RESTAURANT RECOMMENDATION SYSTEM
SMARTINTERNZ FINAL PROJECT REPORT

Team ID: 591739

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## --INTRODUCTION--

- ### PROJECT OVERVIEW

A lot of us like to visit hotels, roadside dhabas, cafes and restaurants to have a taste of the cuisine they serve. One of the many benefits of dining outside is that you have a variety of options to choose from. With the advent of technology, finding new restaurants has become much easier. All you have to do is to search on your browser to find nearby restaurants. The only problem is that there are so many restaurants available now that it becomes difficult to decide which restaurant to choose. After all, we do not get to dine outside daily, right? And when we do, we want the experience to be good and memorable. In 2017, the Indian restaurant industry was estimated to be worth Rs. 75000 crores and is growing at an annual rate of 7 percent. (SMERGERS, 2017) This industry also employs a large workforce and is cause of livelihood for a lot of people. In the Indian city of Bangalore, the number of restaurants is estimated to be nearby 12000.
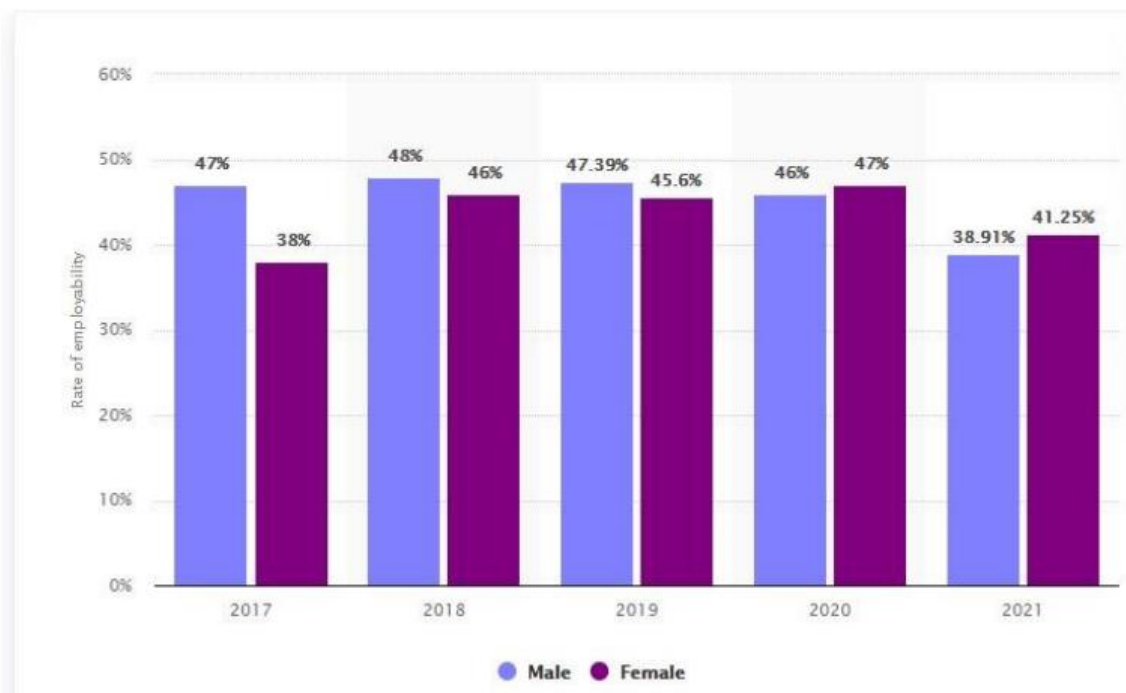
(This diagram shows rate of employability for both males and females in this industry)

These are some of the common factors people take into account while choosing the right restaurant are –
1. Distance of the restaurant from their location.
2. Type of cuisine they offer.
3. Pricing of the available cuisines and if it fits their budget.
4. Booking service is available or not.
5. Ratings and reviews provided by previous customers.
6. Timings of the restaurant.
7. Basic facilities and amenities provided or not.
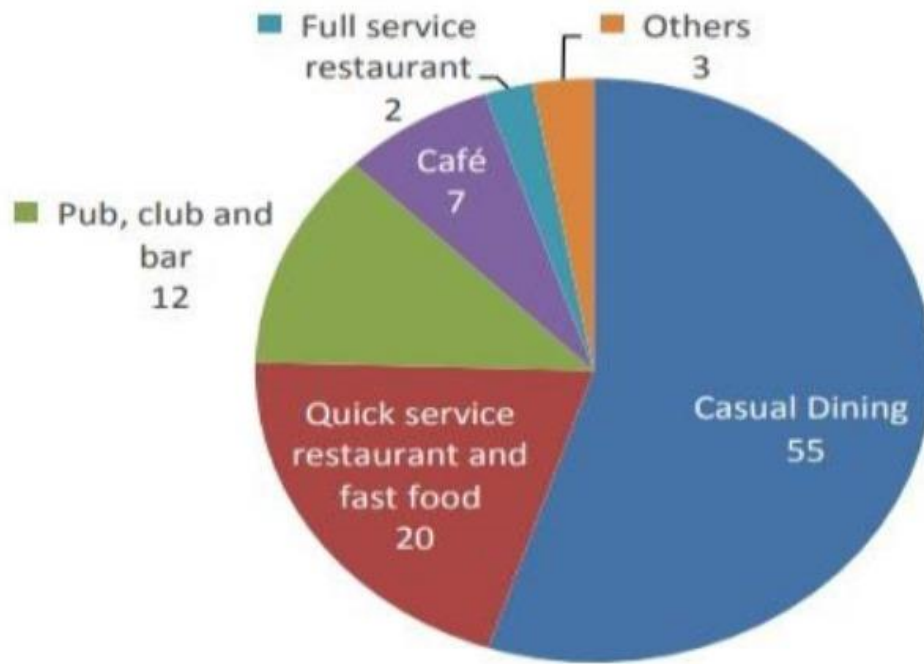
Since me and my team consists of foodies who love trying new places, we aim to create a new web-based platform that helps people like us find the places of our interest to carry out our hobby :p

This entire system consists of two main components :

- Frontend – Web-based interface where users can input their preferences and receive recommendations.
- Backend - An AI model that generates recommendations based on user input and the restaurant database.

Architecture consists of the following :

(So here are the components of architecture which you can see.)

1. **Data:** The system will require a database of restaurants, which should include information such as cuisine, price, location, ratings, and dining options. The system will also need to collect user data, such as their past ratings and preferences.

2. **AI Model**: The AI model can be trained using a variety of machine learning algorithms, such as collaborative filtering, content-based filtering, or hybrid filtering. Collaborative filtering algorithms recommend restaurants to users based on the ratings of other users with similar preferences. Content-based filtering algorithms recommend restaurants to users based on their past ratings and preferences for cuisine, price, location, and other factors. Hybrid filtering algorithms combine collaborative filtering and content-based filtering to generate more accurate

3. **Deployment:** The system can be deployed as a web application or a mobile app. The backend can be deployed on a cloud platform such as Google Cloud Platform, AWS or Azure.

4. **Evaluation:** The system can be evaluated by measuring its accuracy and precision. Accuracy is the proportion of recommendations that users find relevant. Precision is the proportion of relevant recommendations that users click on.

Additional Considerations

1. **Personalization:** The system should be able to personalize recommendations based on each user's individual preferences. This can be done by collecting user feedback and past behaviour

2. **Explain ability:** The system should be able to explain why it recommends certain restaurants to users. This will help users to trust the system and to make more informed decisions about where to eat.

3. **Scalability:** The system should be able to scale to handle a large number of users and restaurants. This can be done by using a cloud-based deployment architecture.

- ## **PURPOSE**

(Lets look at the purpose of this project)

1. Enhancing User Experience: The project should aim to provide users with a convenient and enjoyable dining experience by helping them discover restaurants that match their preferences, whether it's the type of cuisine, location, budget, or dining style.

2. Saving Time and Effort: Users often have to sift through numerous options to find the perfect dining spot. The project can save users time and effort by narrowing down their choices and presenting them with relevant recommendations.

3. Exploring New Culinary Experiences: The project can encourage users to try new and diverse cuisines and dining locations they might not have considered otherwise, thereby broadening their culinary horizons.

4. Supporting Local Businesses: By promoting local restaurants and eateries, the project can help boost the visibility and patronage of smaller, less-known establishments.

(Here are some more points to support the purpose. Lets head forward.)
5. Providing Personalization: Offering personalized recommendations based on user input and behavior allows for a tailored dining experience, increasing user satisfaction.

6. Continuous Improvement: Over time, the project should continuously refine its recommendation algorithms based on user feedback and changing data, ensuring that users receive more accurate and relevant suggestions.

7. Data Analysis: The project can serve as a valuable source of data for analyzing dining trends, popular cuisines, and user preferences, which can be useful for restaurant owners, food critics, and the hospitality industry.

8. Learning and Skill Development: We are building this project as a learning exercise in SmartInternz, it can serve as an opportunity to acquire and hone skills in web development, data analysis, machine learning, and system design.

9. Business Opportunity: Depending on the project's success and user base, it could also serve as a foundation for a potential business venture or partnership with restaurants or food-related services.

10.Community Engagement: If you have a local or community focus, your project can encourage residents to explore and support local dining establishments, fostering a sense of community

--LITERATURE SURVEY--

(Here we have some points on the literature surevey conducted on this project)

1. Information Overload: The abundance of restaurant choices available today can overwhelm consumers. Users often face the problem of information overload when trying to find the right place to dine, leading to choose paralysis.

2. User Preferences Variability: People have diverse preferences when it comes to dining out. What one person considers an excellent dining experience might not be the same for another. This variability in user preferences is a significant challenge for recommendation systems.

3. Inaccurate Recommendations: Existing recommendation systems may not always provide accurate or relevant restaurant suggestions. They may lack the ability to consider various factors that matter to users, such as cuisine, location, budget, and user reviews.

