Reciprocal Recommendation System for Online Dating

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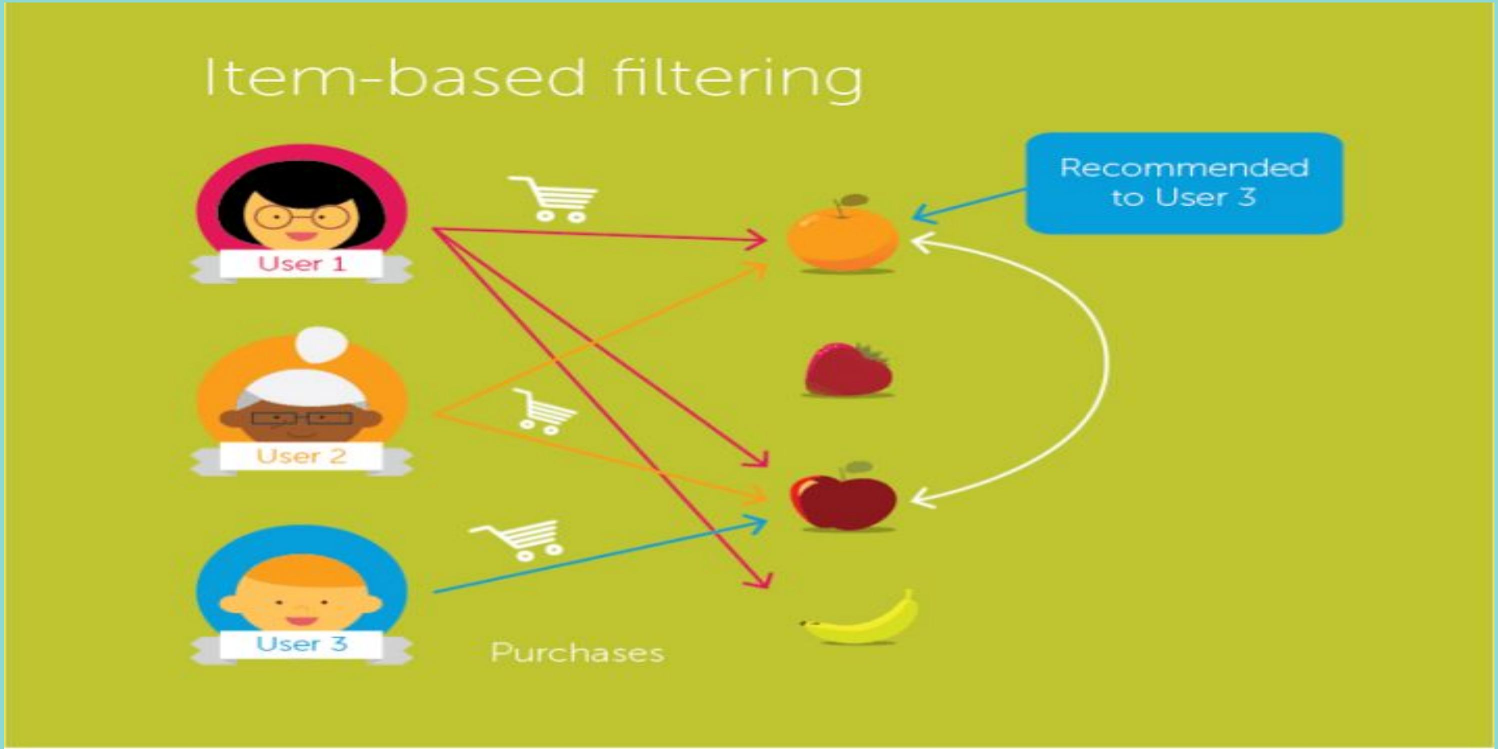
How a typical recommendation engine works ?



