Restaurant Recommendation System

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1. Introduction

Have you ever wanted to go out to eat but didn't know exactly where? Or perhaps you are in a new city and want to find the best restaurants based on your preferences? In this report a content-based recommendation system will be built to give the costumer personalized recommendations. This will be made using data from my hometown (Braga, Portugal) assuming the user already rated several restaurants. Then, based on the user's preferences we will use the recommendation system to give personalized recommendations on different restaurants located in Braga. This recommendation system could be used in other cities if we gathered the information and ratings of the restaurants located in the respective cities. Such could be useful if you are travelling to a new city and want personalized suggestions on where to eat.

2. Data Section

2.1 Acquiring the Data

We will be using Forsquare API to obtain the required data:

- Name and type of different restaurants located in Braga, Portugal.

Firstly, we find the geospatial coordinates of the city of Braga using Nomatim from geopy.geocoders library. Then, after providing our Forsquare API credentials, we can explore the venues in a radius of 1000 relative to the geospatial coordinates. We request them in json file format and then convert it to a pandas data frame, Figure 1.

	Name	Category	Address	Latitude	Longitude
0	Jardim de Sta. Bárbara	Garden	R. Dr. Justino da Cruz, 127 (R. Eça de Queiroz)	41.551308	-8.425489
1	Sé de Braga	Church	R. D. Paio Mendes	41.549835	-8.427574
2	DeGema Hamburgueria Artesanal	Burger Joint	Pç. Dr. José Augusto Ferreira Salgado (R. Dr. ...	41.551292	-8.425344
3	Dona Petisca	Restaurant	Braga	41.549792	-8.427953
4	Setra	Bar	Rua de São João, 15	41.550058	-8.425931
...	...	...	...	...	...
95	A Astoria	Portuguese Restaurant	Portugal	41.551572	-8.423084
96	Lado B	Brewery	4700-422 Braga	41.550167	-8.429622
97	Confeitaria Sto. António	Coffee Shop	Portugal	41.552217	-8.427534
98	Lusitana	Bakery	Rua Dr. Justino Cruz, 127 (Jardim Sta. Bárbara)	41.551325	-8.425460
99	Restaurante Botafogo	Portuguese Restaurant	Rua De Sto. André 11	41.553603	-8.422928

100 rows × 5 columns

Figure 1. Pandas Data frame containing information of venues in Braga, Portugal.

2.2 Data Preprocessing

We are only interested in the venues which have the word 'Restaurant' in the Category column. Therefore, we filtered from the data frame shown in Figure 1 the desired venues, resulting in the data frame displayed in Figure 2.

