

Restaurant Ontology and Personalized Recommendation CS270 Team Symmetra : Ahmed Attia (aattia), David Eng (dkeng), Leo Keselman (leonidk), Stephanie Tang (svtang)

Introduction

Our problem task was to build an ontological reasoning system to recommend restaurants to a user, given their preferences, ranging from dietary restrictions, budget, location, and favored cuisines, in addition to user history.

Data Set

We are using the **Yelp Academic Dataset**. It includes ~800k restaurants, with ~2.5M reviews. Additionally, there are ~500 category tags (Chinese, Fast Food, etc.) that are applied to each business.

These category tags form the basis of our ontology, as we learn how various categories are organized and relate to each other. Along with other properties (city, rating), constitute our data modeling's understanding of the world.

Multi-Class Classification

We built a system to understand how powerful different ontological categories of features are to modeling user preference. For each user's list of reviews, we held out one review and tested whether we could predict the number of stars the user gave to this review, given the remaining reviews. We filtered for users with at least 50 reviews. Random guessing missed by an average of 1.14 stars

Using Business Categories

Using the provided business category information, k-nearest neighbors missed by an average of 1.06 stars.

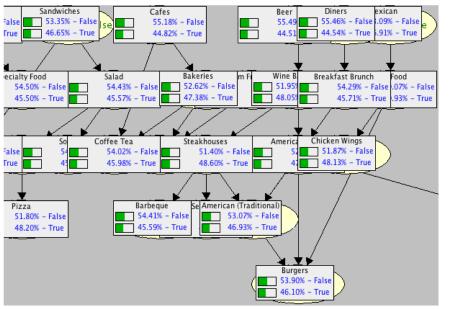
Using User Review Characteristics

We also experimented with extracting adjectives from reviews and using this adjectives to model each business. The top one thousand adjectives were used to construct vectors representing each restaurant, where a restaurant's value for position 'X' in the vector is the number of times users described the restaurant with the adjective corresponding to position X. Using these features, our classifier missed by an average of 0.982 stars with the k-nearest neighbors.

Bayesian Networks

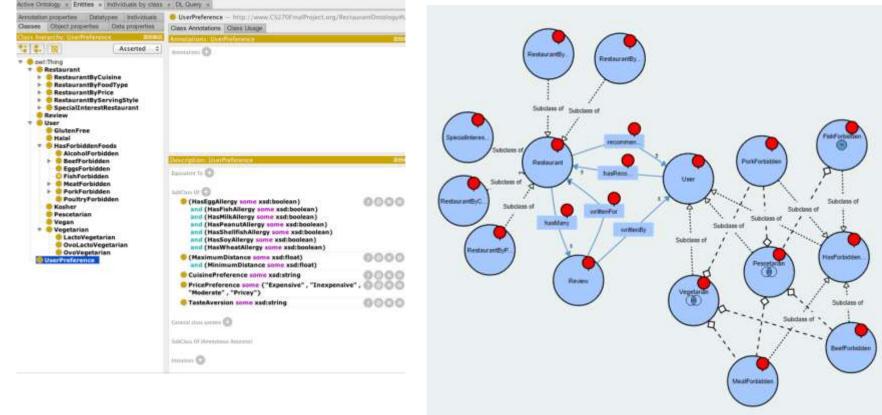
To model the interactions between different categorial labels, we built Bayesian Networks to model an ontological relationship between various categories. Scores better than the restaurant average are considered "liking" the restaurant. We then build a Bayesian network by computing all pairwise independences and modeling statistically dependent relationships with Conditional Probability.

For example, we show how liking Diners, Chicken Wings and traditional American restaurants affects other categories



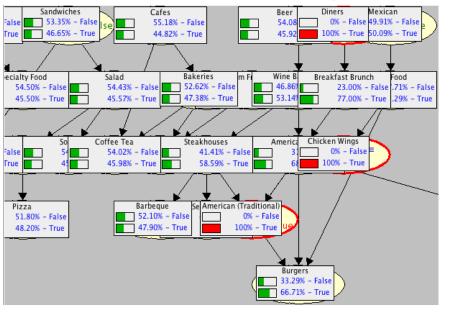
Ontology

We constructed an ontology in Protege, which contains Restaurants, Reviews, Users, and User Preferences.



