**Location-based Collaborative Filtering**

**and Frequent Itemset**

**A Restaurant Recommendation System for Yelp**

Thanh Tung Nguyen (ID: 40042891)

Huy Nguyen (ID: 40023289)

*Date: April 12, 2019*

# Abstract

|  |
| --- |
| Before going out for a meal, Yelp has been one of the most popular choice for customers to check for restaurants quality. To help users make better choices, we use techniques and principles of recommendation systems to create an application which makes predictions based on the user similarities. Using Yelp’s dataset, we develop an enhanced collaborative filtering using location as a key criterion for generating recommendations and then extract collaborative and content-based features to identify customer and restaurant profiles. Besides, we also provide frequent itemset references to users subsequently based on their chosen restaurants. We would evaluate our algorithm using Root metrics Mean Squared Error and Mean Absolute Error, we then evaluate and compare the algorithms. Due to limitation of time and resources, our scope of work will be narrowed to businesses within Canada. |

## Keywords

collaborative filtering, frequent itemset, recommendation, location-based, location, Yelp dataset.

# Introduction

A vast database of reviews, ratings, and general information provided by the community about businesses, Yelp provides consumers with a myriad of options and information even when searching for an especially specific service or goods niche. However, although all required information may be present to make an informed choice, it is often still difficult by just looking at the raw data. Reading all the reviews of a single business alone is time consuming and requires more effort than the average user is willing to expend. As a result, we believe users could greatly benefit from a recommendation system

## Context

Headings of subsections should be in Georgia 11-point bold italics with initial letters capitalized (Heading 2). (Note: for sub-sections and sub-subsections, words like ‘the’, ‘of’, ‘a’, ‘an’ are not capitalized unless it is the first word of the heading.)

### Objectives

Headings for sub-subsections should be in Georgia 10-point bold with initial letters capitalized (Heading 3). Please do not go any further into another layer/level.

## Problem to Solve

Headings of subsections should be in Georgia 11-point bold italics with initial letters capitalized (Heading 2). (Note: for sub-sections and sub-subsections, words like ‘the’, ‘of’, ‘a’, ‘an’ are not capitalized unless it is the first word of the heading.)

### Related Work

Recommendation systems facilitate users to make better choices while dealing with huge amount of data by recommending to them items that they would like.

There has been a lot of work done on designing recommender systems during the last two decades. Amazon.com [3] and Netflix [4] are two popular applications of recommender systems. [5] Presents an online social network-based recommender system that extracts user‟s interests for jobs and then makes recommendations to them accordingly. It is focused on two very popular social networks Facebook and LinkedIn. [6] Implements Naive Bayes to retrieve hidden data from stored database and compares the user values with trained data set. Then mapping of patient‟s attributes with stored database entries is done and probabilistic values are analysed for decision making. It can answer complex queries for diagnosing heart disease and thus assist healthcare practitioners to make intelligent clinical decisions which traditional decision support systems cannot. Sentiment analysis or opinion mining, an imperative research area of

natural language processing, involves the extraction and identification of the attitude of a speaker or writer about a

certain subject matter [7]. Opinion is generally combination of words, sentences, or documents. Opinion mining is

based on the reviews of the other users. Sentiment analysis is used to classify each opinion as positive or negative.[8]

Research paper proposed a novel document quality classification approach, which extracts sentiment value from

SentiWordNet and accumulates the different sentimental influence of each word based on a document level. According

to the experimental results, this proposed approach, which extract sentimental knowledge from SentiWordNet,

outperform the approach in which SentiWordNet is not used for all categories with an exception, which is spam

category. [9] Proposed system uses SentiWordNet library. The data from the reviews first removing stop words, then

stemming by Porter Stemmer algorithm and then that reviews are tagged by their respective parts of speech. Then the

score of review is calculated by pair of part of speech and rank in SentiWordNet.

# Materials and Methods

## Materials

Headings of subsections should be in Georgia 11-point bold italics with initial letters capitalized (Heading 2). (Note: for sub-sections and sub-subsections, words like ‘the’, ‘of’, ‘a’, ‘an’ are not capitalized unless it is the first word of the heading.)

