**PERSONALIZED RESTAURANT RECOMMENDER SYSTEM**

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# Business Understanding

## Business Overview

The dining industry in various states across the United States is a dynamic and diverse landscape, offering a wide array of options from local eateries to upscale restaurants. However, both locals and tourists often struggle to find restaurants that align with their specific preferences in terms of location, cuisine, and quality. The sheer number of choices, coupled with the lack of a centralized platform for personalized recommendations, makes it challenging for users to make informed dining decisions.

Traditional methods of discovering restaurants, such as relying on word-of-mouth or general review platforms, often fall short in delivering tailored suggestions that cater to individual tastes. These solutions tend to be too broad and do not provide real-time, location-based recommendations, leaving users—especially those in unfamiliar areas—frustrated in their search for the perfect dining spot. The need for a more intelligent, user-centric solution is increasingly evident as the dining scene continues to grow.

The personalized restaurant recommender system addresses this gap by offering users customized dining suggestions based on their preferences and historical data. Utilizing advanced technologies like machine learning, the system provides real-time recommendations that are highly relevant and location-specific. The platform’s database includes detailed information about a vast range of restaurants across various states, capturing essential attributes like business details, reviews, ratings, and operational hours.

By analyzing this comprehensive dataset and integrating it with user profiles, the system can deliver personalized recommendations that match user preferences for cuisine, ambiance, proximity, and more. Whether a user is looking for a cozy brunch spot in California or an authentic BBQ joint in Texas, the system can quickly suggest top-rated options that meet their criteria. This tailored approach not only enhances the dining experience but also supports local businesses by driving targeted traffic to their establishments.

The platform's intuitive interface ensures that users can easily refine their search and explore new dining options with confidence. This personalized restaurant recommender system stands out as a valuable tool, helping users navigate the rich culinary landscape with ease and satisfaction.

## Stakeholder Definition

The possible stakeholders in this project include:

•   Users: Individuals seeking personalized dining recommendations based on their unique preferences.

•   Restaurant Owners: Local businesses aiming to attract targeted customers and increase foot traffic.

•   Investors/Partners: Entities interested in the platform’s growth, scalability, and profitability.

## Problem Statement

As the dining industry expands, finding restaurants that match personal preferences is challenging due to the overwhelming number of options. Current platforms often provide generalized recommendations and lack real-time, location-based suggestions, particularly for users in unfamiliar areas. There is a growing need for a smart, user-friendly recommender system that offers personalized, real-time dining suggestions to help users quickly and efficiently navigate diverse culinary choices and improve their dining experiences.

## Objectives

### Main Objective

Develop an intelligent, user-friendly restaurant recommender system that provides personalized recommendations based on user location and cuisine preferences, and additional data sources to ensure accuracy and relevance.

### Specific Objectives

1. Analyze whether businesses in specific categories or locations tend to receive higher or lower average ratings and examine if a higher number of reviews correlates with more positive ratings.
2. Provide content about different cuisines and dining etiquette to enrich the user experience.
3. Create machine learning algorithms to rank restaurants based on user location, cuisine preferences, and ratings.
4. Develop an intuitive, responsive web/mobile application.

## Proposed Solution

We propose developing a Restaurant Recommender System specifically for the United States. The system will:

* **Comprehensive Mapping:** Systematically map and categorize restaurants in the United States, grouping them by cuisine type, location, and other relevant factors.
* **Personalized Recommendations**: Enable users to input their current location and preferred cuisine type, delivering a ranked list of nearby restaurants based on their ratings and proximity.
* **Enhanced User Experience:** Offer an intuitive, user-friendly interface with integrated map features to simplify navigation and help users easily explore and select dining options.

## Metrics of Success

Metrics of Success will include:

•   **User Engagement**: Measured by the number of active users, frequency of use, and user retention rates.

•   **Recommendation Accuracy:** Evaluated through user feedback and satisfaction scores, focusing on how well the recommendations match user preferences.

•   **Business Impact:** Analyzed by the increase in traffic and revenue for partnered restaurants.

•   **Scalability:** Assessed by the system’s ability to handle an expanding user base and restaurant data across various states.

## Challenges

Some of the challenges we may experience during this project include:

* **Data Collection and Quality:** Ensuring the platform has access to accurate and up-to-date restaurant data is crucial, as incomplete or outdated information can lead to poor recommendations and user dissatisfaction.
* **Scalability:** As the user base and the number of restaurants grow, the platform must efficiently handle increased data processing and maintain real-time performance across various states, ensuring a seamless user experience.
* **Competition:** Differentiating the platform from established competitors like Yelp and TripAdvisor is essential. The platform needs to offer unique value propositions to attract users in a crowded market.
* **Privacy and Data Security:** Protecting user data and ensuring compliance with privacy regulations is a significant challenge. Building trust with users regarding data usage is vital to maintaining their engagement and loyalty.

# Data Understanding

The data used to develop this project was collected from a vast Yelp database where reviews and business data was utilized. The business data contained a wide variety of businesses and was filtered to contain only the data from restaurants, coming to a total of 52,286 rows and 14 columns and stored as restaurant data. The reviews data was filtered to only include restaurant reviews and only for one year. This brought the total number of entries to 429,771 rows and 9 columns and was stored as users’ data.

The data was loaded using a dataloader class and a datainfo class to gather all the information together. A datacheck class was employed on the datasets with the following results: The restaurant data contained no duplicates or outliers but had some missing values. There were no duplicates, outliers or missing values in the users’ data.

Exploratory data analysis (EDA) was carried out on the restaurant data where the following was explored, counts of restaurants per state, frequency counts of ratings, frequency of restaurant names, distribution of star rating per state, and review counts vs stars rating.

EDA was also carried out for the users’ reviews data which showed seasonal trends with peaks around April and July and decline in reviews in between September and December. A word cloud was explored for the reviews and most common words included food, place, restaurant, order, service, good.

# Data Preparation

The users’ dataset was first prepared. There were no missing values, outliers or duplicates to handle. The columns useful, funny, cool were dropped as they did not contain any useful information for the recommendation system.

For the restaurant data, the attributes column was missing 0.8% of its dataset. These rows were dropped as attributes column is crucial for modeling. The other rows missing values i.e. address, postal code, hours were filled with Unknown as this information was not to be used in modelling and hence dropping then would result in losing out of data points. A value count of state column revealed 4 states with 1 restaurant each and these rows were dropped i.e. states containing NC, HI, XMS, MT and CO as recommending in a state with 1 restaurant will be flawed. The remaining 14 states were mapped with their full name for better understanding e.g. CA changed to California.

Feature Engineering was carried out on the categories column to explode the categories so as to filter each restaurant. The exploded column was then standardized to remove spacing between words. This was done so as to achieve a dataframe with only the specific cuisine/s in that column e.g. a row having Vietnamese, Food, Restaurants, and Food Trucks as a category was engineered to have Vietnamese as its category.

Further engineering was performed to combine city, state and address into one column called location which would be used to for modeling. The user data containing 429771 rows and 6 columns was saved in a cleaned user data csv, while the restaurant data containing 38,550 rows and 16 columns was pickled for ease of deployment.

# Modelling

The approach take to model the recommender system was split into 3:

1. Content Based Filtering
2. Collaborative Based Filtering
3. Deep Neural Networks
   1. **Content Based Filtering**
   2. **Collaborative Based Filtering**
   3. **Deep Neural Networks**