	Name	Category	Address	Latitude	Longitude
3	Dona Petisca	Restaurant	Braga	41.549792	-8.427953
6	Michizaki	Japanese Restaurant	R. D. Frei Caetano Brandão, 169	41.548418	-8.428323
11	Cozinha da Sé	Portuguese Restaurant	R. D. Frei Caetano Brandão, 95	41.550021	-8.428584
13	Anjo Verde	Vegetarian / Vegan Restaurant	Lg. da Praça Velha, 21 (ao Arco da Porta Nova)	41.550206	-8.429015
21	Adega Malhoa	Portuguese Restaurant	R. D. Paio Mendes, 17	41.549642	-8.428807
23	Lakkana	Thai Restaurant	R. Don Gualdim Pais, 34	41.549186	-8.427645
25	La Piola	Italian Restaurant	R. D. Afonso Henriques	41.548922	-8.427519
26	Lapa Sushi	Asian Restaurant	Praça da República, 4	41.551688	-8.423488
27	Nikko	Sushi Restaurant	Largo de S. Paulo	41.548215	-8.427458
28	Casa de Pasto das Carvalheiras	Tapas Restaurant	R. D. Afonso Henriques, 8	41.548484	-8.428799
29	Brac	Restaurant	Campo das Carvalheiras	41.548646	-8.428869
31	Time To	Restaurant	4700-030 Braga	41.548811	-8.427999
35	Retrokitchen	Restaurant	R. do Anjo, 96	41.548417	-8.425305
36	Alfacinha	Vegetarian / Vegan Restaurant	R. D. Gonçalo Pereira	41.548897	-8.427012
40	Hibiscus	Vegetarian / Vegan Restaurant	Largo de São Francisco 32	41.552486	-8.424120
41	Sale & Dolce	Italian Restaurant	Lg. S. Paulo 1	41.548210	-8.427451
43	Aopé Dasé	Restaurant	Portugal	41.550098	-8.426009
47	Tasca D. Ferreira	Restaurant	R. S. Vicente	41.554479	-8.423207
51	O Alexandre	Portuguese Restaurant	Braga	41.549850	-8.430119
53	Gosto Superior	Vegetarian / Vegan Restaurant	Praça Mouzinho de Albuquerque	41.553455	-8.420367
56	Restaurante Silvas	Restaurant	C. C. Granjinhos (R. 25 de Abril)	41.547361	-8.421606
58	Dom Augusto	Portuguese Restaurant	Rua de São Vicente 222	41.555397	-8.422152
59	Cruz Sobral	Portuguese Restaurant	Campo das Hortas, 7/8	41.550025	-8.429933
63	Ignácio	Portuguese Restaurant	Campo das Hortas, 4	41.550041	-8.429837
65	Mercado das Tapas	Tapas Restaurant	Pç. Conde de Agrolongo, 116	41.553068	-8.428400
71	Trotas	Portuguese Restaurant	Rua do Raio	41.551326	-8.417657
77	Boutique do Leitão	Restaurant	R. Eça de Queirós	41.551668	-8.426193
82	Migaitas da Estação	Portuguese Restaurant	Largo da Estação	41.547984	-8.435113
84	Alma d'Eça	Sushi Restaurant	R. Eça de Queirós	41.551688	-8.425949
85	Norte da China	Chinese Restaurant	Portugal	41.555773	-8.422427
87	BLB - Braga Loves Bifana	Modern European Restaurant	Largo Da Senhora A Branca	41.551941	-8.416705
89	Um Cibo no Prato	Portuguese Restaurant	Braga	41.551852	-8.416348
92	O Bacalhau	Restaurant	Braga	41.549601	-8.430321
95	A Astoria	Portuguese Restaurant	Portugal	41.551572	-8.423084
99	Restaurante Botafogo	Portuguese Restaurant	Rua De Sto. André 11	41.553603	-8.422928

Figure 2. Pandas data frame with the Restaurant venues in Braga, Portugal.

We then checked if any rating was available using Forsquare API. Since there were none, we decided to web scrap the information stored in the link https://d7leadfinder.com/app/view-leads/1680829/, as it contains a list of restaurants in Braga with the respective rating. After doing some data cleaning, such as removing entries with NaN values, we ended up with the list displayed in Figure 3.

	Name	Rating
0	Bira dos Namorados	4.8
1	Michizaki	4.8
2	Restaurant	4.4
3	Restaurante O Jacó	4.5
4	Lakkana	4.6
...	...	...
196	Take Away Wok-Grill	4.3
197	Mammamia - Gelato I...	4.4
198	Carreira do Tiro	4.3
199	Boutique do Leitão	4.0
200	THE TRUTH BRAGA	3.5

201 rows × 2 columns

Figure 3. Pandas Data frame containing the name and rating of some restaurants located in Braga, Portugal.

Now, the goal is to append the ratings displayed in Figure 3 to the restaurants data frame displayed in Figure 2. We accomplished such task by matching the names of the restaurants of both data frames and then construct a new data frame which contains all the restaurants which have a rating. Such data frame is presented in Figure 4.