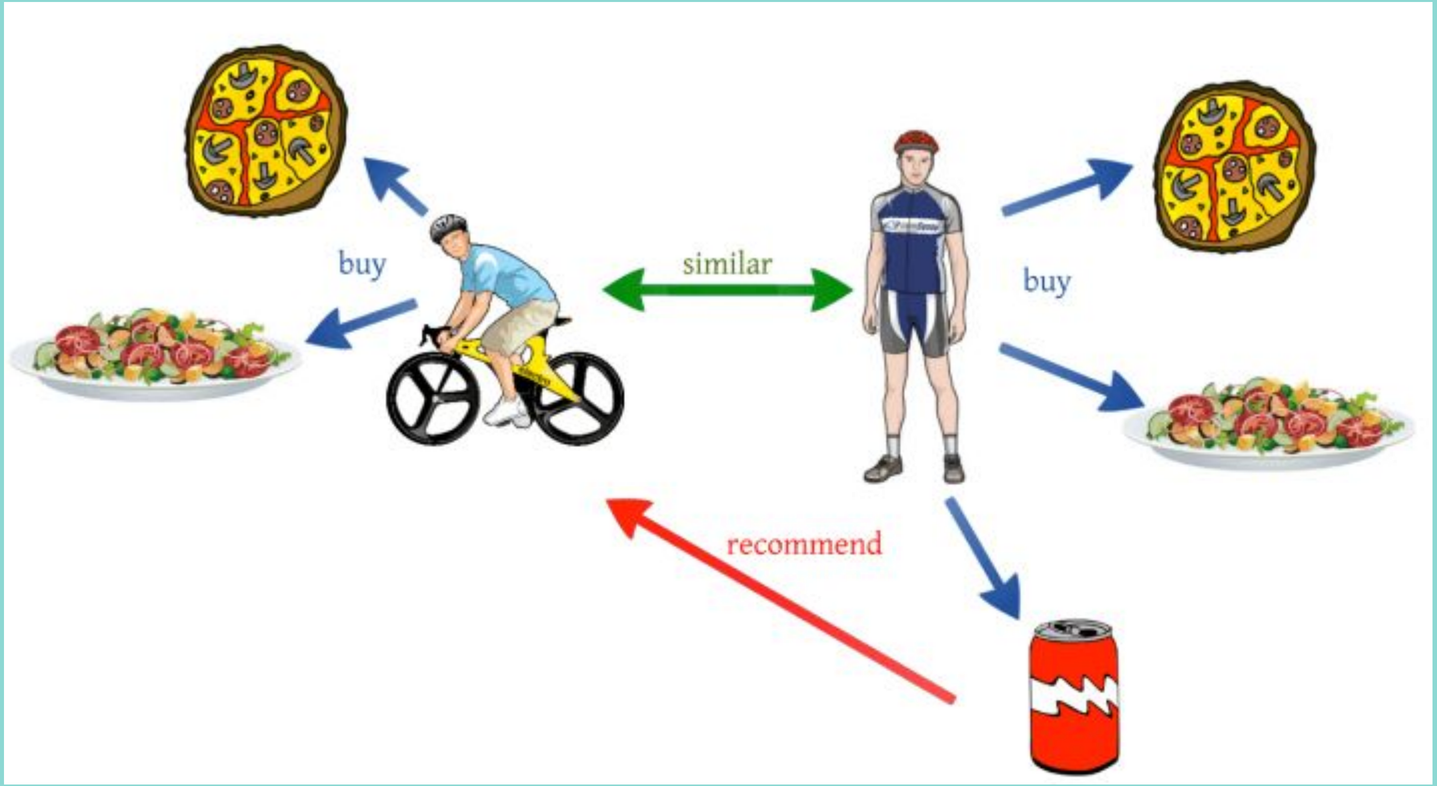
Item-Item collaborative filtering

So in our case we will find the similarity between each movie pair and based on that, we will recommend similar movies which are liked by the users in the past. This algorithm works similar to user-user collaborative filtering with just a little change – instead of taking the weighted sum of ratings of “user-neighbors”, we take the weighted sum of ratings of “item-neighbors”

