

Content-Based Restaurant Recommendation Systems using textual and visual data

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Overview

- Task description
- The Dataset
- Baseline Models
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- Fused Models
- Evaluation

Task Description

ZEITUNG **ESSEN & TRINKEN** EVENTS KINO KINDER BEST OF VIENNA

RESTAURANTS, GASTSTÄTTEN EMPFOHLEN **LOKALKRITIK**

Das Bootshaus



Foto: Jan Lackner

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Stiliches Restaurant an der Alten Donau mit großzügiger Terrasse und Steg direkt am Wasser. Im Sommer Sa, So, Fei 9–11.30 Frühstück; Schwerpunkt auf Fisch und Meeresfrüchte, z.B. Calamari Fritti, Muscheln, Paella; hausgemachte Torten und Mehlspeisen; Cocktails, Sundowner und Longdrinks. Yoga am Steg; Location für Feiern aller Art geeignet. Im Winter Fr, Sa, So nachmittags Punsch und Glühwein auf der Bootsterrasse.

DIESE LOKALE KÖNNTEN SIE AUCH INTERESSIEREN

RESTAURANTS, GASTSTÄTTEN

Zum Knusperhaus

📍 1220 Wien, Luitpold-Stern-Gasse 54

🕒 JETZT GEÖFFNET (BIS 20:00 UHR)



RESTAURANTS, GASTSTÄTTEN

CHINESISCH

Schönes China

📍 1220 Wien, Wulzendorfstraße 2

🕒 JETZT GEÖFFNET (BIS 22:00 UHR)

EMPFOHLEN

RESTAURANTS, GASTSTÄTTEN

Jussi

📍 1220 Wien, Langobardenstraße 121

🕒 JETZT GEÖFFNET (BIS 23:00 UHR)



RESTAURANTS, GASTSTÄTTEN

Flokal

📍 1220 Wien, Süßenbrunner Platz 11

🕒 JETZT GEÖFFNET (BIS 22:00 UHR)



RESTAURANTS, GASTSTÄTTEN

ITALIENISCH

Task Description

🏠 ZEITUNG **ESSEN & TRINKEN** EVENTS KINO KINDER BEST OF VIENNA

RESTAURANTS, GASTSTÄTTEN

Zum Knusperhaus



Foto: Zum Knusperhaus

Ausflugsort am Eingang zum Nationalpark Lobau mit Hausmannskost. Frühstück; Kinderportionen, -sessel. Lokal für 30 Pers., Lobaugastgarten für 80 Pers. Badegewässer direkt vor dem Lokal (Naufahrt und Dechantlacke).

🏠 ZEITUNG **ESSEN & TRINKEN** EVENTS KINO KINDER BEST OF VIENNA

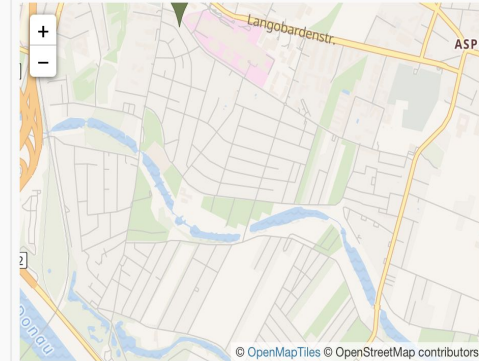
RESTAURANTS, GASTSTÄTTEN **CHINESISCH**

Schönes China

Chinesische Küche (Mo–Fr 11.30–14.30 MM € 7,70 bis € 8,70); Zustellung in den 22. Bezirk. Schanigarten für 30 Pers.

Adresse:

Wulzendorfstraße 2
1220 Wien



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KARTE VERGRÖßERN 🔍

Telefon:

01/922 46 08

GOAL?

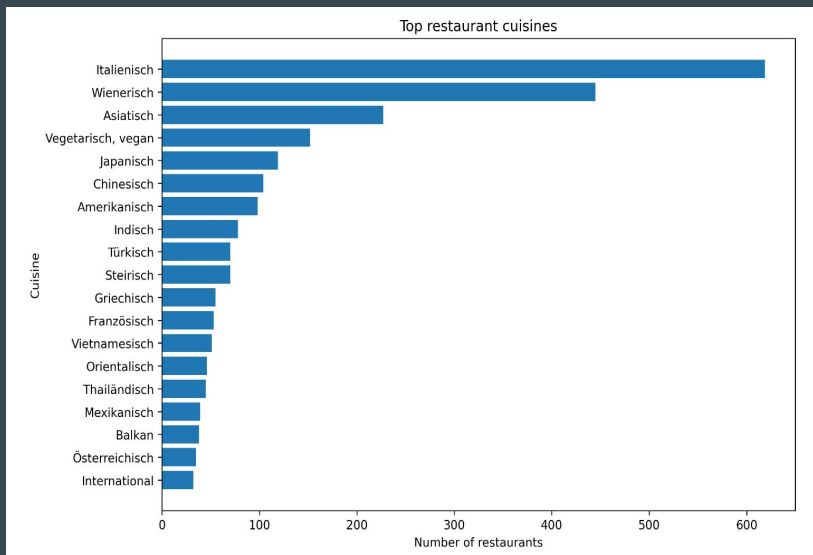
Build an RS that utilizes the content of a restaurant to make recommendations