### Sub-subsections

Headings for sub-subsections should be in Georgia 10-point bold with initial letters capitalized (Heading 3). Please do not go any further into another layer/level.

# Results

Each type of submission (completed research papers, research-in-progress papers, and panels) has specific page length requirements. See additional requirements specific to each type of submission. Any submission that exceeds page length limits will be rejected without review. Paper length limitations are intended to encourage authors to publish full-length papers in journals or other outlets at a later date.

* Complete/full papers: Must not exceed 10 pages all-inclusive (approx. 5,000 words, including author names, abstract, figures, tables, references, appendices).
* Emergent Research Forum (ERF) papers: Must not exceed 5 pages all-inclusive (approx. 2,500 words, including author names, abstract, figures, tables, references, appendices).

## Subsections

Headings of subsections should be in Georgia 11-point bold italics with initial letters capitalized (Heading 2). (Note: for sub-sections and sub-subsections, words like ‘the’, ‘of’, ‘a’, ‘an’ are not capitalized unless it is the first word of the heading.)

### Sub-subsections

Headings for sub-subsections should be in Georgia 10-point bold with initial letters capitalized (Heading 3). Please do not go any further into another layer/level.

# Results

Each type of submission (completed research papers, research-in-progress papers, and panels) has specific page length requirements. See additional requirements specific to each type of submission. Any submission that exceeds page length limits will be rejected without review. Paper length limitations are intended to encourage authors to publish full-length papers in journals or other outlets at a later date.

## Subsections

Headings of subsections should be in Georgia 11-point bold italics with initial letters capitalized (Heading 2). (Note: for sub-sections and sub-subsections, words like ‘the’, ‘of’, ‘a’, ‘an’ are not capitalized unless it is the first word of the heading.)

### Sub-subsections

Headings for sub-subsections should be in Georgia 10-point bold with initial letters capitalized (Heading 3). Please do not go any further into another layer/level.

**Title**

Your paper’s title should be in Georgia 20-point bold. Ensure proper capitalization within your title (i.e. “The Next Frontier of Information Systems” versus “the next frontier of Information systems.”

## Normal or Body Text

Please use a 10-point Georgia font (similar to Times New Roman, but more easily read online) or, if it is unavailable, another proportional font with serifs. The Georgia font is also available on Macintosh. Please use sans-serif or non-proportional fonts only for special purposes, such as source code text (SpecialStyle). [References to Georgia font from this point forward should be interpreted as “Georgia or equivalent.”]

# Sections

The heading of a section should be Georgia 13-point bold, left justified (Heading 1 Style in this template file). Sections should not be numbered.

## Subsections

Headings of subsections should be in Georgia 11-point bold italics with initial letters capitalized (Heading 2). (Note: for sub-sections and sub-subsections, words like ‘the’, ‘of’, ‘a’, ‘an’ are not capitalized unless it is the first word of the heading.)

### Sub-subsections

Headings for sub-subsections should be in Georgia 10-point bold with initial letters capitalized (Heading 3). Please do not go any further into another layer/level.

# Figures, Tables & Captions

Place figures and tables close to the relevant text (or where they are referenced in the text).

Captions should be Georgia 10-point bold (Caption Style in this template file). They should be numbered (e.g., “Table 1” or “Figure 2”), centered and placed beneath the figure or table. Please note that the words “Figure” and “Table” should be spelled out (e.g., “Figure” rather than “Fig.”) wherever they occur. The proceedings will be made available online, thus color figures are possible.

## Inserting Images

Occasionally MS Word generates larger-than-necessary PDF files when images inserted into the document are manipulated in MS Word. To minimize this problem, use an image editing tool to resize the image at the appropriate printing resolution (usually 300 dpi), and then insert the image into Word using Insert | Picture | From File...