4. Cold Start Problem: For new users or restaurants with limited historical data, recommendation systems often struggle to provide meaningful suggestions. This is known as the "cold start" problem

5. Scalability: As the number of restaurants and users in a recommendation system grows, scalability becomes an issue. Systems need to efficiently handle and process large datasets.

6. Data Quality and Completeness: Restaurant data, such as ratings and reviews, can be inaccurate or incomplete. Handling noisy and unreliable data is a challenge.

7. Sparsity: Recommendation systems may encounter sparsity issues when dealing with user-item interactions. Users tend to rate or review only a small fraction of available restaurants.

8. Privacy and Security: Collecting and using user data for recommendations raises privacy and security concerns. Protecting user data while delivering personalized recommendations is a challenge.

9. Adaptability: The restaurant industry is constantly evolving, with new establishments opening and existing ones changing. Recommendation systems need to adapt to changing data and user preferences.

10.Domain-Specific Challenges: The restaurant domain has unique challenges, such as seasonal menu changes, special events, and cultural or dietary considerations. Recommendation systems need to account for these specific factors.

11.Evaluation Metrics: Measuring the performance of recommendation systems and selecting appropriate evaluation metrics can be challenging. Common metrics include accuracy, diversity, novelty, and user satisfaction.

12.Competing Platforms: There are various existing platforms and services (e.g., Yelp, TripAdvisor, Google Maps) that offer restaurant recommendations. The system will need to compete with or integrate with these platforms.

13.Exploration vs. Exploitation: Striking the right balance between recommending well-known, highly-rated restaurants (exploitation) and encouraging users to try new places (exploration) is a challenge.
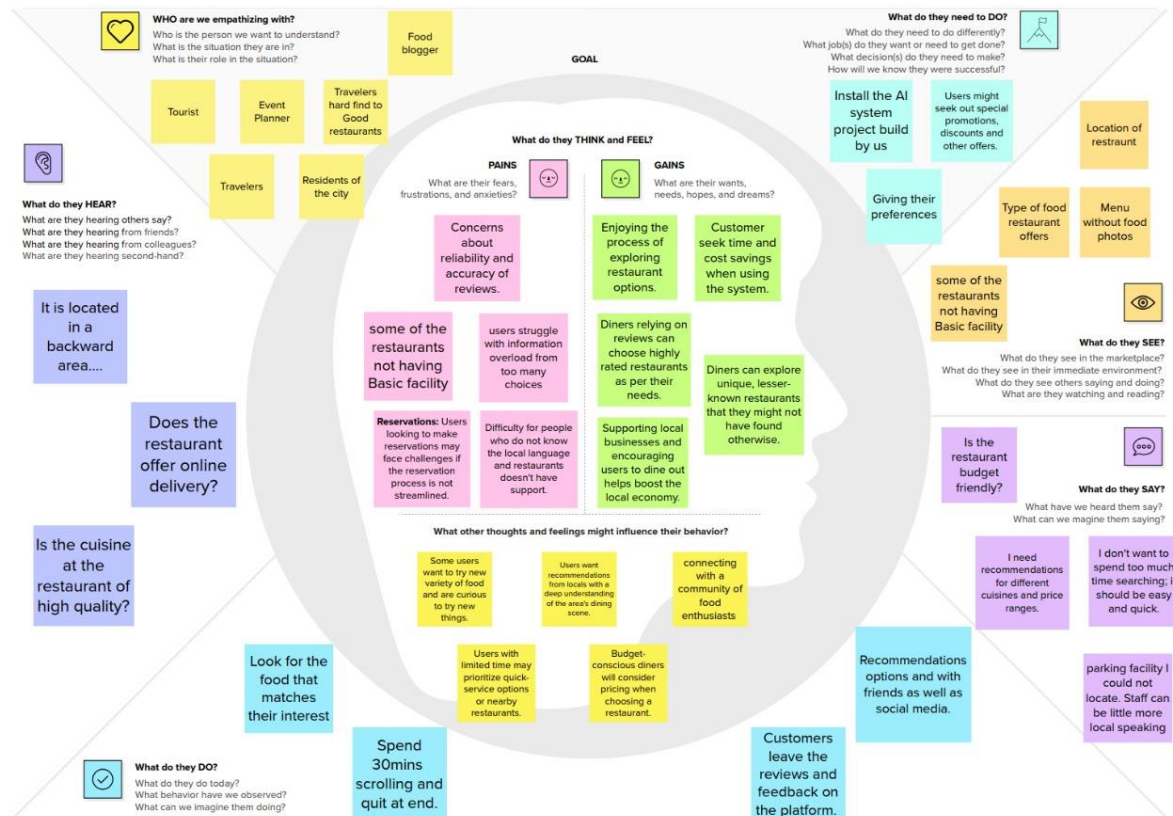
(Lets come to the problem statement)
- **PROBLEM STATEMENT DEFINITION**

In the context of the restaurant industry, diners often face the challenge of selecting the most suitable dining establishments from a vast array of options. The abundance of restaurants, varying user preferences, and the lack of a personalized guidance system lead to information overload and choice paralysis. Users desire a solution that simplifies the decision-making process by providing personalized restaurant recommendations based on factors such as cuisine type, location, budget, user ratings, and individual dining preferences. The existing restaurant recommendation systems often fail to deliver accurate and relevant suggestions, and there is a need for an improved solution that enhances the dining experience and adapts to evolving user tastes and culinary trends. This project aims to design, develop, and evaluate a restaurant recommendation system that leverages data analytics and machine learning techniques to offer personalized and high-quality restaurant suggestions to users, mitigating the challenges associated with dining decision-making

--IDEATION PHASE--

EMPATHY MAPPING
(So here we have the empathy mapping which u can see)

Empathy map diagram containing the following notes:

WHO are we empathizing with?
Who is the person we want to understand?
What is the situation they are in?
What is their role in the situation?

GOAL

Food blogger
Tourist
Event Planner
Travelers hard find to Good restaurants
Travelers
Residents of the city

What do they HEAR?
What are they hearing others say?
What are they hearing from friends?
What are they hearing from colleagues?
What are they hearing second-hand?

It is located in a backward area....
Does the restaurant offer online delivery?
Is the cuisine at the restaurant of high quality?

What do they THINK and FEEL?

PAINS — What are their fears, frustrations, and anxieties?

Concerns about reliability and accuracy of reviews.
some of the restaurants not having Basic facility
users struggle with information overload from too many choices
Reservations: Users looking to make reservations may face challenges if the reservation process is not streamlined.
Difficulty for people who do not know the local language and restaurants doesn't have support.

GAINS — What are their wants, needs, hopes, and dreams?

Enjoying the process of exploring restaurant options.
Customer seek time and cost savings when using the system.
Diners relying on reviews can choose highly rated restaurants as per their needs.
Diners can explore unique, lesser-known restaurants that they might not have found otherwise.
Supporting local businesses and encouraging users to dine out helps boost the local economy.

What other thoughts and feelings might influence their behavior?

Some users want to try new variety of food and are curious to try new things.
Users want recommendations from locals with a deep understanding of the area's dining scene.
connecting with a community of food enthusiasts

What do they DO?
What do they do today?
What behavior have we observed?
What can we imagine them doing?

Look for the food that matches their interest
Spend 30mins scrolling and quit at end.
Users with limited time may prioritize quick-service options or nearby restaurants.
Budget-conscious diners will consider pricing when choosing a restaurant.
Customers leave the reviews and feedback on the platform.

What do they need to DO?
What do they need to do differently?
What job(s) do they want or need to get done?
What decision(s) do they need to make?
How will we know they were successful?

Install the AI system project build by us
Users might seek out special promotions, discounts and other offers.
Location of restraunt
Giving their preferences
Type of food restaurant offers
Menu without food photos
some of the restaurants not having Basic facility

What do they SEE?
What do they see in the marketplace?
What do they see in their immediate environment?
What do they see others saying and doing?
What are they watching and reading?

Is the restaurant budget friendly?

What do they SAY?
What have we heard them say?
What can we imagine them saying?

I need recommendations for different cuisines and price ranges.
I don't want to spend too much time searching; it should be easy and quick.
Recommendations options and with friends as well as social media.
parking facility I could not locate. Staff can be little more local speaking

--REQUIREMENT ANALYSIS--

- ## FUNCTIONAL REQUIREMENTS

1. User Registration and Authentication: Users should be able to create accounts with a valid email address and password. The system must provide secure authentication mechanisms.

2. User Profile Management: Users can update their profiles with personal information, including dietary preferences and location.

3. Restaurant Database: The system should maintain a comprehensive database of restaurants with details such as name, location, cuisine type, price range, ratings, and reviews.

4. Recommendation Algorithm: Develop an algorithm that considers user preferences, past behavior, and location for personalized restaurant recommendations.

5. Search and Filtering: Users should be able to search for restaurants based on their current location or a specified area. Provide filtering options based on cuisine type, price range, ratings, and other relevant criteria.

6. User Interaction: Allow users to submit reviews and ratings for restaurants. Integration with social media for users to share recommendations and reviews.

7. Notifications: Implement personalized alerts to notify users of new restaurant recommendations, special offers, or events based on their preferences. Users should receive feedback alerts to encourage them to provide feedback on recommendations.

8. Reservation Integration: Integrate with a reservation system to enable users to book tables directly through the platform.

9. Mobile-Friendly Interface: Ensure the system is accessible and userfriendly on various devices, particularly mobile phones.

- ## NON-FUNCTIONAL REQUIREMENTS

1. Scalability and Performance: Design the system to handle increased user and restaurant listings without a significant drop in performance. Implement load balancing to distribute traffic efficiently.

2. Feedback and Improvement: Provide a mechanism for users to submit feedback and report issues. Regularly update and enhance the recommendation algorithm based on user feedback.

3. Security: Implement data encryption for user data, especially sensitive information like passwords, and ensure secure communication between the user's device and the system.

4. Documentation: Provide user guides and documentation for both users and administrators. Document any APIs used or exposed.

