Intro to Recommendations Systems

Data Science and Machine Learning Workshop' 2017

Habib University

Acknowledgement

- Slides of this lecture have been taken from following online resources:
  - https://www.slideshare.net/stanleywanguni/overview-of-recommender-system
  - http://katbailey.github.io/post/matrix-factorization-with-tensorflow/

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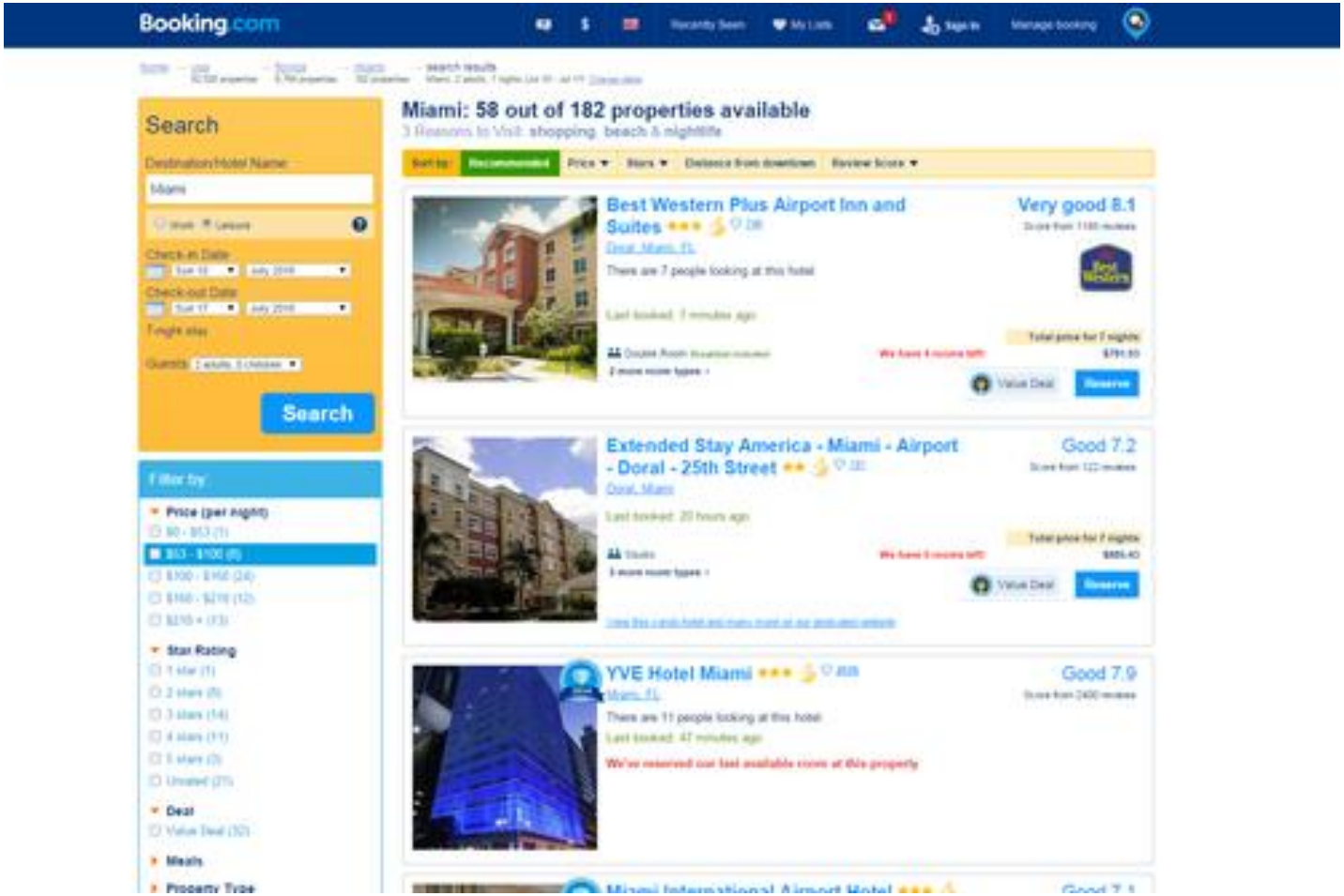
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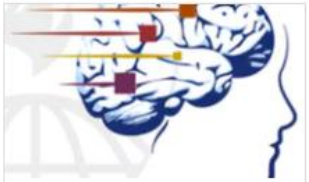
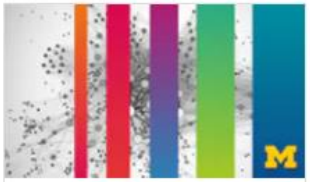


