

UNDERGRADUATE PROJECT REPORT

|  |  |
| --- | --- |
| **Project Title:** | An intelligence recommendation system for online food ordering platform based on Collaborative Filtering |
| **Surname:** | **Quan** |
| **First Name:** | **zhihao** |
| **Student Number:** | **202018010410** |
| **Supervisor Name:** | **Monty Mu** |
| **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.

# **Table of Contents**

[**Declaration** i](#_Toc129605831)

[**Acknowledgment** ii](#_Toc129605832)

[**Table of Contents** iii](#_Toc129605833)

[**Abstract** iv](#_Toc129605834)

[**Abbreviations** v](#_Toc129605835)

[**Glossary** vi](#_Toc129605836)

[**Chapter 1 Introduction** 1](#_Toc129605837)

[**1.1** **Background** 1](#_Toc129605838)

[**1.2** **Aim** 1](#_Toc129605839)

[**1.3** **Objectives** 1](#_Toc129605840)

[**1.4** **Project Overview** 1](#_Toc129605841)

[**1.4.1** **Scope** 1](#_Toc129605842)

[**1.4.2** **Audience** 1](#_Toc129605843)

[**Chapter 2 Background Review** 2](#_Toc129605844)

[**Chapter 3 Methodology** 3](#_Toc129605845)

[**3.1** **Approach** 3](#_Toc129605846)

[**3.2** **Technology** 3](#_Toc129605847)

[**3.3** **Project Version Management** 3](#_Toc129605848)

[**Chapter 4 Results** 4](#_Toc129605849)

[**Chapter 5 Professional Issues** 5](#_Toc129605850)

[**5.1** **Project Management** 5](#_Toc129605851)

[**5.1.1** **Activities** 5](#_Toc129605852)

[**5.1.2** **Schedule** 5](#_Toc129605853)

[**5.1.3** **Project Data Management** 5](#_Toc129605854)

[**5.1.4** **Project Deliverables** 5](#_Toc129605855)

[**5.2** **Risk Analysis** 5](#_Toc129605856)

[**5.3** **Professional Issues** 5](#_Toc129605857)

[**Chapter 6 Conclusion** 6](#_Toc129605858)

[**References** 7](#_Toc129605859)

[**6.1** **Formatting Requirements** 7](#_Toc129605860)

[**6.2** **Written Presentation** 7](#_Toc129605861)

[**Appendices** 8](#_Toc129605862)

# **Abstract**

Up to 250 words, concise outline of background, aims, results, and achievements.  
In response to the dynamic growth of online food delivery services, a comprehensive web platform has been developed utilizing Django, jQuery, MySQL, and Bootstrap. This platform caters to three distinct user groups: customers, merchants, and administrators, each equipped with tailored functionalities. Customers are provided with the ability to browse, purchase, and bookmark products and stores, manage their orders, and engage through comments and ratings. Merchants are empowered to establish and manage their stores, including product listings and order processing. Administrators have oversight over the website's data concerning products, orders, and user activities. A key feature of the website is its encryption security measures, ensuring user account safety and data protection during transactions. Furthermore, the platform distinguishes itself with a personalized recommendation system for customers, utilizing advanced algorithms to tailor product suggestions, thereby enhancing user engagement and satisfaction levels. This system not only optimizes the shopping experience by offering customized recommendations but also contributes to increasing the purchase intention and overall satisfaction of its users. The development and implementation of this online food delivery website represent a significant achievement in enhancing user interaction, security, and personalized shopping experiences in the digital era.

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

# **Abbreviations**

This section should have the definition of any abbreviations used in the report

CF: Collaborative Filtering

User-CF: User-based Collaborative Filtering

Item-CF: Item-based Collaborative Filtering

# **Glossary**

词汇表

This section should have the definition of all the keywords you stated in the “Abstract” section. You can also define other relevant keywords. Particularly, if your final project report includes rare, unfamiliar, specialized, or made-up words or terms, the glossary serves as a dictionary for the reader to reference throughout their reading of the project report. (Note: this section should only contain definitions for specific terms in the project report. It does NOT function as an ordinary dictionary. Hence, common words related to the Computer Science and Software Engineering disciplines should NOT be included in this list.)

