|  |
| --- |
| Restaurant recommender system |

Subhrajyoti patra

|  |  |
| --- | --- |
|  | Acknowledgement |

In preparation of my assignment, I had to take THe help and guidance of some very talented group of people, who have my deepest gratitude, as the completion of this assignment wasn’t an easy task. Their support certainly reduced the burden on my shoulders. I would like to thank to Imtiyaz sir for giving me appropriate guidelines for the assignment throughout numerous consultations. I would also like to expand my gratitude to all those who have directly and indirectly guided me in completing this assignment, this includes my parents and friends who helped me a lot in finalizing is project within the limited time frame.

**CERTIFICATE**

This is to certify that master subhrajyoti patra of class XII B has completed the project, during the academic year 2020-2021 towards the partial fulfillment credit for COMPUTERS practical evaluation and submission of satisfactory report as completed in following pages under my supervision.

Examiner's Signature:

Internal Examiner signature:

|  |  |
| --- | --- |
| 010/09/2020 | Computer Science Project |

Restaurant recommender system is a machine learning model, developed to demonstrate as a capstone project to IBM through coursera. It recommends restaurants based on user’s likes and dislikes and his previous interest data.

**Table of contents**

|  |  |
| --- | --- |
| **Topic** | **Page number** |
| Introduction section | 2 |
| Data section | 4 |
| Methodology section | 7 |
| Result section | 10 |
| Discussion section | 11 |
| Conclusion section | 12 |

1. **Introduction :**

**Problem background:**

Bangalore is the capital and largest city of the Indian state of Karnataka.

The diversity of the cuisine available is reflective of the social and economic diversity of Bangalore. Roadside vendors, tea stalls, South Indian, North Indian, Chinese and Western fast food are all very popular in the city. The Chinese food and the Thai food served in most of the restaurants are can be customized to cater to the tastes of the Indian population. Bangalore can also be called a foodie's paradise because of its vast variety of foods and edibles with a touch of Bangalore's uniqueness and tradition.

**Problem description:**

A frequent traveler gets to experience different types of environment, of which he does not have much knowledge about. In such situations, food is an important factor in deciding how you rate your trips and also recommending it to other people. In such scenarios, we need to find the right place, at a reasonable cost, to serve us in the best possible way. So there are few questions that must be addressed:

1. How many types of food are available in the restaurant?

2. Which is the most nearest to me with a good rating?

3. How many "similar" restaurants are available nearby me?

4. Do the "similar" restaurants cost more? If so, what specialty do they have?

Expectations from this recommender system is to get the answers for the above questions, in such a way that it uncovers the perspective of managing recommendations. It is sighted to show:

1. What types of restaurants are present in a particular area?

2. Where are the similar restaurant present based on a preference to particular food?

3. How do different restaurants rank with respect to my preferences?

**Target Audience:**

Target audiences for this project does not limit to a person who keeps travelling but everyone. People could simply decide to look for a similar restaurant all the time because they are addicted to a specific category of food. People who rarely use restaurants would prefer to have the most rated restaurants nearby them and all this could be easily handled by our recommender system.

**Success rate:**

With restaurants evolving, new food categories emerge, and hybrid food starts to be more popular. We need a system that could help us access vast number of food varieties. It is impossible for a person to ask each and every one about their visit to a particular place and also not everyone remembers everything. On the other hand, Computers are good at remembering things, and with Machine learning to its peak, it is high time that technology be our personal guidance and help us personally based on our likes and dislikes. So people would care about this project as a personal assistance and the success rate could certainly increase with time.

1. **Data :**

**Data requirements:**

To find a solution to the questions and build a recommender model, we need data and lots of data. Data can answer questions which are unimaginable and non-answerable by humans because humans do not have the tendency to analyze such large dataset and produce analytics to find solutions.

Let's consider the base scenario:

Suppose I want to find a restaurant, then logically, I need 3 things:

1. Its geographical coordinates (latitude and longitude) to find out where exactly it is located.

2. Population of the neighborhood where the restaurant is located.

3. Average income of neighborhood to know how much is the restaurant worth.

Let’s take a closer look at each of these:

1. To access location of a restaurant, it’s Latitude and Longitude is to be known so that we can point at its coordinates and create a map displaying all the restaurants with its labels respectively.

