

UNDERGRADUATE PROJECT REPORT

|  |  |
| --- | --- |
| **Project Title:** | An intelligence recommendation system for online food ordering platform based on Collaborative Filtering |
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| **Module Code:** | **CHC 6096** |
| **Module Name:** | **Project** |
| **Date Submitted:** | **May 5, 2023** |

# **Declaration**

Here, students would sign a statement indicating that they adhered to appropriate academic conduct in carrying out their final project.

# **Acknowledgment**

Here, students are given the opportunity to thank those who have provided you with assistance and support.

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# **Abstract**

Up to 250 words, concise outline of background, aims, results, and achievements.  
Food delivery is becoming a new popular food trend in China, and the food delivery market has great potential for development in China. Therefore, this project aims to build an Intelligent online food delivery website with Python, Django and MySQL. For customers, it has features like registration, address management, favorites, shopping carts, and the ability to review and rate purchases.  For shop owners, the website offers features to manage their store and products, as well as order management features. In addition to this, the site uses Hybrid Recommender System (RS) to provide personalized recommendations to the users by using User-based Collaborative Filtering (User-CF) technology along with Content-Based Filtering (CB) technology to analyze the user's preferences as well as the similarity of the products.

This approach not only enhances the shopping experience but also boosts sales by intelligently matching products with customers' preferences. By integrating User-CF and CB, the website provides a tailored experience, whether you're a frequent shopper or new to the platform. The combination of these recommendation systems, along with the site's easy-to-use features and robust security measures, positions our food delivery website as a top choice for customers seeking a personalized shopping experience and for shop owners looking to connect with the right audience.

***Keywords: Recommendation system, Hybrid recommendation, Collaborative filtering, Content-based filtering, User-CF, Food delivery website***

# **Abbreviations**

CF: Collaborative Filtering

User-CF: User-based Collaborative Filtering

RS: Recommendation system

CB: Content-based recommendation

# **Glossary**

**Recommendation System:**

Recommendation systems are information filtering systems providing a personalized item recommendation to a user in a service environment that can hold or collect various data. [1]

**Hybrid recommendation:**

A hybrid recommendation system is a method that combines multiple recommendation techniques to address the shortcomings of individual models. By integrating various methods, it can effectively generate recommendations that align more closely with users' preferences, thereby overcoming the limitations inherent in single-method systems [2].

**Content-based filtering:**

The content-based filtering approach makes recommendations by analyzing the characteristics of products that are of potential interest to the user. The advantage of this method is that it can show users new products [3].

**Collaborative Filtering:**

User-based Collaborative Filtering algorithms will recommend items of interest to the user based on the calculation of user or item similarity [4]. There are two common collaborative filtering methods: user collaborative filtering (User-CF) and Item-based collaborative filtering (Item-CF) [5].

**User-based Collaborative Filtering:**

Is an algorithm in collaborative filtering algorithm, which recommends items or product that similar users like for users by finding similar users for them.

**Cosine Similarity:**

Cosine similarity is a commonly used measure in computer science to determine the similarity between two vectors, often representing user or item preferences in a recommendation system. It calculates the cosine of the angle between two vectors, providing a similarity score typically ranging from 0 to 1. It helps determine the relationship between two related items, making it a common method for assessing the similarity of users or items based on their features or behaviors [6][7].

**Jaccard Index:** The Jaccard index, also known as the Jaccard similarity coefficient, is a statistical measure used to compare the similarity and diversity of sample sets, especially in recommender systems. The index assesses the similarity between sets by calculating the ratio of intersections to unions of sets, focusing only on the presence of items rather than the frequency of items in the set. In recommender systems, this index is used to compare users or items based on their ratings, thus helping to identify similar users or items with common appeal [8].

**Django:**

Django is a Python web framework that provides a set of methods to help developers to develop and maintain websites.

# **Introduction**

## **Background**

This section should describe the overview of the topic and motivations

In the era of highly developed information technology and logistics industry, online take-out has become a new trend sweeping the world, especially in China, ordering take-out has become a new popular way of eating in China [9][10].

However, the increasing health consciousness of customers and their growing demand for healthy food options has become a major trend in the online food delivery market. As a result, online food delivery platforms need to respond by offering a wider range of healthy and sustainable food choices. In addition to this, online food selling platforms have been suffering from reduced information utilization and "information overload", where too many product categories can make it difficult for users to find their favorite information. Over time, users become less interested in the platform [9][11].

In order to solve the problem of information overload, the use of recommender systems has become an effective technical choice [9]. Therefore, in this project a hybrid recommendation system is implemented in which User-CF algorithm is integrated with CB algorithm to provide personalized recommendation of products to the customers through an intelligent recommender system so as to reduce the information overload problem faced by the users. Where CF is an algorithm that provides personalized recommendation of products by basing on the similarity of users, while CB provides recommendations to users by analyzing the content features of products. Integrating these two recommendation methods together is expected to provide users with more accurate and personalized recommendation services [2].

## **Aim**

The overall goal of your project should be stated here. It is recommended that each project should have a single aim.

The main goal of this project is to integrate a User-CF algorithm and CB into a hybrid recommendation system, so as to improve the user experience of the ordering platform by providing highly personalized and targeted food recommendations.

## **Objectives**

Students are to state the several tasks/steps that would help them to accomplish the overall aim/goal of their project.