# **Introduction**

*This is an update of the Introduction from your previous reports. Students are to also incorporate the feedback from their supervisor. Also, include subsequent ideas and research that you have discovered.*

## **Background**

This section should describe the overview of the topic and motivations. Provide appropriate references wherever necessary.

In the era of highly developed information technology and logistics industry, online food delivery has become a new trend sweeping the world[1]. In online food platform, customers can browse menus, place orders, and pay for meals via websites or mobile applications.

However, the increasing health consciousness of consumers and their growing demand for healthy and sustainable 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. [1] However, too many kinds of products will make it difficult for users to find the information they like. Over time, user interest in the platform will decrease. [2]

In order to solve the problem of information overload, the use of recommender systems has become an effective technical choice [3]. Based on collaborative filtering, this project provides personalized product recommendation for customers through intelligent recommendation system, so as to improve user experience and enhance customer satisfaction. Collaborative filtering is a data-driven recommendation algorithm, which realizes accurate product recommendation by analyzing user preferences. This integration method is expected to provide users with more accurate and personalized recommendation services and effectively deal with the challenge of information overload. [2]

## **Aim**

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

The primary aim of this project is to implement a collaborative filtering (CF) recommendation system based on user behavior data. Our goal is to enhance 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 existing recommendation system algorithm.
2. Perform In-Depth Analysis of Online Ordering Platform Functions.
3. Prioritize the functionality of the designed website.
4. Evaluate and Select an Optimal Recommendation System Algorithm.
5. Identify and Acquire a Relevant Dataset for Collaborative Filtering Training.
6. Implement Core Features of the Online Food Ordering Website.
7. Construct an Intuitive and Effective Product Recommendation System Model.
8. Implement and improve the UI of the website.
9. Testing all modules and documenting & analyzing the performance of the recommended systems.

## **Project Overview**

(NB: Most students are working either on a software development-based project or a machine learning/deep learning-based project. Hence, in section 1.4, students must adopt the appropriate theme/content depending on their project topic.)

### **Scope**

The scope of a software development project should answer the questions: what will the software do? How will the software work? The scope for a machine learning/deep learning-based project should focus on answering the questions: what is the purpose of the study? How significant is the study?

The objective of this software development project is to build an Online Food Ordering and Delivery Platform equipped with an intelligent recommendation system. This platform aims to enhance the efficiency of consumers' food exploration by offering a different of food options. The software will facilitate customers in browsing, searching, and placing orders online, while also providing personalized food and restaurant recommendations based on individual customer interests. Additionally, restaurant owners will have access to a comprehensive system allowing them to view order details and customer information.

* How It Works:

Customers will access the platform via a user-friendly interface, where they can explore a different of foods, place orders, and make secure online payments.

Recommender systems analyze customer behavior (e.g., ratings) and historical data to make personalized food and restaurant recommendations.

Restaurant owners can view and manage online order information through their merchant account to improve their operational efficiency.

### **Audience**

The audience for a software development project should focus on who is the software for? The audience for a machine learning/deep learning-based project should focus on who will benefit from the findings.

This software development project primarily targets two key audience groups—restaurant merchants and customers. The designed system aims to cater to their specific needs, providing a seamless and personalized online food ordering experience.

* Customer:

The system focuses on providing a user-friendly platform with personalized recommendations, making the food selection process more convenient and enjoyable.

* Merchant / Restaurant owner:

The system enables restaurant owners to effectively present their products, capture valuable customer insights, and leverage the recommender system to improve customer satisfaction. At the same time, it can help the restaurant advertise, improve its awareness and increase turnover [3].