Johns Hopkins University

Data Science

University of Michigan

Python for Everybody



University of Michigan

Applied Data Science with Python

Duke University

Excel to MySQL: Analytic Techniques for Business

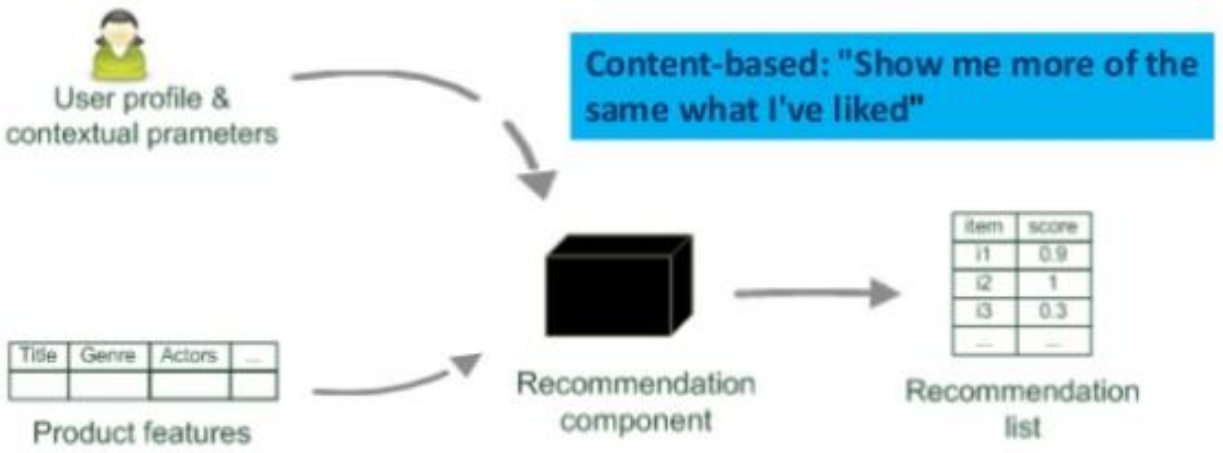
Duke University

Java Programming and Software Engineering Fundamentals

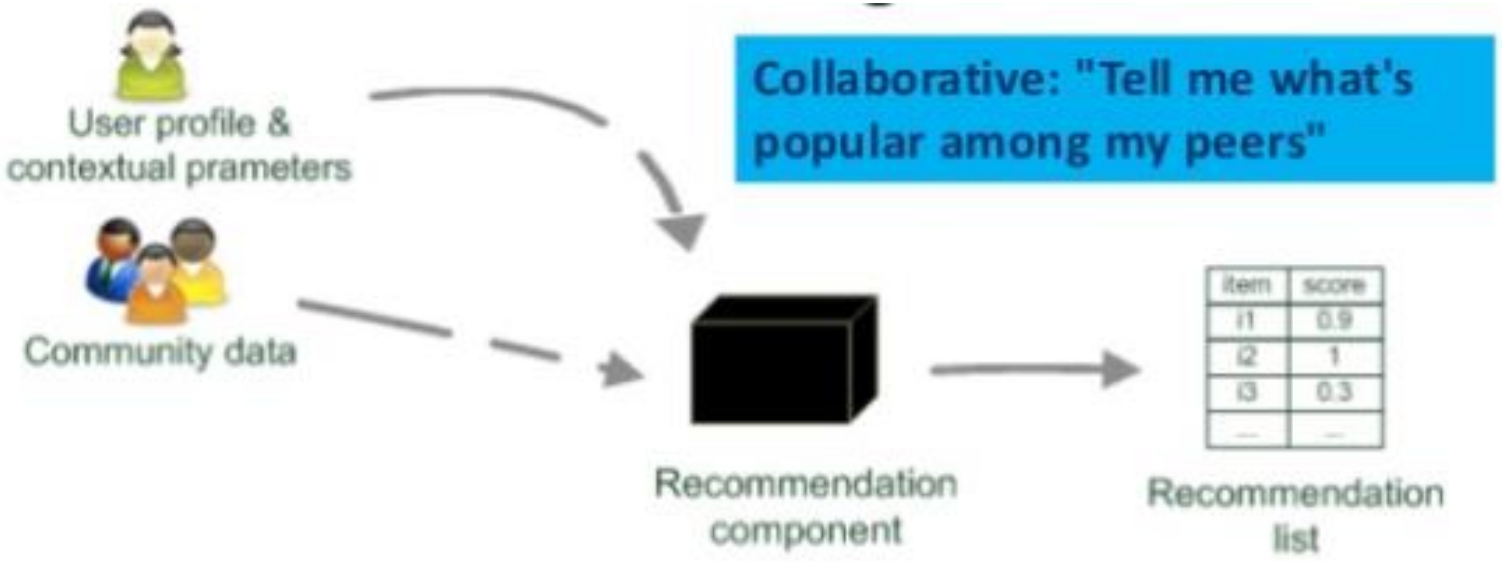
Data

- Item Data
- User Data
- Sales Data
- Ranking Data (Implicit/Explicit)

Content Based Recommendations



Collaborative Filtering (CF)



