1 Introduction

1.1 Purpose

This document has the information on the application architecture and backend details for the credit card recommender course project developed by team 2 in CSE 327 Fall 2018 class.

1.2 Document Conventions

The document follows standard markdown conventions. Bold/Italics will be used to emphasize key words while important information will be presented using tables.

1.3 Intended Audience

Course instructor, other team members.

1.4 Reading Suggestions

Please use the table of contents to navigate.

2 Project Overview

In this project we are developing a credit card recommender to recommend credit and debit cards to professionals, students and general people. We generate the recommendations using machine learning. User is also able to search through the card database with multiple filtering options enabled. We plan to add a card explorer dashboard with interactive data visualizations for giving users more engagement, but the idea is at its infancy.

2.1 Application Architecture

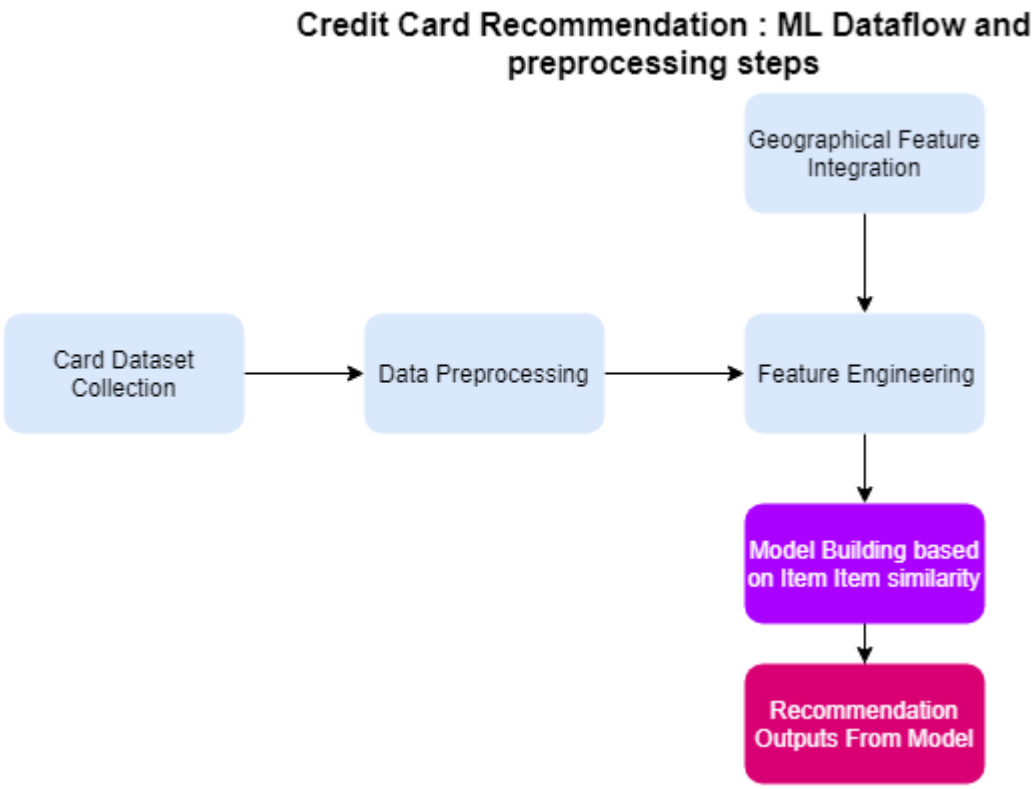
The final product for this project is a responsive web application which will take user preferences into account and generate recommendations with machine learning. For the web application we use python as the backend language and implement the web application using the **MVC**(Model-View-Controller) paradigm along with machine learning concepts.

Previously, a recommender system would have been implemented with a lot of if then statements and hard coding for the user along with many filters according to user preferences. However, taking a machine learning approach we learn from data which cards might be suitable for a certain user. Since the credit card recommender is a machine learning product first, we will analyze how to implement the ideas of MVC in this context of machine learning.