The object are as follows:

1. Research on the Existing Food Delivery Platform
2. Comparison between food delivery platforms
3. Research on recommendation system
4. Research on CF and Content-based filtering
5. Function requirements analysis
6. System design (divided into several modules)
7. Web Implementation (Implement the front-end and back-end)
8. Recommend function design
9. Develop recommend function
10. Test and evaluate website function
11. System testing & performance analysis

## **Project Overview**

### **Scope**

The scope of a software development project should answer the questions: what will the software do? How will the software work?

This project aims to develop an intelligent recommendation system for an online food ordering platform, designed to enhance user experience by offering personalized food and restaurant suggestions. The platform will operate through a web-based application developed using the Django framework, integrating a MySQL database for data storage, and employing Pandas, NumPy, and scikit-learn for data analysis and algorithm implementation. The core functionality will cater to two primary user types: customers and merchants.

For customers, the platform will offer features such as account registration, address management, favorites, shopping cart management, order management and viewing order status, payment features with the option to cancel payments, as well as the ability to post comments and rate stores and products after purchase. Additionally, users will be able to manage orders and search for products or stores. The recommendation system will employ User-Based Collaborative Filtering (User-CF) to filter for logged-in customers with a substantial order history, providing tailor-made suggestions by analyzing preferences of similar users. For new users or those lacking sufficient user history, the platform will implement a Content-based filtering approach, focusing on product attributes like average ratings, the number of times a product has been favorited, and sales volume to generate personalized recommendations.

On the merchant side, the platform will allow for account and store registration, product management, order reception, and shipping management, along with access to store performance data.

The integration of this hybrid recommender system with the online ordering platform will significantly improve users' navigation and product discovery, ensuring a convenient, efficient and personalized ordering experience for non-users. By analyzing and leveraging user data and preferences, the platform aims to increase customer satisfaction and loyalty, ultimately leading to higher exposure and sales for merchants' stores.

### **Audience**

The audience for a software development project should focus on who is the software for?

The primary audience of our platform includes the following:

1. Customers Seeking Personalized Food Recommendation: For users who need to seek personalized recommended food ordering experience, the personalized recommendation system of the website can be more efficient and more accurate to recommend food that may be of interest to them.
2. Restaurant Owners and Merchants: Our platform provides a platform for merchants to connect with customers, showcase their products, and greatly improve the opportunity for merchants to improve sales by leveraging the power of user data and preferences to personalize recommended products for each customer.
3. Busy office workers: For those with limited time and energy, our platform is a more convenient and intelligent solution. The site is able to provide users with fast, personalized meal recommendations based on their data and historical behavior.

# **Background Review**

**Requirement:**

比较现有的方法，包括主题文献综述，并对来源进行批判性评估。

Compare existing approaches and include a themed literature review, with a critical appraisal of the sources. Provide appropriate and sufficient references. Also include *the feedback you received from your supervisor. You can add any additional key sources that you have discovered.*

Students doing software development-based projects can write their background review by providing a **summary of existing approaches (e.g., competitive analysis, if appropriate),**

## **Existing approach of Recommendation system:**

# 两句话介绍推荐系统及其作用

# 先通过Figure 1:overview of recommendation model来简单介绍recommendation system的定义以及其中常见的几类方法

In this section, we will discuss and review the existing approach to recommendation systems.

Faced with the problem of information overload caused by the rapid development of the Internet. Therefore, recommendation systems are designed to solve this problem [12]. Recommendation systems are information filtering systems providing a personalized item recommendation to a user in a service environment that can hold or collect various data [1]. In fact, Recommendation systems are widely used in various fields, such as e-commerce and food delivery recommendation, etc., which not only brings benefits to the merchant, but also brings convenience to the users [9].

The current mainstream approaches to recommendation systems are illustrated in Figure 1. This figure outlines the hierarchy of mainstream sub-models of current recommendation system models into three main approaches: content-based filtering (using item features for recommendation), collaborative filtering and hybrid systems. Collaborative filtering methods are categorized into model-based and memory-based approaches based on the way they process the rating data of users and items [1]. Furthermore, memory-based collaborative filtering can be subdivided into two categories: user-based collaborative filtering and item-based collaborative filtering [13].

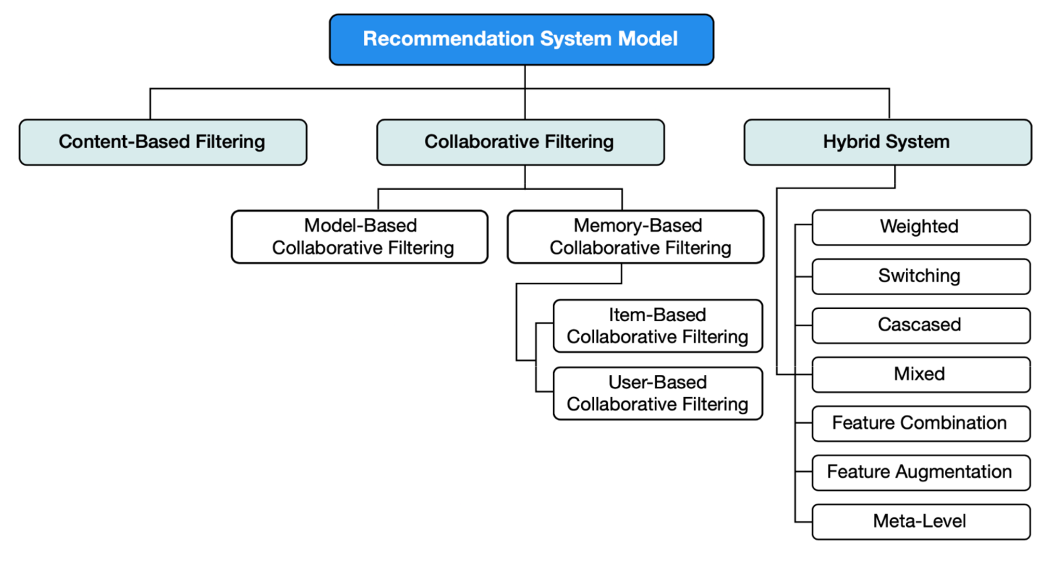


Figure 1: Overview of recommendation models [1].