5. Testing: Implement rigorous testing procedures, including unit testing, integration testing, and user acceptance testing

--PROJECT DESIGN PHASE--

- ## PROPOSED SOLUTION
(In this we have the following statements)
PROBLEM STATEMENT

- Create an AI project that recommends restaurants to users based on their unique preferences and needs that aims to solve challenges like data acquisition, user interaction, personalization and scalability.

- Tourists seek recommendations from locals who have a deep understanding of the area's dining scene to ensure an authentic and enjoyable experience.

- Users express concerns about the reliability and accuracy of restaurant reviews and ratings, leading to uncertainty when, making dining choices.

IDEA/SOLUTION

We will build an AI based web app that integrates with the recommendation system, providing a user experience for on-the-go users, and create detailed user profiles by collecting data on their past restaurant choices, ratings, and reviews.It will be using advanced filtering and sorting options to help users refine their restaurant choices based on their preferences (cuisine, price range, location). Implement a user-friendly interface with clear categorization.

- The AI platform for users will analyse user past choices and suggest similar restaurants the user prefers. By this recommendation system, to improve the restaurants as well. And also learning from user feedback helps fine-tune the recommendations over time.

SOCIAL IMPACT AND CUSTOMER SATISFACTION
(These are the social impacts...)

This project goes beyond traditional recommendations by promoting lesserknown, local, and culturally diverse dining experiences. It also addresses language barriers for tourists and ensures a seamless and inclusive dining experienceBy recommending high-quality restaurants, the system can lead to positive dining experiences and customer satisfaction, resulting in repeat business and positive word-of-mouth referrals.

- The AI platform suggests user to find the best food to try in different cities he travels around with the best quality and ratings

BUSINESS MODEL (REVENUE MODEL)

By recommending a diverse range of local restaurants, the system can contribute to the success of small businesses and help them thrive. This can have a positive economic impact on local communities**Affiliate Marketing:** Include affiliate links to restaurant booking websites or food delivery services. Earn a commission for each successful booking or order made through your platform.**Sponsored Content:** Allow restaurants to pay for sponsored content on your platform, such asfeatured restaurant profiles, articles, or promoted listings.**Marketing and Promotion:** Offer marketing opportunities and promotions to boost restaurant business.**Advertising and Promotions**: Partner with restaurants to display their ads or promotions within the recommendation system.
Data Licensing: Sell the anonymized user data to restaurants and food-related businesses, providing them with valuable insights into customer preferences and behaviors.

SCALIBILITY OF SOLUTION

Database Scalability: Storing and retrieving restaurant data efficiently is crucial. You may need a scalable database solution capable of handling increasing data loads.**Content Delivery Networks Scalability:** Use this scalability, such as ratings and reviews. And this scalability distribute content to edge locations, reducing the load on your servers and improving content delivery speed.**Infrastructure Scalability**: Choose a cloud-based infrastructure provider that allows you to scale resources dynamically. This ensures you can allocate additional computing power, storage,and bandwidth as needed.
Load Balancing: Implement load balancers to distribute incoming traffic evenly across multiple servers or instances. Load balancing prevents overloading a single server and ensures even resource utilization
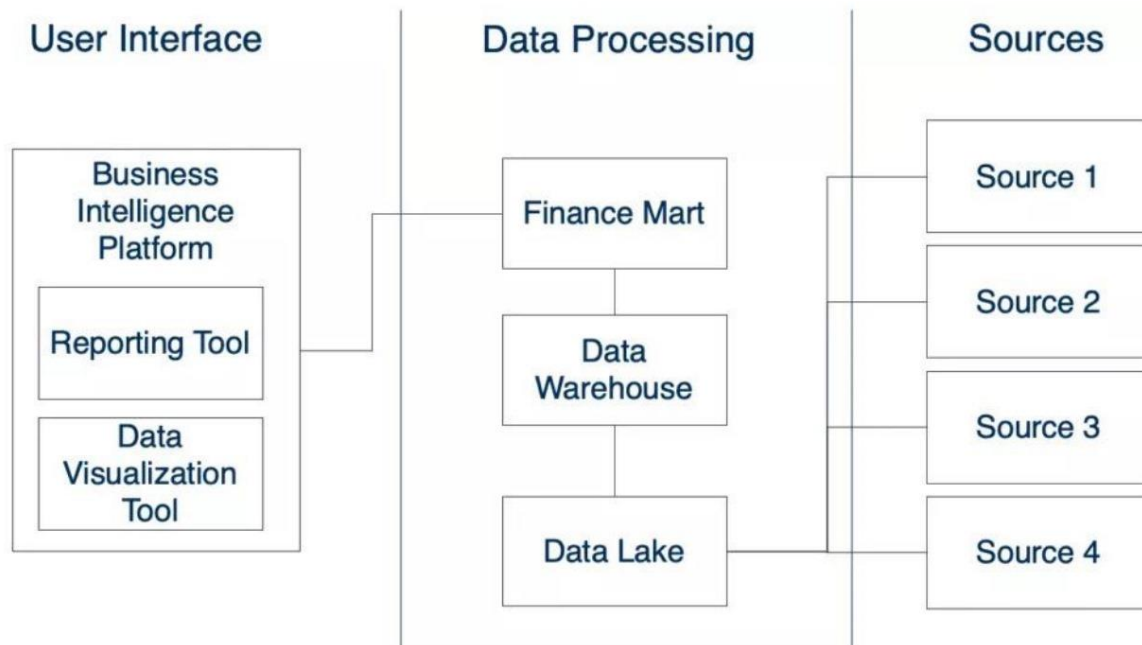
- ## SOLUTION ARCHITECTURE

It provides a comprehensive and organized plan for how various components, systems, and technologies will work together to achieve a particular objective or address a particular need.

This architecture is designed to provide a scalable, secure, and user-friendly solution for a restaurant recommendation system. It allows for the efficient handling of user interactions, data processing, and the delivery of personalized recommendations. Regular monitoring and optimization are essential to maintain system performance and user satisfaction.

The goals of solution architecture are:
(These are the goals of this architecture)

1. Architecture Design: Create a high-level architecture for the system, defining components, their interactions, and data flows. Choose suitable technologies and frameworks.

2. Personalization: Provide highly personalized restaurant recommendations tailored to each user's preferences, including cuisine, location, price range, and dietary restrictions.

3. Scalability: Ensure the system can handle a growing user base and an expanding restaurant database without compromising performance.

4. Performance: Deliver fast response times and a seamless user experience, even during periods of high traffic and increased demand.

5. User Experience: Create a user-friendly interface that simplifies restaurant selection and reservation processes while providing relevant information.

 6. Recommendation Quality: Use advanced recommendation algorithms to provide accurate and diverse restaurant suggestions.

7. Data Privacy and Compliance: Ensure compliance with data privacy regulations and ethical handling of user data.

8. Scalability Planning: Develop a roadmap for future scalability, aligning with business growth and evolving user needs.

9. Monitoring and Analysis: Implement monitoring and analytics tools to track system performance, user behaviour, and system health.

User Interface	Data Processing	Sources
Business Intelligence Platform Reporting Tool Data Visualization Tool	Finance Mart Data Warehouse Data Lake	Source 1 Source 2 Source 3 Source 4

DESIGN PART
(These are components of design part)

1. **Data Collection and Preprocessing:** • Import and preprocess the data from the Excel dataset, ensuring it's cleaned and structured for analysis.

2. **Database**: • Store the pre-processed data in a database (e.g., SQL or NoSQL) for efficient querying and retrieval.

3. **User Interface**: • Develop a user-friendly interface for users to input their preferences, such as budget, distance, and ratings. This could be a web or mobile application.

4. **Input Data Handling:** • Get the input data from the user through the interface.

5. **Recommendation Engine:** • Implement the core recommendation engine, which includes the following components:

i. Collaborative Filtering: Use collaborative filtering algorithms to recommend restaurants based on user behaviour and preferences.

ii. Content-Based Filtering: Utilize content-based recommendation algorithms to match user input parameters (budget, distance, ratings) with restaurant attributes.

iii. Hybrid Models: Combine collaborative and content-based filtering to improve recommendation accuracy.

iv. Machine Learning Models: Implement machine learning models (e.g., decision trees, neural networks) to enhance personalized recommendations.

6. **Data Processing:** • Perform data preprocessing and feature engineering to enhance the quality of input data for the recommendation engine. • Create user and restaurant profiles based on historical interactions and user preferences.

7. Recommendation Scoring: • Assign scores to recommended restaurants based on user preferences (e.g., budget, distance, ratings). • Weight these scores based on user priorities.

8. User Feedback: • Collect user feedback and ratings on recommended restaurants to continuously improve the recommendation engine. • Use this feedback to retrain machine learning models and adapt to changing user preferences.

9. Deployment: • Deploy the system on cloud infrastructure or on-premises servers, depending on your requirements.

10. Monitoring and Analytics: • Implement monitoring tools to track system performance, user interactions, and recommendation accuracy.

