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On Measuring the Role of Social Networks in Project Recommendation

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***Abstract*—** With the emergence of Internet technology, users have started exploring, connecting and socializing themselves on the social media anywhere and anytime. Social networks have reformed the means we communicate. Online social networks are gaining importance due to the generation of large metadata that was never possible before. With this metadata from social networks, recommender systems gain benefit to determine rating preferences of users. Nowadays, social networks are also becoming useful in academics. They promote collaborative learning between students. This paper inspects the role of social networks in recommending projects to students. We propose a system that uses social network information of students to generate recommendations. We use several factors which play essential role in project recommendations. The contextual information from user profiles and the tags that are used by projects for reviewing, rating, tagging or contributing are employed. These tags are then used to extract the most relevant tags on the basis of the factors considered.

***Keywords*—**Recommender system, Social networks, Collaborative learning

I. INTRODUCTION

With the emergence of Internet technology, users have started exploring, connecting and socializing themselves on social media anywhere and anytime. Social networks have reformed the means we communicate. It is easy to connect with anyone, share their experiences and preferences, organize events, and recommend items or information and many more. The success of delivering knowledge to the students is highly based on the procedure of teaching. The infrequent usage of social media in the field of education impedes the quick flow of information. Nowadays, social media plays a significant role in enhancing learning and education. In the modern age where vast amount of data is generated every second, it becomes difficult to select relevant items from the overwhelming set of choices. Many of the times it is difficult to reach a decision without having prior knowledge about the items. The result is that people rely on the advices or recommendations of their friends or some expert. Moreover, teachers are becoming responsive about the need of social networks and collaborative learning in education. Project assignment to students is an important task in undergraduate courses. Collaborative learning and involvement of social network information play a significant role in assigning projects to the students based on their interests, technical skills and eagerness in learning new things in specific areas.

Collaborative learning is "a situation in which two or more people attempt to learn something together" [1]. Recommender systems have been proved helpful in automatic assignment of projects. Recommender systems are important information filtering tools in recommending relevant, interested and striking items to users [2]. This paper uses content filtering approach to design a project recommendation system. The proposed system considers congruent factors that are responsible for generating relevant recommendations. We also propose algorithm that harness contextual information and tag from social users to extract the tags to discover interesting projects for the corresponding student.

The rest of this paper is structured in the following style. Section II gives the overview of recommender systems. Section III discusses the role of social network analysis in recommendation. Section IV surveys the related work of recommender system in education. Section V discusses about the proposed system for building project recommender system. Lastly, Section VI concludes the paper.

II. RECOMMENDER SYSTEM

A recommender system (RS) is an information retrieval system that compares the user profile with profile of similar users or it use the past history or behaviour of the user to recommend items. The rating matrix is used to determine the preferences of a user for an item. Recommender systems play a vital role in handling the problem of information overload [2]. Collaborative filtering, content-based filtering and hybrid filtering are the widest used algorithms in recommendations. Collaborative filtering based algorithms are inspired from the idea that similar user have similar tastes. Content-based filtering algorithms use the past behaviour of users whereas hybrid algorithms exploit the concepts of both these

algorithms to build a better recommender system. Other recommendation algorithms such as knowledge-based, co-occurence based, demographic based algorithms have also been applied to build better RSs. But traditional RSs were primarily based on collaborative filtering or content filtering or hybrid filtering algorithms. Unfortunately, traditional recommender systems undergo various issues such as data sparsity, cold-start and trust [3, 4]. Traditional recommender systems use preferences of similar-minded people or use past activities to generate recommendations to users. Furthermore, anyone can build fake profile with the aim to give false ratings due to which users prefer trust relationships. Social networks come to the scene where users connected to others possess some level of trust between them. Social networks assist in eliminating the issues of recommender system. The social relations from the social networking sites improve the relevancy of recommender systems. The rapid advancement in social networks has intensified the usefulness of social recommendation. Recommender systems using social network information help in collaborative learning as trustful relations are more reliable than ordinary relations.

III. SOCIAL NETWORKS

Social networks have become a platform to organize, share, promote and enhance various courses, projects, books, events and other learning material. Generally, social networks are built by the users sharing similar activities, backgrounds and interests. When two users are connected in a social network, we call the connection as the link and users as the nodes. In the 21st century, students frequently use social media to communicate and learn [5]. The multiple types of social networking data play a major job in knowledge discovery, information dissemination and application development. Community structure is an inherent feature of social networks. Community detection is an important task of social network analysis [6]. Community is a group of people sharing similar tastes to people inside the group and less similar to people outside the group. Figure 1 shows a social graph where users are connected.