# **Background Review**

This chapter is an update of the Background Review from your previous reports, using the feedback you received from your supervisor. 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),** and others doing research-oriented projects (machine learning & deep learning projects) can write their background review by stating **a summary of related literature (e.g., annotated bibliography, or initial literature review, with a brief summary of sources).**

**Annotated Bibliography aids as in doing a good literature review. It is not the literature review. However, your final background review must be paragraphs with appropriate citations. Whenever appropriate, a table can be adopted.**

With the continuous development of Internet services, we are facing the challenge of information overload. Recommender systems are an algorithm designed to cope with this problem. They are designed to assist individuals in finding the choice that best matches their individual interests and preferences in a variety of contexts from a vast collection of options and information [4].

In e-commerce recommendation systems, collaborative filtering is a common method to recommend products by analyzing user behaviors and preferences. It works by collecting user rating feedback for a given scope of items, and then exploiting the similarity of the rating behavior of multiple users to determine how to recommend items [5].

* Approach of Recommendation-System:

There are two main types of collaborative filtering approaches: user-based collaborative filtering and item-based collaborative filtering [5].

Item-based filtering (ItemCF) is a recommendation system generation method, which usually generates accurate recommendation results based on user characteristics and specific preferences, without considering ratings and other user preferences. In other words, the method recommends similar items to those users with a specific propensity [4]. It exploits the similarity between items to recommend relevant elements based on the preferences of a particular user.

On the other hand, the principle of user-based collaborative filtering is based on the ratings given by the users to the restaurants, 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 [3].

* 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 [6]. 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 some functional comparisons of the three platforms. Through comparison, it is found that the basic functions of search, recommendation, purchase, shopping cart and order management are well implemented on the three platforms, while the payment methods are different due to different countries. It is worth noting that Uber eats performs better than the other two software in terms of Delivery Method and schedule.

|  |  |  |  |
| --- | --- | --- | --- |
| Feature Comparison | MeiTuan food delivery [7] | Ele.ME [8] | Uber eats [9] |
| Register required Information | **Phone number** | **Phone number** | **Email &**  **Phone number** |
| Shopping Cart | **YES** | **YES** | **YES** |
| Search restaurants | **YES** | **YES** | **YSE** |
| Search foods in restaurant page | **YES** | **YES** | **NO** |
| Favorite function | **YES** | **YES** | **YES** |
| Modify personal information | **YES** | **YES** | **YES** |
| Delivery Method | **Delivery** | **Delivery** | **Delivery & Pickup** |
| Schedule pickup | **NO** | **NO** | **YES** |
| Recommended  Restaurants | **YES** | **YES** | **YES** |
| Address Management | **YES** | **YES** | **YES** |
| Order view | **YES** | **YES** | **YES** |
| Payment method | **Alipay, Wechat payment, Meitun payment** | **Alipay, Wechat payment, China unionpay** | **Paypal, Cash, Credit card** |
| Customer rating function | **YES** | **YES** | **YES** |

# **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.

The approach for a machine learning/deep learning-based project should focus on describing the core machine learning model to be employed. Describe the mathematical basis, the algorithm details, and the optimization strategy, if applicable. Also, describe the datasets and data processing techniques to be used where relevant.

### 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.

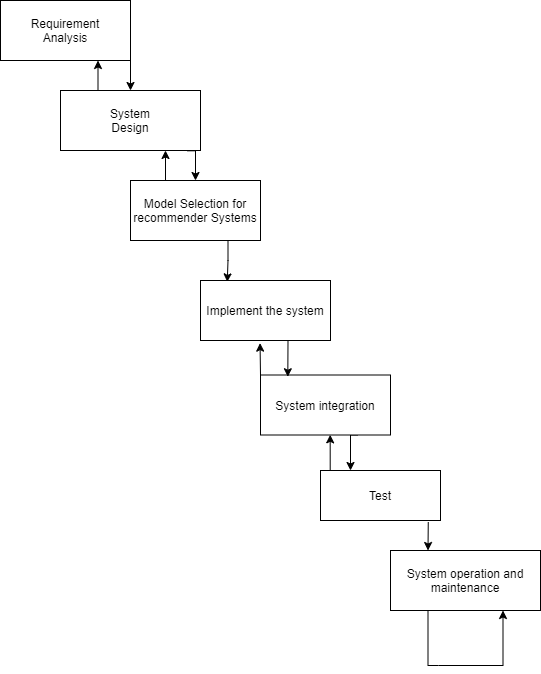


Figure 1: Waterfall model

### Requirement collect method:

* Market research: Utilize 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 products: Observe the popular online ordering software (Meituan, Ele.me, uber eats etc.) recorded to analyze which requirements are the most needed by users.