2.2 Recommender Constraints

Recommender systems where we don't already have a large amount of user and item interaction information available suffer from the problem of "cold start". Cold start in this context basically means according to collaborative filtering ideas, for a certain card, if we knew the subset of users who like that card, we could have taken similar users and recommended that card to those similar users who have not used that card yet. In a movie context we may think it as if my taste and my friend's taste in movies are same, a movie that my friend liked but I've not watched is the one I might like too.

To tackle this situation instead of user-user similarity, we consider item-item similarity first. If we know user preferences, we can take those information, send to the model, and the model will send us the similar cards according to those preferences. A diagram showing how the machine learning pipeline will be implemented is given below.

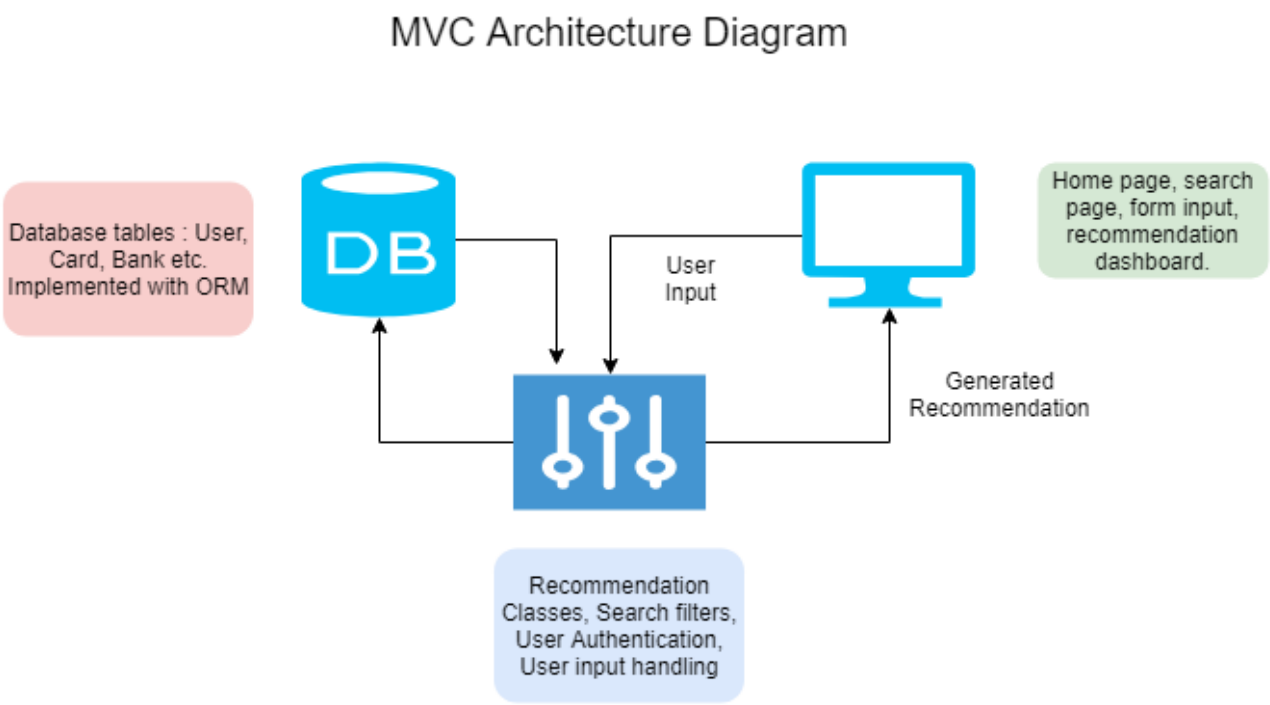


2.3 Model-View-Controller Implementation

Since we have the machine learning intuition for how the product will work behind the scenes, instead of machine learning we will focus on explaining our application architecture MVC and how it fits in with the ML parts. When considering the backend of our web application, we can consider the recommender as simple component of our backend logic or subset of our controller code. Recommender API also interacts with the model(database), but it does it as part of the controller class which also handles the search functionalities and user authentication.

