



Local optimization of POI recommendations in query context space

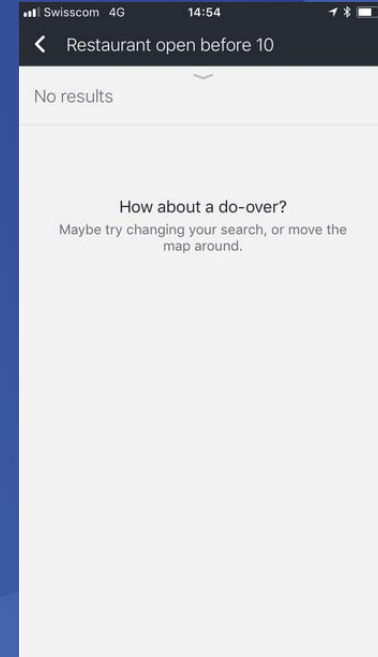
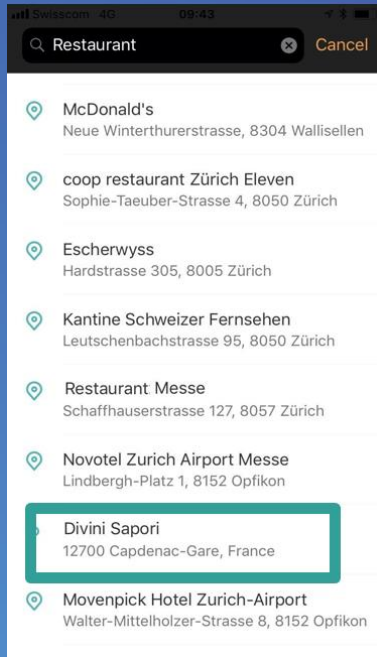
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HERE Platform Research

May 23, 2019

What would be 'good' recommendations? → No answer

- However, there are bad recommendations

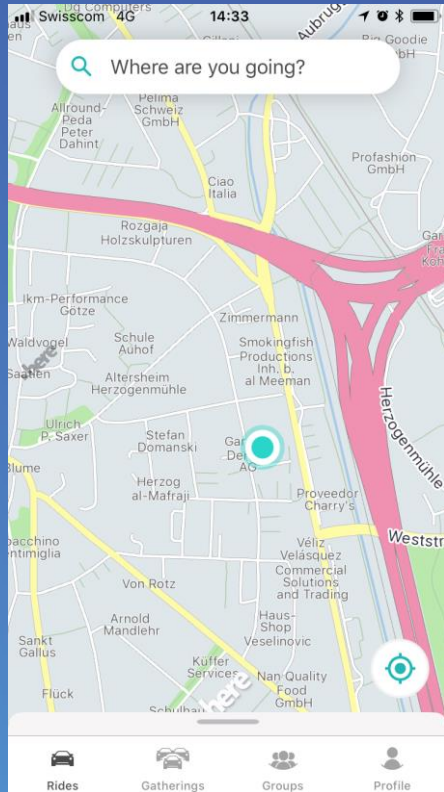


Query location : Zurich, Switzerland

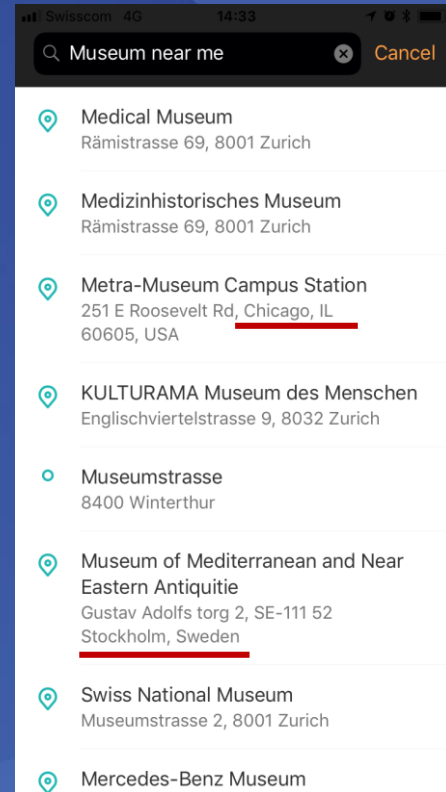
Query : 'restaurant' in non-English

Compound query

- Again, bad recommendations by SoMo



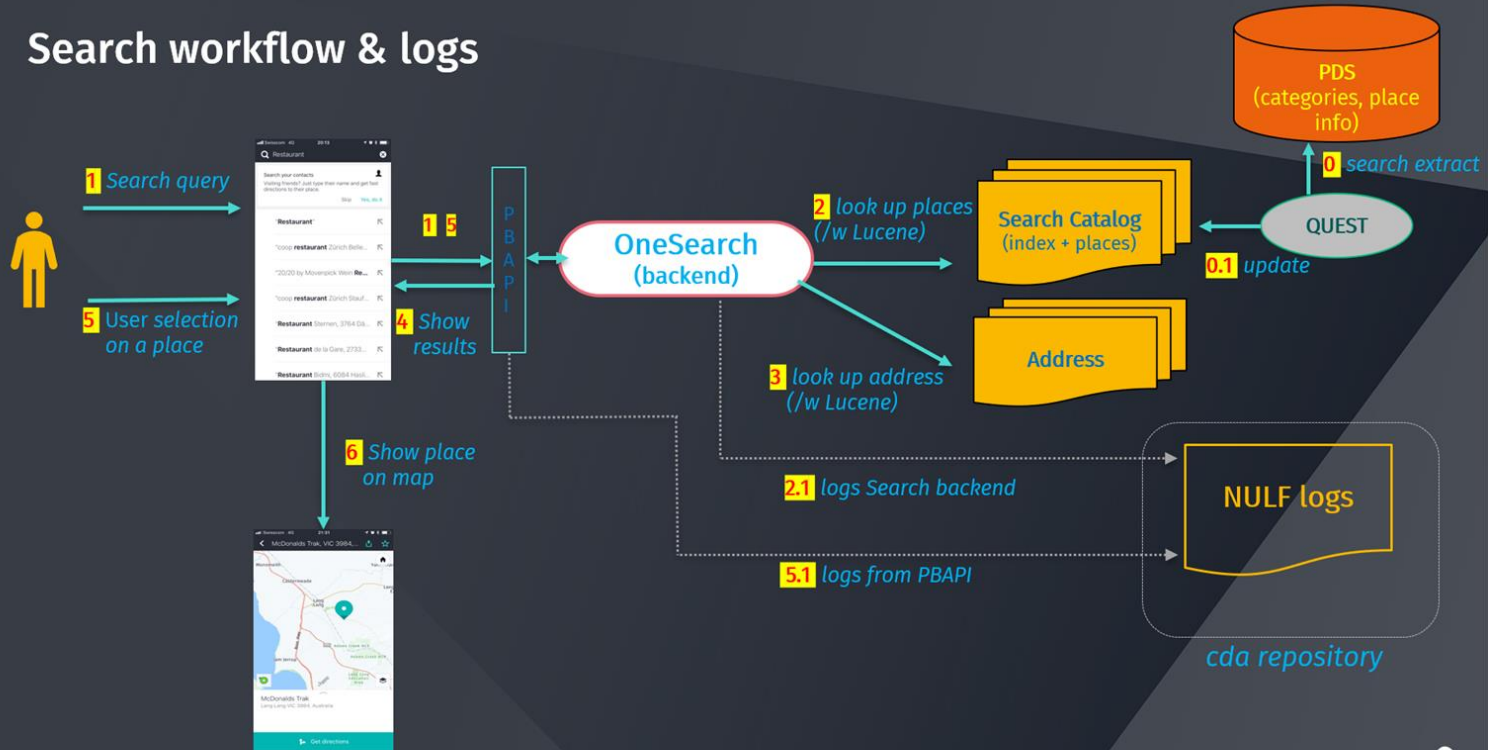
Query : 'Museum near me'