11. Continuous Improvement: • Regularly update and fine-tune the recommendation engine with new data and improved algorithms to enhance the quality of recommendations

SOLUTION ARCHITECTURE DIAGRAM
(Here we have diagram to demonstrate the architecture)
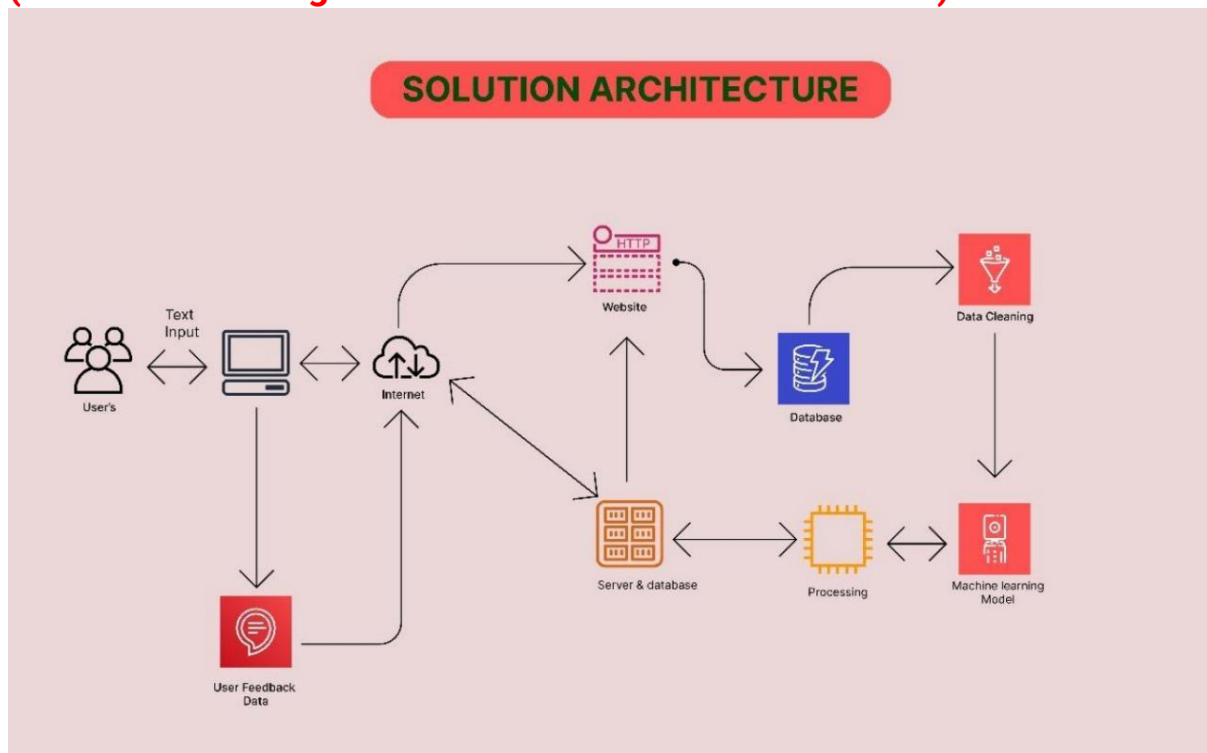
- **DATA FLOW DIAGRAM AND USER STORIES**

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.

(This is the Data flow diagram of this project)

USER STORIES
(Here we have the user stories and a table that highlights the requirement, type and release and priority.)

User stories are concise, informal descriptions of a feature or functionality from an end user's perspective. They are a common tool in agile software development and are used to capture requirements and communicate them between the development team and stakeholders.

User stories focus on the who, what, and why of a feature, leaving the how (implementation details) to be discussed later.

They help ensure that the development team understands the user's needs and that the delivered product provides value to the end user. User stories are often written on index cards or in digital tools and are part of the product backlog in agile development methodologies.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance Criteria	Priority	Release
Customer	Registration	USN-1	As a user, I can register for the application by entering my email, Password, and confirming my password.	Ensure a secure, user-friendly, and reliable registration process for the application	High	Sprint-1
Customer		USN-2	As a user, I can use the services without registering as a user.	provide some guidelines to ensure that the user can effectively use the services without the need for registration.	High	Sprint-1
Old user	Profile Management	USN-3	As a user, I want to be able to edit my profile information, including preferences such as budget range, cuisine preferences, and distance range.	Users should be able to edit specific profile fields, including but not limited to: Username, Email or Password	Medium	Sprint-1
Old user	Login	USN-4	As a user, I can log into the application by entering my email & password.	The application provides a secure and user-friendly login experience, prioritizing both convenience and data protection.	High	Sprint-1
New User	Interface	USN-5	Users want a user-friendly interface that is easy to navigate and understand.	Users should be able to easily navigate through the application's features and sections without confusion and accommodates a diverse range of users.	High	Sprint-2
New User	Search	USN-6	As a User, I want to discover the best restaurants in my area.	Users should be able to enter their location or allow the application to access their location.	Medium	Sprint-2
Hungry User		USN-7	As a hungry user, I want to be able to input my location and dietary preferences so that the AI system can recommend nearby restaurants.	The application should provide a user-friendly interface for users to input their location and dietary preferences.	High	Sprint-2
On-a-diet user	Filter	USN-8	As a customer, I want the option to filter restaurant recommendations based on dietary restrictions.	The system should allow users to specify dietary restrictions such as vegetarian, vegan, gluten-free, etc.	Low	Sprint-3
Traveler		USN-9	As a user, I want the AI system to provide me with a list of fast-food restaurants with high ratings near my location, so I can quickly find a place to eat on my lunch.	To provide a seamless and efficient experience for users seeking fast-food restaurant recommendations with high ratings near their current location.	High	Sprint-3
Health-Conscious user		USN-10	As a health-conscious user, I desire the AI system to offer restaurant recommendations that consider nutritional information, enabling me to make healthier dining choices.	Health-conscious users can receive personalized restaurant recommendations that align with their nutritional goals and preferences, promoting informed and healthier dining choices.	Medium	Sprint-3
Frequent User		USN-11	As a user, I want to receive personalized restaurant recommendations based on my past dining history and preferences, enhancing my dining experiences.	The system should ask the user to input their preferred cuisine type.	High	Sprint-4
Food blogger and critic	Review	USN-12	As a user, I want to write reviews and rate restaurants I've visited, helping other users make informed dining choices	It covers various aspects to ensure that users can easily contribute meaningful reviews and ratings to help others make informed dining choices.	Medium	Sprint-4
Normal User		USN-13	As a User, Users want to access reviews and ratings to make informed decisions about restaurant choices.	users can access reliable and informative reviews and ratings when making decisions about restaurant choices.	High	Sprint-4

--PROJECT PLANNING PHASE--

- **TECHNOLOGY STACK**

Technical Architecture:

1. User Interface (UI):

   - Collects user preferences (food, location, budget).
   - Sends user input to the backend.
   - Also collects ratings provided by the user.

2. Backend Application Logic:

   - User Input Processing:
     - Receives and processes user input from the UI.
   - Data Retrieval:
     - Accesses the restaurant dataset stored in a data storage component.
   - AI Recommendation Engine:
     - Utilizes machine learning models (if applicable) to generate restaurant suggestions based on user preferences.
   - Filtering and Sorting:
     - Applies filters and sorting algorithms based on user preferences.
   - Result Compilation:
     - Gathers the final list of recommended restaurants.
   - Response to UI:
     - Sends the list of recommended restaurants to the UI for display.
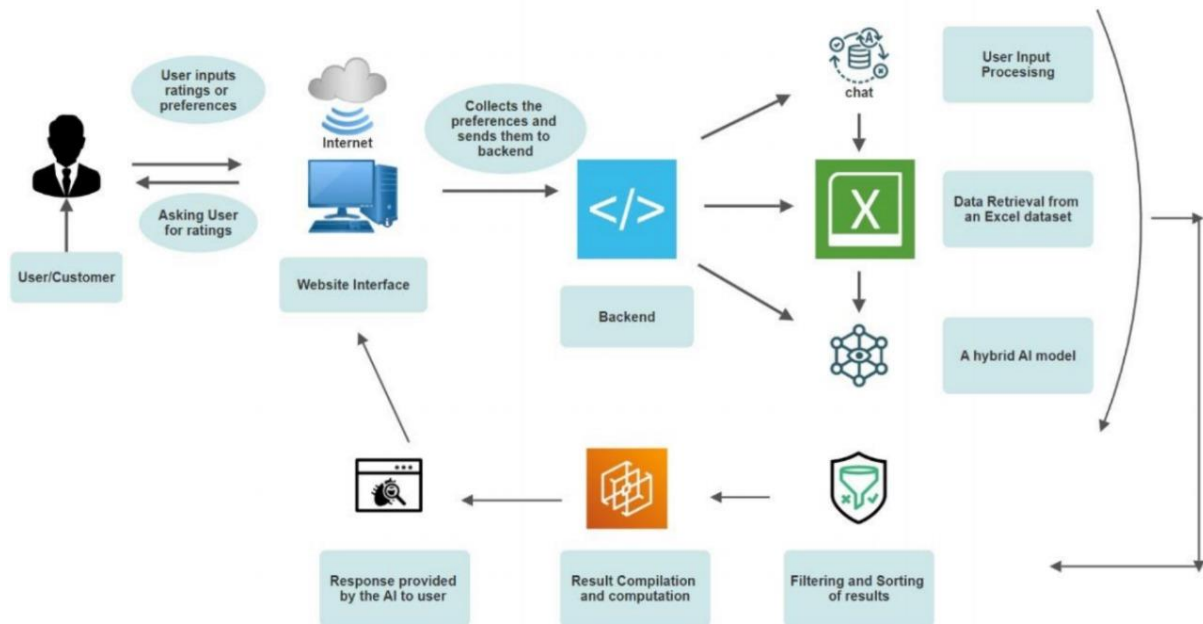
(This diagram demonstrate the flow diagram of function of the entire project.)