2. Population of a neighborhood is very important factor in determining a restaurant's growth and amount of customers who turn up to eat. Logically, the more the population of a neighborhood, the more people will be interested to walk openly into a restaurant and less the population, less number of people frequently visit a restaurant. Also if more people visit, better the restaurant is rated because it is accessed by different people with different taste. Hence it is a very important factor.

3. Income of a neighborhood is also a significant factor. Income is directly proportional to the richness of a neighborhood. If people in a neighborhood earn more than the average income, then it is very much possible that they will spend more however this is not always true. So a restaurant assessment is proportional to income of a neighborhood.

**Data collection:**

1. I decided to use Google maps API to fetch latitude and longitude but google API has limited number of calls that I could make with my free account. So it took around 15 - 20 days to fetch location of all the neighborhoods in Bangalore.

Initially I scrapped the list of neighbor's using beautifulSoup4 from Wikipedia (https://en.wikipedia.org/wiki/List\_of\_neighbourhoods\_in\_Bangalore). The table headings becoming the boroughs and data becoming the neighborhoods. Bangalore has 8 boroughs and 64 neighborhoods. So I manually googled each neighborhood to find its corresponding latitude and longitude. After doing so, I produced the following data frame.



2. I was able to find population data for a few cities. [Here is the link](https://indikosh.com/dist/655489/bangalore). Rest other neighborhood population is assumed and may be inaccurate but since this is a demonstrating project, the main idea is to get the working model. The data frame for Bangalore neighborhood population looks like:



3. Income by neighborhood is again easy to find out given that it’s readily available. But in case of Bangalore, it is again not the case. i was able to find Income data for main city. [link](https://en.wikipedia.org/wiki/List\_of\_Indian\_cities\_by\_GDP\_per\_capita). Neighborhood Income is assumed and may be inaccurate but since this is a demonstrating project, the main idea to get the working model. The data frame for Bangalore neighborhood population looks like:



4. Foursquare API:

Use of foursquare is focused to fetch nearest venue locations so that we can use them to form a cluster. Foursquare API leverages the power of finding nearest venues in a radius (in my case: 500mts) and also corresponding coordinates, venue location and names. After calling, the following data frame is created:



1. **Methodology :**

**Exploratory analysis:**

Scrapping the data from different sources and then combining it to form a single-ton dataset is a difficult task. To do so, we need to explore the current state of dataset and then list up all the features needed to be fetched.

Exploring the dataset is important because it gives you initial insights and may help you to get partial idea of the answers that you are looking to find out from the data.

While exploring the dataset, I found out that Indiranagar has most number of venues while Varthur has the least.



Also while producing the graph for number of clusters, I produced a graph to explore all the values for n\_clusters and then found the best by exploring the elbow graph.



**Inferential analysis:**

Most important factors while building the recommender system were population and income. They were the most important factors because they have a nonlinear relationship according to our dataset.

I needed to make some inferential analysis to understand this nonlinear relationship. As the population increases, it does not necessarily mean that average income of a neighborhood will also increase. It is true for many cases but also many cases differ to follow this trend. Similarly, a neighborhood with less number of people may not necessarily have less average income. It is possible to have less number of people and more income and vice versa. This can be inferred from the following graph:



1. **Result :**

The result of the recommender system is that it produces a list of top restaurants and the most common venue item that the user can enjoy. During the runtime of the model, a simulation was done by taking ‘Whitefield’ as the neighborhood and then processed through our model so that it could recommend neighborhoods with similar characters as that of ‘Whitefield’.

The following image shows the result:



1. **Discussion :**

Since there was a nonlinear relationship between income and population, it can be concluded that we must always perform inferential approach to find relationship among different set of features. Also during clustering, similar neighborhoods must be dumped into the right cluster.

The following graph shows the clusters:



Another observation that we can make is that different values for the number of clusters could produce very diverse results. Some may be over fitted or some may be under fitted. Hence analysis of number of clusters must be done.

1. **Conclusion :**

The recommender system is a system that considers factors such as population, income and makes use of Foursquare API to determine nearby venues. It is a powerful data driven model whose efficiency may decrease with more data but accuracy will increase. It will help users to finish their hunger by providing the best recommendation to fulfil all their needs.