Query location : Zurich, Switzerland

Search / Recommendation workflow

Search workflow & logs



Matrix Factorization

- Handles **whole users and products** rather than each individual
- Solve the problem more mathematical manner using linear regression

Ultimately, find matrix X which has minimum

$$\text{cost function} \sum_{ai \in D} \frac{(y^{(i)} - Y_{ai})^2}{2} + \frac{\lambda}{2} \sum_{ai} Y_{ai}^2$$

Y_{ai} : rating from observed data

$y^{(i)}$: predicted rate value

m products

5	5						5		
		3	5	1	3	4	4		4
	4	2			2				
		5							5
4	5							4	
4							4		
5		4	5	1		4			
	4								
5				4					
5						4			
		5				5	3		

n users

Y_{ai}

Collaborative Filtering algorithm & data size

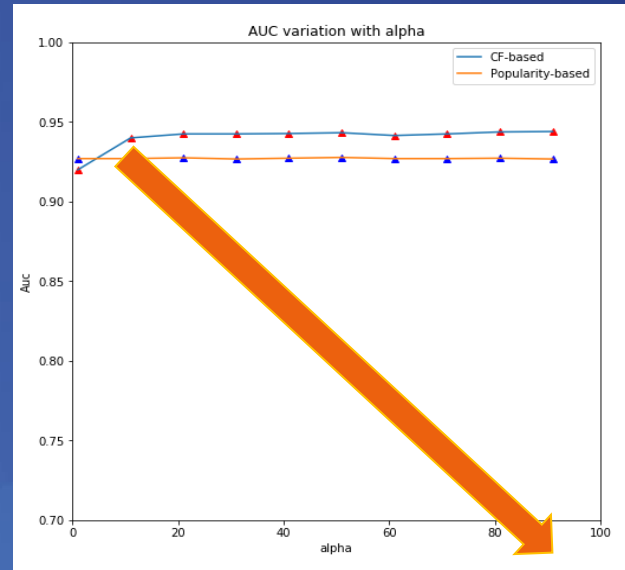
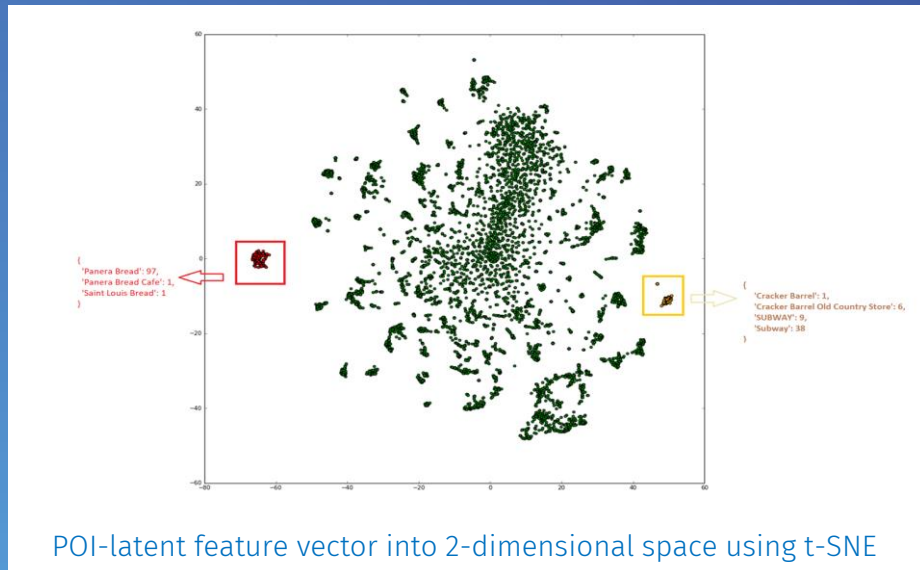
Place (POI)	User				
		1		2	
	1		1		
				1	
					C_{ui}
	1		1		
				3	