# TODO: 然后详细介绍文章中使用的User-CF与Content based recommendation(包括这两个方法的适用情况)，再指出其局限性和不足（如果可以，再添加一些描述 这些问题如何在外卖推荐背景下的具体表现及其对用户体验的影响。），**可以参考文章Comparison of Collaborative Filtering Algorithms: Limitations of Current Techniques and Proposals for Scalable, High-Performance Recommender Systems**

### CB (Content Based Filtering)

CB is an algorithm that recommend items to users based on the features of the items and the user's preferences. For example, recommending products to users based on their information about the product itself of interest [3]. For the CB recommendation algorithm, it is characterized by its ability to accurately extract the user's interests and does not require data from other users [13].

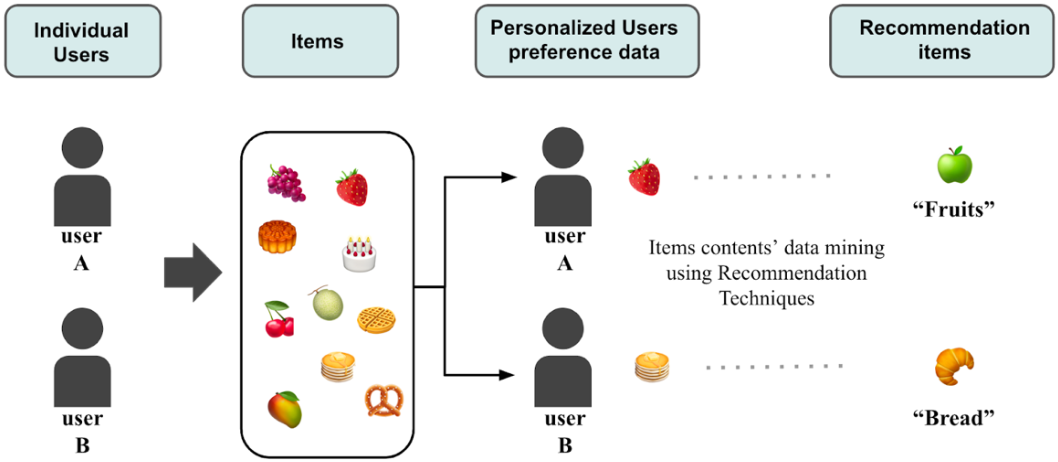
Figure 2 below outlines the principles of content-based filtering models in recommendation systems. As an example, it shows that for different users, in a collection of food items, these items are associated with personalized user preference data, indicating that user A likes strawberries and user B likes pancakes. By using recommendation techniques to analyze the content of the items, recommendations can be obtained for specific categories, such as "fruit" for User A and "bread" for User B.

Figure 2: Recommendation principle of Contents-Based Filtering Model [1].

### User CF (User-based collaborative filtering)

recommends a product by providing recommendations based on a product liked by other users, such as opinions or ratings [3]. usually using Pearson correlation or Angle cosine to determine the similarity between users. Based on the similar tastes between similar users, similar good restaurants are recommended [9] [5].

# TODO: 更详细的介绍User-CF包括其优点(与在外卖网站中的应用),可以再添加一张关于User CF的图片

### Hybrid recommendation:

# TODO:下面列出两个算法的limitation并引出hybrid recommendation

However, both User-CF and CB Recommendation have limitations, especially under conditions of data sparsity, which can lead to the cold start problem - difficulty in making accurate recommendations for new users or items without sufficient data. This problem is particularly acute in the context of food delivery, where new restaurants or menu items are frequently added. These limitations can negatively impact the user experience by resulting in less accurate or less personalized recommendations.

**# TODO: 然后引入添加关于hybrid recommendation是什么以及其如何解决上述的问题。**

To address these challenges, hybrid recommender systems are introduced. A hybrid recommender system is a method that combines multiple recommendation techniques, which can combine the advantages of multiple models and mitigate the disadvantages of a single model. By integrating these approaches with additional data on item popularity and sales, our system can provide more robust and accurate recommendations even in the face of the typical cold-start problem associated with new items or users [9].

This hybrid system is designed to leverage multiple sources of information, thereby improving the accuracy and personalization of recommendations provided to users. It represents a significant step forward in addressing the inherent limitations of traditional recommendation models, thereby significantly improving user satisfaction and engagement on the platform [14].

According to the paper A user-based recommendation approach is combined with a content-based recommendation approach in a weighted combination. Compared with the traditional recommendation approaches, it is found that the hybrid recommendation approach performs more accurately in identifying the sentiments of user evaluations, and takes into account the similarities between users and foods [15].

Based on existing models, a hybrid recommendation approach that combines a weighted combination of User-CF and CB methods is able to capture user ratings of food more accurately than a single traditional recommendation technique, while also taking into account the similarity between users and food. This hybrid approach is not limited to specific domains such as e-commerce, restaurants or finance, but has the potential for a wide range of applications [15].

