

Restaurant Recommendation System

Jorge Silva | April 5th 2021

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 work a content-based recommendation system will be built to give the costumer personalized recommendations.
- ▶ Based on the user's preferences, we will use the recommendation system to give personalized recommendations on different restaurants located in **Braga, Portugal**.
- ▶ Such system could be useful if you are travelling to a new city and want personalized suggestions on where to eat.

Acquiring Data

- Use Foursquare API to obtain the name and type of different restaurants.

	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

- Web scraping to obtain the ratings of the restaurants.

	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

[<https://d7leadfinder.com/app/viewleads/1680829/>]

Data Preprocessing

- Match the names on both dataframes and include the rating on the main data frame.

	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. Gonalo Pereira	41.548897	-8.427012	4.7
3	Alma d'Ea	Sushi Restaurant	R. Ea de Queirs	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 Leito	Restaurant	R. Ea de Queirs	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 So 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	Praa Mouzinho de Albuquerque	41.553455	-8.420367	4.7
10	Hibiscus	Vegetarian / Vegan Restaurant	Largo de So Francisco 32	41.552486	-8.424120	4.6
11	Igncio	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 Brando, 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 Botafofo	Portuguese Restaurant	Rua De Sto. Andr 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

Data Analysis

- The model will be built taking into consideration the category of the specific restaurant: let's edit them based of the following 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 nonvegetarian healthy food.
 - **Sushi Restaurant vs Japanese Restaurant:** Sushi restaurants focus mainly on Sushi while Japanese restaurants serve traditional japanese dishes.

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

Content-based Recommendation System

- ▶ Its purpose is to figure out which restaurant categories the user prefers and use it to suggest new restaurants.
- ▶ One Hot Encoding technique is used to feed categorical data and calculate the category weights.

User Input Dataset

	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



Category weights

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

Content-based Recommendation System

- ▶ The weighted average of each restaurant in the table will be calculated and used to build the recommendation table.

Weighted Average Formula

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

w_{avg} → weighted average

w_i → weight of i^{th} category
of users

v_{rest} → one hot encoding vector of
each restaurant entry of the
restaurant data frame

Visual representation of the Formula

v_{rest} →

	Chinese Restaurant	Healthy Food Restaurant	Italian Restaurant	Japanese Restaurant	Modern European Restaurant	Portuguese Restaurant	Sushi Restaurant	Tapas Restaurant	Thai Restaurant	Vegetarian / Vegan Restaurant
0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0

✗

Chinese Restaurant	0.0	w_0
Healthy Food Restaurant	0.0	w_1
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	w_9

Name: Weights, dtype: float64

$\sum_i w_i$ →

sum

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

Results

- Let's sort the restaurant table according to the weighted average!

Weighted Average values

```
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
```



Sorted table

	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
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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

Results

- One can further improve the recommendation table if we sort the ones with the same weighted values by ranking!

Final Recommendation table

	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

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.
- ▶ The same restaurant can be recommended 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.

Conclusion

- ▶ 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.
- ▶ 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.
- ▶ 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.