Confidence value C_{ui}
on User u on Place i

confidence value C_{ui} : $C_{ui} = 1 + \alpha * r_{ui}$

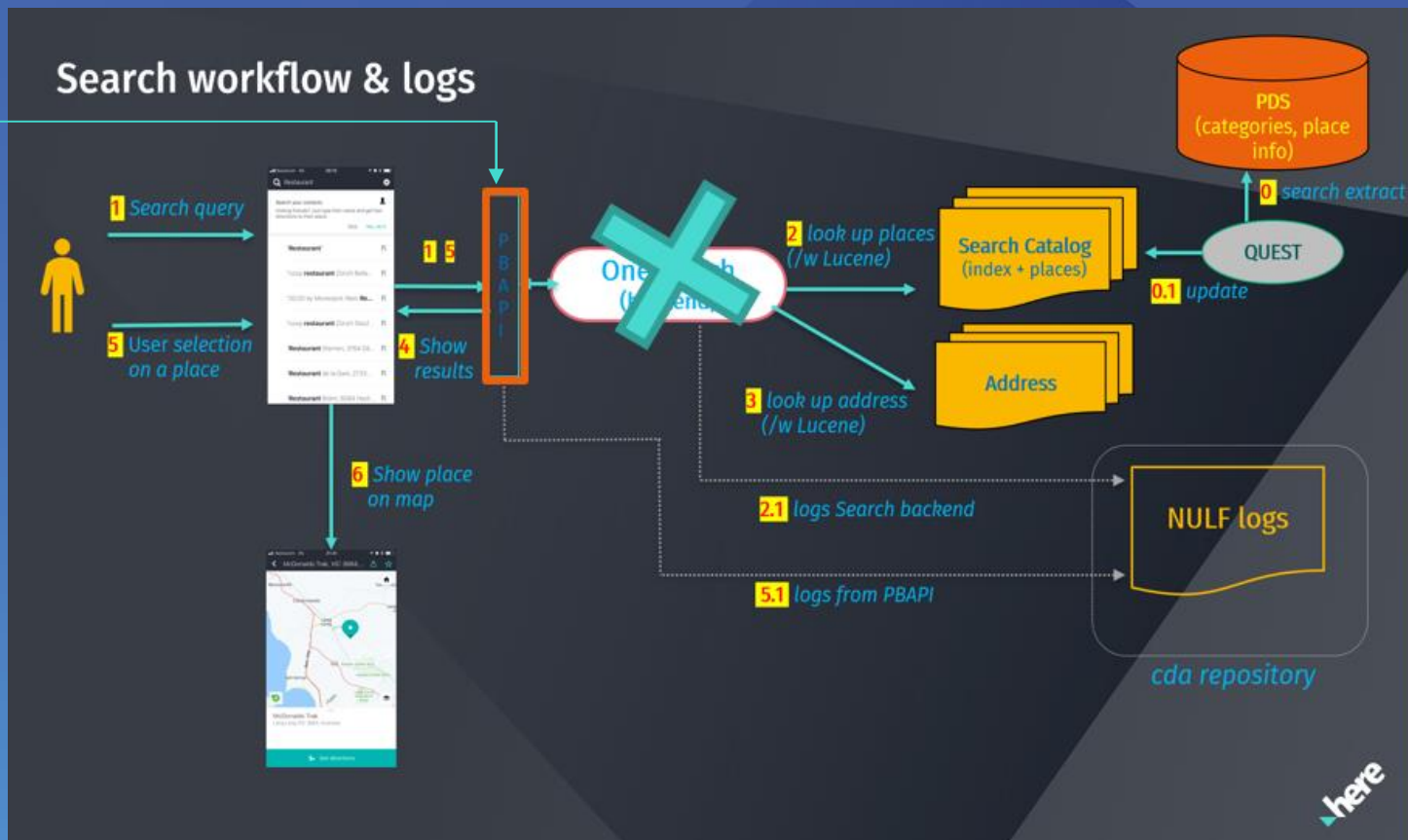


Source :
The New Yorker

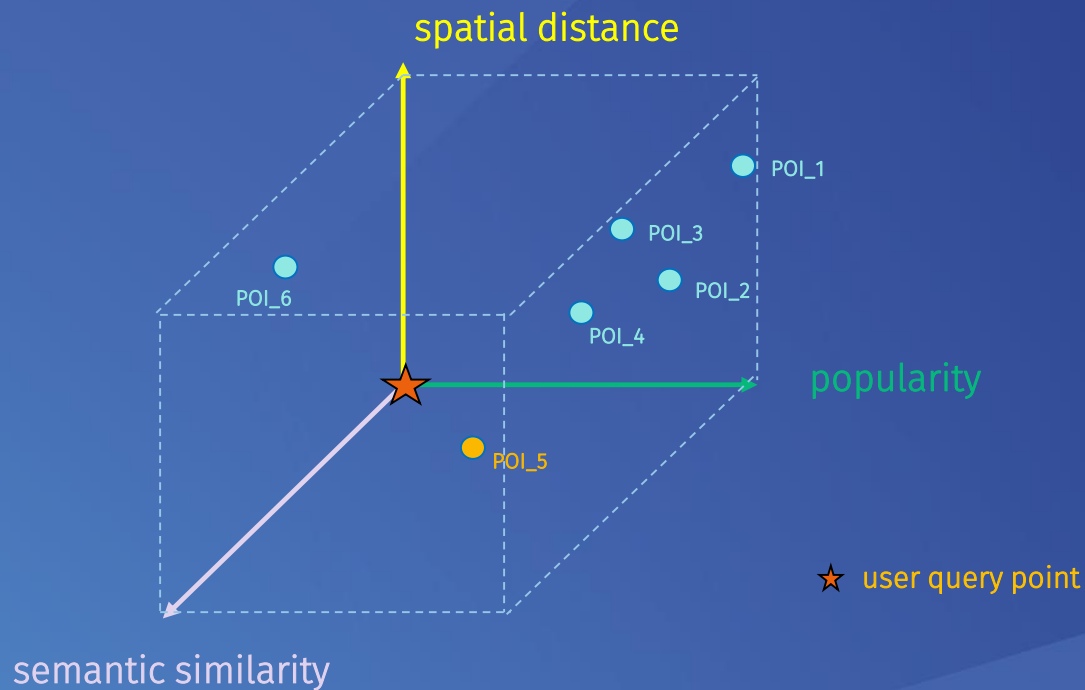


AUC value 0.67

Local optimization on final recommendations



POI representation in 3-dimensional query context space



The diagram illustrates the search workflow and logs architecture. It shows a user interacting with a search interface, which sends queries to a OneSearch (backend) service. The OneSearch service then interacts with a Search Catalog (Index + Plans) and a Data Catalog (Table + Views). The Data Catalog is connected to a PostgreSQL (Postgres) database. The OneSearch service also interacts with a NULF logs service, which is connected to a data repository. The NULF logs service is also connected to a PostgreSQL (Postgres) database. The OneSearch service is also connected to a Search Catalog (Index + Plans) and a Data Catalog (Table + Views). The OneSearch service is also connected to a NULF logs service, which is connected to a data repository. The NULF logs service is also connected to a PostgreSQL (Postgres) database.

Semantic similarity – Semantic distance between query & place

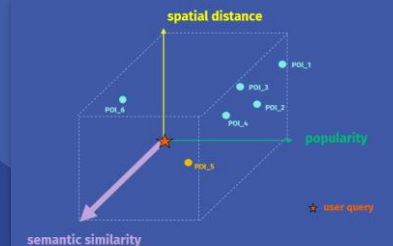
Challenge :

1. No description about places
2. inconsistent categories and contradictory food type

ppid_int	place_name	category_names	food_type
878	7-Eleven	['Convenience Store', 'Restaurant', 'ATM']	['']
8045	7-Eleven	['Petrol-Gasoline Station', 'Convenience Store', 'Restaurant']	['']
3241	7-Eleven	['Convenience Store', 'Deli', 'Restaurant']	['Sandwich']
3245	7-Eleven	['ATM', 'Convenience Store', 'Restaurant']	['']
14056	7-Eleven	['Convenience Store', 'Restaurant', 'ATM']	['']
9086	7-Eleven	['Specialty Store', 'Convenience Store', 'Fast Food', 'Restaurant']	['Pizza']
8947	7-Eleven	['Convenience Store', 'Restaurant']	['Pizza', 'Sandwich']
3363	7-Eleven	['Petrol-Gasoline Station', 'Convenience Store', 'Restaurant']	['']
8036	7-Eleven	['Convenience Store', 'Restaurant', 'ATM']	['']
11224	7-Eleven	['Convenience Store', 'Restaurant']	['']
6172	7-Eleven	['Convenience Store', 'Casual Dining', 'Restaurant', 'ATM']	['International']
11226	7-Eleven	['Convenience Store', 'restaurant']	['']
8043	7-Eleven	['Convenience Store', 'Restaurant']	['']
8045	7-Eleven	['Petrol-Gasoline Station', 'Convenience Store', 'Restaurant']	['']

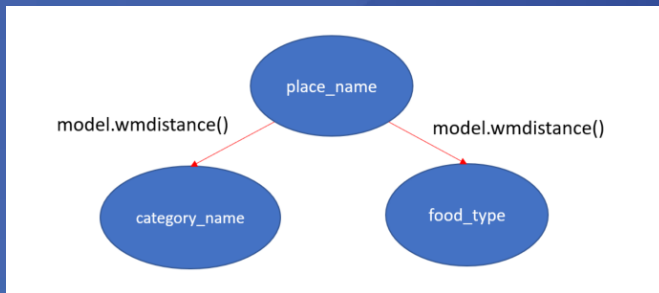
7-Eleven Category & Food type

name_chosen	result_index	distance	category_names	food_type
New Rebozo Chicago	0	1.415389709	['Restaurant']	['Mexican']
Buzz Balt Taqueria	1	0.306916712	['Fast Food', 'Taqueria', 'Food Market-Stall', 'Restaurant']	['Mexican', 'Seafood']
Velvet Taco Chicago	2	0.736410394	['Fast Food', 'Restaurant']	['American', 'Mexican']
Seoul Taco	3	1.267746047	['Casual Dining', 'Restaurant']	['Mexican', 'Asian', 'Korean']
Taco Joint River North	4	1.548860881	['Casual Dining', 'Fast Food', 'Taqueria', 'Restaurant']	['Mexican']
Chipotle	5	0.610077149	['Fast Food', 'Restaurant']	['Mexican']
Adobo Grill Old Town	6	0.419497398	['Casual Dining', 'Restaurant', 'Bar or Pub']	['American-Southwestern', 'Mexican', 'Vegetarian', 'Grill']
North & Clark Caf�	7	0.519407544	['Casual Dining', 'Restaurant', 'Coffee Shop']	['American']
Adobe Gila's	8	0.942252066	['Restaurant']	['American', 'American-Southwestern', 'Mexican']
Foodlife	9	1.36662062	['Casual Dining', 'Restaurant']	['American', 'Mexican', 'Chinese', 'Pizza', 'International']
Downtown Dogs	10	1.357212909	['Fast Food', 'Restaurant']	['American', 'Mexican', 'Hot Dogs']
Blue Agave Tequila Bar & Restaurant	11	0.808963288	['Casual Dining', 'Restaurant', 'Bar or Pub']	['American', 'American-Southwestern', 'Mexican']
Sedgwick's Bar & Grill	12	1.214224529	['Casual Dining', 'Restaurant', 'Bar or Pub']	['American', 'American-Southwestern', 'Mexican', 'Grill']
Zia	13	1.285569986	['Restaurant']	['Mexican']
Dublin's Bar & Grill	14	0.808963288	['Casual Dining', 'Nightlife-Entertainment', 'Restaurant', 'Bar or Pub']	['Mexican', 'Irish', 'Grill']
Salpicon	15	0.206274781	['Fine Dining', 'Restaurant']	['Mexican']
Flaco's Tacos	16	1.327053537	['Casual Dining', 'Restaurant']	['Mexican', 'Chicken']
Nacional 27	17	1.42418577	['Casual Dining', 'Dancing', 'Restaurant']	['Mexican', 'Cuban', 'Spanish-Tapas', 'South American', 'Latin American', 'International']
Tallboy Taco	18	1.404815148	['Fast Food', 'Restaurant', 'Bar or Pub']	['Mexican']
Chipotle	19	1.788856131	['Fast Food', 'Restaurant']	['Mexican']
Su Casa Mexican Restaurant	20	1.698143879	['Casual Dining', 'Restaurant']	['American-Southwestern', 'Mexican']
Chipotle	21	0.465271672	['Fast Food', 'Restaurant']	['Mexican']
Patron's Hacienda	22	1.457809211	['Casual Dining', 'Dancing', 'Restaurant', 'Bar or Pub', 'Take Out and Delivery Only']	['Mexican']
Downtown Pizza	23	0.258072038	['Fast Food', 'Restaurant']	['Pizza']
Taco King	24	0.47842907	['Restaurant']	['Mexican']
Burrito Bistro	26	1.244444824	['Restaurant']	['Mexican']