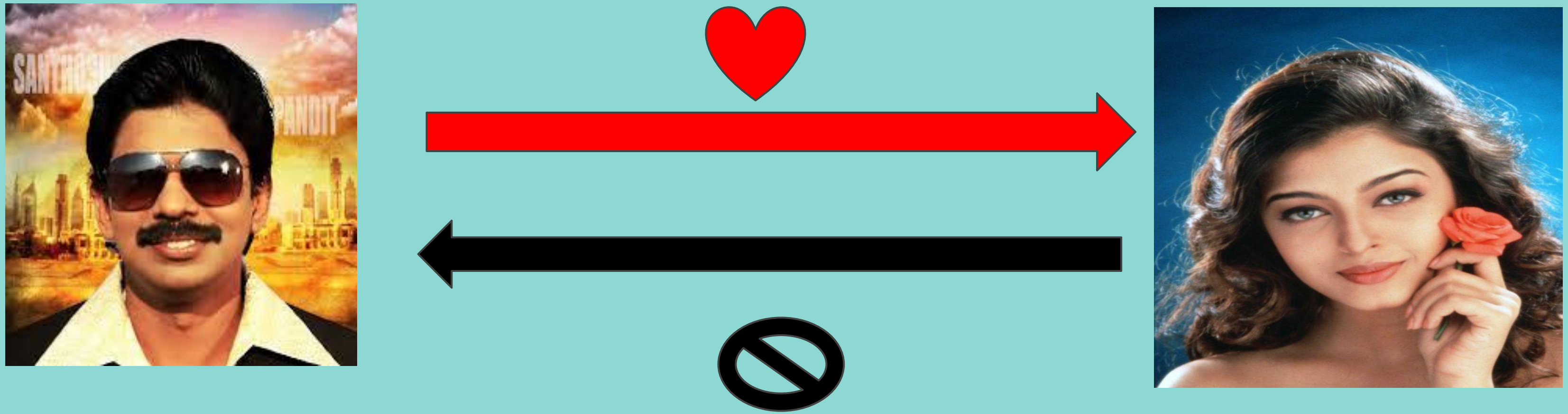
User-User collaborative filtering

This algorithm first finds the similarity score between users. Based on this similarity score, it then picks out the most similar users and recommends products which these similar users have liked or bought previously.

user -user filtering



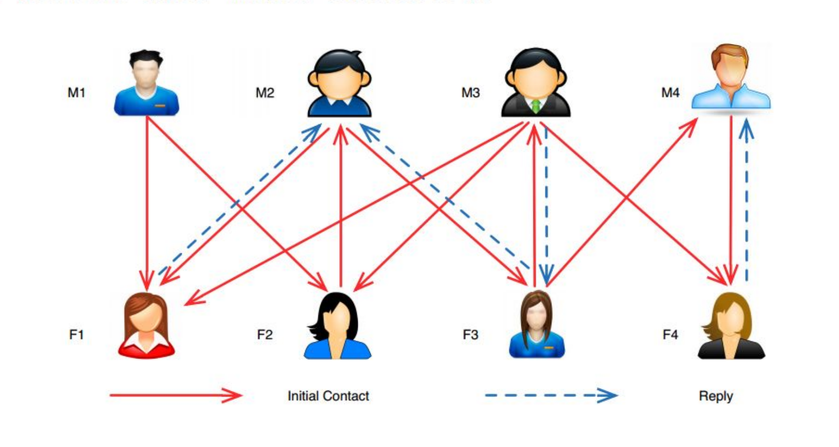
Why this does not work in case of Dating apps or Social networks ?



There should be acceptance between two sides.Both of them should be able accept each other,if we follow normal recommendation system this won’t happen.This is the idea of reciprocity.

When a user2 is recommended to user1.The system should make sure that both users are satisfied with each other.

