



Short communication

## Case-based reasoning for identifying knowledge leader within online community

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### ABSTRACT

Case-based Reasoning (CBR) has been extensively used as its capability to reuse previous solvable problems in recommending new solution through its adaptation strategy. In our work, CBR is chosen as the strategy to identify the leader of specific domain within the online community based on the profile that was developed through one's social participation and contribution as well as feedbacks from the community, called CBRIKL (CBR for Identifying Knowledge Leader). CBRIKL continuously builds leader profiles based on the identified knowledge domains and problems are assigned to them based on their expertise. The novelty introduced in the paper is on building a user profiling based on mixed sources in identifying leader and measuring and comparing strategy on expertise skill set in locating new knowledge leader. The methods and approaches that are developed are made to be usable to other problem domains

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### 1. Introduction

Online communities are formed in an organizational setting or personal-driven setting (Criado, Rashid, & Leite, 2016; Liao, Chu, Chen, & Chang, 2012). The former describes a community where members are assigned based the virtue of their position in the organization for a specific purpose and the duration of the membership in the online community group last until the completion of the tasks. It is characterized as exclusive in membership, well-focused on the topic of the discussion and short-lived in duration. The examples of these are such as student work group, organizing committee or project collaboration. The latter has an open membership with a common interest on some topics to be discussed but the discussion is not focused towards achieving specific goal. They are social volunteer group or special interest group where their involvements are based on the personal effort and interest and the mode of discussion inclines towards knowledge sharing and creating awareness. In both situations, the leadership emerged within the online community is volatile and dynamic compared to physically connected community setting where leaders are usually determined through formal appointment. Identification of leaders in online environment has been attempted previously by Akbar Hussain (2010) using binary search, Shafiq, Ilyas, Liu, and Radha (2013) using LUCI method and Lü, Zhang, Yeung, and Zhou (2011) using Leader Rank. Each of these techniques are

different in terms of classifying the leaders and differentiating the types of leaders (Emilyn & Keerthana, 2015).

In our observations, the focuses of these techniques are different and their applications are useful for their own unique context which are different with our efforts. The first differentiating factor in our work is the context of application where the online learning community is within the same environment on a single platform such that members belong to the same organization or group such that their profiles which describe their formal qualifications and skill-based certification are known and are used as source of identifying their capabilities. These information is usually maintained by human resource department. In an open environment, such as Facebook, Linked and others, collection of data to form a unified set of expert profile would a challenging task due to uncertainties of the availability of some important sources (for example, completion of information on user profile is not regulated and monitored and hence identification of an individual's skills and competencies can be dampened with lack of accurate details). The second differentiating factor is on the mechanism for substituting the leader in a progressive manner based on the accumulated score which is calculated based on two-sided sources. First side will be the community who provides direct feedbacks based on the contextual knowledge of the member and social network analysis (SNA) which is a generated information based on the network connections (for example, a person who has been referred mostly in his/her posting in a e-forum and responded to every reference indicates that s/he is leading the discussion group). Unlike in the traditional organizational setting where formal appointment of a leader is based on recommendation of higher management

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and the position is rather permanent, in the online community, recognition of a leadership must be earned through the support from the majority members of the community. For this, the existing (SNA) techniques can be used to complement our needs and enhance them with dynamic capability to allow continuous monitoring of leadership performances and replacement with the better candidate in leading the group when necessary. The third differentiating factor is to use the cases which present the profile of the potential leaders and the past performances of group members that could be used to recommend the potential candidate as suitable leader for solving problem of a specific domain. Case-based reasoning (known as CBR) has been deployed in various domains for recommendation purposes (Marling, Montani, Bichindaritz, & Peter, 2014; Yurin, 2012). CBRIKL uses CBR concept to store the records of the leaders of several domains as cases and use these profiles to select the best candidate for a given problem and make a recommendation the most probable knowledge leader.

In the subsequent sections, we explicitly state the problems, relate our work with the previous work to emphasize the gap, demonstrate how profiling can be done in CBR context, explain the CBR processes, briefly describe how knowledge domain can be built and finally illustrate the overall process of CBRIKL.