Collaborative Filtering

User Based Collaborative Filtering

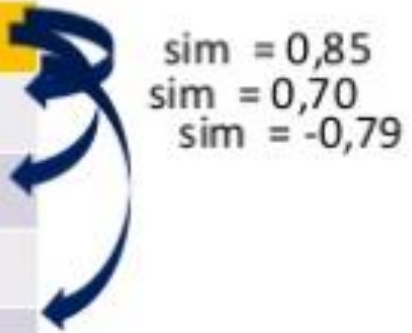
- what people with similar tastes seem to like

Item Based Collaborative Filtering

- what other items are similar to what user liked

Nearest Neighbor CF

	Item1	Item2	Item3	Item4	Item5
Alice	5	3	4	4	?
User1	3	1	2	3	3
User2	4	3	4	3	5
User3	3	3	1	5	4
User4	1	5	5	2	1



Item Based CF

Basic idea:

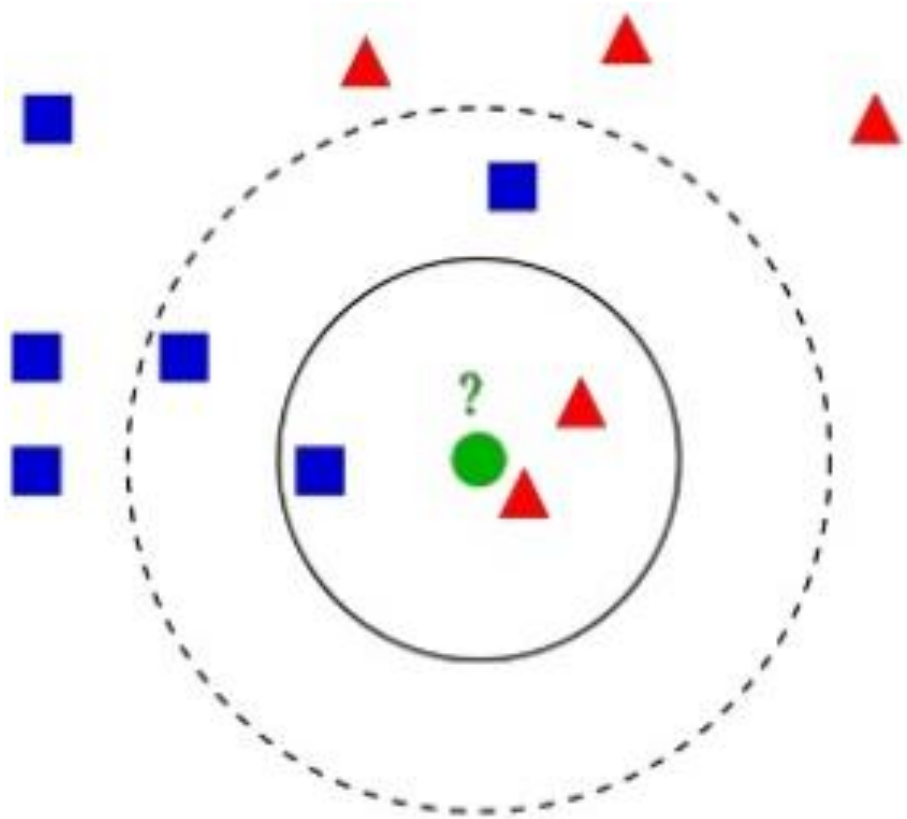
- **Use the similarity between items (and not users) to make predictions**

