses to budget and plan for monthly loan payments. Even if the loan is an adjustable-rate loan, business owners can use a simple spreadsheet to compute future payments in the event of a change in rates

Disadvantages:

Tough to Qualify

One of the greatest disadvantages to bank loans is that they are very difficult to obtain unless a small business has a substantial track record or valuable collateral such as real estate. Banks are careful to lend only to businesses that can clearly repay their loans, and they also make sure that

they are able to cover losses in the event of default. Business borrowers can be required to provide personal guarantees, which means the borrower's personal assets can be seized in the event the business fails and is unable to repay all or part of a loan.

High Interest Rates

Interest rates for small-business loans from banks can be quite high, and the amount of bank funding for which a business qualifies is often not sufficient to completely meet its needs. The high interest rate for the funding a business does receive often stunts its expansion, because the business needs to not only service the loan but also deal with additional funding to cover funds not provided by the bank. Loans guaranteed by the U.S. Small Business Administration offer better terms than other loans, but the requirements to qualify for these subsidized bank loans are very strict.

Chapter 11: CONCLUSION

The analysis starts from data cleaning and processing missing value, exploratory analysis and finally model building and evaluation of the model. The best accuracy on public test set is when we get higher accuracy score and other performance metrics which will be found out. This project can help to predict the approval of bank loan or not for a candidate.

Chapter 12: FUTURE SCOPE

In order to analyse the risk associated for the bank, credit evaluation largely involves gathering information about the customer and examining the project's technical, financial, and economic viability and this process developed a lot

Chapter 13: APPENDIX

13.1 Source Code

index.html

```
<form action='/prediction.html' method="post" onsubmit="return valid()" class="px-24 mx-12">
    <div class="mb-3">
      <label for="exampleFormControlInput1" class="form-label">Name</label>
        <input type="text" class="form-control" id="Name" name="Name" placeholder="Enter your
Name" required>
    </div>
    <div class="mb-3">
      <label for="exampleFormControlInput1" class="form-label">Email ID</label>
        <input type="email" class="form-control" id="email" name="email" placeholder="Enter your
Email ID" required>
    </div>
    <div class="mb-3">
      <label for="exampleFormControlInput1" class="form-label">Mobile Number</label>
          <input type="text" class="form-control" id="mon" name="mon" placeholder="Enter your
Mobile Number" required>
    </div>
    <div class="mb-3">
      <label for="exampleFormControlInput1" class="form-label">Gender</label>
        <select class="form-select" id="gender" name="gender" aria-label="Default select example"
required>
        <option selected>-- Select Gender --</option>
        <option value="Male">Male</option>
        <option value="Female">Female</option>
```

```
  </select>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Married</label>
   <select class="form-select" id="married" name="married" aria-label="Default select example"
required>
    <option selected>-- Select Status --</option>
    <option value="Yes">Yes</option>
    <option value="No">No</option>
  </select>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Dependents</label>
     <select class="form-select" id="dependents" name="dependents" aria-label="Default select
example" required>
    <option selected>-- Select Dependents --</option>
    <option value="0">0</option>
    <option value="1">1</option>
    <option value="2">2</option>
    <option value="3+">3+</option>
  </select>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Education</label>
        <select class="form-select" id="education" name="education" aria-label="Default select
example" required>
    <option selected>-- Select Education --</option>
```

```
    <option value="Graduate">Graduate</option>
    <option value="Not Graduate">Not Graduate</option>
  </select>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Self Employed</label>
        <select class="form-select" id="employed" name="employed" aria-label="Default select example" required>
    <option selected>-- select Self Employed --</option>
    <option value="Yes">Yes</option>
    <option value="No">No</option>
  </select>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Credit History</label>
       <select class="form-select" id="credit" name="credit" aria-label="Default select example" required>
    <option selected>-- select Credit History --</option>
    <option value="Yes">Yes</option>
    <option value="No">No</option>

  </select>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Property Location</label>
         <select class="form-select" id="proparea" name="proparea" aria-label="Default select example" required>
```

```
    <option selected>-- select Property Location --</option>
    <option value="Semiurban">Semiurban</option>
    <option value="Urban">Urban</option>
    <option value="Rural">Rural</option>
  </select>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Enter Applicant Income</label>
  <input type="text" class="form-control" id="ApplicantIncome" name="ApplicantIncome"
    placeholder="Applicant Income" required>

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

```
    <option value="Other">Other</option>
  </select>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Enter Loan Amount</label>
                <input type="text" class="form-control" id="LoanAmount" name="LoanAmount"
placeholder="Loan Amount" required>
 </div>
 <div class="mb-3">
                <label for="exampleFormControlInput1" class="form-label">Enter Loan Amount
Term</label>
                                <input type="text" class="form-control" id="Loan_Amount_Term"
name="Loan_Amount_Term"
    placeholder="Loan Amount Term" required>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Enter Aadhar Number</label>
        <input type="text" class="form-control" id="Adhar" name="Adhar" placeholder="Aadhar
Number" required>
 </div>
 <div class="mb-3">
  <label for="exampleFormControlInput1" class="form-label">Enter PAN Card ID</label>
     <input type="text" class="form-control" id="PAN " name="PAN " placeholder="PAN Card ID"
required>
 </div>
```

```
      <br><br>
      <div class="mb-3">
        <button type="submit" value="PREDICT" class="btn btn-dark">Predict</button>
      </div>
    </form>
```

app.py

```
from flask import render_template, Flask, request
import numpy as np
import pickle
from sklearn.preprocessing import scale
app = Flask(_name_, template_folder='templates')

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


@app.route('/')
def home():
    return render_template('home.html')


@app.route('/login.html')
@app.route('/home.html')
def home1():
    return render_template('home.html')


@app.route('/prediction.html')
def formpg():
    return render_template('prediction.html')
```

```
@app.route('/prediction.html', methods=['POST'])
def predict():
    if request.method == 'POST':
        name = request.form['Name']
        gender = request.form['gender']
        married = request.form['married']
        dependents = request.form['dependents']
        education = request.form['education']
        employed = request.form['employed']
        credit = request.form['credit']
        proparea = request.form['proparea']
        ApplicantIncome = float(request.form['ApplicantIncome'])
        CoapplicantIncome = float(request.form['CoapplicantIncome'])
        LoanAmount = float(request.form['LoanAmount'])
        Loan_Amount_Term = float(request.form['Loan_Amount_Term'])
    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 employed == 'Yes':
    employed = 1
else:
    employed = 0

if dependents == '3+':
    dependents = 3
if credit == 'Yes':
    credit = 1
else:
    credit = 0
if proparea == 'Urban':
    proparea = 2
elif proparea == 'Rural':
    proparea = 0
else:
    proparea = 1

features = [gender, married, dependents, education, employed, ApplicantIncome,
        CoapplicantIncome, LoanAmount, Loan_Amount_Term, credit, proparea]

con_features = [np.array(features)]

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

```
    if prediction == 1:
        return render_template('approve.html', prediction_text='Congratulations! '+name+' You are eligible for loan')
    else:
        return render_template('reject.html', prediction_text='Sorry '+name+' You are not eligible for loan')


if _name_ == "_main_":
    app.run(debug=True)
```

13.2 GitHub& Project Demo Link

GitHub link:

https://github.com/IBM-EPBL/IBM-Project-10223-1659114439

Project Demo Link:

https://www.youtube.com/watch?v=m-YZPUUtQ1o