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	The User filters to narrow down their search based on criteria like cuisine, price range, location, ratings	HTML, CSS
2.	Application Logic-1	Gather data on restaurants, including information such as location, cuisine type, price range, ratings, reviews, and user preferences	CSS / Python
3.	Application Logic-2	Clean and preprocess the data, collaborative filtering, content-based filtering for patterns for the data.	Python, HTML
4.	Application Logic-3	Implement features that enable personalized recommendations based on the user's history, preferences, and behavior	Python, CSS
5.	Database	Data like restaurant name, cuisine type, location, ratings, and reviews. Configure the parameters of the recommendation algorithm, including learning rates, regularization terms.	MySQL, NoSQL, etc.
6.	Cloud Database	Database service on the cloud is initialized when data is utilized in the cloud SQL, the data is fully structured and organized based on data sets	IBM DB2, IBM Cloudant etc.
7.	File Storage	Images and multimedia content considering the size and files quantity. Restaurant cuisines and popular dishes is stored in the pdf format.	IBM Block Storage or Other StorageService or Local Filesystem
8.	External API-1	API integrating with Google Maps helps users locate restaurants easily. Integrating with weather APIs can provide users with additional context for their dining choices	IBM Weather API, etc
9.	External API-2	Utilizing Authentication API'S like social media logins. Connecting to restaurant reservation APIs enables users to make reservations directly from the application.	Social Media API'S, etc.
10.	Machine Learning Model	Machine learning model is required for providing personalized and accurate recommendations to users.	Object Recognition Model, etc.
11.	Infrastructure (Server / Cloud)	Local system: Database, Backend server, Model deployment Cloud server: Cloud CDN, Storage, Scalability Monitoring	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Framework	Apache Mahout, TensorFlow Recommenders (TFRS), Flask	Python, Java, Flask, MySQL,
2.	Security Implementations	Data Encryption, Authorization, Securing API endpoints, Vulnerability	OpenSSL, OAuth, Django, OWASP ZAP
3.	Scalable Architecture	Microservices, Load balancing, Horizontal scaling, Caching, Auto Scaling	Kubernetes, NGINX, AWS, Redis, Azure Auto scaling
4.	Availability	Redundancy, multiple servers for preventing overloading, Maintenance	Load balancing, alerting systems, Automation tools
5.	Performance	Sharding mechanisms, CDN, Optimized database, Asynchronous processing	Amazon Aurora, Apache Kafka, Database indexing, Cloudflare

- # PROJECT PLANNING

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, Password, and confirming my password.	2	High	Arsh S SK Mohid Babu
Sprint-1		USN-2	As a user, I can use the services without registering as a user.	1	High	Rupa V
Sprint-1	Profile Management	USN-3	As a user, I want to be able to edit my profile information, including preferences such as budget range, cuisine preferences, and distance range.	1	Medium	Charith Y Arsh S
Sprint-1	Login	USN-4	As a user, I can log into the application by entering my email & password.	2	High	SK Mohid Babu
Sprint-2	Interface	USN-5	As a User, I want a user-friendly interface that is easy to navigate and understand.	2	High	Rupa V
Sprint-2	Search	USN-6	As a User, I want to discover the best restaurants in my area.	2	Medium	Charith Y
Sprint-2		USN-7	As a hungry user, I want to be able to input my location and dietary preferences so that the AI system can recommend nearby restaurants.	3	High	Charith Y SK Mohid Babu
Sprint-3	Filter	USN-8	As a customer, I want the option to filter restaurant recommendations based on dietary restrictions.	1	Low	Rupa V
Sprint-3		USN-9	As a user, I want the AI system to provide me with a list of fast-food restaurants with high ratings near my location, so I can quickly find a place to eat on my lunch break.	2	High	Arsh S Rupa V SK Mohid Babu
Sprint-3		USN-10	As a health-conscious user, I desire the AI system to offer restaurant recommendations that consider nutritional information, enabling me to make healthier dining choices.	1	Medium	Charith Y Arsh S
Sprint-4		USN-11	As a user, I want to receive personalized restaurant recommendations based on my past dining history and preferences, enhancing my dining experiences.	2	High	Arsh S Rupa V SK Mohid Babu Charith Y
Sprint-4	Review	USN-12	As a user, I want to write reviews and rate restaurants I've visited, helping other users make informed dining choices	1	Medium	Arsh S SK Mohid Babu
Sprint-4		USN-13	As a User, Users want to access reviews and ratings to make informed decisions about restaurant choices.	2	High	Rupa V Charith Y

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

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	6	4 Days	3 Nov 2023	7 Nov 2023	6	07 Nov 2023
Sprint-2	7	5 Days	8 Nov 2023	13 Nov 2023	7	13 Nov 2023
Sprint-3	4	2 Days	14 Nov 2023	16 Nov 2023	4	16 Nov 2023
Sprint-4	5	3 Days	17 Nov 2023	20 Nov 2023	5	20 Nov 2023

VELOCITY

(We did a sprint and calculated the team's average velocity. It turned out to be 6.56)

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)

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

Average Velocity (Sprint 1) = 6/4 = 1.5

Average Velocity (Sprint 2) = 7/5 = 1.4

Average Velocity (Sprint 3) = 4/2 = 2

Average Velocity (Sprint 4) = 5/3 = 1.66

Total Average Velocity = 1.5 + 1.4 + 2 + 1.66 = 6.56

BURNOUT CHART

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

Sprint progress

███████████████████████░░░░░░░ **71% done**

Done	In progress	Not started
71%	**29%**	**0%**

Epic progress   ❓ ∨

This sprint is working towards **2 epics**
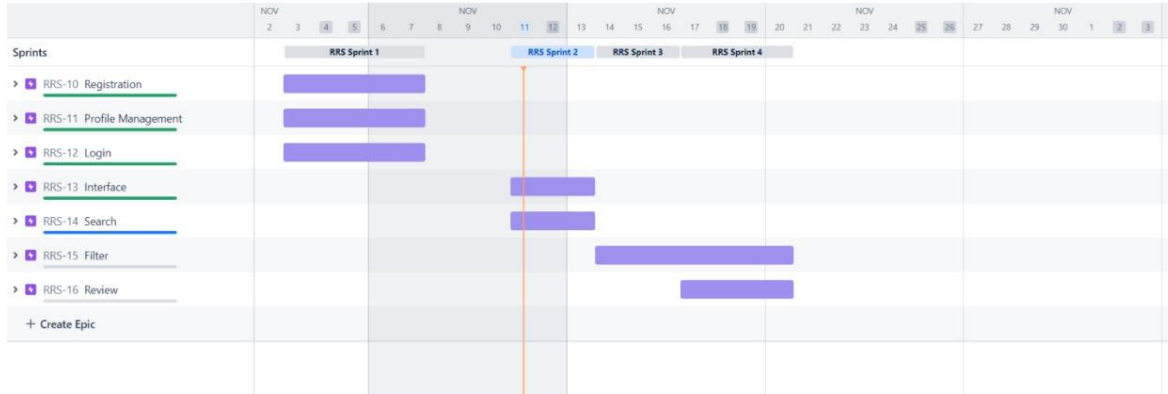
RRS-14 Search	100% done
████████████████████████████████	

RRS-13 Interface	0% done
████████	

TimeLine:

NOV					NOV				NOV						NOV				NOV					NOV					NOV

Timeline bars: 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3

Sprints: RRS Sprint 1 | RRS Sprint 2 | RRS Sprint 3 | RRS Sprint 4

- > RRS-10 Registration
- > RRS-11 Profile Management
- > RRS-12 Login
- > RRS-13 Interface
- > RRS-14 Search
- > RRS-15 Filter
- > RRS-16 Review
- + Create Epic

BackLog:

Jira Software — Your work ∨ · Projects ∨ · Filters ∨ · Dashboards ∨ · Teams ∨ · Apps ∨ · Create

Projects / Restaurant recommended system
Backlog

Epic ∨

SB AS RV CY

Import work · Insights · View settings

Epic ✕

Issues without epic

- > Registration
- > Profile Management
- > Login
- > Interface
- > Search
- + Create epic

∨ RRS Sprint 2 11 Nov – 13 Nov (3 issues)   0 **5** **2** Complete sprint ···
Complete the Interface and search epic

RRS-21 As a User, I want a user-friendly interface that is easy to navigate and u...	INTERFACE	DONE ∨	2	AS
RRS-22 As a User, I want to discover the best restaurants in my area.	SEARCH	IN PROGRESS ∨	2	SB
RRS-23 As a hungry user, I want to be able to input my location and dietary pre...	SEARCH	IN PROGRESS ∨	3	RV

+ Create issue

∨ RRS Sprint 1 3 Nov – 7 Nov (4 issues)   0 **0** **6** Start sprint ···
Complete the registration, Profile management and Login

RRS-17 As a user, I can register for the application by entering my email, P...	REGISTRATION	DONE ∨	2	= SB
RRS-18 As a user, I can use the services without registering as a user.	REGISTRATION	DONE ∨	1	Quickstart ✕
RRS-19 As a user, I want to be able to edit my profile information, including pre...	PROFILE MAN...	DONE ∨	1	RV

Jira Software — Your work ∨ · Projects ∨ · Filters ∨ · Dashboards ∨ · Teams ∨ · Apps ∨ · Create

Projects / Restaurant recommended system
Backlog

Epic ∨

SB AS RV CY

Import work · Insights · View settings

Epic ✕

Issues without epic

- > Registration
- > Profile Management
- > Login
- > Interface
- > Search
- + Create epic

∨ RRS Sprint 1 3 Nov – 7 Nov (4 issues)   0 **0** **6** Start sprint ···
Complete the registration, Profile management and Login

RRS-17 As a user, I can register for the application by entering my email, P...	REGISTRATION	DONE ∨	2	= SB
RRS-18 As a user, I can use the services without registering as a user.	REGISTRATION	DONE ∨	1	= AS
RRS-19 As a user, I want to be able to edit my profile information, includin... ✏	PROFILE MAN...	DONE ∨	1	RV ···
RRS-20 As a user, I can log into the application by entering my email & passwo...	LOGIN	DONE ∨	2	CY

+ Create issue

4 issues | Estimate: 0

∨ RRS Sprint 3 14 Nov – 16 Nov (3 issues)   4 **0** **0** Start sprint ···
Complete the Filter epic Task

| RRS-25 As a customer, I want the option to filter restaurant recommendations b... | FILTER | TO DO ∨ | Quickstart ✕ |

