A First Step Towards Keyword-Based Searching for Recommendation Systems

María del Carmen Rodríguez-Hernández[1], Francesco Guerra[2], Sergio Ilarri[1], and Raquel Trillo[1]

[1] Department of Computer Science and Systems Engineering
University of Zaragoza, Zaragoza, Spain
`mary0485@gmail.com, silarri@unizar.es, raqueltl@unizar.es`
[2] University of Modena and Reggio Emilia, Modena, Italy
`francesco.guerra@unimore.it`

Abstract. Due to the high availability of data, users are frequently overloaded with a huge amount of alternatives when they need to choose a particular item. This has motivated an increased interest in research on recommendation systems, which filter the options and provide users with suggestions about specific elements (e.g., movies, restaurants, hotels, news, etc.) that are estimated to be potentially relevant for the user. Recommendation systems are still an active area of research, and particularly in the last years the concept of context-aware recommendation systems has started to be popular, due to the interest of considering the context of the user in the recommendation process.

In this paper, we describe our work-in-progress concerning pull-based recommendations (i.e., recommendations about certain types of items that are explicitly requested by the user). In particular, we focus on the problem of detecting the type of item the user is interested in. Due to its popularity, we consider a keyword-based user interface: the user types a few keywords and the system must determine what the user is searching for. Whereas there is extensive work in the field of keyword-based search, which is still a very active research area, keyword searching has not been applied so far in most recommendation contexts.

Keywords: keyword-based search, recommendation systems, mobile computing

1 Introduction

Recommendation Systems (RS) [4] suggest (relevant) items to users. The suggestions can help to solve certain decision-making problems which are presented to the users, such as which books to buy, which movies to watch, or which online news to read. They try to adapt the suggestions to each user individually, based on his/her preferences.

Existing recommendation approaches usually assume that the type of item needed by the user is accurately determined by using some external procedure (e.g., the user selects an option from a list of predefined types of items). We

argue that this approach lacks generality and is quite inflexible for the user. For example, in a dynamic environment where new data sources could appear or disappear at any time, the available types of items cannot be predefined and collected in a static list of options. Moreover, a solution based on a selection among a list of options could be tedious and uncomfortable for the user, who is forced to use a specific vocabulary and patiently navigate menus.

Therefore, we advocate offering a keyword-based interface to allow users to freely expresses their needs. While intensive research has been performed in the area of keyword-based searching, the application of the proposed techniques in recommendation contexts is rather scarce. For example, we believe that keyword-based searching approaches for relational databases cannot be applied directly for recommendation systems, and so studying the needed adaptations and evaluating them in different recommendation scenarios is needed.

In this paper, we present our work-in-progress on keyword-based searching for pull-based recommendations. In Section 2, we summarize the starting point of our research. In Section 3 we explain our purpose and the novelty of the intended research. Finally, in Section 4 we present the feature steps.

2 Context of the Research

Motivated by the increased interest in *Context-Aware Recommendation Systems* (*CARS*), that take into account context factors (e.g., the time of the day, the location of the user, the weather conditions, the transportation mode used, etc.) in the recommendation process, we aim at the design and implementation of a context-aware recommendation architecture for mobile environments, which facilitates the creation of context-aware mobile recommendation systems through plug-and-play of different components that may be fine-tuned for different scenarios [5]. With this architecture, we intend to contribute to bridge the gap between the fields of mobile computing and recommendation systems. We highlight two modules in the architecture, focused on different types of recommendations:

– Push-based recommendation: a module that supports proactive recommendations, provided without explicit requests from the user. Push-based approaches are usually exploited by context-aware systems that detect some condition in the environment that triggers the appropriate recommendation process (e.g., the user is out at dinner time, and so the user receives recommendations of restaurants and bars in the area).
– Pull-based recommendation: a module that provides explicit (or reactive) recommendations, obtained as an answer to a query explicitly submitted by the user (by using keywords related to the type of item required) and evaluated by the system as a continuous query.

The architecture proposed in [5] is quite ambitious and we are developing it incrementally. So far, we have focused on the definition of the general architecture and the evaluation of approaches for the pull-based recommendation module, assuming that the system already knows the type of item that should be recommended to the user.

3 Purpose and Motivation

We intend to study keyword-based search mechanisms in order to support expressing the necessity of information of the users by using keywords. In the area of Information Retrieval (IR), where generally the data are unstructured (e.g., searching relevant documents in the Web), the problem of keyword-based query answering by using an inverted index has been studied in depth. For structured data, the field of keyword-based search has started to emerge more recently. So, for example, there are several systems that support keyword-based searching over structured sources such as relational databases [8].

Despite the benefits offered by keyword-based search systems, most recommendation approaches assume that the type of item the user is interested in has been precisely identified in advance, and therefore few works apply keyword-based searching in recommendation [6, 7]. Moreover, existing approaches consider mainly unstructured data sources. So, our study combining keyword-based searching over structured data sources and recommendation systems would represent a step forward for the community of researchers in this field, and also an important contribution for the development of our proposed architecture.

Specifically, we would like to adapt the *Pull-Based Recommendation* module with existing or novel keyword-based search mechanisms over structured data sources. This will allow the user to express his/her recommendation needs using keywords. The system will interpret the semantic meaning of the keywords and take into account semantic relations such as synonyms, similar keywords, related actions, etc. (e.g., restaurant – hungry – eat, coffee shop – bar – sleepy, bored – cinema). We argue that existing techniques for keyword searching in relational databases are not appropriate because they focus on a different problem; for example, techniques such as those proposed in [1, 2] are specialized in queries that retrieve information from several tables at the same time (i.e., join queries), and therefore their adaptation or direct application in scenarios where simpler queries are often needed may result in inefficient solutions.

4 Status and Future Work

Our current research focuses on the development of a generic component for pull-based recommendations. Particularly, in this paper we have outlined our work on the definition of a keyword-search component that determines the type of item the user is interested in. We are currently studying different alternatives to build such a component. In particular, we are considering the possibility to use probabilistic approaches based on *Hidden Markov Models* (*HMM*), inspired by works such as [3]. However, we plan to study also the applicability of more classical techniques such as the use of domain ontologies that conceptualize knowledge about different types of items. Finally, pure IR approaches could also be considered if we transform the contents of data sources storing information of items into standard text documents.

It should be noted that we aim at the definition of a general solution that makes no assumption about the types of keyword-based queries that the user

may submit or about the types of data sources available (that provide information about different types of items) or their structure. For example, some available data sources could provide information about a single item, others about several types of items, some may store the information in plain text files, others in relational databases with a table for each type of item or even with a generic table for multiple types of items, etc. Attacking such a generic problem may require combining different solutions that may be appropriate for specific situations. Moreover, applying techniques for query expansion by using lexical resources (e.g., considering synonyms) and automatically refining the query by using context information are also aspects that we would like to analyze.

Acknowledgements

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