

Designing a Conversational Travel Recommender System Based on Data-Driven Destination Characterization

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TUM Uhrenturm

Problem

Recommend global cities for traveling

Challenges

- Large item space
- Intangible items
- No ratings available
- Expert-based characterization of items is very costly
- High-stakes recommendation
- Complex decision making

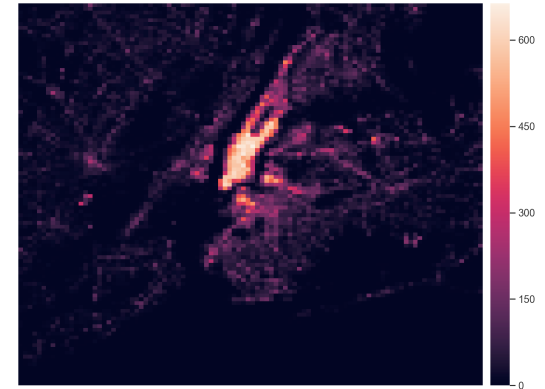


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Destination Characterization

Collect City Data

- From Foursquare, via official API
- 180 cities on all continents
- Download of all venues in the city
- Analyze distribution
- Enrich cities with cost and climate data



Heatmap of New York City Venues

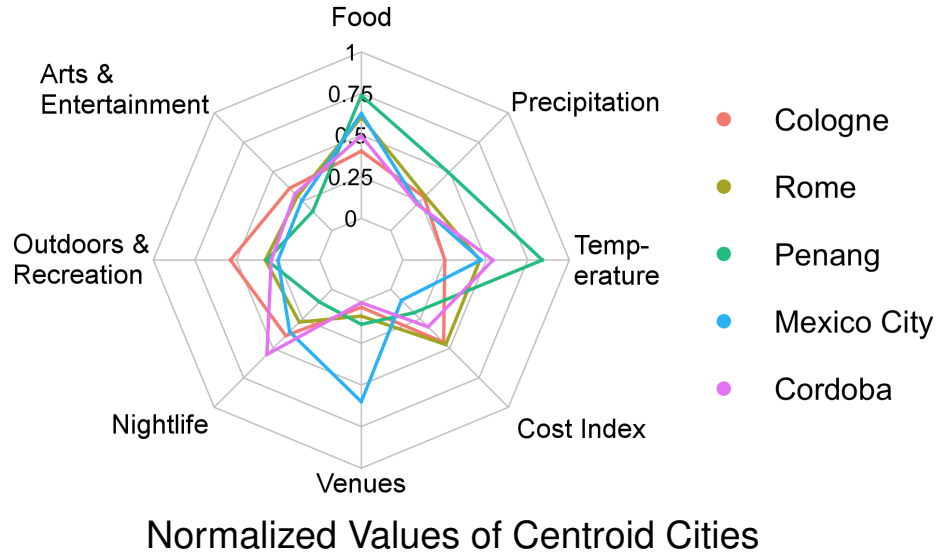
Table 1: Raw values of exemplary cities

City	Venues	Arts	Food	Nightlife	Outdoors	Cost Index	Temperature	Precipitation
Rome	36,848	1,995	12,264	2,063	3,482	69.03	15.7°C	798mm
Mexico City	213,612	12,158	83,225	16,780	19,330	34.18	15.9°C	625mm
Cologne	16,163	966	4,107	1,144	2,127	67.36	10.1°C	774mm
Penang	50,647	2,193	21,389	1,686	5,273	43.98	25.7°C	1,329mm
Cordoba	3,636	246	1,282	427	379	55.11	17.8°C	612mm

Destination Characterization

Cluster Analysis

- Normalize raw data by number of venues
- Normalize feature values using min-max
- Compare k-mean, k-medoids, hierarchical clustering
- Determine cluster quality using silhouette width
- **Best result:** Hierarchical clustering with 5 clusters



CityRec - A recommender syst
+
Not Secure | cityrec.
/rec/preferences?v=2

CityRec

Tell us your preferences! Please select 3 to 5 cities from the list below, which you like best.

