Abstract

Aggregation of information or opinions obtained from multiple sources often leads to better solutions in different applications. If we want to find which movies a user might be interested to watch, we may consider which movies the user's *friends* have liked or what the *experts* say about the different movies. Today multiple search engines are available for information retrieval. It might be useful to combine the ranked results given by different search engines as response to a user query to produce the final ranked list to be shown to the user. In this dissertation, we have worked on two such application domains e.g. Recommender Systems and Rank Aggregation for Metasearch that use aggregation of information obtained from different sources, and develop algorithms for approaching different problems from these domains.

We consider two different problems from the recommender systems domain. The first problem is the *rating prediction* problem and is relevant for recommender systems where the users provide absolute ratings to different items. The problem attempts to find the ratings for the items that a user has not rated yet. The second problem is the *item recommendation* problem. In this problem, the goal is to recommend a list of items for a user. For these problems, we like to identify a few different aspects that the algorithms should give importance to. Our work on recommender systems focus on two such aspects: the form of user feedback and the time-of-purchase information.

It has been discussed in recent literature that there are some drawbacks of absolute rating based feedback mechanism in recommender systems. In this thesis, we develop algorithms that use *preference relation* or *relative rating* information as user feedbacks. The algorithms can be used with current absolute ratings based feedbacks, as relative ratings can be induced from the absolute ratings. Moreover, if the system allows the users to express their feedbacks as preference relations, then that information also can be directly used by the algorithms. We develop a method that can use preference relations in *neighborhood based collaborative filtering* framework for the rating prediction problem. We propose preference relations based *matrix factorization* algorithms for both the rating prediction and the item recommendation problems.

Which items a user would access from a system depends on the current interest of the user. The interest profile of the user often changes with time, which we refer to as *user dynamics*. While recommending items to the users, the system should give importance to this user dynamics. Similarly, the selling trends of the items also vary with time. We refer to this phenomenon as *item dynamics*. If an item was very popular in the past but does not sell much now, then it might not be a good strategy to recommend that item to many users *even now*. In this thesis, we explore collaborative filtering algorithms that use purchase-time information to address these issues of user and item dynamics for the item recommendation problem.

The rank aggregation problem accepts a set of rankings as input and combines them to generate a single ranking of items. Rank aggregation has been used to approach problems from different domains such a NLP, bioinformatics, metasearch etc. For many of these problems, getting labeled data is difficult or expensive ; hence unsupervised rank aggregation is an important problem to study. Recently, a few datasets have been released that contain supervised data for the metasearch application. In this thesis, we analyze why some of the unsupervised rank aggregation algorithms do not perform well for metasearch on the supervised metrics, and design an unsupervised rank aggregation algorithm that does well for metasearch according to the supervised evaluation measures.

Keywords: Recommender Systems, Rating Prediction, Item Recommendation, Preference Relations, Collaborative Filtering, Non-negative Matrix Factorization, Temporal recommendation, Rank aggregation, Metasearch.