Evaluation

Users were asked qualitative questions about how useful the system was helpful addressing their information needs - Our model requires users to specify a latitude and longitude for the "closest to" metric to be computed. Users didn't have any issues with navigating the UI. The search features were limited and very exact.



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SQL Web Application

restaurants, reviews, and our models of user preferences

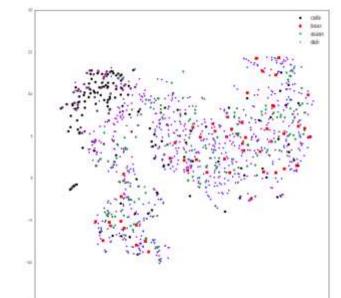
Search			
Anything not input will not be taken into account			
Restaurant ID	Example Users (Click name to populate with a sample user preference.)		
Restaurant Name (Exact Match)	Alice () like close, cheap things)		
Category \$ Min Price \$\$\$\$ \$ Max Price \$\$\$\$\$ \$	Bob () like close, good things) Chris () like good, expensive things)		
Restaurants Search			

Item Information RestaurantID URSA 3.5 Rating Latitude 43.6448755 \$\$\$\$ -79.415863 Canadian (New);

to reviews for this item in the database

Clustering & Similarity Measures

User checkin data was used to model, in an unsupervised way, the ontological similarity between attributes, such as business relationships or even the times of the week.



Discussion

- quality search results.
- restaurant than yelp's given restaurant descriptors.



We built a web front-end for searching and examining

Name			Price (Num \$)	City	Rating	
URSA				SSSS	Toronto	3.5
Kaiseki Yu-zen Hashimoto				SSSS	Toronto	4.5
HY's Steakhouse & Cocktail Bar				\$\$\$\$	Toronto	3.5
Fring's				\$\$\$\$	Toronto	3.5
Thoroughbred Food & Drink				SSS	Toronto	4.5
Marinellas Italian Restaurant				\$\$\$	Toronto	4.5
Maple Leaf Tavern				SSS	Toronto	4.0
Coppi Ristorante			SSS	Toronto	3.5	
		5				
			-1tt.879	1.8769922		
			Vietnamese;			
	Stars	Review				
	 pros 1. the veg are fresh 2: the resisurant is clean, love II: must give the owner a 5 stars on clean/mess of the place, even the sauces on the table (covers were not covered anspilled sources). 3: convenient com 1: expensive 2: service is very slow (you will be thrushated if you are hungry), we went there 4 times and it average about 20 minutes for the 1st order to come an there was a time the 2nd boal of noodles takes another 20 minutes in the 1st order to come an there was a time the 2nd boal of noodles takes another 20 minutes in the 1st order to come an there was a time the 2nd boal of noodles takes another 20 minutes in the 1st order to come an there was a time the 2nd boal of noodles takes another 20 minutes. 3, the beel in the beel noodles are lean meat. I prefer fatty beel when I eat Vietnamese noodles just like how they do it in Chicago or LA. This is my go-to for any meal honestly. Howe how quick and easy everything is. The service can be strange to those who aren't used to Asian owned establishments. But I enjoy that there's no forced conversations and unnecessary check ups on us while we rull 5. S, service is straight to the point and quick! The food though, is never disappointing for me. I choose to eat here for hang uverts, for a quick lond, and sometimes even just a quick spring mill anad. I highly recommend the just delicious food with good service and the owner will always remember your face 1 I abodutely loved ealing at unPHOgettable! This was one of my first experimeces ading ph0, and I there is a variety of main ingredient claims to choose from (chicken, beet, pork and vegetarian options like tofu). Minus one star because the service was eith- the wattresses weren't exactly "warm" if you know that 1 mean. Overail, the food was relacuously good. I would recommend the place to anyone eating to try ph0 for the first the or to an experienced ph0 eater. 					

The web application could be expanded to allow users to express more preferences, allowing us to return higher

Moreover, if we could acquire menu data, which would allow for more stringent filtering of foods & dietary restrictions. We found that the descriptors of a business found in user reviews were more useful in predicting a user's rating for a