The discussed recommendation algorithms, while effective, exhibit inherent limitations, particularly under data sparsity conditions which exacerbate the cold-start problem, affecting their ability to recommend new items or predict preferences for new users. According to Cacheda, F., Carneiro, V., Fernández, D., & Formoso, V. (2011). Comparison of Collaborative Filtering Algorithms: Limitations of Current Techniques and Proposals for Scalable, High-Performance Recommender Systems, significant improvements in accuracy and efficiency are noted when addressing these issues through innovative approaches [4]. To overcome these drawbacks, our project integrates these methods into a hybrid recommendation system. This system not only utilizes the strengths of both User-CF and CB but also incorporates popularity and sales data to effectively manage new items and users, thereby mitigating the cold-start problem.

### Item Popularity recommendation:

# TODO:引入 item-based popularity recommendation，来补充解决cold start

在上面的基础上，为了缓解冷启动问题，我们考虑设计了一个

## **Analysis of existing food delivery platforms:**

Online food ordering platforms have become increasingly popular in recent years, revolutionizing the way customers order food and receive delivery. Several companies, including Meituan, Ele. me and Uber eats, are commercial giants in the food delivery platform space, with Meituan and Ele.me being the most used delivery software in China [16]. These platforms have transformed the food industry, providing consumers with an easy and convenient way to order food online.

Therefore, in order to analyze and investigate the characteristics of Online food ordering platforms, Table 1 below shows functional comparisons of the different platforms. Through comparison, it is found that the basic functions of search, recommendation, purchase, shopping cart and order management are well implemented on the four platform.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Feature Comparison | MeiTuan food delivery [17] | Ele.ME [18] | Uber eats [19] | Just eat [20] |
| Customer register required Information | **Phone number** | **Phone number** | **Email &**  **Phone number** | **Email** |
| Become a merchant | **YES** | **YES** | **YES** | **YES** |
| Product Category function | **YES** | **YES** | **YES** | **YES** |
| Shopping Cart function | **YES** | **YES** | **YES** | **YES** |
| Search shop function | **YES** | **YES** | **YSE** | **YES** |
| Search product function | **YES** | **YES** | **NO** | **NO** |
| Collection shop function and management | **YES** | **YES** | **YES** | **NO** |
| Collection product function and management | **NO** | **NO** | **NO** | **NO** |
| Comment function | **YES** | **YES** | **NO** | **NO** |
| Delivery Method | **Delivery** | **Delivery** | **Delivery & Pickup** | **Delivery & Collection** |
| Recommended  Restaurants | **YES** | **YES** | **YES** | **YES** |
| Individual Recommended products | **NO** | **NO** | **NO** | **NO** |
| Address Management | **YES** | **YES** | **YES** | **YES** |
| Order status view and management | **YES** | **YES** | **YES** | **YES** |
| Shop rating function | **YES** | **YES** | **YES** | **YES** |
| Product rating function | **NO** | **NO** | **NO** | **NO** |

Table 1: Feature comparison between different platforms.

# **Methodology**

## **Approach**

The approach for a software development project should focus on the description of the software development methodology being used for the project. For example, the software development model, requirement-gathering methods, etc.

### **Software development model:**

In the choice of software development model, the waterfall model is a common and classic development model, which shows the software development process in linear order. As shown in Figure 1 below, the software development process can be divided into seven parts in linear order: Requirement Analysis, System design, Model selection, Implement the system, system integration, test, system operation and maintenance.

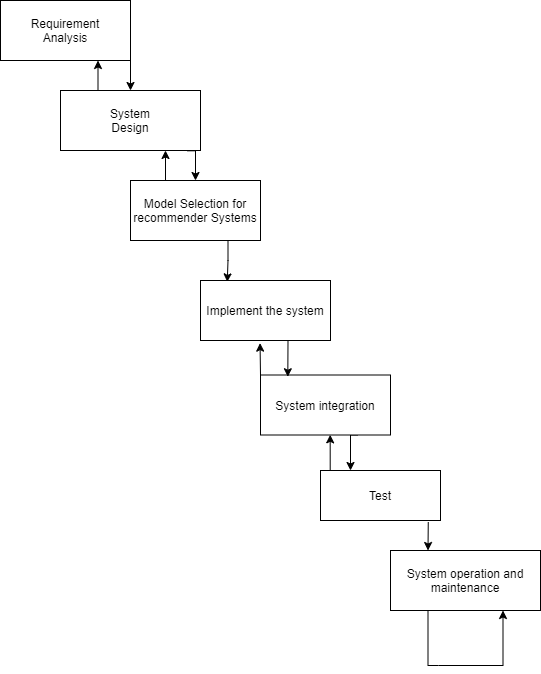


Figure 3: Waterfall model.

### **Demand collection:**

* Market research: Research on data analyze websites like statista to study the relevant market and competitors to understand the needs and preferences of users across the market. Relevant information can be obtained by investigating industry reports, data from market research agencies, and product analysis from competitors.
* User observation: Observe the behaviors and interactions of friends and classmates around when using the online takeout platform, so as to obtain the needs and problems of users in actual usage scenarios.
* Analysis for competitive food delivery website: Observe the popular online ordering software (Meituan, Ele.me, uber eats etc.) recorded to analyze which requirements are the most needed by users.