Recommended POIs on query 'Mexican restaurants near my location'

word2vec, doc2vec for measuring semantic similarity



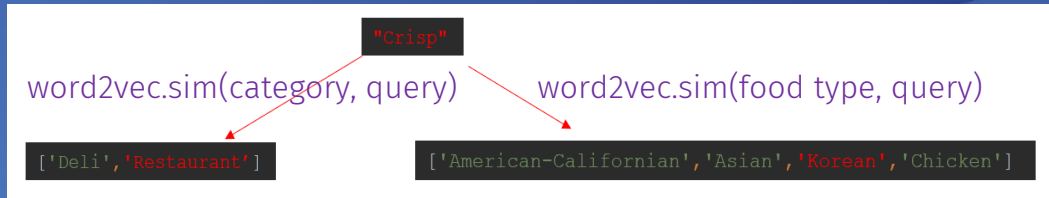
POI description = adjective (from food types) + noun (from categories)

[Example]

query_raw	result_name	place_name	category_names	food_type
restaurant	840dp3wt-92cd8484bd004c478c658f8e81ab6edf	Vegetarian Express	['Casual Dining', 'Food-Beverage Specialty Store', 'Fast Food', 'Restaurant']	['Vegan', 'Vegetarian']
restaurant	840dp3wt-b08ea990ec684846ab81c9aeba45d8eb	Crisp	['Deli', 'Restaurant']	['American-Californian', 'Asian', 'Korean', 'Chicken']



"vegetarian food-beverage specialty store"



"Korean Restaurant"

Measuring semantic similarity between query and place

Place name

Home Run Inn Pizza - Lakeview
Deuce's & The Diamonds Club
Cesar's Killer Margaritas - Broadway
Dryhop Brewers
Aliveone Chicago
Bills Backers Delilah's
Chicago Diner
BIG & little's Restaurant - Lakeview
Q BBQ Lakeview
El Mariachi Restaurant
L & L Tavern
Cesar's Killer Margaritas - Clark
Bites Asian Tapas & Sushi
Yoshi's Cafe Chicago
Drew's on Halsted
Duke of Perth
HopCat - Chicago

Place Description

Chicken Restaurant
American Casual Dining
Grill Restaurant
BrewPub Restaurant
Cocktail Lounge
Restaurant
American Casual Dining
BritishIsles Restaurant
AmericanBarbecueSouthern Casual Dining
Mexican Restaurant
American Restaurant
Grill Cocktail Lounge
JapaneseSushi Restaurant
Brunch Casual Dining
International Restaurant
European Restaurant
American Casual Dining

Semantic similarity

cosine similarity(query, desc)

0.000574
0.039194
0.023126
0.044399
0.027969
0.022897
0.027345
0.033803
0.017323
0.046672
0.037736
0.034237
0.039513
0.073775
0.005090
0.047289
0.036268



POI description = adjective (from food types) + noun (from categories)

Semantic distance

Similarity value : similarity between two document vectors

Semantic distance : the shorter, more similar

0.054446
0.074642
0.040288
0.040374
0.025003
0.010263
0.032436
0.011861
0.037797
0.024087
0.042448
0.026686
0.021785
0.028433
0.034772
0.015085
0.045380

$$normalized_sim = (dist_max - dist_min) \frac{Sim - Sim_{min}}{Sim - Sim_{min}} + dist_min$$

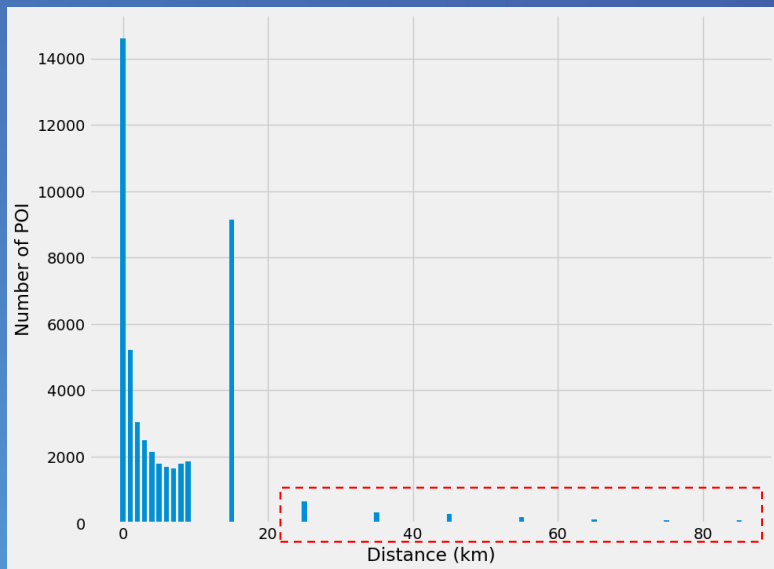
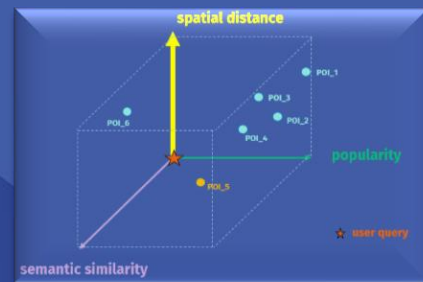