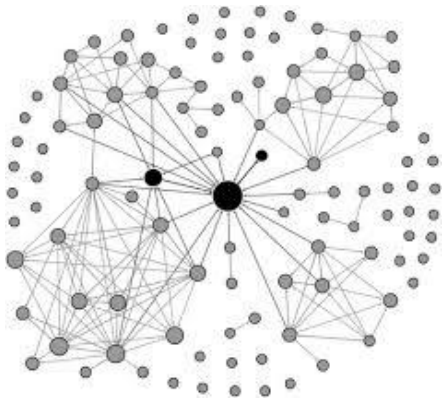

Figure 1. Social users graph

Communities play an essential role in assigning projects to students with similar skills and other similar factors. Paper sharing through Mendeley is one of the popular examples of recommending papers to communities. However, such recommendations are context-aware. When social networks information is integrated in recommender system, it is known as social recommender system [7]. Social networks and recommender systems share mutual benefits. Another important task in social networks is link prediction which is closely related to recommendation. Predicting potential and upcoming links in social networks increases the efficiency of recommender system [8]. Such prediction ultimately helps in education recommender systems.

IV. RELATED WORK

Social media is recently becoming prominent in academics and a number of factors are responsible for the effective use of social media in academics [9]. Social networks improve collaborative learning, communication and encourage education in higher education [10]. Rana and Jain [11] have used content filtering approach to propose a book recommender system. Their system employs user's preferences and diverse recommendations. They have also added temporal dimension that counts the number of times a book is preferred or chosen by a user. Authors in [12] investigated the differences between general RS and educational RS. Tang and McCalla [13] used collaborative filtering approach to propose paper recommender system. Their RS is based on the following parameters: overall performance, peer recommendation, value added, learner interest, background knowledge. Recker et al. [14] have highlighted the dual purpose of collaborative filtering approach in education. Collaborative filtering is proven helpful to educators and learners in discovering useful material. This approach is also effective in bringing similar-minded people together that ultimately assist in the process of learning. Alwi et al. [5] have performed a survey and investigated the frequent use of social media by undergraduate students. On the other hand, authors in [15] have highlighted the impact of collaborative learning in modern education system. Recently, Shokeen and Rana [16] studied the benefits of incorporating trust and social networks into recommender systems to alleviate the issues of data sparsity, cold-start and fraud. They have discussed various factors, properties and metrics of trust for computing trust in social recommender systems. On the other hand, Sharma and Gupta [17] proposed a method to find and track the growing user profiles on websites. They used the web log record method to mine the patterns usage.

V. PROPOSED WORK

Most of the recommender systems are based on user's profile similarity or item's similarity to generate recommendations.

Our proposed system use social network information and temporal details to give project recommendations to the undergraduate students. The social network information gives details about the closeness and interest similarity of users. The temporal information further improves the quality of the recommender system by updating the changing requirements of users. Diversity is an important parameter in providing new and prevailing projects to the students [18]. Table 1 lists different factors affecting project recommendations and the level to which these factors influence in generating recommendations. The level 5 signifies the factor influencing the most in recommendations and the influencing power decreases as the level decreases.

Our proposed work harnesses these factors for recommending projects. However, the level to which these factors may influence the project recommendation to students is different for different students. The factors that are likely to affect the recommendations are given high weights. In the proposed system, user interest, novelty and resources are given more weights than other factors. These factors reveal the current areas of students. The curiosity and awareness about certain specific topics in a field or area depict the interest of the user. Generally, the interests of a user indicate the current fascination of the user for those areas. Technical knowledge is another factor that affects project recommendation significantly. Technical knowledge of a user is the ability and intelligence of that user for a particular technology. For example, a user having technical knowledge in deep learning and robotics are expected to have interests in the related areas that uses deep learning technique in robotics. However, in rare cases, users may switch to different technologies and areas. Automatic recommendations cover the suggested projects by automatic recommender systems. User profile is also a factor that influence in suggesting projects. However, the attributes retrieved from user profile such as demographic attributes, background and languages known influence the least in case of suggesting projects. Here, past interests include the past projects undertaken by students. In real-world scenario, students who have already worked out on some projects have knowledge regarding those areas and are most probable to extend their previous works. Novelty of projects is an important parameter in impacting recommendation of projects as novelty of projects represents the recent and significant projects playing a vital role in the development. Lastly, we employ resources as the principal factor. Here, resources imply the tags, ratings, thesaurus, contributors, reviews and content provided by the users.