### **Database design:**

# TODO: 展示Database ER diagram或者UML diagram，并简单解释

### **Function analysis:**

# TODO: 展示一个System Architecture diagram(显示系统下的各种Module)

# TODO: 展示Customer & merchant User case diagram

# TODO: 展示一个更美观的overall function diagram(基于下面的figure 2修改)

All the function analysis of online food delivery website are shown in the Figure 2:

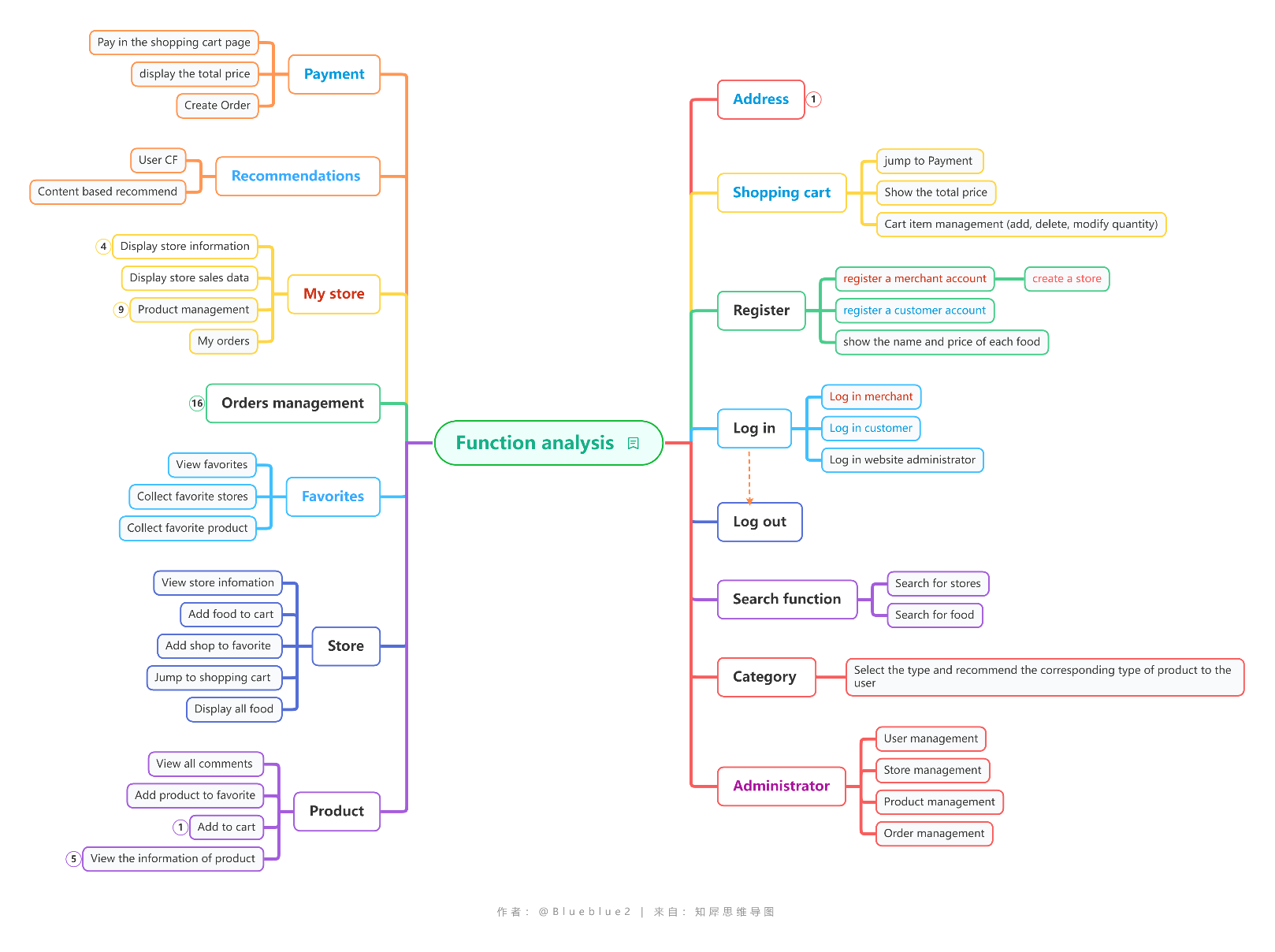


Figure 4: Overall function diagram.

### **Recommendation system approach:**

# TODO: 画一张Recommendation road map

# TODO: 画一张Hybrid recommendation model (optional)

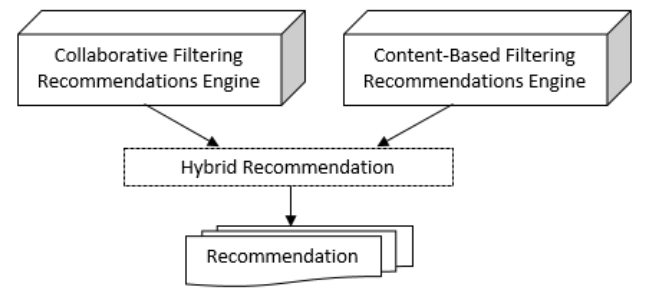


Figure 5: Hybrid (Collaborative Filtering and Content-Based Filtering) [2].