## 2. Problem statement

Identification of a leader has been a research area by itself in the traditional setting of an organization and we believe that online community would pose new challenge in this respect. It should be clearly differentiated between leader in the context of management role and “knowledge leader” who is the subject matter expert leading a community as result of his/her expertise in the field. We adopted three attributes of knowledge leader that was discussed by Debowski (2006) which are knowledge motivator, knowledge facilitator and knowledge communicator. The three attributes are selected as we believe relevant data can be captured in the online environment such that these attributes can be interpreted. Hence, the problems that we are addressing in determining the knowledge leader are categorized as follows:

Problem 1. Knowledge leader is determined based on information from various online sources such as one’s social internet networking, online forum participation and contribution to the learning and feedbacks from the community. The challenging aspect is the mechanism to structure these sources of information as the standard features in building CBR cases;

Problem 2. In the online environment, knowledge leader is identified in a progressive manner, that is the attributes and qualities are measured in a continuous process on a short interval. Hence, an architecture to support this process is required to demonstrate the overall work processes with the integration of CBR component.

Problem 3. The approach of using CBR for determining knowledge leader in a dynamic fashion is novel, hence we need to demonstrate how CBR is applied in this problem domain.

Literature has not shown any attempt to use CBR in identifying knowledge leader but few related efforts in determining the technique to identify leaders in various online forum structure, such as virtual communities, online blogs, social networks and discussion forum. The following section describes how the past works are different with our approach and they can be reusable in CBRIKL architecture.

## 3. Related work

Identification of a leader has been a huge area of research by itself and the focus of this paper is on online environment. Zhang and Dhong (2008) attempted to identify Opinion Leaders (OL) in

a virtual environment where OL is measured using three procedures, namely i. identifying a person who has lots of followers based on certain topics; ii. investigating the online group members on the opinion of whom they think their leader is iii. determine one or more leaders based on the information gathered in i and ii. Their work proposed the use of matrix to plot the respective response of the members to an individual in recognizing one to be an opinion leader. UCINET (Social Network Analysis software) was used as the tool to compute the centrality value in determining the person with the highest followers. Shafiq et al. (2013) used Longitudinal User Centered Influence (LUCI), a modified method of Friedkin-Johnsen Influence Model to determine leaders who are extrovert, introvert and followers or neutrals depending on the period of the interaction on the social network clusters. However, it is stated that the content of the interactions among the members was not used as part of the analysis due to confidentiality issues on the content of the discussion. Hence, the opinion leader selection is based entirely on social network analysis. Akbar Husain (2010) also analyzes on social network graph using binary approach to determine a node representing follower or leader depending on the spillover value. Again, this approach uses social network structure as the basis to differentiate between leader and follower using centrality measures based on the three values: degree, between-ness and closeness. Lü et al. (2011) investigated the most influential users on online social network using LeaderRank and PageRank algorithms. Their report showed that LeaderRank is more suitable for determining ranking of the social member compared to PageRank due to its tolerances to missing links, dynamism of the social structure which occur in social network. Jeba and Keerthana (2015) studied and made comparative analysis on four algorithms based on the computational complexity and method used. Other relevant work that is worth to mention is by Meo, Ferrara, Fiumara, and Provetti (2013) who attempted to detect the existence of group within a community within a large-scale network. Another quantitative approach in analyzing the popularity and influences is on bloggers by Khan and Daud (2017). The influences of bloggers are calculated based on the in-link and out-link and the activities such as number of postings and responses.

In our view, there have been great efforts from various researches to investigate the SNA algorithms in analyzing network pattern to identify leaders in the network. However, these attempts do not regard the context and content of the discussion among the members as they depend merely on the graph topology and structure. These are graph-based algorithms that analyze the syntactical structure of the nodes, hence, the semantic aspects such as context of the relationship between leader and follower, the relevancy of the content of discussion of two members and whether the relation can be recognized as between a follower and a leader and the issue raised on whether merely addressing vertices-edges connections are sufficient to determine the leadership of an individual. While we do not refute the usefulness of the work, the output of these social network analysis is essential as feeder to our proposed system.

## 4. Leadership profiling through CBR

Literature has shown that Case-Based Reasoning (CBR) has been used for profiling such as mail hacker profiling, user profiling, complexity profiling and customer profiling (Craw, Massie, & Wiratunga, 2007; Park, Kim, & Kim, 2015; Schiaffino & Amandi, 2000; Waszkiewicz, Cunningham, & Byrne, 1999). It is reported that the profiles are kept as case problem with recommended solutions which can be reused if the case query has an exact match with the existing case problem; otherwise, an adaptation process is applied on the recommended solution. Subsequently, new case

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