Board:
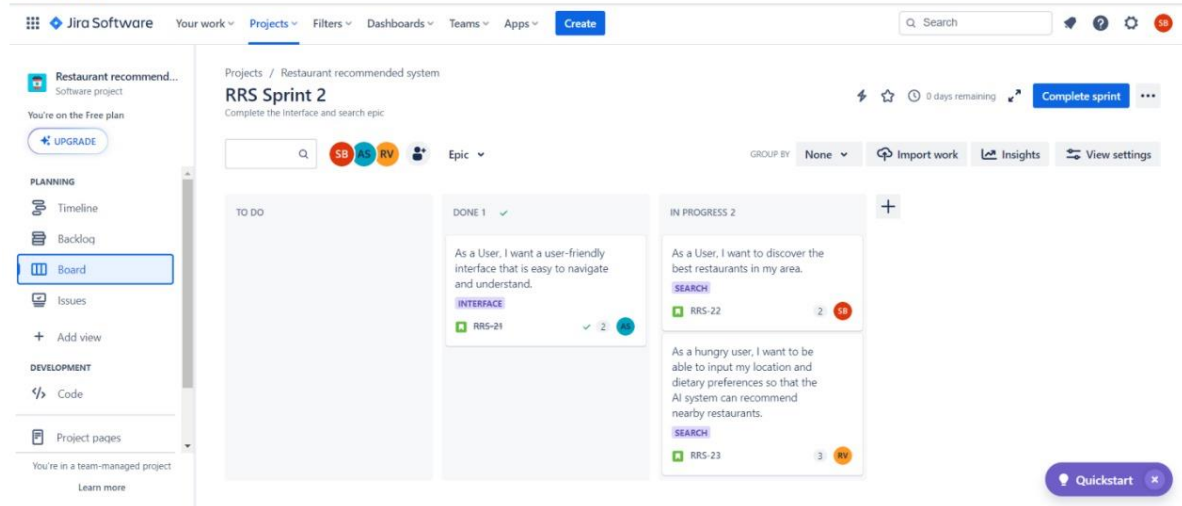
PROJECT DEVELOPEMENT PHASE

Import Libraries

Import the below essential libraries for data pre-processing and creating recommendation system. Pandas and NumPy are used for data pre-processing and cleaning. Seaborn, Plotly and Matplotlib helped in creating visual graphics and bar plots for the dataset

Import Libraries

```
In [6]:   import numpy as np
          import pandas as pd
          import matplotlib.pyplot as plt
          import seaborn as sns
```

Reading the dataset

Our dataset format might be in .csv, excel files, .txt, json, etc. We can read the dataset with the help of pandas.
In pandas we have a function called read_csv () to read the dataset. As a parameter we have to give the directory of csv file.

|	url	address	name	online_order	book_table	rate	votes	phone	lo
0	https://www.zomato.com/bangalore/jalsa-banasha...	942, 21st Main Road, 2nd Stage, Banashankari, ...	Jalsa	Yes	Yes	4.1/5	775	080 42297555\r\n+91 9743772233	Banash
1	https://www.zomato.com/bangalore/spice-elephan...	2nd Floor, 80 Feet Road, Near Big Bazaar, 6th ...	Spice Elephant	Yes	No	4.1/5	787	080 41714161	Banash
2	https://www.zomato.com/SanchurroBangalore?cont...	1112, Next to KIMS Medical College, 17th Cross...	San Churro Cafe	Yes	No	3.8/5	918	+91 9663487993	Banash
3	https://www.zomato.com/bangalore/addhuri-udupi...	1st Floor, Annakuteera, 3rd Stage, Banashankar...	Addhuri Udupi Bhojana	No	No	3.7/5	88	+91 9620009302	Banash
4	https://www.zomato.com/bangalore/grand-village...	10, 3rd Floor, Lakshmi Associates, Gandhi Baza...	Grand Village	No	No	3.8/5	166	+91 8026612447\r\n+91 9901210005	Basava

Overview of features

In [9]:
```python
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 51717 entries, 0 to 51716
Data columns (total 17 columns):
 #   Column                       Non-Null Count  Dtype
---  ------                       --------------  -----
 0   url                          51717 non-null  object
 1   address                      51717 non-null  object
 2   name                         51717 non-null  object
 3   online_order                 51717 non-null  object
 4   book_table                   51717 non-null  object
 5   rate                         43942 non-null  object
 6   votes                        51717 non-null  int64
 7   phone                        50509 non-null  object
 8   location                     51696 non-null  object
 9   rest_type                    51490 non-null  object
 10  dish_liked                   23639 non-null  object
 11  cuisines                     51672 non-null  object
 12  approx_cost(for two people)  51371 non-null  object
 13  reviews_list                 51717 non-null  object
 14  menu_item                    51717 non-null  object
 15  listed_in(type)              51717 non-null  object
 16  listed_in(city)              51717 non-null  object
dtypes: int64(1), object(16)
memory usage: 6.7+ MB
```

Checking for null values in the dataset

In [10]:
```python
data.isnull().sum()
```

Out[10]:
```
url                              0
address                          0
name                             0
online_order                     0
book_table                       0
rate                          7775
votes                            0
phone                         1208
location                        21
rest_type                      227
dish_liked                   28078
cuisines                        45
approx_cost(for two people)    346
reviews_list                     0
menu_item                        0
listed_in(type)                  0
listed_in(city)                  0
dtype: int64
```

Checking for null values for cleaning the dataset

```
In [37]:  data.isnull().sum()
```

```
Out[37]:  url                0
          address            0
          name               0
          online_order       0
          book_table         0
          votes              0
          phone              0
          location           0
          rest_type          0
          cuisines           0
          Cost               0
          reviews_list       0
          listed_in(type)    0
          listed_in(city)    0
          Rating             0
          dtype: int64
```

Checking mean ratings with restaurant name and ratings of restaurant

```
In [41]:  data.head()
```

Out[41]:

	url	address	name	online_order	book_table	votes	phone	location
0	https://www.zomato.com/bangalore/jalsa-banasha...	942, 21st Main Road, 2nd Stage, Banashankari, ...	Jalsa	Yes	Yes	775	080 42297555\r\n+91 9743772233	Banashankari
1	https://www.zomato.com/bangalore/spice-elephan...	2nd Floor, 80 Feet Road, Near Big Bazaar, 6th ...	Spice Elephant	Yes	No	787	080 41714161	Banashankari
2	https://www.zomato.com/SanchurroBangalore?cont...	1112, Next to KIMS Medical College, 17th Cross...	San Churro Cafe	Yes	No	918	+91 9663487993	Banashankari
3	https://www.zomato.com/bangalore/addhuri-udupi...	1st Floor, Annakuteera, 3rd Stage, Banashankar...	Addhuri Udupi Bhojana	No	No	88	+91 9620009302	Banashankari
4	https://www.zomato.com/bangalore/grand-village...	10, 3rd Floor, Lakshmi Associates, Gandhi Baza...	Grand Village	No	No	166	+91 8026612447\r\n+91 9901210005	Basavanagudi

Data visualization

Data visualization is where a given data set is presented in a graphical format. It helps the detection of patterns, trends and correlations that might go undetected in text-based data.

Understanding your data and the relationship present within it is just as important as any algorithm used to train your machine learning model

To visualize the dataset, we need libraries called Matplotlib, Seaborn. The Matplotlib library is a Python 2D plotting library which allows you to generate plots, scatter plots, histograms, bar charts