$$MAX_{sim} - normalized_sim$$

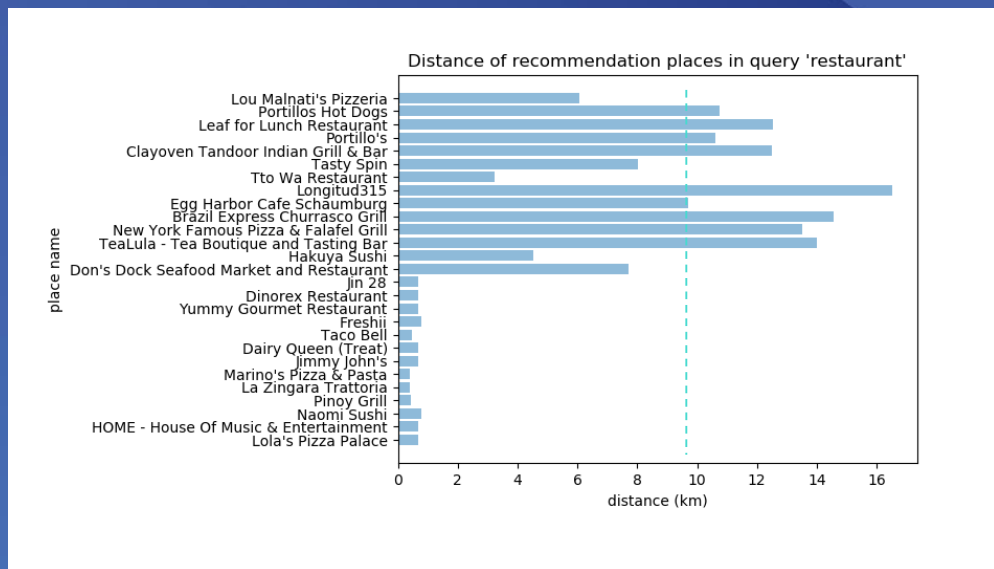
1.1939191529002144
0.45175623430212664
1.7141999508488324
1.7110280687336585
2.2758773012504414
2.8175510203467
2.0027228082226136
2.758813567967369
1.8057323644449563
2.309546138577818
1.6348333547621325
2.214040247884846
2.3941258057429327
2.1498331127298678
1.9168832180084272
2.640335386080889
1.5270790297769778

Spatial distance to query location

- Example of proximity sensitive queries (Chicago 2017)
 “stores **near** me”, “library **near** me”, “**nearest** gas station”, “**Nearest** Airport”
 “african restaurant **near** me”, “mosque **near** me Chicago”, “best restaurant **near** me”
 “mexican restaurants **near** my location”, “lodging **near** arlington heights, IL”



distance from query location



Recommendation places & distance on query 'restaurant'

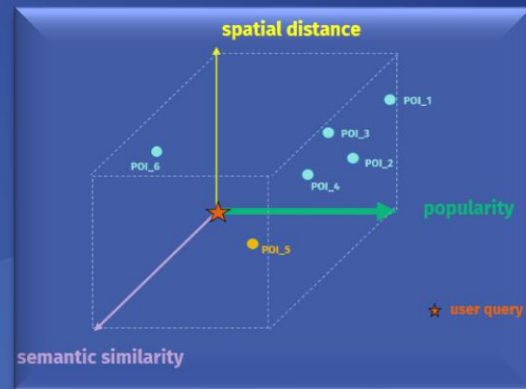
Popularity

- Obtain rates of POIs from multiple sources (e.g. TripAdvisor, Yelp, Facebook)
- Normalize rate values into range (dist_min = 0.0, dist_max = 5.0)

$$normalized_sim = (dist_max - dist_min) \frac{Sim - Sim_{min}}{Sim - Sim_{min}} + dist_min$$

- Inversed rate value : max_rate – normalized rate
- Average Inversed rate values

$$\frac{1}{n} \sum_{i=1}^n (MAX_{rate} - normalized_r)$$

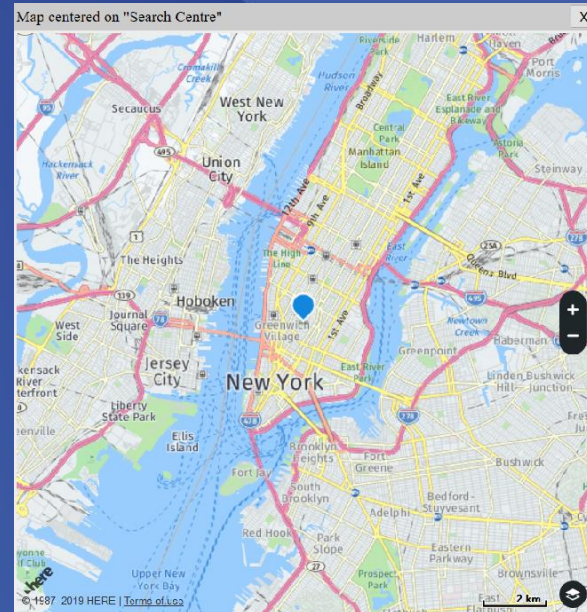


Query : "Museum"

Viewport : New York City

q_lat	q_lon	distance	result_index	name_chosen	lat	lon	category_names
40.7307	-73.996	960	1	New Museum	40.7224	-73.993	Other Museum, Art Museum, Other Landmark-Attraction
40.7307	-73.996	458	2	Merchant's House Museum	40.7277	-73.9923	Other Museum, History Museum, Other Landmark-Attraction
40.7307	-73.996	878	3	International Center of Photography Museum	40.7231	-73.9934	Art Museum, Other Museum, Other Landmark-Attraction
40.7307	-73.996	825	4	Center for Jewish History	40.738	-73.9939	Other Museum, History Museum, Tourist Attraction, Historical Monument, Other Landmark-Attraction
40.7307	-73.996	1057	5	Afa Gallery	40.7222	-74.0016	Art Museum, Other Museum, Gallery, Other Landmark-Attraction
40.7307	-73.996	1065	6	Theodore Roosevelt Birthplace	40.7387	-73.9889	Other Museum, History Museum, Tourist Attraction, Historical Monument, Other Landmark-Attraction
40.7307	-73.996	1055	7	Rubin Museum of Art	40.7401	-73.9977	Other Museum, Art Museum, Other Landmark-Attraction
40.7307	-73.996	1114	8	Deitch Projects	40.722	-74.0026	Other Shop, Art Museum, Gallery, Historical Monument, Other Landmark-Attraction
40.7307	-73.996	627	9	Ukrainian Museum	40.7277	-73.9898	Other Museum, Art Museum, Other Landmark-Attraction
40.7307	-73.996	1155	10	Museum of Illusions	40.7397	-74.003	Children's Museum, Art Museum, Other Museum, Other Landmark-Attraction
40.7307	-73.996	1118	11	Artists Space	40.7218	-74.002	Other Museum, Book Store, Art Museum, Other Theater, Music and Culture, Gallery
40.7307	-73.996	221	12	Margo Feiden Galleries	40.7325	-73.9949	Art Museum, Other Museum, Gallery, Other Landmark-Attraction
40.7307	-73.996	1088	13	KGB Spy Museum	40.7396	-74.0014	History Museum, Other Museum, Other Landmark-Attraction
40.7307	-73.996	1091	14	Fusion Arts Museum	40.722	-73.9902	Art Museum, Other Museum, Other Landmark-Attraction
40.7307	-73.996	417	15	American Artist Professional League	40.7343	-73.9946	Art Museum, Gallery
40.7307	-73.996	1093	16	Fitzgerald Fine Arts	40.722	-74.002	Art Museum, Other Museum, Gallery, Other Landmark-Attraction
40.7307	-73.996	639	17	Fortnight Institute	40.7266	-73.9907	Art Museum
40.7307	-73.996	899	18	Museum of Beautiful People	40.7239	-73.9902	Art Museum
40.7307	-73.996	944	19	TML Arts Collective	40.7331	-74.0009	Art Museum, Gallery
40.7307	-73.996	513	20	Eva Presenhuber	40.7268	-73.9929	Art Museum, Other Museum, Gallery, Other Landmark-Attraction
40.7307	-73.996	862	21	Judd Foundation	40.7234	-73.9995	Art Museum, Other Museum, Gallery, Other Landmark-Attraction
40.7307	-73.996	663	22	Leslie Lohman Prince Street Project	40.7257	-74.0001	Art Museum, Gallery
40.7307	-73.996	3730	23	Museum of Modern Art	40.7611	-73.9772	Tourist Attraction, Cinema, Art Museum, Other Museum, Other Theater, Music and Culture, Other Landmark-Attraction
40.7307	-73.996	6004	24	Metropolitan Museum of Art, New York	40.7784	-73.9625	Art Museum, Gallery
40.7307	-73.996	6591	25	Solomon R Guggenheim Museum	40.783	-73.9591	Other Museum, Art Museum, Residential Area-Building, Other Landmark-Attraction
40.7307	-73.996	1488	26	Whitney Museum of American Art	40.7395	-74.0094	Other Museum, Art Museum, Library, Tourist Attraction, Gallery, Other Landmark-Attraction
40.7307	-73.996	5088	27	Frick Collection	40.7709	-73.9672	Other Museum, Art Museum, Other Theater, Music and Culture, Residential Area-Building, Gallery, Other Landmark-Attraction
40.7307	-73.996	7155	28	Brooklyn Museum of Art	40.6715	-73.9628	Other Museum, Art Museum, Gallery, Historical Monument, Other Landmark-Attraction
40.7307	-73.996	2366	29	Morgan Library and Museum	40.7491	-73.9818	Other Museum, Art Museum, Library, Other Landmark-Attraction
40.7307	-73.996	6377	30	New Gallery New York	40.7813	-73.9603	Other Museum, Book Store, Gift, Antique and Art, History Museum, Art Museum, Other Landmark-Attraction
40.7307	-73.996	12226	31	New York Hall of Science	40.7471	-73.8525	Other Museum, Science Museum, Tourist Attraction, Other Landmark-Attraction
40.7307	-73.996	1154	32	Children's Museum of The Arts	40.7205	-73.9986	Children's Museum, Tourist Attraction, Other Museum
40.7307	-73.996	4504	33	New York Transit Museum	40.6905	-73.99	History Museum, Other Theater, Music and Culture, Other Government or Community Facility, Tourist Attraction, Other Landmark-Attraction
40.7307	-73.996	9559	34	Studio Museum in Harlem	40.8085	-73.9475	Other Museum, Art Museum, Tourist Attraction, Other Landmark-Attraction
40.7307	-73.996	7808	35	Museum of the City of New York	40.7925	-73.952	Other Museum, History Museum, Other Theater, Music and Culture, Other Landmark-Attraction
40.7307	-73.996	5766	36	Hayden Planetarium	40.7797	-73.9734	Other Museum, Science Museum, Historical Monument, Other Landmark-Attraction
40.7307	-73.996	5611	37	Liberty Science Center	40.7078	-74.0553	Other Museum, Cinema, Science Museum, Other Theater, Music and Culture, Tourist Attraction, Other Landmark-Attraction
40.7307	-73.996	3092	38	Discovery Times Square	40.7577	-73.9873	Other Museum, History Museum
40.7307	-73.996	6880	39	Jewish Museum	40.7852	-73.9573	Other Museum, Art Museum, Other Theater, Music and Culture, Tourist Attraction, Gallery, Other Landmark-Attraction
40.7307	-73.996	4887	40	American Folk Art Museum	40.7733	-73.9817	Other Museum, Art Museum, Tourist Attraction, Other Landmark-Attraction