# TODO:介绍一下下面的算法原理，以及如何hybrid

* Normalize归一化(optional)
* Cold start methodology (optional):

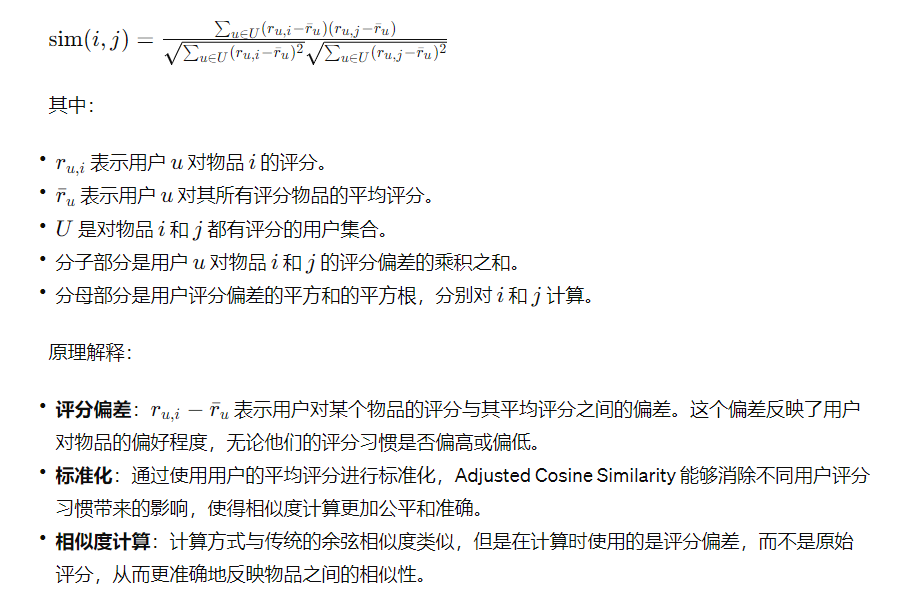
#### User-CF algorithm:

User-based algorithms, also known as neighborhood-based, are one of the most popular strategies of collaborative filtering. They follow a three-step process.

(1) Calculate the similarity between the active user and the rest of the users.

(2) Select a subset of the users (neighborhood) according to their similarity with the active user. (3) Compute the prediction using the neighbor ratings [4].

Adjusted Cosine Similarity:



#### Content-based filtering algorithm:

Jaccard Index:

其中，AA 和 BB 是两个集合。公式中的表示集合 AA 和集合 BB 的交集的元素数量，而 表示集合 AA 和集合 BB 的并集的元素数量。Jaccard Index的值介于0到1之间，其中0表示两个集合完全不相交，1表示两个集合完全相同。

交集（Intersection）:∣A∩B∣ 是两个集合中共同元素的数量。如果两个集合有更多的共同元素，则他们被认为是更相似的。

并集（Union）:∣A∪B∣ 是将两个集合中的所有元素合并后的总数，不包括重复的元素。

Jaccard Index的计算: 通过计算交集的大小与并集大小的比例，得到一个表示相似度的值。这个比值越大，说明两个集合的相似度越高。

## **Technology**

The hardware used in the project are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Computer** | **CPU** | **GPU** | **Random Access Memory** |
| ASUS Tianxuan | R7-4800H | GTX 1650ti 4GB | 16GB |

Table 2: Hardware environment of project

The software used in the project are as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Language** | **OS** | **Database** | **Framework** | **Front-end** | **Back-end Third library** |
| Python | Windows 10 | Mysql 8.0,  Mysql workbench | Django | Javascript,  Jquery,  Boostrap,  Feather icon | PyMysql,  Pandas,  Numpy,  scikit-learn |

Table 3: software environment of project

**Image Data set:**

I used the Food image dataset from Kaggle.

Data set Url: <https://www.kaggle.com/datasets/kmader/food41>

## **Project Version Management**.

In this project, I used Github desktop as a project version management software tool and created a repository on the Github platform. This repository stores all the code for the project, the files along with their versions and upload times.

Here is Github repository url: <https://github.com/Blueblue22two/202018010410_project_recommendation-system>

# **Implementation and Results**

Here students are to provide detailed descriptions and documentation of results and testing. Critical evaluation and discussion of results, issues encountered constraints, limitations, and originality.

The subsection layouts of this section mostly depends on the type of project that the student is carrying out. Students can introduce subsections that will help the readability of their work.

For instance, students doing software development-based projects should provide the detailed use of their software in this chapter. Screenshots (images) of their graphical user interfaces can be depicted in this chapter. Other relevant details about the testing and evaluation of their software can be stated here as well.

Also, students doing research-oriented projects (machine learning & deep learning projects) should state the results of their model training, validation and testing. Use appropriate graphs and figures to illustrate your results. Results from case studies and ablation study of hyper-parameters should be stated here. In a situation where a machine learning-based project was deployed as a web or mobile application, students are to provide details of functionality tests.

