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Relationship recommender system in a business and employment-oriented social network

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ABSTRACT

In the last ten years, social networks have had a great influence on people's lifestyles and have changed, above all, the way users communicate and relate. This is why, one of the main lines of research in the field of social networks focuses on finding and analyzing possible connections between users. These developments allow users to expand on their network of contacts without having to search among the total set of users. However, there are many types of social networks which attract users with specific needs, these needs influence on the type of contacts users are looking for. Our article proposes a relationship recommender system for a business and employment-oriented social network. The presented system functions by extracting relevant information from the social network which it then uses to adequately recommend new contacts and job offers to users. The recommender system uses information gathered from job offer descriptions, user profiles and users' actions. Then, different metrics are applied in order to discover new ties that are likely to convert into relationships.

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1. Introduction

Two decades ago, the geographical distance between people was the parameter that had the most influence on our lives; it determined who we related with. We established contacts with people that lived close by, such as neighbors and colleagues. However, this traditional way of establishing contacts changed with the appearance of new technologies and more specifically with rapid advances in social networks. Twitter, Instagram, Google+ and especially Facebook, have changed the way contacts are established and how friends are made.

Among different approaches, the one presented in [46] determines which contacts should be suggested to social network users, by evaluating the level of affinity between their profiles.

Social networks have become more than just a means of communicating and sharing with friends. They have evolved to include the professional environment, expanding the users' work opportunities and possibilities. Social networks such as LinkedIn, Monster or XING, specialize in establishing professional links between users.

The research presented in this paper, focuses on a relationship recommendation system for a business and employment-related social network called beBee [4]. On beBee, companies and users share content, and users search for and apply to

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the published job offers. Therefore, in the case of this social network, our recommender system will not only serve for connecting similar user profiles but also for providing work related suggestions to users and companies.

For this purpose, we identified different factors that could be extracted from the information provided by users, and we analyzed the information found in the published job offers. One of the challenges that we had to address was the extraction of information, since the required information is often not available or it is not properly structured. Thus, it was necessary to apply text mining and information extraction techniques in order to evaluate possible ties between users as well as users and job offers.

These techniques ensure that the job offers recommended to users, correspond to the information provided in their profile; they possess the skills required by the offer, they have been previously interested in similar offers, etc. However, the use of these techniques does not guarantee that the offer suggested by the system, satisfies all user expectations.

To provide accurate suggestions, it is important to analyze the reasons for which a particular user could reject or accept a suggestion. To do such an analysis, it is necessary to employ techniques such as case-based reasoning (CBR), which allows to feedback the system with information on previous cases. CBR is a problem solving methodology and its use in this project is essential since it will allow the recommender system to learn and improve over time by re-using similar past experiences which are stored in cases [30].

To evaluate the proposed system it has been divided into two parts: user-user relationships and user-job offer relationships. Different subsets of real and active users, as well as recently published job offers, have been selected to gather information for this evaluation. The results obtained in this evaluation are satisfactory.

The rest of the article is structured as follows: in the background Section 2, we make an analysis of the previously proposed relationship recommendation techniques for users in other environments. We also examined different information extraction and classification techniques for unstructured texts. In Section 3, the proposed system is described and in Section 4 the results of its evaluation are presented. Finally, conclusions are drawn on the performance of the proposed system and future work is discussed in Section 5.

2. Background

Three main technologies have been used in this work: Recommender Systems (RSs); their mechanism determines possible relationships between users and provides the system with suggestions. The use of text mining is crucial for the extraction of the different factors that can be contained in an untagged or tagged text, these factors are necessary for detecting affinity. The third essential technology are Virtual Organizations (VOs) of agents which allow the system to obtain the best solution; their modular basis provides the system with great independence when applying all these methodologies.

The rest of this section describes the role of these three technologies in similar studies found in the literature.

2.1. Recommender systems

The overwhelming amount of information on the Internet has made RSs a very important tool for those who provide information, as well as those who receive it; the users. RSs consider users' personal preferences, guiding them in a large space of possible options, to those items that they may find interesting or useful [10]. The implementation of RSs on the Internet has increased and with it, their application in different areas [35]. Among others, RSs have been deployed in contexts such as e-Commerce sites [44,45], online and mobile advertising [9], real time broadcasting [36], general and specific rating sites [2] and social networks [32,34]. Due to the large number of contexts, many different methodologies have been proposed.

In the context of the present work, we will focus specifically on social RSs. The popularity of social media sites causes an immense production of content, and users have to be helped to view or access the information they are interested in. Thus, social RSs aim to reduce the information overload for social site users. In addition, the ability to find the content we are looking for easily can encourage users to keep using the network, which means that recommendation technologies can play an important role in the success of social networks and the social web as a whole, assuring that each user is provided with content that they personally find interesting and attractive.

Therefore, this type of RSs use techniques that adapt to the needs and interests of individual users or groups [26] recommending content to [43] other users [46] or other groups [11].

Collaborative filtering is an approach used in social RSs [22]. This technique keeps track of users' likes and dislikes on the basis of their Internet history and it is usually used with other filtering techniques like content or social knowledge-based techniques [6].

Knowledge-based techniques are able to feedback the system and provide each user with better solutions. An example of knowledge-based technique is case based reasoning, which can be used in recommendation systems to exploit user histories, [8]. CBR systems rely on the knowledge they obtained from previous cases, when analyzing and finding solutions to a new problem. They do this by using algorithms to search, retrieve, compare and adapt a problem to a similar situation from the past. A case is defined as a past experience and is composed of: the description of the problem, the solution and the result [18].

Moreover, the evolution of RSs has shown the importance of using hybrid techniques [10]. In addition to knowledge-based techniques, using content-based techniques is really useful. Determining context information is an important factor

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