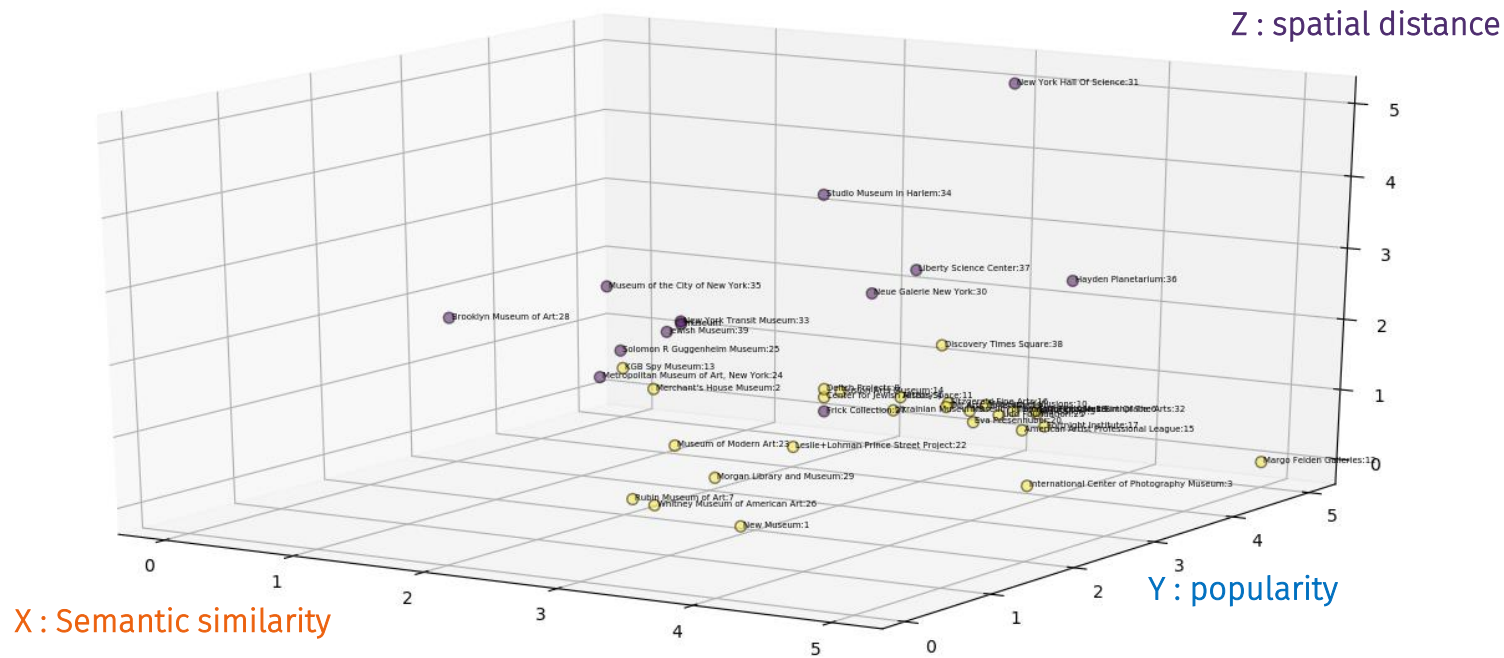
recommendation places on query 'museum' in NYC



Query location

place context vector = [semantic similarity, spatial distance, popularity]

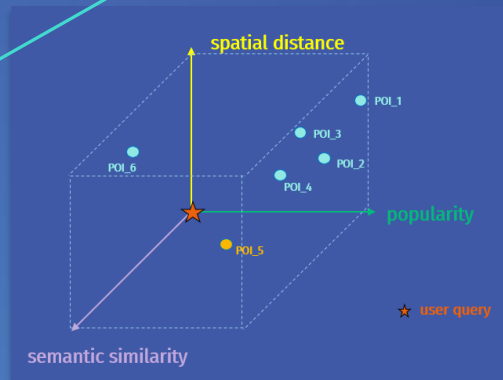
Recommendation places (NYC museums) in query context space