	Name	Category	Address	Latitude	Longitude	Rating
0	A Astoria	Portuguese Restaurant	Portugal	41.551572	-8.423084	3.8
1	Adega Malhoa	Portuguese Restaurant	R. D. Paio Mendes, 17	41.549642	-8.428807	4.2
2	Alfacinha	Vegetarian / Vegan Restaurant	R. D. Gonçalo Pereira	41.548897	-8.427012	4.7
3	Alma d'Eça	Sushi Restaurant	R. Eça de Queirós	41.551688	-8.425949	4.5
4	BLB - Braga Loves Bifana	Modern European Restaurant	Largo Da Senhora A Branca	41.551941	-8.416705	4.3
5	Boutique do Leitão	Restaurant	R. Eça de Queirós	41.551668	-8.426193	4.0
6	Brac	Restaurant	Campo das Carvalheiras	41.548646	-8.428869	4.6
7	Dom Augusto	Portuguese Restaurant	Rua de São Vicente 222	41.555397	-8.422152	4.6
8	Dona Petisca	Restaurant	Braga	41.549792	-8.427953	4.6
9	Gosto Superior	Vegetarian / Vegan Restaurant	Praça Mouzinho de Albuquerque	41.553455	-8.420367	4.7
10	Hibiscus	Vegetarian / Vegan Restaurant	Largo de São Francisco 32	41.552486	-8.424120	4.6
11	Ignácio	Portuguese Restaurant	Campo das Hortas, 4	41.550041	-8.429837	4.2
12	La Piola	Italian Restaurant	R. D. Afonso Henriques	41.548922	-8.427519	4.4
13	Lakkana	Thai Restaurant	R. Don Gualdim Pais, 34	41.549186	-8.427645	4.6
14	Michizaki	Japanese Restaurant	R. D. Frei Caetano Brandão, 169	41.548418	-8.428323	4.8
15	Nikko	Sushi Restaurant	Largo de S. Paulo	41.548215	-8.427458	4.1
16	Norte da China	Chinese Restaurant	Portugal	41.555773	-8.422427	4.3
17	O Bacalhau	Restaurant	Braga	41.549601	-8.430321	3.9
18	Restaurante Botafogo	Portuguese Restaurant	Rua De Sto. André 11	41.553603	-8.422928	4.0
19	Restaurante Silvas	Restaurant	C. C. Granjinhos (R. 25 de Abril)	41.547361	-8.421606	4.4
20	Retrokitchen	Restaurant	R. do Anjo, 96	41.548417	-8.425305	4.7
21	Tasca D. Ferreira	Restaurant	R. S. Vicente	41.554479	-8.423207	4.6
22	Time To	Restaurant	4700-030 Braga	41.548811	-8.427999	4.5
23	Trotas	Portuguese Restaurant	Rua do Raio	41.551326	-8.417657	4.5
24	Um Cibo no Prato	Portuguese Restaurant	Braga	41.551852	-8.416348	4.5

Figure 4. Pandas Data frame with the restaurants and its ratings.

3. Methodology
3.1 Data Analysis

Now, let's look at the different categories and edit them so we can build a better recommendation system. Some editing will be made based on the following category descriptions:

- **Portuguese Restaurant**: Traditional portuguese cuisine.
- **Vegetarian / Vegan Restaurant**: Vegetarian / Vegan options only.
- **Modern European Restaurant**: Modern approach of Mediterranean cuisine.
- **Healthy Food Restaurant**: Includes vegetarian / vegan options as well as non-vegetarian healthy food.
- **Sushi Restaurant vs Japanese Restaurant**: Sushi restaurants focus mainly on Sushi while Japanese restaurants serve traditional japanese dishes.

Important Note: If a restaurant fits in more than one category, it is reasonable to insert it more than one time under different categories (eg. *Michizaki* serves traditional Japanese cuisine as well as sushi, so we will insert two different entries for this restaurant). The data frame containing the correct Categories is displayed in Figure 5.