The Dataset

- Overall more than 6800 restaurants
- Almost all of them contain a short description
- ~300 dedicated reviews (critiques)
- ~3500 contain images
- Important features:
 - Category
 - Cuisine
 - Description
 - Image

The Dataset: Challenges

- Category Imbalance
 - Only 2500 restaurants have a cuisine
- Too little critiques
- Critiques linguistically complicated



"Rudern ist ein toller Sport. Elegant, lautlos, schnell, effizient – quasi das Rennradfahren unter den Wassersportarten (wenngleich man mit dem Ruderboot umkippen und sodann ertrinken kann; da dann doch lieber Rennrad ...). Und weil zwei Söhne von Berndt und Irmgard Querfeld, Wiens unangefochtenem Kaffeehaus-Kaiserpaar, diesen Sport auf wettkampflichem Niveau betreiben, sahen sich die Querfelds veranlasst, das Schutzhaus Neu Brasilien an der Alten Donau zu übernehmen..."¹

A translation with Google Translate gives us the following:

"Rowing is a great sport. Elegant, silent, fast, efficient - the racing bike among the water sports, so to speak (although you can tip over with the rowing boat and then drown; then it's better to have a racing bike ...). And because the two sons of Berndt and Irmgard Querfeld, Vienna's undisputed royal couple in the coffee house, practice this sport at a competitive level, the Querfelds feel compelled to take over the Neu Brazil refuge on the Old Danube..."

Baseline Models

- Text Features
 - TF-IDF
 - For Lemmatization: [HannoverTagger](#)
 - Stop-Word Removal (also words that are used often in the restaurant context)
 - Common words include: Schanigarten, Speisen, etc.
- Image Features
 - VGG-16
 - Pre-trained model from ImageNet Dataset
 - Color Palette similarities
 - For computing similarities: [Earth Mover's Distance](#)

EMD Color Similarity Example



(a) Given Image



(b) 1st recommendation



(c) 2nd recommendation



(d) 3rd recommendation

State-Of-The-Art Model: SBERT

- An upgrade from BERT
 - Time reduction
- Using pre-trained model specialized in the German and English Language
 - T-Systems roberta
- The model “understands” the topic of discussion and recommends restaurants with similar topics/cuisines

Fused Models

- Goal: Making use of all data-types (textual, visual) in order to make recommendations
- TF-IDF + VGG-16
- SBERT + VGG-16
- Fusion achieved by concatenating feature vectors
 - $X=(x_1, x_2..., x_n)$ and $Y=(y_1, y_2..., y_n) \Rightarrow XY = (x_1, x_2..., x_n, y_1, y_2..., y_n)$
- Note: Only ~half of the dataset can be used (only ~3500 images = ~3500 restaurants)
- Challenge: Different feature scales (does scaling even make sense?)

Evaluation

- Quantitative Method
 - Good for quick estimations
 - Use the meta-data (type of cuisine) to check if a recommendation has the same cuisine type as the given restaurant
 - Hit-Rate of Top-10 lists
- Qualitative Method
 - Consulting a Falter Expert
 - Expert was shown recommendation lists and was asked to rate them and provide a short feedback
 - Lists were divided in three categories
 - Restaurants with a given cuisine
 - Restaurants without a cuisine, but with specialties specified in description
 - Restaurants without a cuisine and no specialties

Quantitative Evaluation Results

Kitchen	TF-IDF	SBERT
Italian	84.05%	81.35%
Asian	84.84%	77.66%
Viennese	68.20%	80.53%
Indian	49.49%	42.95%
Average	71.65%	70.62%

Qualitative Evaluation Results

- TF-IDF offers less diverse recommendations whereas SBERT offers novel and diverse recommendations.
- TF-IDF performs better when a cuisine attribute is given but SBERT performs better on general cases.
- Restaurant's atmosphere is highly important
- Same restaurant, different rating

Restaurants With Focus on Certain Food but No Specified Kitchen Attribute in the Dataset

TF-IDF recommendations for Das Bootshaus	Rating
Ufertaverne	7
Pizzeria Adamo	5
Neuzeit	6
Gasthaus Käpt'n Otto	6
Cafe Restaurant Denito	7

SBERT recommendations for Das Bootshaus	Rating
Landtmann's Jausen Station	6
Mühlwasser Platz'l	6
Klyo	9
Zur Alten Kaisermühle	10
propeller	6

TF-IDF recommendations for Do & Co	Rating
Mikado Sushi Style	4
Onyx Restaurant	10
Gastwirtschaft Wolfsberger	6
Wok House	3
Wienerwald	1

SBERT recommendations for Do & Co	Rating
Restaurant ON	10
Stuwer – Neues Wiener Beisl	9
Rochus	8
Gasthaus Alt Wien	6
Konditorei Housecafe	3

Questions?