Using tables to hold places can work very well in Word. If you want to copy a figure from another application (such as PowerPoint) and then paste to the place where you want your figure to be, make sure that (1) the figure stays in the position, and (2) it does not take up too much space. You can ensure the former by double clicking the figure, then go to “Layout” tab, and select “In line with text.” To ensure the latter, use “Paste Special,” then select “Picture.” You can resize the figure to your desired size once it is pasted.

## Table Style

Inserting a table in the text can work well. See Table 1 below. If you do not use this style, then you may want to adjust the vertical spacing of the text in the tables. (In Word, use Format | Paragraph… and then the Line and Page Breaks tab. Generally, text in each field of a table will look better if it has equal amounts of spacing above and below it, as in Table 1.)

|  |  |  |
| --- | --- | --- |
|  | Treatment 1 | Treatment 2 |
| Setting A | 125 | 95 |
| Setting B | 85 | 102 |
| Setting C | 98 | 85 |
| Table 1. A Very Nice Table | | |

# Language, Style, and Content

With regard to spelling and punctuation, you may use any dialect of English (e.g., British, Canadian, US, etc.) provided this is done consistently. Hyphenation is optional. To ensure suitability for an international audience, please pay attention to the following:

* Write in a straightforward style.
* Try to avoid long or complex sentence structures.
* Briefly define or explain all technical terms that may be unfamiliar to readers.
* Explain all acronyms the first time they are used in your text – e.g., “Digital Library (DL)”.
* Explain local references (e.g., not everyone knows all city names in a particular country).
* Be careful with the use of gender-specific pronouns (*he*, *she*) and other gendered words (*chairman*, *manpower*, *man-months*). Use inclusive language that is gender-neutral (e.g., *they*, *s/he*, *chair*, *staff*, *staff-hours*, *person-years*).

# Conclusion

It is important that you write for a general audience. It is also important that your work is presented in a professional fashion. This guideline is intended to help you achieve that goal. By adhering to the guideline, you also help the conference organizers tremendously in reducing our workload and ensuring impressive presentation of your conference paper. We thank you very much for your cooperation and look forward to receiving your nice looking, camera-ready version!

# Acknowledgements (Optional)

Please do *not* add acknowledgements to your original submission because it may identify authors. Add any acknowledgements to the revised, camera-ready version of your paper.

## References and Citations

References are to be formatted using the **new** *MIS Quarterly* style (<http://www.misq.org/manuscript-guidelines> under MISQ References Format). References must be complete, i.e., include, as appropriate, volume, number, month, publisher, city and state, editors, last name & initials of all authors, page numbers, etc. If you use EndNote, be aware that different versions of the software change the styles, creating some inconsistencies. Please also be aware that the *MIS Quarterly* style provided by default in the EndNote X4 software (and all earlier versions) is for the **old** *MIS Quarterly* style. You may download the Endnote Style [here](http://ais.site-ym.com/resource/resmgr/Files/MISQ-Revised.zip).

Your references should comprise only published materials accessible to the public. Proprietary information may not be cited.

# REFERENCES (Ensure that all references are fully complete and accurate as per the examples)

Ackoff, R. L. 1961. "Management Misinformation Systems," *Management Science* (14:4), pp. 147-156.

Benbasat, I., and Zmud, R. W. 2003. “The Identity Crisis within the IS Discipline: Defining and Communicating the Discipline’s Core Properties,” *MIS Quarterly* (27:2), pp. 183-194.

Bonini, C. P. 1963. *Simulation of Information and Decision Systems in the Firm*, Englewood Cliffs, NJ: Prentice-Hall.

Broadbent, M., Weill, P., O’Brien, T., and Neo, B. S. 1996. “Firm Context and Patterns of IT Infrastructure Capability,” in *Proceedings of the 14th International Conference on Information Systems*, J. I. DeGross, S. Jarvenpaa, and A. Srinivasan (eds.), Cleveland, OH, pp. 174-194.

Carroll, J. 2005. “The Blacksburgh Electronic Village: A Study in Community Computing,” in *Digitial Cities III: Information Technologies for Social Capital*, P. van den Besselaar and S. Kiozumi (eds.), New York: Springer-Verlag, pp. 43-65.