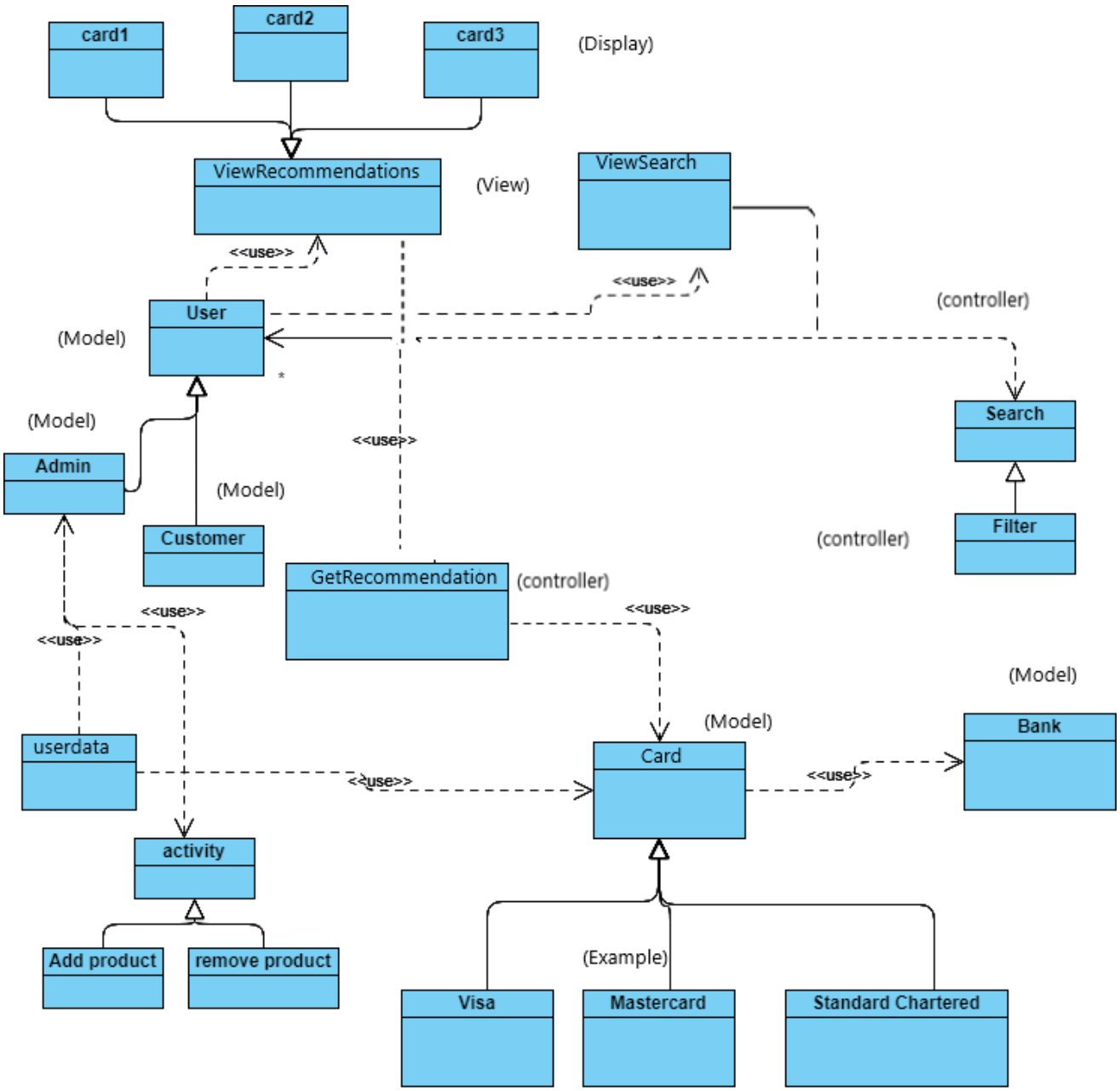
In our implementation the model, view and controller is divided like this :

- Model : Consists of the POSTGRESQL database and objects. ORM like SQLAlchemy or Django ORM will be used to implement model classes.
- Controller : Consists of classes for delegating user input to recommendation classes and sending search results and generated recommendations back to the view. Controller will also handle user authentication.
- View : All visual interfaces e.g home page, search page, user profile form input page.