	Name	Category	Address	Latitude	Longitude	Rating
0	A Astoria	Portuguese Restaurant	Portugal	41.551572	-8.423084	3.8
1	Adega Malhoa	Portuguese Restaurant	R. D. Paio Mendes, 17	41.549642	-8.428807	4.2
2	Alfacinha	Vegetarian / Vegan Restaurant	R. D. Gonçalo Pereira	41.548897	-8.427012	4.7
3	Alma d'Eça	Sushi Restaurant	R. Eça de Queirós	41.551688	-8.425949	4.5
4	BLB - Braga Loves Bifana	Modern European Restaurant	Largo Da Senhora A Branca	41.551941	-8.416705	4.3
5	Boutique do Leitão	Portuguese Restaurant	R. Eça de Queirós	41.551668	-8.426193	4.0
6	Brac	Modern European Restaurant	Campo das Carvalheiras	41.548646	-8.428869	4.6
7	Dom Augusto	Portuguese Restaurant	Rua de São Vicente 222	41.555397	-8.422152	4.6
8	Dona Petisca	Tapas Restaurant	Braga	41.549792	-8.427953	4.6
9	Gosto Superior	Vegetarian / Vegan Restaurant	Praça Mouzinho de Albuquerque	41.553455	-8.420367	4.7
10	Hibiscus	Vegetarian / Vegan Restaurant	Largo de São Francisco 32	41.552486	-8.424120	4.6
11	Ignácio	Portuguese Restaurant	Campo das Hortas, 4	41.550041	-8.429837	4.2
12	La Piola	Italian Restaurant	R. D. Afonso Henriques	41.548922	-8.427519	4.4
13	Lakkana	Thai Restaurant	R. Don Gualdim Pais, 34	41.549186	-8.427645	4.6
14	Michizaki	Japanese Restaurant	R. D. Frei Caetano Brandão, 169	41.548418	-8.428323	4.8
15	Nikko	Sushi Restaurant	Largo de S. Paulo	41.548215	-8.427458	4.1
16	Norte da China	Chinese Restaurant	Portugal	41.555773	-8.422427	4.3
17	O Bacalhau	Portuguese Restaurant	Braga	41.549601	-8.430321	3.9
18	Restaurante Botafogo	Portuguese Restaurant	Rua De Sto. André 11	41.553603	-8.422928	4.0
19	Restaurante Silvas	Portuguese Restaurant	C. C. Granjinhos (R. 25 de Abril)	41.547361	-8.421606	4.4
20	Retrokitchen	Healthy Food Restaurant	R. do Anjo, 96	41.548417	-8.425305	4.7
21	Tasca D. Ferreira	Portuguese Restaurant	R. S. Vicente	41.554479	-8.423207	4.6
22	Time To	Modern European Restaurant	4700-030 Braga	41.548811	-8.427999	4.5
23	Trotas	Portuguese Restaurant	Rua do Raio	41.551326	-8.417657	4.5
24	Um Cibo no Prato	Portuguese Restaurant	Braga	41.551852	-8.416348	4.5
25	Michizaki	Sushi Restaurant	R. D. Frei Caetano Brandão, 169	41.548418	-8.428323	4.8

Figure 5. Pandas data frame of restaurants in Braga with corrected categories.

Since we are building a content-based recommendation system, it is ideal to feed categorical data using the One Hot Encoding technique. Basically we convert the respective features (in this case restaurant categories) in vectors, so that if a restaurant matches that feature it gives a value of 1, and if it doesn't then it retrieves a value of 0. Such data frame is displayed in Figure 6.

	Name	Portuguese Restaurant	Vegetarian / Vegan Restaurant	Sushi Restaurant	Modern European Restaurant	Tapas Restaurant	Italian Restaurant	Thai Restaurant	Japanese Restaurant	Chinese Restaurant	Healthy Food Restaurant
0	A Astoria	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Adega Malhoa	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Alfacinha	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	Alma d'Eça	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	BLB - Braga Loves Bifana	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
5	Boutique do Leitão	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	Brac	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
7	Dom Augusto	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	Dona Petisca	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
9	Gosto Superior	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Hibiscus	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	Ignácio	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	La Piola	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
13	Lakkana	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
14	Michizaki	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
15	Nikko	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Norte da China	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
17	O Bacalhau	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	Restaurante Botafogo	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	Restaurante Silvas	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	Retrokitchen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
21	Tasca D. Ferreira	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	Time To	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
23	Trotas	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	Um Cibo no Prato	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	Michizaki	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 6. Pandas data frame when one hot encoding of the restaurant categories is performed.