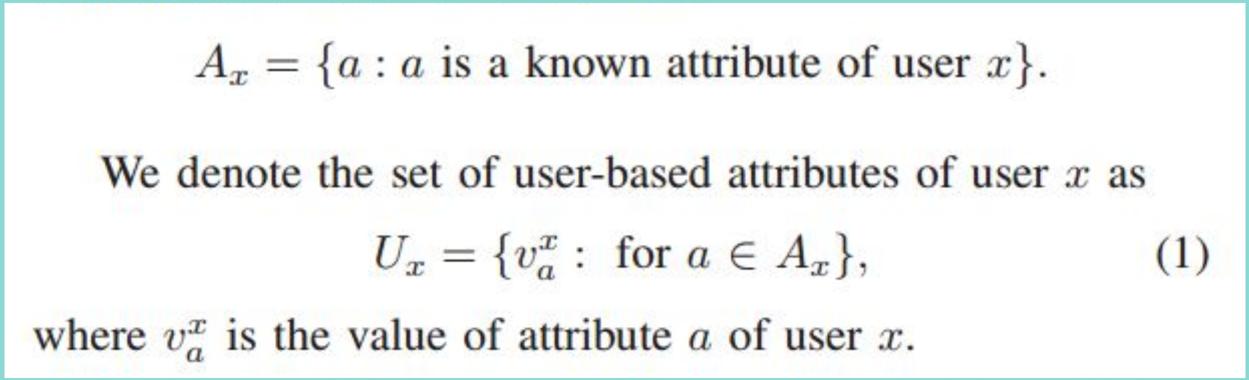
The success of a reciprocal recommendation system lies in its ability to recommend users with whom the service user has mutual interest and thus they are likely to communicate with each other. The interaction records between a pair of users are a good indicator of actual interest and attractiveness between the sender and receiver. If a recommended user matches the service user's interest, the service user will be more likely to approach the recommended user. Also, if the service user's attractiveness is compatible with the recommended user's interest, the recommended user will be more likely to reply to the service user when contacted.



How to tackle this problem ?

Similarity functions

In content-based recommendation system, every recommended user can be represented by a feature vector or an attribute profile. These features can be numeric or nominal values representing some aspect of the user, such as age, height, income, and etc



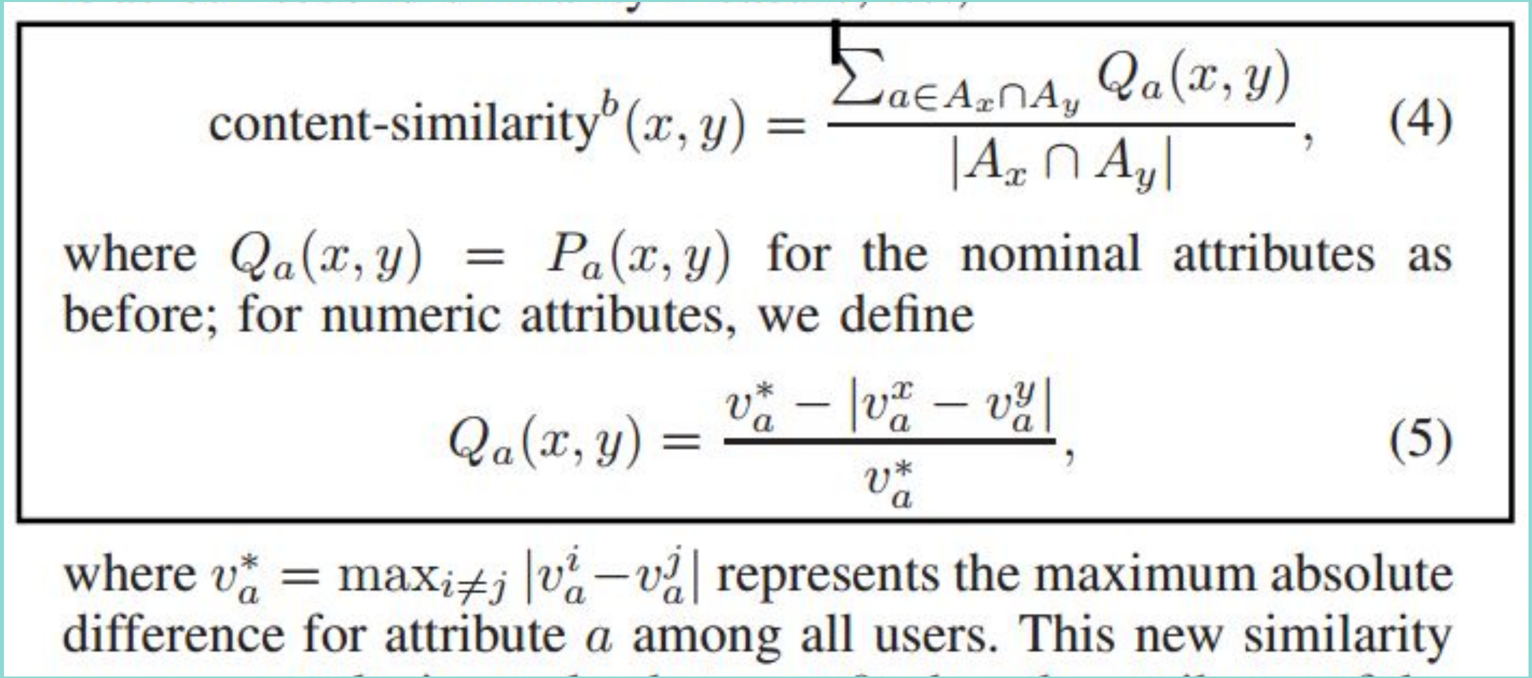
$$A_x = \{a : a \text{ is a known attribute of user } x\}.$$

