Collaborative Filtering Method with the use of Production Rules

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Abstract — this paper proposes a new collaborative filtering method with the calculation of unknown similarity coefficients between users via the application of production rules, which aims to improve the work quality of recommendation systems, to develop production rules for the developed system. The methods used are: graph theory, the theory of algorithms, mathematical statistics, object-oriented programming, and fuzzy logic. The developed systems are new collaborative filtering methods with the definition of unknown similarity coefficients between users through the application of production rules was developed, software for the implementation and testing of this method was developed, experiments on the developed software was conducted. The production rules to determine unknown similarity coefficients in recommendation systems was proposed. The new method of collaborative filtering with the application of production rules has been developed to find unknown similarity coefficients between users that may be possibly used to improve the work quality of the recommendation system. The conducted experiments showed that the developed method enhances the quality indicators of the recommendation system, such as item space coverage and the total number of predicted preferences of users.

Keywords — recommendation systems, production rules, collaborative filtering, similarity coefficients

I. INTRODUCTION

A recommendation system (RS) is a system used to predict individual preferences of users of some website or an application based on previously collected information about them for creating recommendation lists of items that may be of interest to them [1, 2]. Recommendation systems are an alternative to ordinary data search for users and an additional marketing tool for website owners and apps owners.

Today, there are many data filtering methods for building recommendation systems. Methods of data filtering for building various recommendation systems can be classified into the following types [1-3]:

- collaborative filtering – based on the determining similarity of users or similarity of items; information about ratings of items are used;
- content-based filtering – item descriptions and user profile data are used; often based on computer linguistics;
- knowledge-based filtering – knowledge about user behavior in a system are used; knowledge base for formation of recommendations are used;
- community-based filtering – may apply if a website or an application contains social network elements that allow receiving a graph of user social connections, in this case, information on preferences of his friends will be taken into account when recommendations are creating;
- context-based filtering – the formation of recommendations happens on the basis of contextual information, such as demographic data about a user.

Each of the methods of filtering data for recommendation systems has its drawbacks. Let's examine them in more detail.

One of the most common problems of all recommendation systems is the cold-start problem (CSP) [1, 5]. This problem occurs when a new user is registered in the system, about which nothing is yet known (user cold-start), or a new item is added to the system, for which no one has yet set ratings or attributes (item cold-start). To solve this problem filtering methods are combined into hybrids that may have different hybridization strategies. An example of such a hybrid could be the hybridization of the collaborative filtering method with the content- and context-based filtering methods, in the absence of the cold-start problem recommendations will be generated by collaborative filtering, and in the presence, they will be generated by content- and context-based filtering [1, 6].

CSP may become cyclical in real recommendation systems. This is due to the fact that, for example, already known users can change their preferences over time or as a result of some events. This problem was called the continuous cold-start problem (CoCoS) [5].

The continuous cold-start problem can occur with users (user continuous cold-start) and items (item continuous cold-start) too. It turns out, that properties of items of a recommender system may be changed either as a result of user actions on these items or as a result of a change in users' views on them.

To solve the problem of the continuous cold-start, need to track changes in preferences of users and adapt to them. For the solution of this problem to date, researchers are trying to use machine learning tools [1, 4, 5].

No less important problem of recommendation systems is the filter bubble problem. As a rule, recommender systems create recommendations using only information about possible preferences of users, based on information early collected about them. Consequently, a user receives recommendations list exclusively consisting of items that are similar to items known to him. And he will be fenced off from new to him and possibly important and useful information.