At this point you may be wondering why are we doing this if each restaurant fits in just one category. One must consider the possibility of a restaurant having different menu options such as Michizaki (serves both sushi and Japanese traditional food). Attributing different categories to the same restaurant has a drawback: since each restaurant has only one general rating it makes it a bit ambiguous (the rating *4.5* for the restaurant *Michizaki* applies for both sushi and Japanese tradition food, despite of representing different categories). However, it is also reasonable to assume that if the restaurant has a very good/low rating you will probably enjoy/not enjoy the food for all the categories. On a separate note this feature could be useful in the user rating input since we can attribute different ratings for the same restaurant under different categories.

3.2 Building a content-based recommendation system

A content-based recommendation system recommends the user new items based on the user's preferences. In this case, we are going to figure out which restaurant categories the user prefers and use it to suggest new restaurants.

In order to build a content-based recommendation system, user rating data of different restaurants needs to be inserted. I will construct a user input dataset based on my previous experiences. Such data frame can be found in Figure 7.

	Name	Category	Rating
0	Il Fiume	Italian Restaurant	4.0
1	Sale & Dolce	Italian Restaurant	4.9
2	Otsu Biru	Sushi Restaurant	4.5
3	Pórtico	Portuguese Restaurant	4.7
4	Temple San	Sushi Restaurant	4.0
5	Café Aires	Portuguese Restaurant	3.0
6	Pausa Útil	Vegetarian / Vegan Restaurant	4.5

Figure 7. Pandas data frame of the user's input restaurant dataset.

After performing the One Hot Encoding technique on the user's input restaurant dataset, we are able to calculate the weights relative to each category by summing the ratings, Figure 8.

```
Chinese Restaurant                    0.0
Healthy Food Restaurant               0.0
Italian Restaurant                    8.9
Japanese Restaurant                   0.0
Modern European Restaurant            0.0
Portuguese Restaurant                 7.7
Sushi Restaurant                      8.5
Tapas Restaurant                      0.0
Thai Restaurant                       0.0
Vegetarian / Vegan Restaurant         4.5
Name: Weights, dtype: float64
```

Figure 8. Output of the calculated weights using the user's input dataset.

We now have all the necessary information to calculate the weighted average of each restaurant:

$$w_{avg} = \frac{v_{rest} \times w_i}{\sum_i w_i},$$

where w_{avg} is the weighted average of a restaurant, w_i is the weight of ith category displayed in Figure 8 and v_{rest} is the one hot encoding vector of the respective restaurant in the datafame of Figure 6. For a correct calculation one has to firstly to drop the *Name* column of the data frame of Figure 6 and then sort the columns alphabetically (to match the order presented in Figure 8).

4. Results

The weighted average for each restaurant is listed in Figure 9.

```
12    0.300676
15    0.287162
3     0.287162
25    0.287162
21    0.260135
24    0.260135
1     0.260135
23    0.260135
5     0.260135
7     0.260135
11    0.260135
0     0.260135
17    0.260135
18    0.260135
19    0.260135
9     0.152027
2     0.152027
10    0.152027
13    0.000000
14    0.000000
22    0.000000
20    0.000000
8     0.000000
16    0.000000
6     0.000000
4     0.000000
dtype: float64
```

Figure 9. Weighted average of each restaurant. The numbers on the left column are the indexes of the each restaurant.

We can now build a recommendation table, where the restaurants are sorted according to its weighted average value, Figure 10.

One can further improve the recommendation system if we sort the restaurants with equal weighted average by rating. In this way, the higher rated restaurants that have the same weighted average will appear first on the recommendation table, Figure 11.