## **Technology**

State all the implementation tools & resources, such as hardware and software that have been adopted for your project.

The hardware used in the project are as follows:

**Hardware**:

* Computer: ASUS Tianxuan
* CPU: R7-4800H
* Random Access Memory: 16GB

The software used in the project are as follows:

**Software:**

* Language: Python, Javascript
* IDE: Pychram
* Database: Mysql 8.0, Mysql workbench, PyMySQL
* Backend framework: Django
* UI: Javascript, Html, Css, JQuey, Bootstrap, feather icon
* Operating system: windows 10
* Third library: Pandas, Numpy, scikit-learn
* Algorithm Model: Collaborative Filtering Algorithm, Content based recommendation

**Data set:**

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

## **Project Version Management**

In this section, students must describe how they have used resources such as Baidu drive, Gitee, etc., to manage their project source codes. The link to the full project source should be provided.

I used the github platform as the software for project version management, and created a repository on it to manage all my code.

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**

State the complete tasks for each objective. The details here can be presented by a table.

|  |  |  |  |
| --- | --- | --- | --- |
| 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 recommendation | Investigated the workings of Collaborative Filtering (CF) and Content-Based Recommendation 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 (divided into several modules) | 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 recommendation two parts and the implementation process. | 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 recommendation 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 2: Activity table

### **Schedule**

In this section, you can use a Gantt chart or other charts to show the activities and their deadlines. Highlight all completed tasks in the project schedule chart.



Figure 7: 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.

### **Project Deliverables**

In this section, briefly list all the documents and project resources that have been submitted for assessment. Example: Project proposal, progress report, final report, project code/ software, poster presentation file, etc.

## **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.

## **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.

# **Conclusion**

Summary of what was achieved and potential future work.

# **References**

[1] Statista Market Insights, ‘Online Food Delivery: market data & analysis’, Statista Market Insights, Mar. 2023. Accessed: Oct. 30, 2023. [Online]. Available: https://www.statista.com/study/40457/food-delivery/

[2] X. Li, ‘Research on the Application of Collaborative Filtering Algorithm in Mobile E-Commerce Recommendation System’, in *2021 IEEE Asia-Pacific Conference on Image Processing, Electronics and Computers (IPEC)*, Dalian, China: IEEE, Apr. 2021, pp. 924–926. doi: 10.1109/IPEC51340.2021.9421092.

[3] L. Wang and B. Yi, ‘Research on O2O take-away restaurant recommendation system: taking ele.me APP as an example’, *Cluster Comput*, vol. 22, no. S3, pp. 6069–6077, May 2019, doi: 10.1007/s10586-018-1814-y.

[4] C. N. Sánchez, J. Domínguez-Soberanes, A. Arreola, and M. Graff, ‘Recommendation System for a Delivery Food Application Based on Number of Orders’, *Applied Sciences*, vol. 13, no. 4, p. 2299, Feb. 2023, doi: 10.3390/app13042299.

[5] H. Liu, ‘Implementation and Effectiveness Evaluation of Four Common Algorithms of Recommendation Systems - User Collaboration Filter, Item-based Collaborative Filtering, Matrix Factorization and Neural Collaborative Filtering’, in *2022 International Conference on Cloud Computing, Big Data Applications and Software Engineering (CBASE)*, Sep. 2022, pp. 224–227. doi: 10.1109/CBASE57816.2022.00049.

[6] Statista, ‘Catering-services-in-china’, Statista. Accessed: Nov. 01, 2023. [Online]. Available: https://www.statista.com/study/63164/catering-services-in-china/

[7] ‘Meituan Waimai’. Meituan.

[8] ‘Ele.me’. Ele.me.

[9] ‘Uber Eats’. Uber Eats.

* 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**