We denote the set of user-based attributes of user x as

$$U_x = \{v_a^x : \text{ for } a \in A_x\}, \tag{1}$$

where v_a^x is the value of attribute a of user x.

Content similarity



$$\text{content-similarity}^{b}(x,y) = \frac{\sum_{a\in A_x\cap A_y} Q_a(x,y)}{|A_x\cap A_y|}, \qquad (4)$$

where $Q_a(x,y) = P_a(x,y)$ for the nominal attributes as before; for numeric attributes, we define

$$Q_a(x,y) = \frac{v_a^* - |v_a^x - v_a^y|}{v_a^*}, \qquad (5)$$

where $v_a^* = \max_{i\neq j} |v_a^i - v_a^j|$ represents the maximum absolute difference for attribute a among all users. This new similarity

This new similarity measure results in a value between 0 when the attributes of the two users have the maximum difference.for example if Va*=25 and Vax-Vay=25,ie there is max difference between age of users.Similarity will be 0.

Graph-based Similarity Functions

Based on the message traces between users, we define the following two graph based measures to capture the user's active level and attractiveness.

Se(x) = {y : x has sent a messages to y}

Re(x) = {y : x has received a message from y}

where Se(x) is defined as the set of out-neighbors of x and its cardinality reflects the activeness of user x; Re(x) is defined as the set of in-neighbors of x and its cardinality reflects the attractiveness of user x.

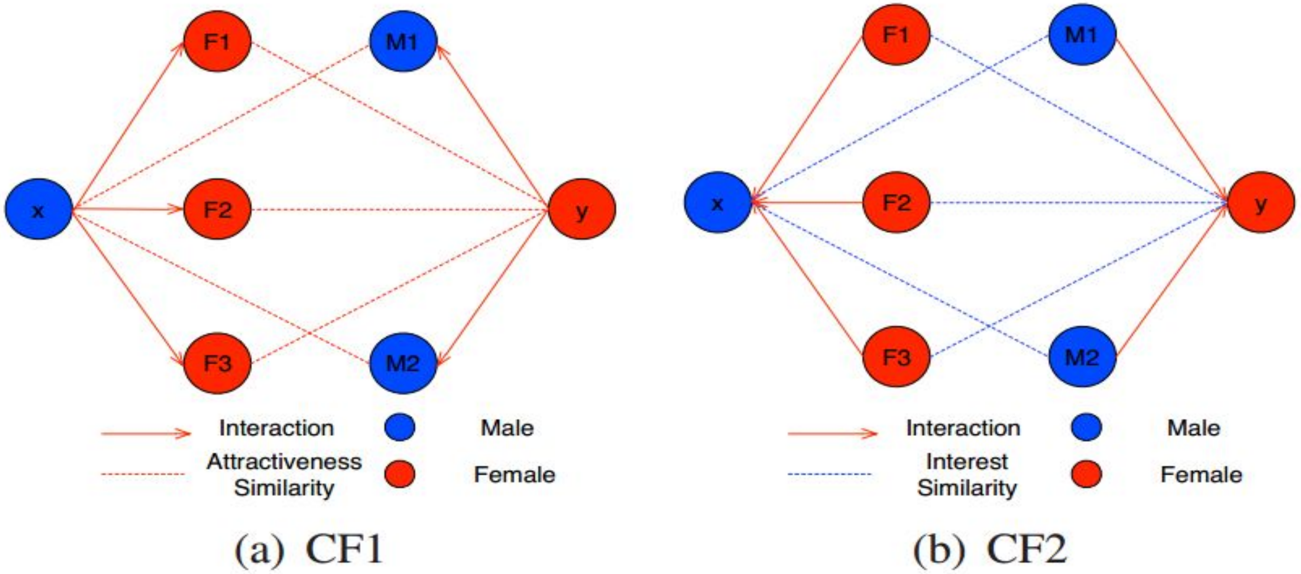
Interest similarity and attractiveness similarity.