	Name	Category	Address	Latitude	Longitude	Rating
12	La Piola	Italian Restaurant	R. D. Afonso Henriques	41.548922	-8.427519	4.4
15	Nikko	Sushi Restaurant	Largo de S. Paulo	41.548215	-8.427458	4.1
3	Alma d'Eça	Sushi Restaurant	R. Eça de Queirós	41.551688	-8.425949	4.5
25	Michizaki	Sushi Restaurant	R. D. Frei Caetano Brandão, 169	41.548418	-8.428323	4.8
21	Tasca D. Ferreira	Portuguese Restaurant	R. S. Vicente	41.554479	-8.423207	4.6
24	Um Cibo no Prato	Portuguese Restaurant	Braga	41.551852	-8.416348	4.5
1	Adega Malhoa	Portuguese Restaurant	R. D. Paio Mendes, 17	41.549642	-8.428807	4.2
23	Trotas	Portuguese Restaurant	Rua do Raio	41.551326	-8.417657	4.5
5	Boutique do Leitão	Portuguese Restaurant	R. Eça de Queirós	41.551668	-8.426193	4.0
7	Dom Augusto	Portuguese Restaurant	Rua de São Vicente 222	41.555397	-8.422152	4.6
11	Ignácio	Portuguese Restaurant	Campo das Hortas, 4	41.550041	-8.429837	4.2
0	A Astoria	Portuguese Restaurant	Portugal	41.551572	-8.423084	3.8
17	O Bacalhau	Portuguese Restaurant	Braga	41.549601	-8.430321	3.9
18	Restaurante Botafogo	Portuguese Restaurant	Rua De Sto. André 11	41.553603	-8.422928	4.0
19	Restaurante Silvas	Portuguese Restaurant	C. C. Granjinhos (R. 25 de Abril)	41.547361	-8.421606	4.4
9	Gosto Superior	Vegetarian / Vegan Restaurant	Praça Mouzinho de Albuquerque	41.553455	-8.420367	4.7
2	Alfacinha	Vegetarian / Vegan Restaurant	R. D. Gonçalo Pereira	41.548897	-8.427012	4.7
10	Hibiscus	Vegetarian / Vegan Restaurant	Largo de São Francisco 32	41.552486	-8.424120	4.6
13	Lakkana	Thai Restaurant	R. Don Gualdim Pais, 34	41.549186	-8.427645	4.6
14	Michizaki	Japanese Restaurant	R. D. Frei Caetano Brandão, 169	41.548418	-8.428323	4.8
22	Time To	Modern European Restaurant	4700-030 Braga	41.548811	-8.427999	4.5
20	Retrokitchen	Healthy Food Restaurant	R. do Anjo, 96	41.548417	-8.425305	4.7
8	Dona Petisca	Tapas Restaurant	Braga	41.549792	-8.427953	4.6
16	Norte da China	Chinese Restaurant	Portugal	41.555773	-8.422427	4.3
6	Brac	Modern European Restaurant	Campo das Carvalheiras	41.548646	-8.428869	4.6
4	BLB - Braga Loves Bifana	Modern European Restaurant	Largo Da Senhora A Branca	41.551941	-8.416705	4.3

Figure 10. Recommendation table where the values are sorted according to the weighted average of each restaurant.