# **Professional Issues**

## **Project Management**

### **Activities**

|  |  |  |  |
| --- | --- | --- | --- |
| Objective | Detail | Start data | End date |
| 1. Investigation on the Existing Food Delivery Platform | Researched prominent food delivery platforms (Meituan, Ele.me, Uber Eats). | 2023/10/16 | 2023/10/24 |
| 1. Comparison between food delivery platforms | Compared features, market positions, and user feedback of selected platforms. | 2023/10/20 | 2023/10/28 |
| 1. Research on recommendation system | Study and analyzes different types of recommendation systems and explores the application of these methods in takeout platforms. | 2023/10/24 | 2023/10/29 |
| 1. Write Project proposal | Developed and submitted a comprehensive project proposal. | 2023/10/25 | 2023/11/3 |
| 1. Research on CF and Content-based filtering | Investigated the workings of Collaborative Filtering (CF) and Content-based filtering algorithms | 2023/10/29 | 2023/11/10 |
| 1. Function requirements analysis | Analyze the website and different types of users and record their software requirements. | 2023/11/1 | 2023/11/18 |
| 1. System design | Design the website architecture by breaking it down into the following modules:   1. Customer module 2. Merchant module 3. Store module 4. Product module 5. Order module 6. Recommendation module | 2023/11/14 | 2023/11/30 |
| 1. Database design | 1. Based on Function requirements analysis design the framework of database mode. 2. Implement the database by Mysql. 3. Connect database with Django. | 2023/11/20 | 2023/11/26 |
| 1. Web Implementation (Implement the front-end and back-end) | 1. Web UI design 2. Completed the front-end user interface for customers, merchants, and administrators. 3. Implemented back-end function. | 2023/12/1 | 2023/2/10 |
| 1. Progress report | Implement the progress report. | 2023/12/10 | 2023/12/27 |
| 1. Recommend function design | Design the architecture of the recommendation system, including the use of user-based collaborative filtering recommendation and content-based filtering. | 2024/1/2 | 2024/1/10 |
| 1. Develop recommend function | 1. Developed and implemented the two main components of the recommendation system: the user collaborative filtering algorithm and the content-based filtering algorithm.  2. Integrated these algorithms into the website's backend, ensuring proper data circulation and updates. | 2024/1/11 | 2024/3/1 |
| 1. Test and evaluate website function | Planned testing and evaluation for the collaborative filtering recommendation. | 2024/3/1 | 2024/3/10 |
| 1. System testing & performance analysis | Conduct comprehensive system testing of the website, including functional testing, user interface testing and performance testing. | 2024/3/11 | 2024/3/15 |
| 1. Write Final report | Implement the final report | 2024/3/18 | 2024/4/6 |
| 1. Create Poster | Will design and create a poster for project presentation. | 2024/4/6 | 2024/4/15 |

Table 4: Activity table

### **Schedule**



Figure 6: Gantt chart of activity

### **Project Data Management**

In this section, students must describe how they have used resources such as Baidu drive, Gitee, etc., to manage project logs, reports, literature, etc.

* For Weekly reports, I upload them to the Weekly report folder every week.
* Upload all the reports to the Reports folder.
* Upload all the Reference files to the References folder.
* Upload all the code to a code file and do version management.
* Upload other files (such as charts) to the others folder.
* Upload the files related to Presentation to the Presentation folder.
* Upload UI-related files to the UI folder.

The figure 4 below shows the file format in the repository in detail.

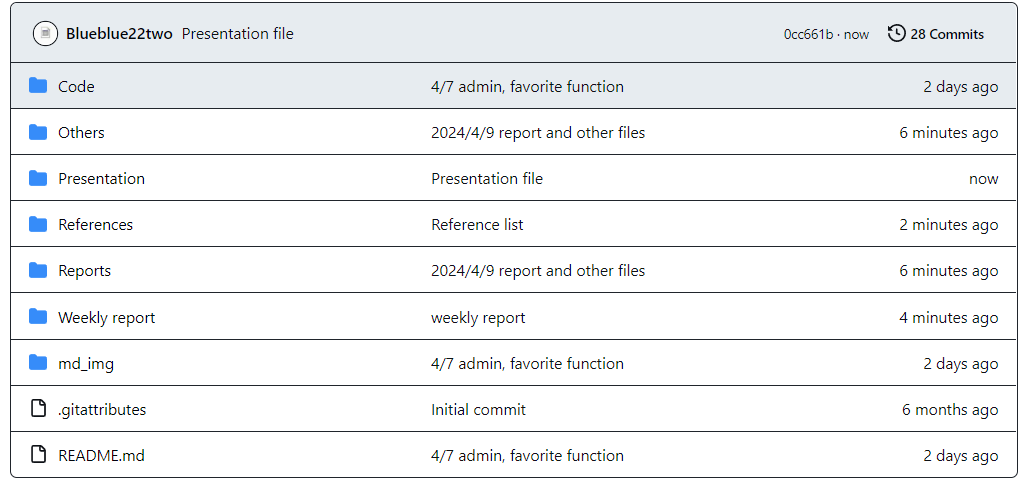


Figure 7: Github project repository

### **Project Deliverables**

|  |  |
| --- | --- |
| Type | Content |
| **Document** | Project proposal |
| Progress report |
| Final report |
| Weekly report |
| Ethical from |
| Presentation & poster |
| Reference files |
| **Code** | Database sql file |
| Front-end file and code |
| Back-end code |

Table 5: Project deliverable

## **Risk Analysis**

Risk analysis as informed by the current project progress; Resolved risks and the success of the mitigation strategy; Changes to the project plan as a result of risks; Future risks.