Table 1. Factors affecting Project Recommendations

Factors	Description	Level
Interest	This includes curiosity and awareness of students towards some topics	5
Technical knowledge	The abilities and information related to technology	4
Automatic Recommendation	The suggested projects by recommender systems	3
User profile	It includes all primary features such as language, demographic and background	3
Past interest	It includes the previous projects undertaken by students	4
Novelty	The recent and significant projects playing a vital role in development	5
Resources	Tags, ratings, thesaurus, contributors, reviews and content	5

A. Proposed System

We describe here the overview of the proposed project recommendation system as follows:

The project recommendation system is divided into five phases:

1. Raw data collection
2. Pre-processing of collected data
3. Incorporating social network data into processed data
4. Interpretation of data
5. Generating Recommendations

In the first phase, the user collects the raw data from the websites and analyzes that data. The data collected is a set of different projects in different fields such as cloud computing, artificial intelligence and pattern recognition. The user registers on the website and creates its profile which contains personal information about the user and the projects that are already liked by the user. After the user logins to the system, the system investigates user behaviour using his or her navigation pattern. In the second phase, the system analyzes this information and uses content filtering approach to analyze different factors responsible for project recommendations. In the third phase, the system uses social network information to match user profiles.

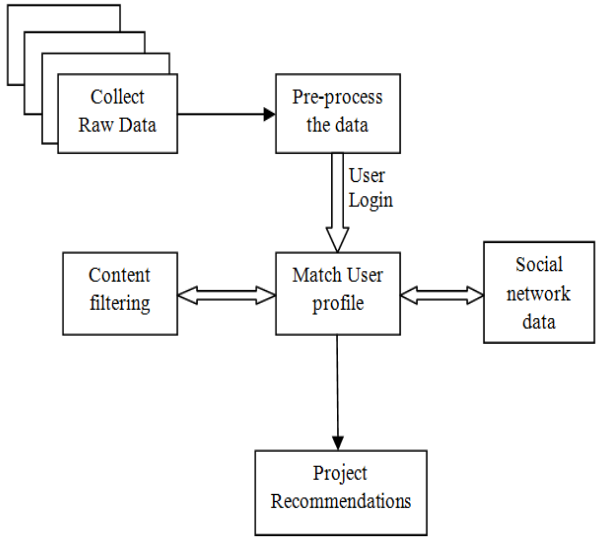

Figure 2. Proposed System for Project Recommendation System

In case the user is naïve to the system, the system relies on the information obtained from social networks. The social network information is used to predict user's interests based on the preferences of his direct or indirect friends. In the fourth phase, the system exploits the factors: interest, technical knowledge, automatic recommendations, user profile, past interest, novelty and resources. The system interprets these factors and also uses students' current interest, events followed and other recent activities to give recent and meaningful recommendations. In the final phase, the system performs revised analysis to refine the results and generate top-N recommendations for different types of projects that may interest a user.

The system uses categorical data such as tags to measure preferences of social users. In the proposed system, we use Robust Clustering using Links (ROCK) algorithm [19] to measure similarity between tags. ROCK algorithm is best suited for categorical data and uses links for similarity measurement. It calculates the tags similarity using Jaccard coefficient as a similarity measure. It is a hierarchical agglomerative algorithm that clusters the categorical data. Moreover, ROCK algorithm can handle the outliers effectively. Here, outliers are the tags that are less similar to other tags. Therefore, such tags can be discarded from the set of extracted tags. Table 2 shows the steps of ROCK algorithm in the proposed work.

Algorithm: ROCK

1. Create a cluster for each tag from the set of extracted tags.
2. Merge the clusters if they meet the goodness or similarity measure.
3. Repeat Step 2 until the clusters remain the same in further iterations.

Algorithm: Project Recommendation using Social networks

Input: $U = (u_1, u_2, ..., u_n)$ set of N social network users
$P = (p_1, p_2, ..., p_m)$ set of M projects
$NOV = \{nov_1, nov_2, ...\}$ set of recent, novel and useful areas
P_UI = User interested projects
UP = User Profile

Output: Interested Projects to user u_i

previous=0
for each user $u_i \in U$:
do
Gather information from Social Users:
UP = Collect contextual information to compose User Profile
tag=0
start: RecommendProjectsToUser(UP)
ExtractTags(UP)
ActivationSet=tags
For each project p_i in User's resources:
if user u_i tagged or reviewed or rated or contributed in a project p_i then
tags= ExtractTagsFromproject(p_i)
Add(tags,ActivationSet)
Call *ROCK*
InterestedProject = Activation Set
Add(p_i,InterestedProject)
if project $p_i \in nov_i$ and $p_i \in P\_UI$
Add(p_i,InterestedProject)
Recommend(u_i, p_i)
else
end

VI. CONCLUSION

A voluminous research has been done in recommender items in different domains. It is an active research area where profound work is still required to advance the process of learning. Also, the recent growth in social networks is beneficial in improving the capabilities of recommender systems. In this paper, we have inspected the role of social networks in education domain. We discussed how social networks can help recommending projects to students by using the content filtering approach. We proposed a project recommendation system and an algorithm that employ information of social users and different factors that are responsible for recommending relevant projects. The tags extracted from the profile of users and the tags that are being used in the projects for rating, contributing or reviewing are used for finding interesting projects. However, the interested projects further depend on different factors. For the future

work, we would like to implement this algorithm on the real world dataset and measure the efficiency of this algorithm.

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