

Restaurant Recommendation System by Using Data Mining Techniques

Uditha Punchihewa

149226G

Faculty of Information Technology

University of Moratuwa

November 2018

Restaurant Recommendation System by Using Data Mining Techniques

Uditha Punchihewa

149226G

Dissertation submitted by Faculty of Information Technology,
University of Moratuwa, Sri Lanka for the fulfillment of the requirement of the
Honors Degree
of MSc in Information Technology

November 2018

Declaration

We declare that this thesis is our own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Name of Student

U.V. Punchihewa

Signature of Student

Date:

Supervised by:

Name of Supervisor

Mr. Saminda Premaratne

Senior Lecture,

Faculty of Information Technology,

University of Moratuwa.

Signature of supervisor

Date:

Dedication

This dissertation is dedicated to my beloved mother, father, wife, family and friends who gave me endless courage and support to achieve my tasks whenever I discouraged.

Acknowledgment

My heartiest thanks should go to my supervisor Mr. Saminda Premaratne for the guidance, assistance, encouragement and providing this opportunity to do the research on this field. Also, sincerely thanks to all my teachers and demonstrators who taught subjects in my MSc IT degree and the things that I learned from many subjects helped me to fulfill the hard task to be a manageable one. In addition to those, I'm taking this opportunity thank my loving parents, my wife and family who helped and encouraged to make this research successful. Last but not least, my sincere thank should go to all my friends who helped me in numerous ways to make this work possible

Abstract

Nowadays we can see many restaurants in different category in different locations. But do you know what the best restaurants there are? Is there a way to identify the best restaurants? With this proposed solution, we can identify the best restaurants around you that is called “Restaurant recommendation system”. It provides a good experience to the end user to find the best restaurant for their preferences.

Based on previous user experience or feelings about the restaurant we can get some idea about the restaurant. If someone recommends a system, we can think of it as a good restaurant. In this system takes three user inputs on restaurant menu items. The first one is recommending or not recommending as direct input on a restaurant. The second input is rating on a restaurant menu item scaling one to five. The third input is analyzing users’ reviews about the restaurant menu item. So, we can apply data mining techniques like opinion mining and Apriori algorithm on the user inputs and get the output as recommended menu item along with the restaurant.

Based on those three user inputs above mentioned we could decide what the best restaurant meals are by calculating average ratings and ranking them. Not only that. This system will also provide suggestions about restaurants or meals of a restaurant based on users’ preferences by using data mining techniques like collaboration filtering. The collaboration filtering is focused on users’ preferences. And, it uses opinion mining techniques to analyze reviews. This system is a web application with the REST service. For the front-end development used Angular to make it rich application and for back end uses Java with REST web service. In addition to that uses spring framework and hibernate for object relational mapping.

Table of Contents

Introduction.....	1
1.1 Prolegomena.....	1
1.2 Background and Motivation.....	1
1.3 Problem Statement.....	2
1.4 Hypothesis.....	2
1.5 Aim and Objectives	2
1.6 Approach of Recommending Restaurant	3
1.7 Structure of the Thesis	4
1.8 Summary.....	4
Achievements and Challenges in Recommendation of Restaurants.....	5
2.1 Introduction.....	5
2.2 Early Development	5
2.3 Collaboration Filtering.....	7
2.4 Opinion Mining Techniques.....	7
2.5 Modern Trends in Data Mining	8
2.6 Future Challenges of Data Mining.....	8
2.7 Problem Definition	8
2.8 Summary.....	8
Technologies	9
3.1 Introduction.....	9
3.2 Java.....	9
3.3 Angular	9
3.4 REST	9
3.5 Spring	10
3.6 Hibernate.....	10
3.7 MySQL	10
3.8 Weka.....	10
3.9 Summary.....	11
Novel Approach to Restaurant Recommendation.....	12
4.1 Introduction.....	12
4.2 Hypothesis.....	12
4.3 Recommendation Engine	12
4.4 Apriori Algorithm for Associations	13
4.4.1 Create Relationship Table Food Item Against User	13
4.4.2 Calculate Support for Food Item	14
4.4.3 Filter High Support Food Items.....	14
4.4.4 Filter High Support Food Item and Make Association	14
4.5 Sentimental Analysis	15
4.5.1 Apply Bag of Words.....	16
4.5.2 Recursive Neural Network (RNN)	16
4.6 Users	17
4.7 Input.....	17
4.8 Output	18
4.9 Process	18
4.9.1 Login Process	18
4.9.2 Recommendation Process	18
4.9.3 Rating Process.....	18
4.9.4 Review Process	19
4.9.5 Final Rate Calculation Process.....	19
4.10 Features.....	19
4.11 Data Collection.....	19
4.11.1 Business JSON.....	20