This section shows a risk analysis and mitigation strategies for the project.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Risk ID | Potential Risk | Cause ID | Potential Causes | Severity | Likelihood | Risk | Mitigation ID | Mitigation |
| R1.1 | User dissatisfaction with recommendation system | C1.1.1 | Poor algorithm performance | 3 | 3 | 9 | M1.1.1 | Regularly evaluate and update the recommendation algorithm based on user feedback and usage patterns. |
| C1.1.2 | Inadequate user data collection | 2 | 2 | 4 | M2.1.2 | Implement robust data collection mechanisms and ensure transparency in data usage policies to gain user trust. |
| R1.2 | Low user engagement with the platform | C1.2.1 | Limited variety of restaurants and cuisines | 3 | 2 | 6 | M1.2.1 | Expand the range of available restaurants and cuisines through partnerships and collaborations. |
| C1.2.2 | Poor user interface design | 2 | 3 | 6 | M1.2.2 | Invest in user experience design and conduct usability testing to enhance the platform's ease of use. |
| R1.3 | Technical infrastructure issues | C1.3.1 | Unanticipated scalability challenges | 4 | 3 | 12 | M1.3.1 | Conduct thorough scalability testing and implement scalable architecture from the beginning. |
| C1.3.2 | Third-party service failures | 3 | 2 | 6 | M1.3.2 | Have backup plans and redundancies for critical third-party services. |
| R1.4 | Security vulnerabilities | C1.4.1 | Poor data encryption practices | 4 | 3 | 12 | M1.4.1 | Implement strong encryption methods for sensitive user data. |
| C1.4.2 | Insufficient user authentication measures | 3 | 2 | 6 | M1.4.2 | Enhance user authentication protocols and incorporate multi-factor authentication. |
| R1.5 | Legal and regulatory compliance issues | C1.5.1 | Inadequate understanding of local food safety regulations | 3 | 3 | 9 | M1.5.1 | Engage legal experts to ensure compliance with local food safety regulations and standards. |
| C1.5.2 | Privacy concerns and data protection laws | 4 | 2 | 8 | M1.5.2 | Implement robust privacy policies and obtain explicit user consent for data processing. |

Table 6: Risk table

## **Professional Issues**

Identification and discussion of relevant legal, social, ethical, and environmental issues in the context of the project. Refer to professional codes of conduct, e.g. BCS, ACM.

### Legal Issues

Identification:

In the context of our online food delivery platform project, legal issues primarily revolve around Intellectual Property Rights (IPR), Health & Safety (H&S), and compliance with data protection laws, including GDPR.

Discussion:

IPR: Careful attention will be given to the use of proprietary information and software. Unauthorized use may lead to legal consequences, necessitating thorough validation of research documents, source code, and external libraries. Compliance with licenses such as MIT License and copyright laws is crucial for lawful use.

Data Protection (GDPR): Adherence to GDPR regulations is paramount, ensuring the secure handling of user data, privacy, and informed consent.

### Social Issues

Identification:

Social issues in our project involve considerations of social responsibility and the prevention of unintended biases and discriminatory behavior.

Discussion:

Social Responsibility: The application's design and development will adhere to the Web Accessibility Initiative, ensuring accessibility, user-friendliness, and inclusivity for all users.

### Ethical Issues

Identification:

Ethical considerations focus on the responsible use of research and developments, particularly emphasizing educational and research purposes and avoiding risks associated with malfunctioning Machine Learning (ML) models.

Discussion:

Educational and Research Purpose: Emphasis on the strictly educational and research-oriented nature of the project to mitigate risks associated with ML models.

Avoidance of Commercial Use: Clear communication that the product is not for commercial use and should not influence or affect financial or investment decisions.

### Environmental Issues

Identification:

While not explicitly stated in the given material, environmental issues may arise from the potential environmental impact of the project.

Discussion:

Environmental Impact: Consideration of the project's environmental impact, such as energy consumption and resource usage, to minimize any negative effects.

# **Conclusion**

Summary of what was achieved and potential future work.

# **References**

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* The layout above is a suggestion of how to present your Final Project Report. Whenever appropriate, introduce sections that will help the readability of your work.
* The Length of the final report should be **8000 – 10000 words**.
* All sections and subsections should be numbered for cross-referencing purposes.
* Regarding citations and references, students must adhere to the University guidelines or IEEE referencing style. **Students doing software development-based projects can cite related websites, web applications, developer documentation, etc. They can cite related articles to their projects, but it is not required. Students doing research-oriented projects should focus on citing research articles. They can also cite appropriate websites whenever necessary. Students are advised to use appropriate reference management software such as Mendeley Reference Manager or Zotero to ensure the correctness of all references.**

## **Formatting Requirements**

Your written report must be presented in the following format:

* All main sections/chapters should begin on a new page. The Declaration page, Tables of Contents pages, Acknowledgment, Abstract, Abbreviation, Glossary, Project Chapters (Chapters 1 to 6), and Appendices should all start on a new page.
* It must be word-processed in 11-point Arial font.
* It must be black text on a white or ivory background
* All pages must be numbered. Follow the appropriate page numbering format specified in the template.
* Margins must be as follows: Top: 1 inch, Bottom: 1 inch (2.5 cm), Left: 1.25 inches, Right:
* 1.25 inches (3.2 cm)
* Use a line spacing of 1.5
* Numbers and captions to figures and tables should be at the bottom of the figure or table. If the figure or table is mounted sideways into the report, then its bottom is on the right-hand side of the report. **All tables and figures must be labeled**.
* Normally, the report should not contain more than 80 tables/figures.

## **Written Presentation**

* The final project report must have a concise written presentation and referencing style.
* It should also have a clear & logical presentation.

**NOTE:**

1. **All the text in red colour are basic guidelines and must be DELETED after using this guide.**
2. **Finally, update the “Table of Contents” appropriately to display the correct section titles and corresponding page numbers.**

# **Appendices**

This section can have the essential information/data that are necessary to be included within the report but would disrupt the flow of the main argument. This section is not marked. Examples include links to data and software repositories, questionnaires, raw survey results, and wireframes.

**总字数8000-10000**