Example:

- **Look for items that are similar to Item5**
- **Take Alice's ratings for these items to predict the rating for Item5**

	Item1	Item2	Item3	Item4	Item5
Alice	5	3	4	4	?
User1	3	1	2	3	3
User2	4	3	4	3	5
User3	3	3	1	5	4
User4	1	5	5	2	1

K- Nearest Neighbor



Measuring Similarity

- Jaccard coefficient:

$$sim(a,b) = \frac{(1+1)}{(1+1+1)+(1+1+1+1)-(1+1)}$$

- Cosine similarity:

$$sim(a,b) = \cos(\vec{a},\vec{b}) = \frac{\vec{a}\bullet\vec{b}}{\|\vec{a}\|_2 * \|\vec{b}\|_2} = \frac{(1*1+0.5*1)}{\sqrt{(1^2+0.5^2+1^2)*(1^2+0.5^2+1^2+1^2)}}$$

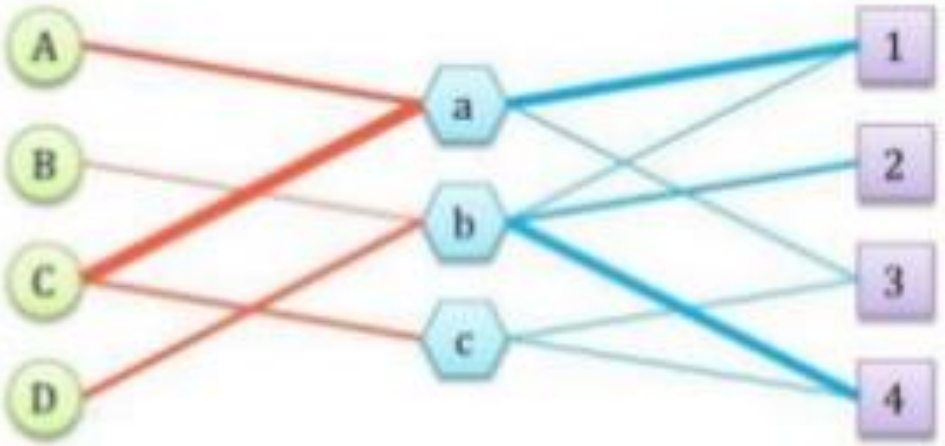
- Pearson Correlation:

$$corr(a,b) = \frac{\sum_i (r_{ai}-\overline{r_a})(r_{bi}-\overline{r_b})}{\sqrt{\sum_i (r_{ai}-\overline{r_a})^2 \sum_i (r_{bi}-\overline{r_b})^2}} = \frac{m\sum a_i b_i - \sum a_i \sum b_i}{\sqrt{m\sum a_i^2 - (\sum a_i)^2}\sqrt{m\sum b_i^2 - (\sum b_i)^2}}$$

$$= \frac{match\_cols * Dotprod(a,b) - sum(a) * sum(b)}{\sqrt{match\_cols * sum(a^2) - (sum(a))^2}\sqrt{match\_cols * sum(b^2) - (sum(b))^2}}$$

Latent Factor Model

- Users and items are connect by latent features.



User-Item Rating

	Item 1	Item 2	Item 3	Item 4	Item 5
User 1	0?	3	0?	3	0?
User 2	4	0?	0?	2	0?
User 3	0?	0?	3	0?	0?
User 4	3	0?	4	0?	3
User 5	4	3	0?	4	0?

Matrix Factorization

	Feature 1	Feature 2
User 1	?	?
User 2	?	?
User 3	?	?
User 4	?	?
User 5	?	?

X

	Item 1	Item 2	Item 3	Item 4	Item 5
Feature 1	?	?	?	?	?
Feature 2	?	?	?	?	?

=

	Item 1	Item 2	Item 3	Item 4	Item 5
User 1	0?	3	0?	3	0?
User 2	4	0?	0?	2	0?
User 3	0?	0?	3	0?	0?
User 4	3	0?	4	0?	3
User 5	4	3	0?	4	0?

http://katbailey.github.io/post/matrix-factorization-with-tensorflow/

Libraries for Recommendations

- Python
  - GraphLab
  - Crab.
  - Surprise
  - Python Recsys
  - MRec
- Java
  - Mahout
-

Challenges

- Sparsity
- Synonymy
- Scalability
- Gray Sheep
  - refers to the users whose opinions do not consistently agree or disagree with any group of people
- Privacy