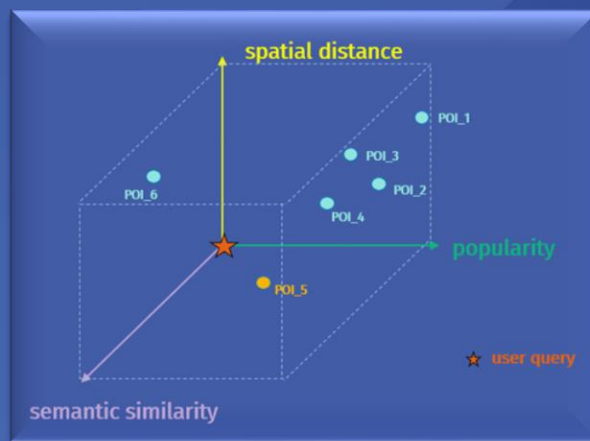
Gaussian Mixture Model clustering

Recommendation ordered by contextual distance

distance_l	result_index	name_chosen
960	1	New Museum
458	2	Merchant's House Museum
878	3	International Center of Photography Museum
825	4	Center for Jewish History
1057	5	Afa Gallery
1065	6	Theodore Roosevelt Birthplace
1055	7	Rubin Museum of Art
1114	8	Deitch Projects
627	9	Ukrainian Museum
1155	10	Museum of Illusions
1118	11	Artists Space
221	12	Margo Feiden Galleries
1088	13	KGB Spy Museum
1091	14	Fusion Arts Museum
417	15	American Artist Professional League
1093	16	Fitzgerald Fine Arts
639	17	Fortnight Institute
899	18	Museum of Beautiful People
944	19	TMJ Arts Collective
513	20	Eva Presenhuber
862	21	Judd Foundation
663	22	Leslie+Lohman Prince Street Project
3730	23	Museum of Modern Art
6004	24	Metropolitan Museum of Art, New York
6591	25	Solomon R Guggenheim Museum
1488	26	Whitney Museum of American Art
5088	27	Frick Collection
7155	28	Brooklyn Museum of Art
2366	29	Morgan Library and Museum
6377	30	Neue Galerie New York
12226	31	New York Hall Of Science
1154	32	Children's Museum Of The Arts
4504	33	New York Transit Museum
9559	34	Studio Museum in Harlem
7808	35	Museum of the City of New York
5766	36	Hayden Planetarium
5611	37	Liberty Science Center
3092	38	Discovery Times Square
6880	39	Jewish Museum
4887	40	American Folk Art Museum



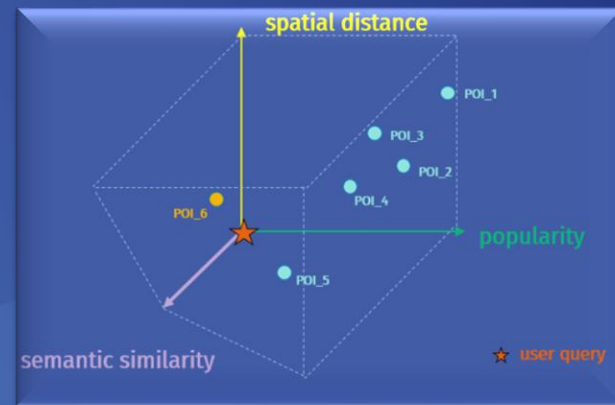
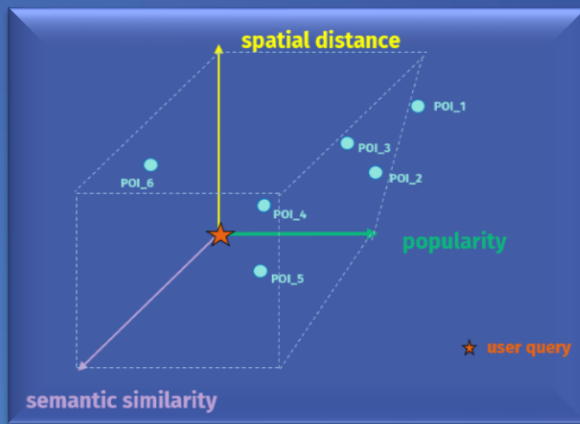
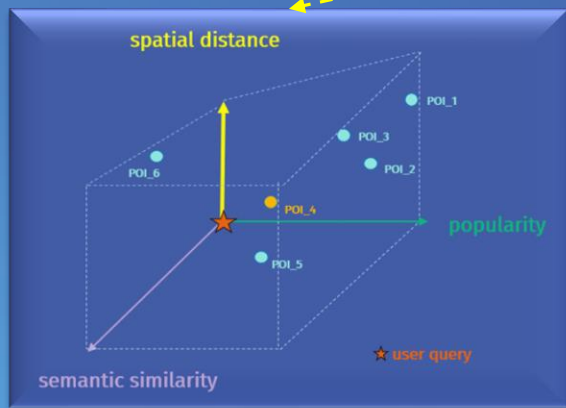
original_rank	name_chosen	distance_in_3d
7	Rubin Museum of Art	2.960503585
26	Whitney Museum of American Art	3.328606081
28	Brooklyn Museum of Art	3.49653933
29	Morgan Library and Museum	3.708922969
23	Museum of Modern Art	3.812016077
1	New Museum	3.84352818
24	Metropolitan Museum of Art, New York	3.973314957
40	American Folk Art Museum	4.045054129
25	Solomon R Guggenheim Museum	4.085124956
35	Museum of the City of New York	4.171340831
33	New York Transit Museum	4.214433757
22	Leslie+Lohman Prince Street Project	4.219482346
39	Jewish Museum	4.262505434
27	Frick Collection	4.865965489
2	Merchant's House Museum	5.007465215
13	KGB Spy Museum	5.013039959
30	Neue Galerie New York	5.216194487
4	Center for Jewish History	5.269443445
8	Deitch Projects	5.305872099
14	Fusion Arts Museum	5.324920236
3	International Center of Photography Museum	5.383101961
9	Ukrainian Museum	5.464678703
11	Artists Space	5.500076398
19	TMJ Arts Collective	5.653880834
16	Fitzgerald Fine Arts	5.658006157
20	Eva Presenhuber	5.739949411
18	Museum of Beautiful People	5.749962701
38	Discovery Times Square	5.751233977
34	Studio Museum in Harlem	5.756837282
10	Museum of Illusions	5.795685979
21	Judd Foundation	5.846686848
15	American Artist Professional League	5.950175595
37	Liberty Science Center	5.950658188
6	Theodore Roosevelt Birthplace	5.964634827
5	Afa Gallery	5.991657094
32	Children's Museum Of The Arts	6.00467816
17	Fortnight Institute	6.052078377
36	Hayden Planetarium	6.18170235
12	Margo Feiden Galleries	7.071067812
31	New York Hall Of Science	7.700919545



shorter distance

more popular

query semantic context



Distance (Euclidean Loss) in query context space

$$\sqrt{(P_x - Q_x)^2 + (P_y - Q_y)^2 + (P_z - Q_z)^2}$$

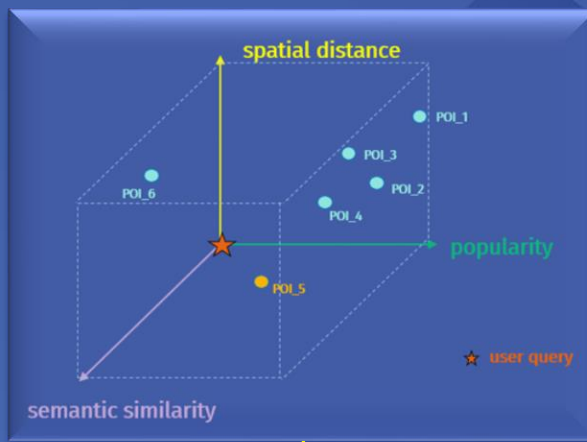
Multi-class query context classifier
(spatial distance/popularity/semantic context)



weights change, re-scale : $P_y \rightarrow P'_y$

$$\sqrt{\alpha(P_x - Q_x)^2 + \beta(P'_y - Q_y)^2 + \gamma(P_z - Q_z)^2}$$

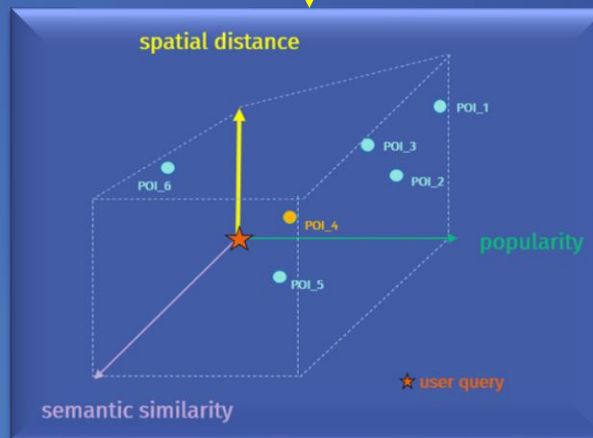
Query “museum near me”