Data visulization in pie chart

Distribution of Restaurants in Different Locations
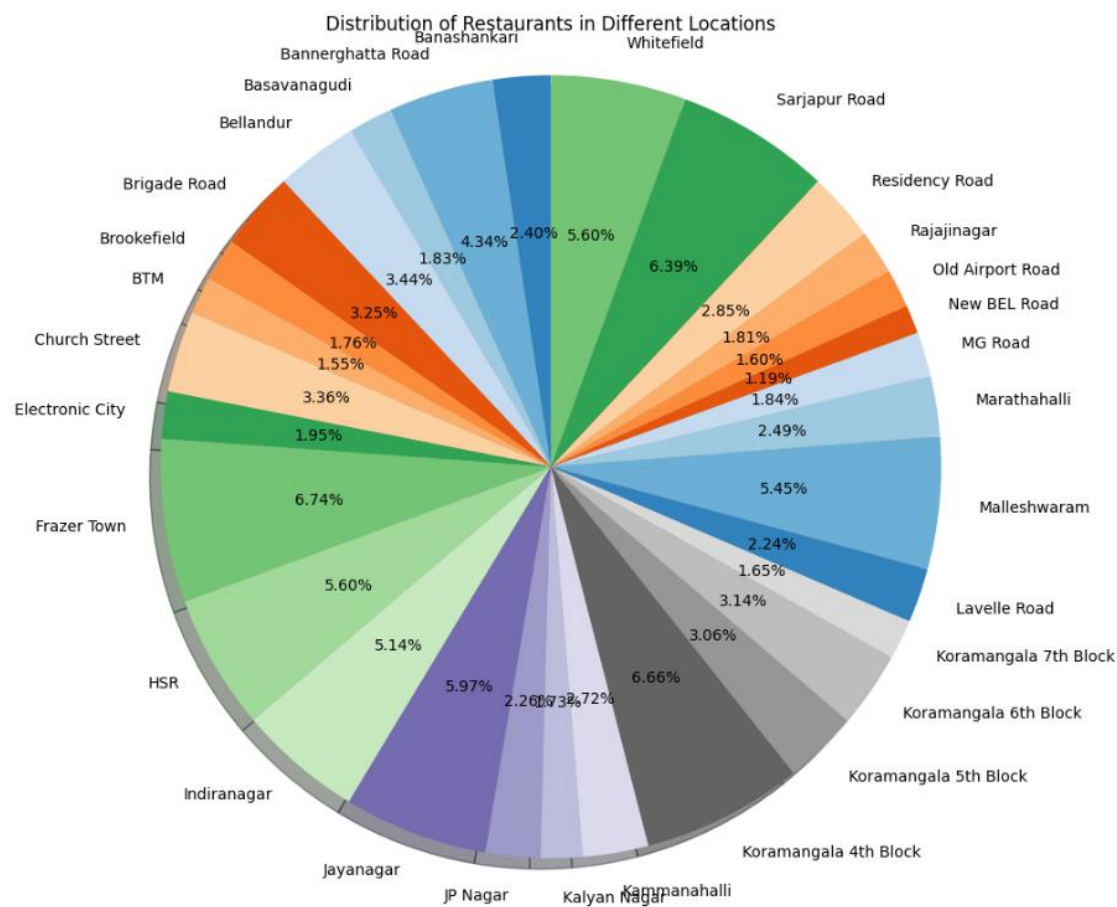
Data visulization as barh
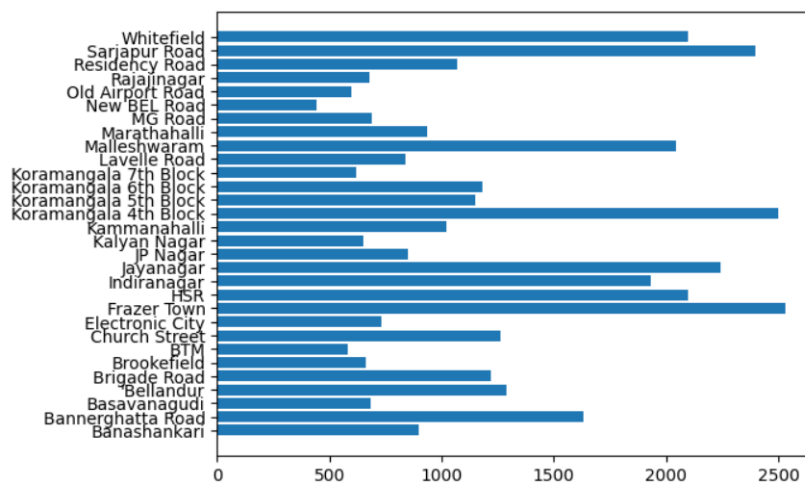
Data visulization as Histogram
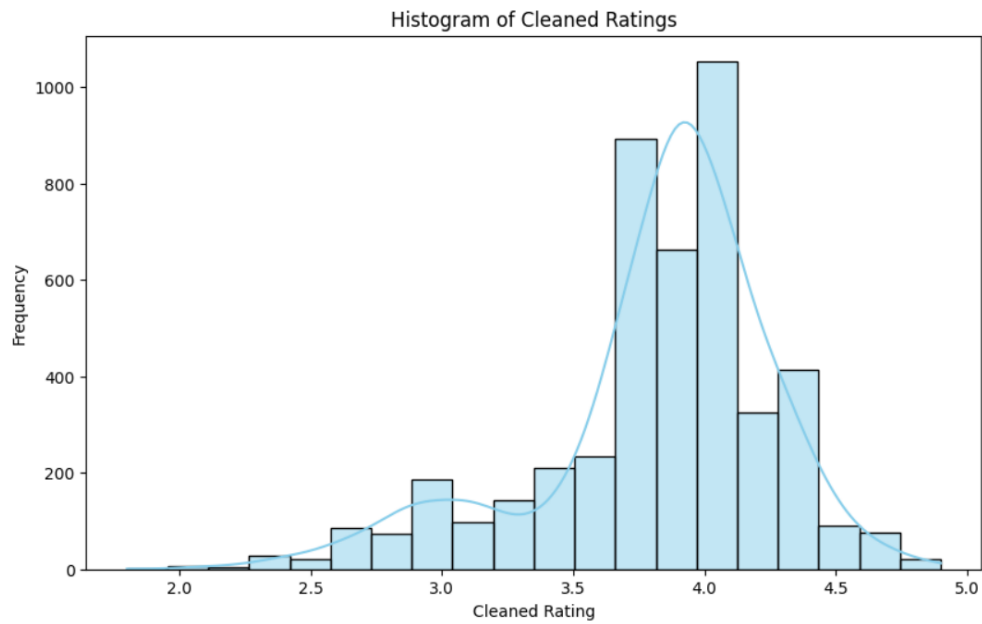
Data visulization as countplot
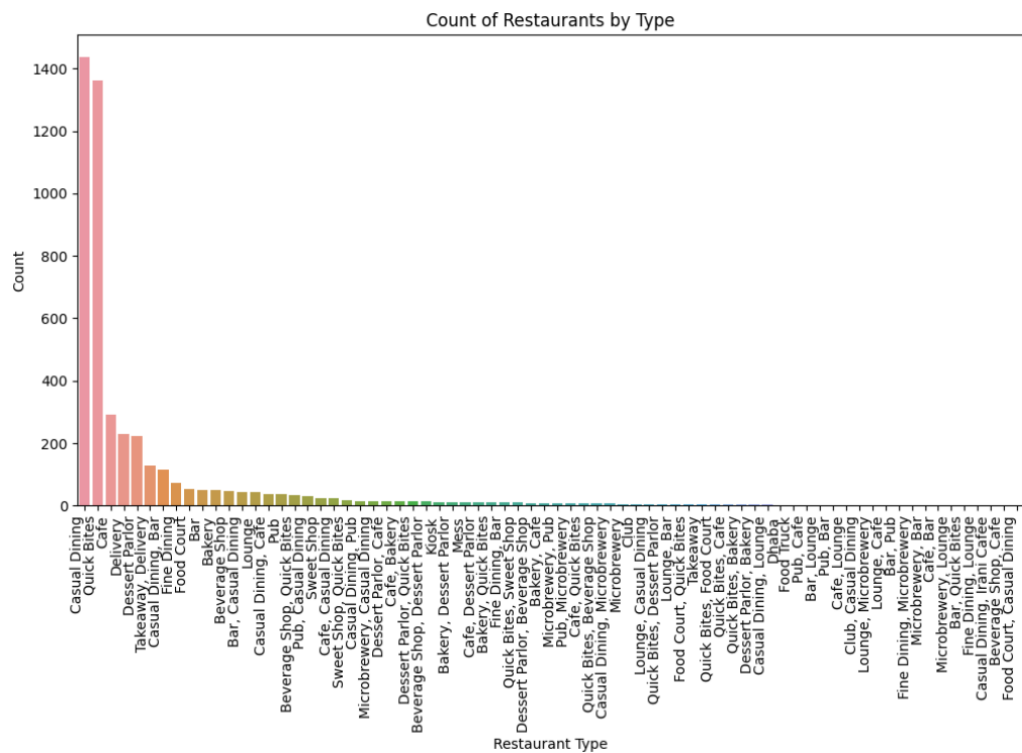
Data visulization as pairplot

Pairplot of Votes, Cleaned Rating, and Approx Cost

Data visulization as boxplot

Count of Restaurants with Online Order Option
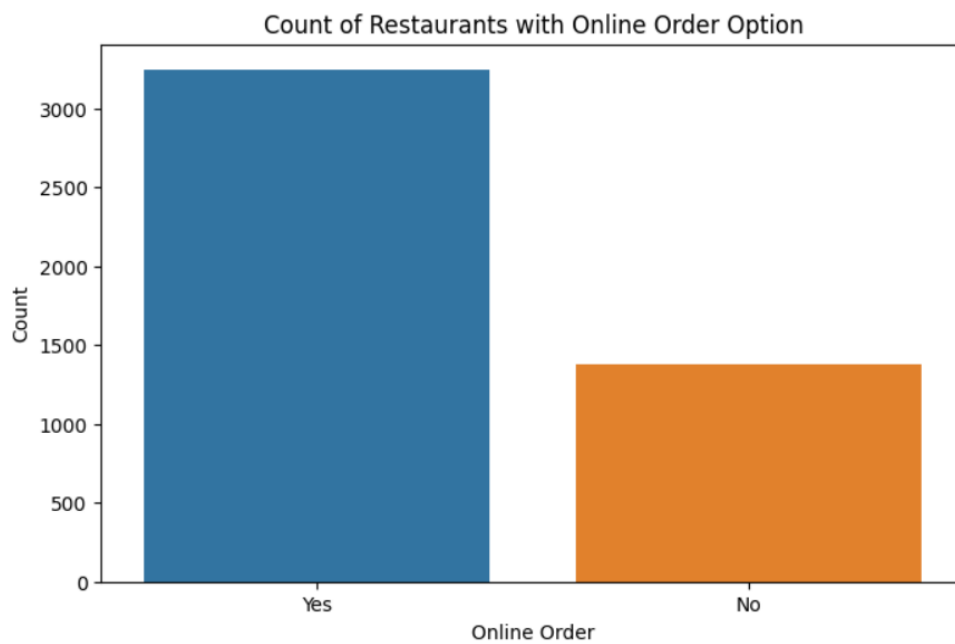
Data visualization as scatterplot

Scatter plot of Votes vs. Cleaned Rating with Cost Representation
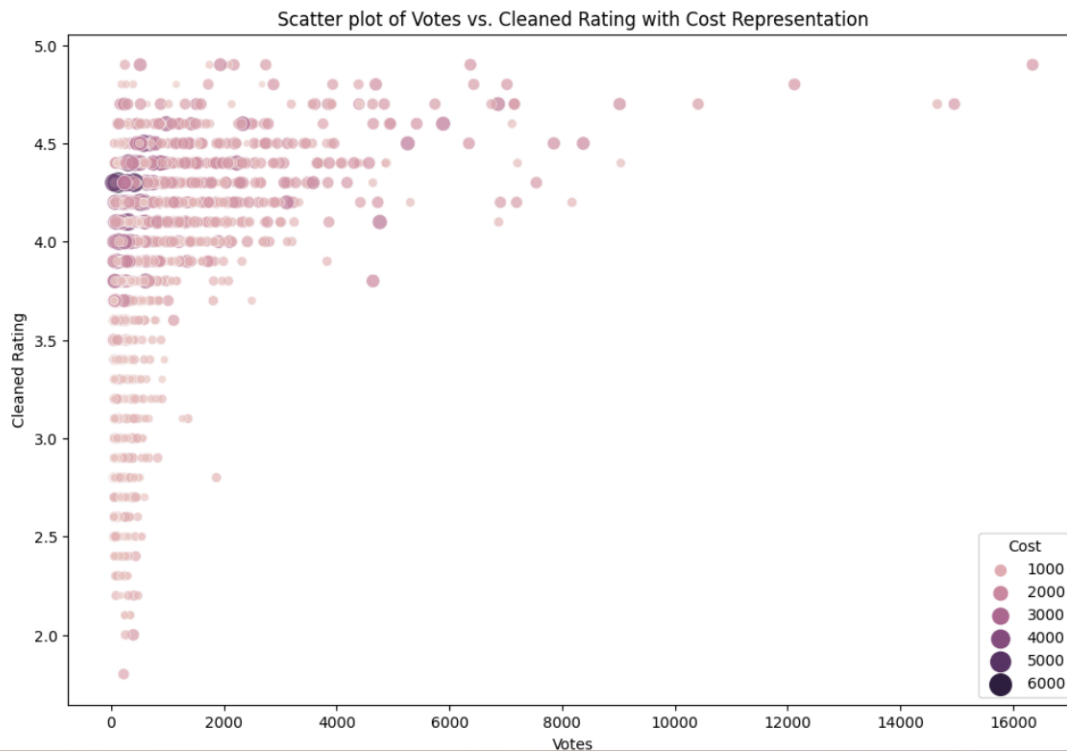
Data visualization as barplot