Interest similarity: Measures of the similarity in interest of two users of same gender.

$$\text{interest-similarity}(x, y) = \frac{|Se(x) \cap Se(y)|}{|Se(x) \cup Se(y)|}$$

Attractiveness similarity : Measures the relative attractiveness between users.

$$\text{attractiveness-similarity}(x, y) = \frac{|Re(x) \cap Re(y)|}{|Re(x) \cup Re(y)|}.$$



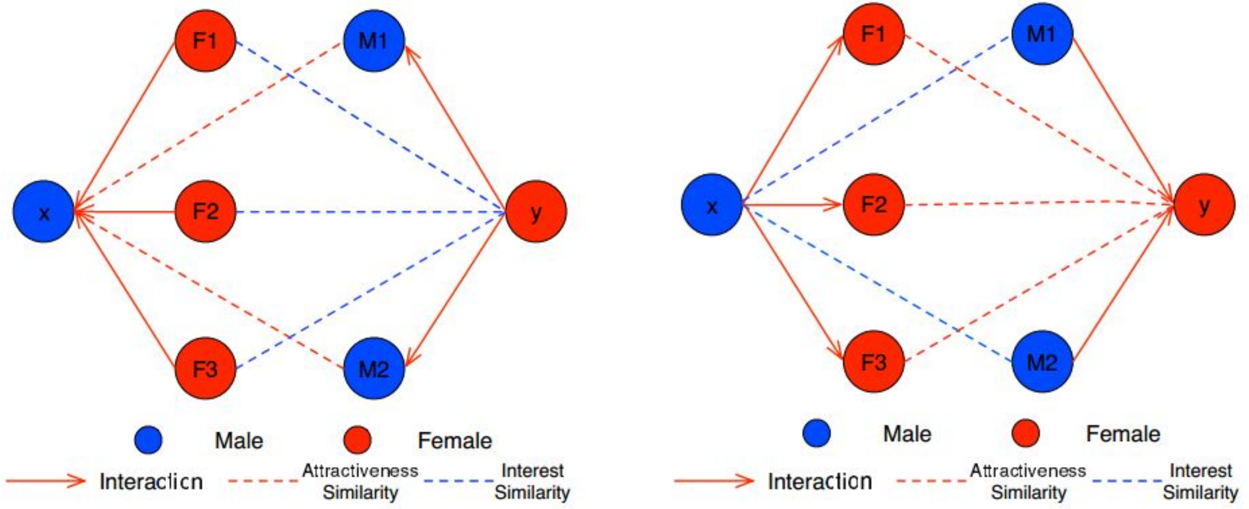
(a) CF1

(b) CF2

Fig. 2. Example of CF1 and CF2 algorithms.

illustrates the mechanism of CF1 and CF2 algorithms. In the example of CF1 shown in Figure 1, service user x sent messages to users F1, F2 and F3. These out neighbors of service user x share similar attractiveness with user y, i.e., user y and F1, F2, F3 received messages from at least one common user. Also, user y sent messages to users M1 and M2 who share similar attractiveness of user x. Therefore, CF1 captures the mutual attractiveness between the service user and recommended users. If the reciprocate score between x and y ranks in the top-K position, user y will be included in the recommendation list for service user x. Figure 2 shows an example of CF2, which captures the mutual interest between the service user x and user y, i.e., user x's interest in user y and user y's interest in service user x.

Putting all together..



(a) CF3

(b) CF4

Thank you :)

References:

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