$$\sqrt{(P_x - Q_x)^2 + (P_y - Q_y)^2 + (P_z - Q_z)^2}$$

$\Downarrow P_z \rightarrow P'_z$

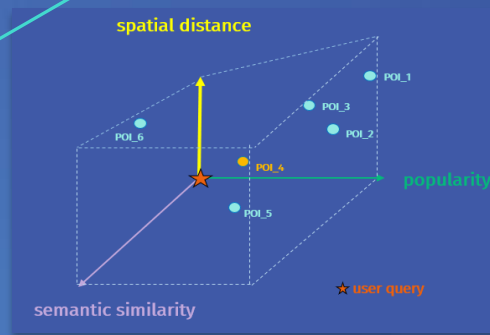
shorter distance



$$\sqrt{\alpha(P_x - Q_x)^2 + \beta(P_y - Q_y)^2 + \gamma(P'_z - Q_z)^2}$$

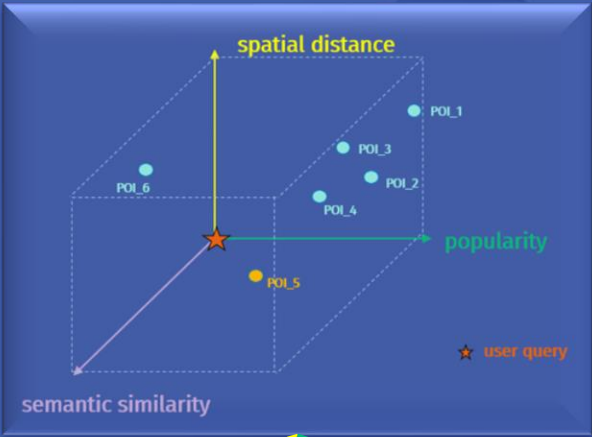
Query context space after re-scale spatial distance component

distance_	result_index	name_chosen
960	1	New Museum
458	2	Merchant's House Museum
878	3	International Center of Photography Museum
825	4	Center for Jewish History
1057	5	Afa Gallery
1065	6	Theodore Roosevelt Birthplace
1055	7	Rubin Museum of Art
1114	8	Deitch Projects
627	9	Ukrainian Museum
1155	10	Museum of Illusions
1118	11	Artists Space
221	12	Margo Feiden Galleries
1088	13	KGB Spy Museum
1091	14	Fusion Arts Museum
417	15	American Artist Professional League
1093	16	Fitzgerald Fine Arts
639	17	Fortnight Institute
899	18	Museum of Beautiful People
944	19	TMJ Arts Collective
513	20	Eva Presenhuber
862	21	Judd Foundation
663	22	Leslie-Lohman Prince Street Project
3730	23	Museum of Modern Art
6004	24	Metropolitan Museum of Art, New York
6591	25	Solomon R Guggenheim Museum
1488	26	Whitney Museum of American Art
5088	27	Frick Collection
7155	28	Brooklyn Museum of Art
2366	29	Morgan Library and Museum
6377	30	Neue Galerie New York
12226	31	New York Hall Of Science
1154	32	Children's Museum Of The Arts
4504	33	New York Transit Museum
9559	34	Studio Museum in Harlem
7808	35	Museum of the City of New York
5766	36	Hayden Planetarium
5611	37	Liberty Science Center
3092	38	Discovery Times Square
6880	39	Jewish Museum
4887	40	American Folk Art Museum



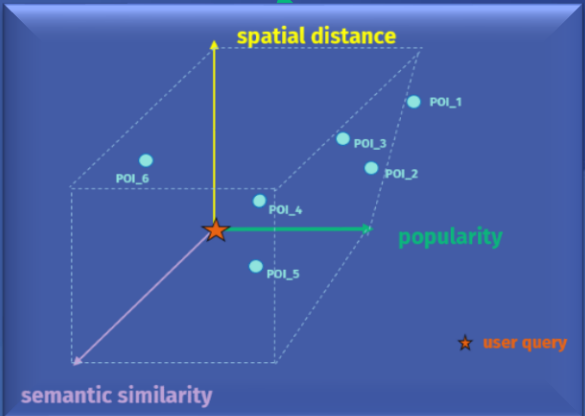
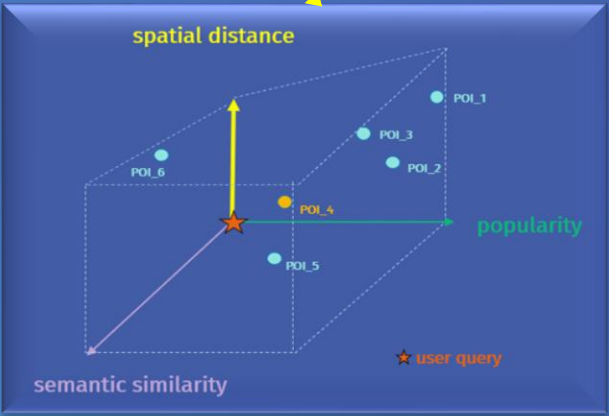
result_index	name_chosen	distance_in_3d
28	Brooklyn Museum of Art	1.944008036
35	Museum of the City of New York	2.708702253
7	Rubin Museum of Art	2.884562181
24	Metropolitan Museum of Art, New York	3.075487991
25	Solomon R Guggenheim Museum	3.215634538
26	Whitney Museum of American Art	3.227113843
39	Jewish Museum	3.331808723
23	Museum of Modern Art	3.479077001
40	American Folk Art Museum	3.537107718
29	Morgan Library and Museum	3.698730279
33	New York Transit Museum	3.813989279
1	New Museum	3.945985885
22	Leslie-Lohman Prince Street Project	4.168553815
34	Studio Museum in Harlem	4.231938417
27	Frick Collection	4.534992227
30	Neue Galerie New York	4.545722956
13	KGB Spy Museum	5.000130568
2	Merchant's House Museum	5.006074114
4	Center for Jewish History	5.256904786
8	Deitch Projects	5.276860818
14	Fusion Arts Museum	5.29431061
3	International Center of Photography Museum	5.420865365
9	Ukrainian Museum	5.448986036
11	Artists Space	5.466585435
37	Liberty Science Center	5.518249528
38	Discovery Times Square	5.613459603
19	TMJ Arts Collective	5.627264684
16	Fitzgerald Fine Arts	5.693510651
18	Museum of Beautiful People	5.704702539
20	Eva Presenhuber	5.786897195
10	Museum of Illusions	5.813412772
31	New York Hall Of Science	5.881987773
21	Judd Foundation	5.890290357
15	American Artist Professional League	5.923079719
6	Theodore Roosevelt Birthplace	5.923867409
5	Afa Gallery	5.979805427
17	Fortnight Institute	6.009715833
32	Children's Museum Of The Arts	6.031164343
36	Hayden Planetarium	6.17404459
12	Margo Feiden Galleries	7.071067812

Query “best museum near my location”



shorter distance

more popular



Future Work

- * Find good α, β, γ and *scaling factor* by cross-validation

$$\sqrt{\alpha(P_x - Q_x)^2 + \beta(P_y - Q_y)^2 + \gamma(P'_z - Q_z)^2}$$

- * Extend query context space by adding new components
 - Mode (walk-mode, drive-mode, parking-mode)
 - Time
 - Social context (leisure, business)
 - Personal preference factor

Vielen Dank!

Recommendation based on semantic context & PRISM

place recommendation
results

PRISM will be
constructed
using PDS data

(evaluation)

A/B Test on recommendation results