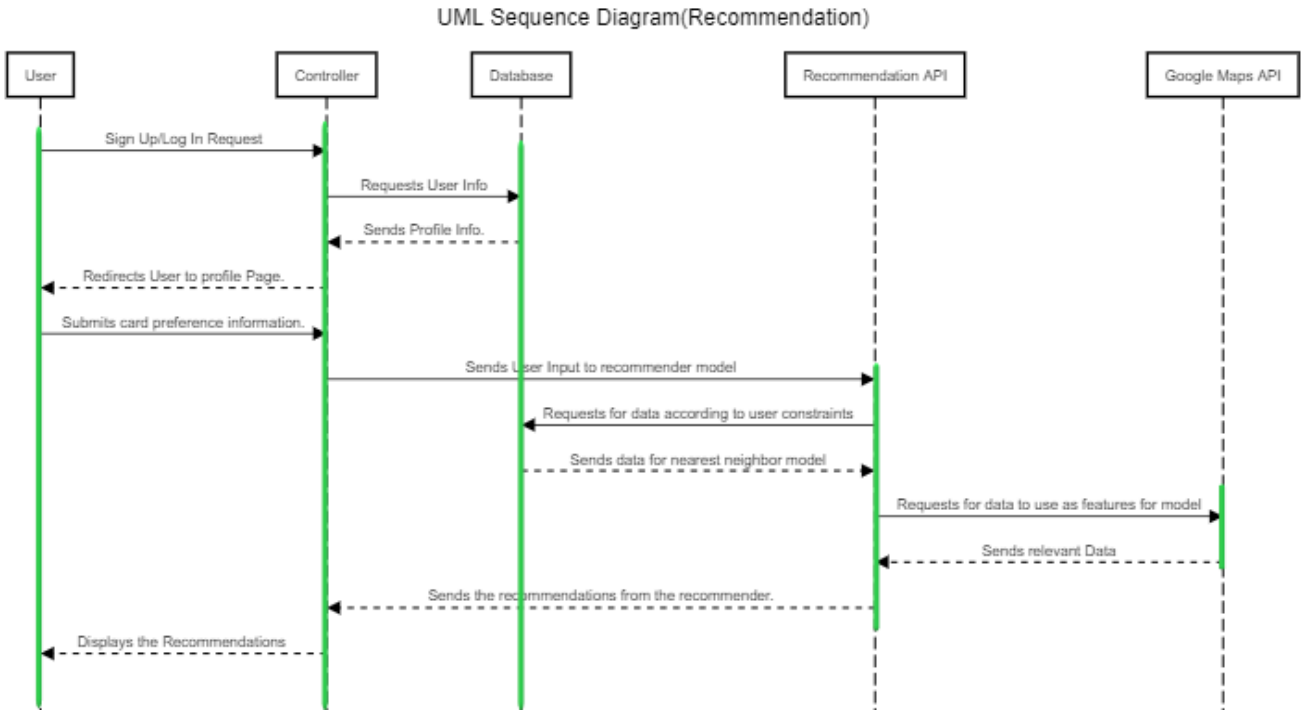
3 UML Class Diagrams

A simplified view of how the model, view and controller classes interact are shown below with UML class diagrams. View classes have been clearly separated from the model and controller. Controller exchanges data between the model and view when using the GetRecommendation class. Again, search functionalities will be implemented similarly where ViewSearch class will be responsible for showing the search results and controller will exchange data between Search class and ViewSearch. Our fundamental model entities are users and cards to build association between users and credit cards via the recommender.



3.1 UML Sequence Diagram

Shows how the user request triggers multiple actions in the backend and how message passing between different components happen until the controller sends the results back to the view. Green bars signal how much time a particular component was active.