	Name	Category	Address	Latitude	Longitude	Rating
12	La Piola	Italian Restaurant	R. D. Afonso Henriques	41.548922	-8.427519	4.4
25	Michizaki	Sushi Restaurant	R. D. Frei Caetano Brandão, 169	41.548418	-8.428323	4.8
3	Alma d'Eça	Sushi Restaurant	R. Eça de Queirós	41.551688	-8.425949	4.5
15	Nikko	Sushi Restaurant	Largo de S. Paulo	41.548215	-8.427458	4.1
21	Tasca D. Ferreira	Portuguese Restaurant	R. S. Vicente	41.554479	-8.423207	4.6
7	Dom Augusto	Portuguese Restaurant	Rua de São Vicente 222	41.555397	-8.422152	4.6
24	Um Cibo no Prato	Portuguese Restaurant	Braga	41.551852	-8.416348	4.5
23	Trotas	Portuguese Restaurant	Rua do Raio	41.551326	-8.417657	4.5
19	Restaurante Silvas	Portuguese Restaurant	C. C. Granjinhos (R. 25 de Abril)	41.547361	-8.421606	4.4
1	Adega Malhoa	Portuguese Restaurant	R. D. Paio Mendes, 17	41.549642	-8.428807	4.2
11	Ignácio	Portuguese Restaurant	Campo das Hortas, 4	41.550041	-8.429837	4.2
5	Boutique do Leitão	Portuguese Restaurant	R. Eça de Queirós	41.551668	-8.426193	4.0
18	Restaurante Botafogo	Portuguese Restaurant	Rua De Sto. André 11	41.553603	-8.422928	4.0
17	O Bacalhau	Portuguese Restaurant	Braga	41.549601	-8.430321	3.9
0	A Astoria	Portuguese Restaurant	Portugal	41.551572	-8.423084	3.8
9	Gosto Superior	Vegetarian / Vegan Restaurant	Praça Mouzinho de Albuquerque	41.553455	-8.420367	4.7
2	Alfacinha	Vegetarian / Vegan Restaurant	R. D. Gonçalo Pereira	41.548897	-8.427012	4.7
10	Hibiscus	Vegetarian / Vegan Restaurant	Largo de São Francisco 32	41.552486	-8.424120	4.6
14	Michizaki	Japanese Restaurant	R. D. Frei Caetano Brandão, 169	41.548418	-8.428323	4.8
20	Retrokitchen	Healthy Food Restaurant	R. do Anjo, 96	41.548417	-8.425305	4.7
13	Lakkana	Thai Restaurant	R. Don Gualdim Pais, 34	41.549186	-8.427645	4.6
8	Dona Petisca	Tapas Restaurant	Braga	41.549792	-8.427953	4.6
6	Brac	Modern European Restaurant	Campo das Carvalheiras	41.548646	-8.428869	4.6
22	Time To	Modern European Restaurant	4700-030 Braga	41.548811	-8.427999	4.5
16	Norte da China	Chinese Restaurant	Portugal	41.555773	-8.422427	4.3
4	BLB - Braga Loves Bifana	Modern European Restaurant	Largo Da Senhora A Branca	41.551941	-8.416705	4.3

Figure 11. Final recommendation table where the values are sorted firstly according to the weighted average of each restaurant and also by its rating (if the weighted average is the same).

5. Discussion

The results presented in the final recommendation table makes sense based on the user input dataset: it rates the Italian restaurants higher, then the sushi restaurants and so on. No user's input rating is available for certain categories such as Japanese, Healthy Food, Thai, Tapas, Modern European and Chinese restaurants so this are placed in the bottom of the table. This indicates that such method gives highly personalized recommendations, but might miss on something the user hasn't experienced yet and might like. Here the user input dataset had only 6 entries: once the user starts going to different restaurants and provide a rating for each, the user input dataset will grow and more accurate suggestions will be made.

Note that the same restaurant can be recommended to you more than once (eg. *Michizaki*), and each category of the respective restaurant will have its own place on the recommendation table. Contrary to content-based movies recommendation systems, where all categories/genres are incorporated in one movie entry, here the categories are evaluated separately. This makes sense, because when you watch a movie you have no choice upon the different genres which are incorporated in the movie whereas when you go to a restaurant you can choose what type of food to order. One of the main disadvantages of a content-based recommendation system is that it doesn't take into consideration other user's preferences, and this targets that drawback.

6. Conclusion

In this report a content-based recommendation system of different restaurants located in Braga was built using Forsquare API and web scraping. Restaurant categories and respective ratings were taken into consideration, and reasonable recommendations were made taking into account the user's input dataset. The recommendation system is highly personalized for the user and learns from the user's preferences.

Building a recommendation system based only on restaurant categories can be limiting, as it doesn't address the location of the place, nor the price. These parameters could be useful to make a better recommendation system in the future. Also, getting the user to try and rate different restaurants would be of extreme importance since the recommendations heavily depend on the user input ratings.

This system could be applied to any city/area given that the restaurant information from that area can be retrieved.