4.11.2 Review JSON	22
4.11.3 User JSON	22
4.12 Storing Data	23
4.13 Summary	23
Design of Restaurant Recommendation	24
5.1 Introduction	24
5.2 Top Level Design	24
5.3 Web Application	24
5.4 Web Service	25
5.5 Database	25
5.6 Web Container	25
5.7 Java Tool	25
5.8 Detailed Design	26
5.9 Main Modules	26
5.9.1 Login Module	27
5.9.2 User Module	27
5.9.3 Restaurant Module	28
5.9.4 Dashboard	28
5.9.5 Search Module	28
5.9.6 Recommendation Engine	29
5.10 Summary	29
Implementation	30
6.1 Introduction	30
6.2 Overall Solution	30
6.3 Collecting, Reading and Storing Data	30
6.4 Sentimental Analysis	34
6.5 Apriori Algorithm	35
6.5.1 Definition	36
6.5.2 Prepare Data Set to Apply Apriori Algorithm	36
6.5.3 Generate ARFF File for Association Rules	37
6.5.4 ARFF File	37
6.5.5 Generate Association Rules Using ARFF	38
6.6 The Ways of Recommending Restaurant Meals	40
6.6.1 Recommend Restaurant Meals Based on User Recommendations	41
6.6.2 Recommend Best Restaurant Meals	41
6.7 Summary	42
Evaluation	43
7.1 Introduction	43
7.2 Evaluation of Web Application	43
7.3 Evaluation of Final Rating	43
7.4 Evaluation of Opinion Mining	45
7.5 Evaluation of Restaurant Menu Item Final Rating	46
7.6 Evaluation of Restaurant Menu Item on User Recommendations	47
7.7 Evaluation of Restaurant Menu Item on User Ratings	48
7.8 Evaluation of Restaurant Menu Item on User Reviews	49
7.9 Summary	49
Conclusion	50
8.1 Introduction	50
8.2 Conclusion	50
8.3 Achievement of Objectives	50
8.4 Further Works	51
8.4.1 Content Based Filtering	52
8.5 Summary	52
Appendix A	54
1. User Login Page	54
2. User Registration Page	55
3. Restaurant Creation Page	56

4. Restaurant View Page.....	57
5. Restaurant List Page.....	58
6. Menu Item List Page.....	59
7. Menu Item Page.....	60
8. Menu Item Creation Page.....	61
Appendix B.....	62
1. User Table.....	62
2. Restaurant Table.....	62
3. Menu Table.....	63
4. Menu Item Table.....	63
5. Restaurant Controller.....	64
6. User Controller.....	64
7. AprioriUtil.....	65
8. SentimentUtil.....	66

List of Figures

Figure 2.3.1 – Collaboration Filtering.....	7
Figure 4.4 – Apriori Algorithm.....	13
Figure 4.5 – Sentimental Analysis.....	15
Figure 4.5.2 – Recursive Neural Network (RNN).....	16
Figure 5.2.1 – Top Level Design.....	24
Figure 5.8.1 – Detailed Design.....	26
Figure 5.9.1.1 – Login Module.....	27
Figure 5.9.5.1 – Search Module.....	28
Figure 6.3.1 – Business JSON.....	30
Figure 6.3.2 – Restaurant Table.....	32
Figure 6.5.2.1 – Associations As CSV.....	36
Figure 6.5.3.1 – Weka Tool for Associations.....	37
Figure 6.5.4.1 – ARFF File.....	38
Figure 6.5.5.1 – Association Rules.....	39
Figure 7.3 – Restaurant Average Rating on Specific Time Period.....	43
Figure 7.5.1 – Fried Rice of Messing Restaurant.....	46
Figure 7.6.1 – Restaurant Menu Item Recommend Data.....	47
Figure 7.7.1 – Restaurant Menu Item Rate Data.....	48
Figure 7.8.1 – Restaurant Menu Item Review Data.....	49
Figure 8.4.1.1 – Content Based Filtering.....	52
Figure Appendix A – User Login Page.....	54
Figure Appendix A – User Registration Page.....	55
Figure Appendix A – Restaurant Create Page.....	56
Figure Appendix A – Restaurant View Page.....	57
Figure Appendix A – Restaurant List Page.....	58
Figure Appendix A – Menu Item List Page.....	59
Figure Appendix A – Menu Item Page.....	60
Figure Appendix A – Menu Item Creation Page.....	61
Figure Appendix B – User Table.....	62
Figure Appendix B – Restaurant Table.....	62
Figure Appendix B – Menu Table.....	63
Figure Appendix B – Menu Item Table.....	63