5 Database Definitions

List Of Tables

- User
- Card
- Bank
- user_has_bank_account
- bank_has_card

ER Diagram

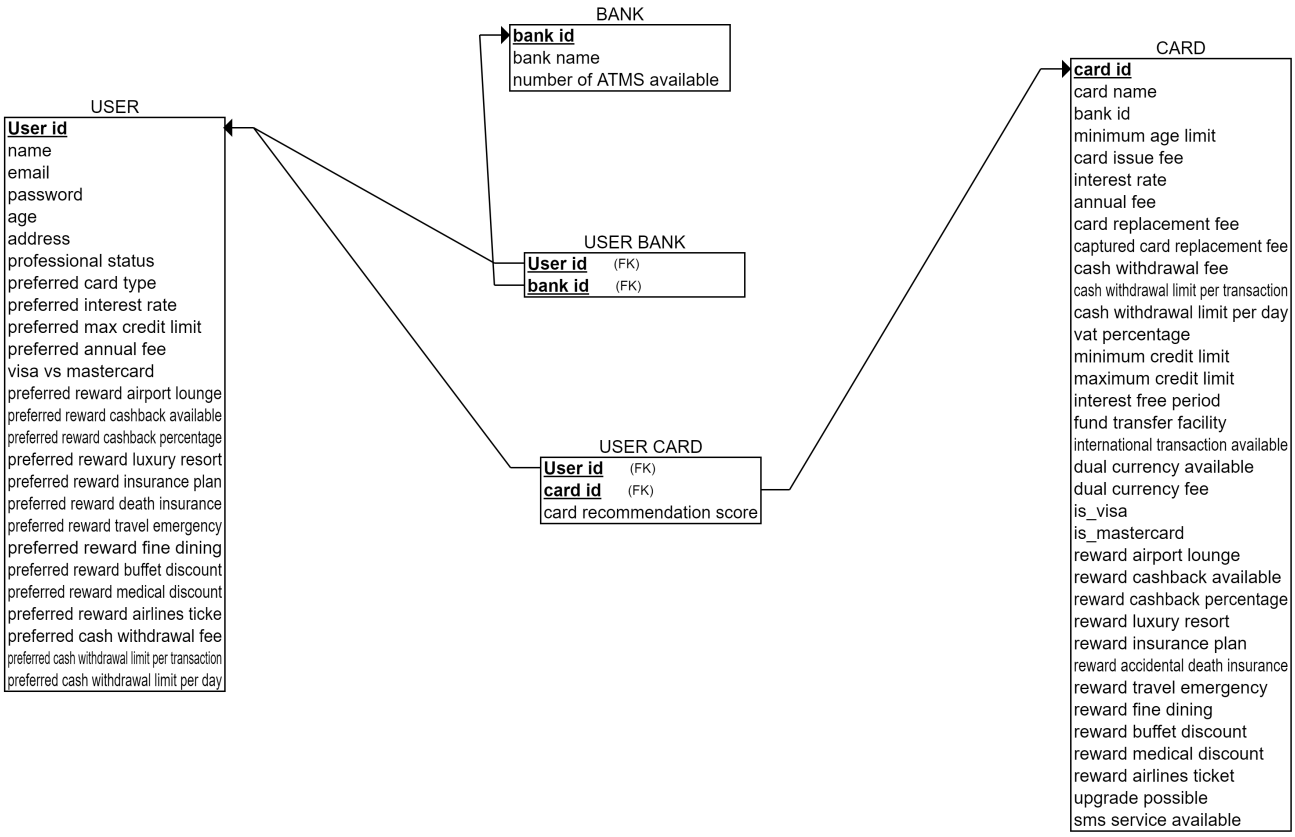


Table Descriptions

TABLE: USER (ATTRIBUTES)	Description of Attributes
User id	Id of user to log in (Primary key)
name	Name of the user
email	Email used for sign up
password	User's password to log in
is_admin	Boolean. True or False.
age	User's age
address	User's address
professional status	Current status of user
preferred card type	credit vs debit
preferred interest rate	how much credit interest rate is preferred by the user
preferred max credit limit	what is the max credit limit tolerable to the user
preferred annual fee	how much annual fee is user willing to pay
visa vs master card	whether the user wants visa or mastercard
preferred reward airport lounge	if user wants airport lounge as reward
preferred reward cashback available	if user wants cashback or not
preferred reward cashback percentage	how much cashback percentage user wants etc
preferred reward luxury resort	if the user wants discount to resorts
preferred reward insurance plan	if the user needs insurance plan discount
preferred reward death insurance	if the user requires death insurance
preferred reward travel emergency	if the user requires travel emergency assistance
preferred reward fine dining	if the user requires fine dining discount
preferred reward buffet discount	if the user requires buffet discount
preferred reward medical discount	if the user requires medical discount
preferred reward airlines ticket	if the user requires airlines ticket
preferred cash withdrawal fee	how much cash withdrawal fee is expected by the user

TABLE: USER (ATTRIBUTES)	Description of Attributes
preferred cash withdrawal limit per transaction	how much cash withdrawal limit is minimally required by the user for each transaction
preferred cash withdrawal limit per day	how much cash withdrawal limit is minimally required by the user per day

TABLE: CARD (ATTRIBUTES)	DESCRIPTION OF ATTRIBUTES
card id	card id (Primary Key)
card name	name of card
card type	if card is credit or debit
bank name	bank the card is from, foreign key from bank table
cardholder minimum age	minimum age for card approval
card issue fee	fee required for issuing card
interest rate	interest rate for the credit card
annual fee	annual fee given to the bank
card replacement fee	card replacement fee if the card is lost
captured card replacement fee	card replacement fee if the card is captured in an ATM machine
cash withdrawal fee	cash withdrawal fee for each transaction