click here for more information

<div> Marseille FRANCE </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Mediterranean </div>	<div> Orlando UNITED STATES </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Humid subtropical </div>	<div> Amsterdam NETHERLANDS </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Marine west coast </div>	<div> Caracas VENEZUELA </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Tropical wet and dry </div>
<div> Tallinn ESTONIA </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Humid continental </div>	<div> Medellin COLOMBIA </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Tropical wet </div>	<div> San Sebastian SPAIN </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Mediterranean </div>	<div> Boston UNITED STATES </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Humid subtropical </div>
<div> Sao Paulo BRAZIL </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Marine west coast </div>	<div> Rome ITALY </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Mediterranean </div>	<div> Cordoba SPAIN </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Mediterranean </div>	<div> Graz AUSTRIA </div> <div> </div> <div> PRICE LEVEL \$\$\$\$\$ </div> <div> CLIMATE TYPE Humid continental </div>

NEXT STEP >

1. Tell us your general preferences
2. Refine your preferences
3. Get recommendations

CityRec - A recommender syst
+
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/rec/refining?v=2
CityRec
Please check out the initial recommendations below and provide some feedback!
click here for more information
How did you find the price level aspect/score of the initial recommendations?
-- should be much lower - should be a bit lower = just right + should be a bit higher ++ should be much higher
NEXT QUESTION
Seattle
UNITED STATES
Boston
UNITED STATES
Washington DC
UNITED STATES
Amsterdam
NETHERLANDS
PRICE LEVEL
\$\$\$\$\$
CLIMATE TYPE
Mediterranean
AVERAGE TEMPERATURE
10.9°C
FOOD
ARTS AND ENTERTAINMENT
PRICE LEVEL
\$\$\$\$\$
CLIMATE TYPE
Humid subtropical
AVERAGE TEMPERATURE
9.8°C
FOOD
ARTS AND ENTERTAINMENT
PRICE LEVEL
\$\$\$\$\$
CLIMATE TYPE
Humid subtropical
AVERAGE TEMPERATURE
13.3°C
FOOD
ARTS AND ENTERTAINMENT
PRICE LEVEL
\$\$\$\$\$
CLIMATE TYPE
Marine west coast
AVERAGE TEMPERATURE
9.2°C
FOOD
ARTS AND ENTERTAINMENT
NEXT STEP >
1. Tell us your general preferences
2. Refine your preferences
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Evaluation

Independent variable: Critiquing vs. non-critiquing baseline

Dependent variables:

- Time to result
- Clicks
- Self assessment of the importance of Food, Arts & Entertainment, Outdoors, and Nightlife
- ResQue Questionnaire
 1. The travel destinations recommended to me by CityRec **matched my interests**
 2. The recommender system helped me **discover new travel destinations**
 3. **I understood** why the travel destinations were recommended to me
 4. I found it **easy to tell the system what my preferences** are
 5. I found it **easy to modify my taste profile** in this recommender system
 6. The layout and labels of the recommender **interface are adequate**
 7. Overall, I am **satisfied** with this recommender system
 8. **I would use this recommender system again**, when looking for travel destinations

Results

Variable	Baseline	Critiquing	p	W	Significance
(Q1) Interest match	3.58	3.88	0.043	645	*
(Q2) Novelty	3.44	3.75	0.118	705	ns
(Q3) Understanding	3.46	3.77	0.073	673.5	ns
(Q4) Tell prefs.	3.73	3.90	0.328	775	ns
(Q5) Modify profile	3.24	3.48	0.17	723.5	ns
(Q6) Interface	4.15	3.62	0.009	1,044	**
(Q7) Satisfaction	3.66	3.92	0.037	649	*
(Q8) Future use	3.49	3.67	0.166	724	ns
Time to results	60.92s	184.07s	<0.001		***
Clicks	6.32	21.35	<0.001		***
PCC Food	-0.11	-0.01	0.341		ns
PCC Arts	0.05	0.38	0.066		ns
PCC Outdoors	0.02	0.45	0.024		*
PCC Nightlife	0.2	0.57	0.028		*

Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Conclusions

Recommendation accuracy > User effort

Critiquing system did better in capturing user preferences

Future work

Evaluate destination characterization

Compare different user interaction paradigms

Sources available <https://github.com/divino5/cityrec-prototype>

Try out CityRec <http://cityrec.cm.in.tum.de/>