Top 10 Locations with the Most Restaurants
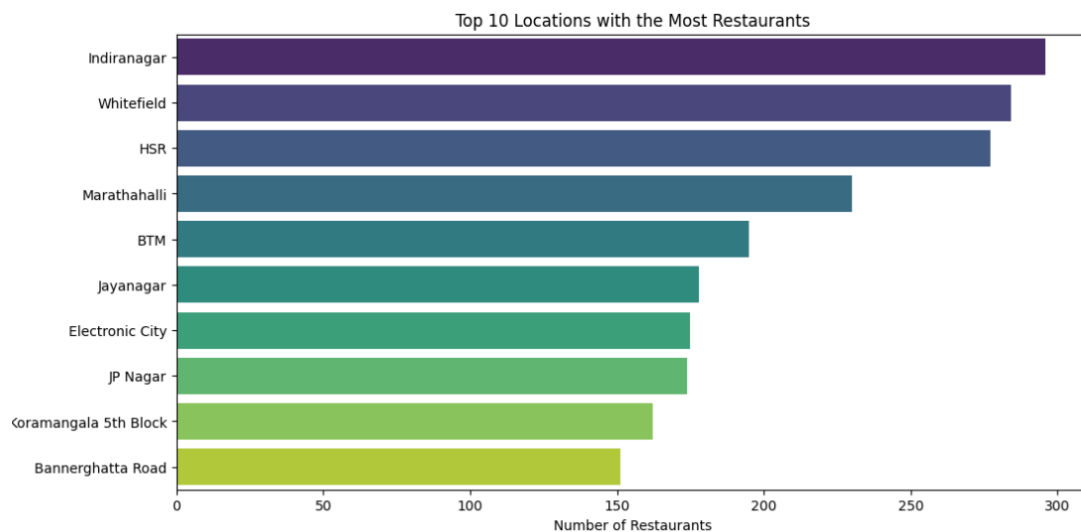
Application Buliding
Now as we have trained our model, we will build a flask application to run our recommendation website which will run with the user interface in the local browser
The inputs are taken form the HTML file and, this factors are reqired for the model to recommend the restaurents for the user.

Create HTML Page
- Using HTML Software for designing the website front and back end
- The home HTML Page navigates towards the Home Page

- Recommendations page navigates towards the Recommendation of the restaurants based on the Input provided
- The review HTML page navigates the user towards the feedback of the entire website performance and share valuble feedback

HOME :-

ABOUT :-

RECOMMENDATIONS :-

CONTACT US :-

REVIEW FORM :-

SIGN IN :-

OUTPUT :-
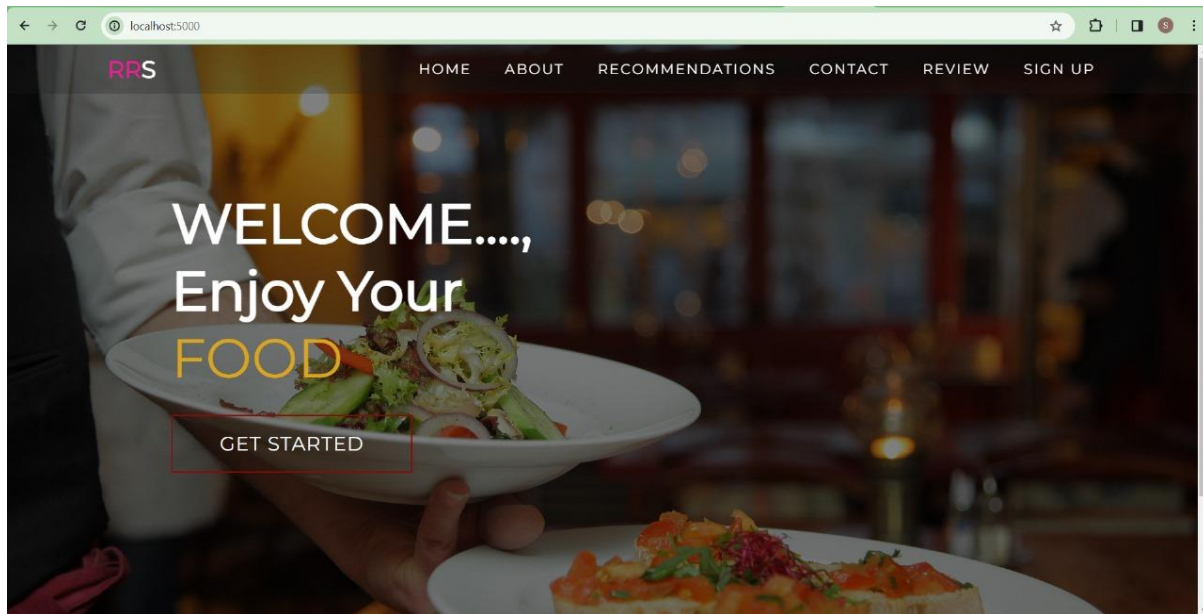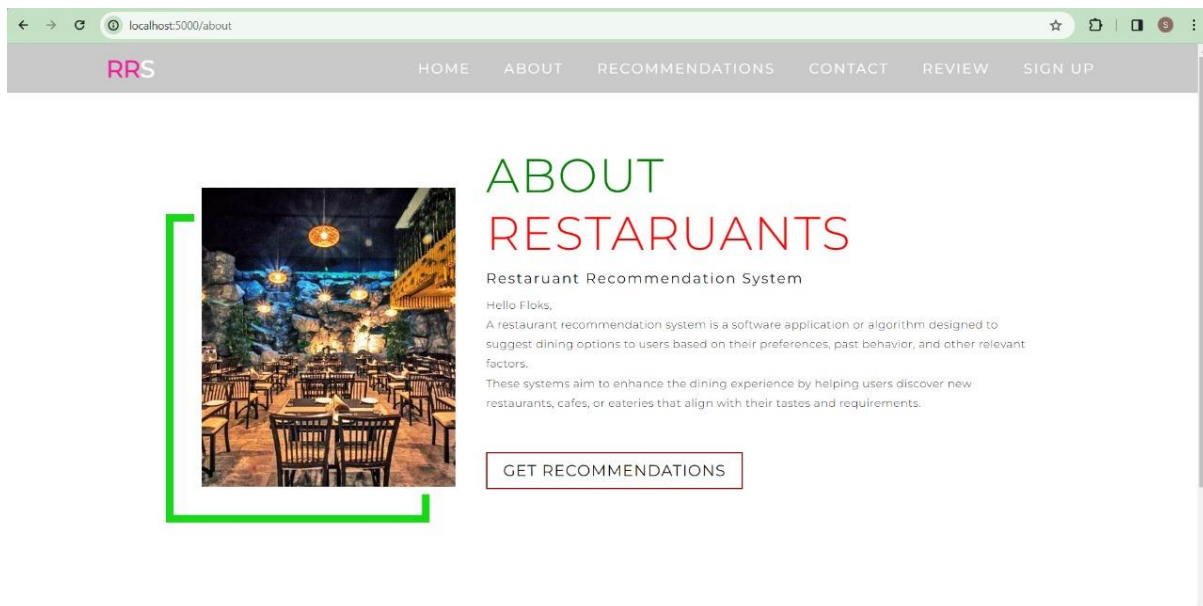
RRS   HOME   ABOUT   RECOMMENDATIONS   CONTACT   REVIEW   SIGN UP

Recommendations for jalsa in all - all

Restaurant Name	Location	Rating	Cost	Restaurant Type	Table Booking	Online Order	Phone	Address
jalsa	Banashankari	4.1	800	Casual Dining	Yes	Yes	080 42297555 +91 9743772233	942, 21st Main Road, 2nd Stage, Banashankari, Bangalore
jalsa gold	Marathahalli	4.5	1300	Casual Dining	Yes	No	+91 9066887021 +91 7022455300	20\5, Panathur Junction, Outer Ring Road, Kadubeessanahalli, Marathahalli, Bangalore
the hidden home	Sarjapur Road	4.3	1300	Casual Dining	Yes	Yes	080 49653432	82/4B, Next To Wipro Corporate Office, Sarjapur Road, Bangalore
sidewalk - the garden bar	Marathahalli	4.5	1300	Bar, Casual Dining	Yes	Yes	+91 9591325180 +91 9999266306	Ground Floor, Soul Space Paradigm, Next to Innovative Multiplex, Bata Showroom, Marathahalli, Bangalore
foxtrot	Marathahalli	4.4	1200	Pub, Casual Dining	Yes	Yes	+91 9108136001 +91 9108136003	89/1, Monnekollal Village, Varthur Hobli, Outer Ring Road, Marathahalli, Bangalore
jalsa	Marathahalli	4.2	1500	Casual Dining	Yes	Yes	+91 7406617555 +91 7406627555	25/7, Doddannakundi, Outer Ring Road, Mahadevapura, Marathahalli, Bangalore
jalsa gold	Marathahalli	4.5	1300	Casual Dining	Yes	No	+91 9066887021 +91 7022455300	20\5, Panathur Junction, Outer Ring Road, Kadubeessanahalli, Marathahalli, Bangalore
the hidden home	Sarjapur Road	4.3	1300	Casual Dining	Yes	Yes	080 49653432	82/4B, Next To Wipro Corporate Office, Sarjapur Road, Bangalore
hangover	HSR	4.3	1500	Bar, Casual Dining	Yes	Yes	080 49652578	2324, 17th Cross, 27th Main, Opposite Studio Pepper Fry, Sector 1, HSR, Bangalore