cash withdrawal limit per transaction	maximum amount of money that can be withdrawn in one transaction
cash withdrawal limit per day	maximum amount of money that can be withdrawn per day
vat percentage	annual VAT percentage for the card
minimum credit limit	minimum credit limit for credit cards
maximum credit limit	maximum amount of credit limit
interest free period	interest free period in months
fund transfer facility	boolean . whether the card can transfer fund with other cards
international transaction available	boolean. if card can be used for international transaction.
dual currency available	boolean. if card can be used for multiple currencies.
dual currency fee	boolean
is_visa	if card is visa or not
is_mastercard	if card is mastercard or not
reward airport lounge	if card rewards users with airport lounge usage
reward cashback available	if card has cashback available or not
reward cashback percentage	percentage of cashback available
reward luxury resort	if card awards resort discount

TABLE: CARD (ATTRIBUTES)	DESCRIPTION OF ATTRIBUTES
reward insurance plan	if card awards discounted insurance plan
reward accidental death insurance	if card awards death insurance plan
reward travel emergency	if card awards emergency help during travel
reward fine dining	if card awards fine dining experience discount
reward buffet discount	if card awards buffet discount
reward medical discount	if card awards medical discount
reward airlines ticket	if card awards airlines ticket
upgrade possible	if card has upgraded versions
sms service available	if card has sms based transactions

TABLE: BANK (ATTRIBUTES)	DESCRIPTION OF ATTRIBUTES
bank id	Id of the bank
bank name	name of bank
number of ATMS available	Available ATMs

TABLE: USER BANK (ATTRIBUTES)	DESCRIPTION OF ATTRIBUTES
User id	foreign key(from table 'USER')
bank id	foreign key(from table 'BANK')

TABLE: USER CARD (ATTRIBUTES)	DESCRIPTION OF ATTRIBUTES
User id	foreign key(from table 'USER')
bank id	foreign key(from table 'BANK')
card recommendation score	AI will recommend a card for user

4 Technical Stack

Front End

HTML,CSS, Bootstrap, Vue.js/Angular.js

Back End

Flask/Django, Python.

Machine Learning

Python packages : Scikit-learn, Surprise(Recommender Systems package)

Deployment

Docker and Heroku.

5 Work Plan

Task List and Assignee Name

Task Name	Assignee
Building Recommender Engine + project management	Mayeesha
Front end development + backend management	Sakib
Data collection for recommender system	Novera
Backend Development + Database Work	Pranto
Database primary management	Tashfique.