Modeling SNA result to improve learning community

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Abstract

The use of Social Network Analysis (SNA) for online learning communities’ analysis is common and usually performed after the ending of semester. Yet, even if such analysis is very useful, it is costly, and cannot be performed many times during the semester. In this paper, we present a model of automated SNA based inference, for a large-scale community, taking into account specific environment of developing higher education system. The model is designed so to send automated reminders to all users, according their activity in the period of two weeks. One additional analysis after the mid-term exams checks if activity matches performance. It has crucial role in directing both students and educators towards the common goal: success at the final exams. The presented model enables inference on user attributes, which are stored in student model ontology. As such, the model is a step in the development of semantic and adaptive learning environment.

1. Introduction

In the past years, we were involved in analysis of a large-scale online learning community at the Faculty of Information Technologies - FIT in Mostar, Bosnia and Herzegovina (BiH). We investigated the topology of the communication, and it turned out to be a scale-free, small world network (Bijedic and Burak, 2006). Investigating the network properties, we proved that parts of FITCS (FIT Community

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Server) provide knowledge sharing (Hamulic and Bijedic, 2009, Bijedic and Hamulic, 2009). In addition to this, we recently presented a semi-adaptive e-learning model suited for the limiting environment of Bosnia and Herzegovina (Radosav et al., 2010). All of these efforts are aiming to increase quality of higher education in post-war Bosnia and Herzegovina, especially concerning the new trend of online learning.

In this paper, we use the previous results to offer a model for automation of SNA results as inputs to adaptive learning management system. We base our model on FITCS, but it can be used for other large-scale learning communities.

The model deploys two types of analysis: periodical activity analysis, and mid-term success analysis.

The first aims to motivate all users to share knowledge in a proper way.

The second is supposed to help all users to improve performance, and is mostly based on mid-term exams results. Both are expressed in algorithmic form, for the sake of better understanding.

We are also addressing some specific problems for BiH environment, such as high drop-out rate, underdeveloped labor market, etc.

Concerning the students, there exists significant lack of motivation and high dropout rate, which are the results of underdeveloped labor market in the country. Such situation results in significant number of spammers in the online learning community, and we treat such students in an adequate way.

The situation with educators is quite similar, due to brain-drain. There is significant lack of teachers, so it is very difficult to work in small groups. In practice, one educator is responsible for at least fifty students, which makes it very difficult to monitor student’s progress. Since it is impossible to perform SNA many times during a semester, we here present a model in which automated inference should help all users of an online learning community to improve performance (Pardanjac et al., 2010).

2. Model of communication

2.1. FITCS

FITCS exists for more than five years now. It was originally designed for distance learning students, but in time, it became the most popular way of communication for all FIT students. FITCS consists of several units, and one of them is reserved for communication on curriculum subjects. That part was designed for knowledge and information sharing. FITCS is now numbering around 800 active students. Their communication is grouped by the semester of study, where students can exchange experience on subjects, and personal interests, such as computer networks, security, etc.

In our previous research of online knowledge sharing, we explored the parts of FITCS concerned with first year subjects.

The reason for choosing freshmen was simple: they need more help at the beginning, and if their knowledge sharing works out, we argued that the rest certainly will too.

Additionally, in order to analyze behavior of large groups, in the end we focused on freshmen (average of around 250 active users per year), and the most difficult subjects from both fall and spring semesters.

Therefore, in this paper we base our model on those experiences.

2.2. Social network model

For the purpose of our research, we explored various possibilities and modeled communication at FITCS as directed and undirected, weighted and non-weighted graphs, but in the end, we chose the
undirected non-weighted graph, where students and educators are nodes, and communication in one topic links all of the involved users.

We argued that it is not important who is answering to whom, or who initiated the topic, but that the importance lies in the fact that all users share interest in the topic. That is the reason we chose undirected graph. In addition, since users communicate inside one topic, we argued that the topic is the smallest unit and we did not weight the links, for it was irrelevant. Nevertheless, we suggest attaching the number of posts in the sub forum to each user.

3. Data analysis

3.1. Types of analysis

In this analysis, we suggest usage of the node degree, and number of posts for both students and educators, and students’ success at the exam.

We suggest calculating the node degree for each user, and ordering the degrees from highest to lowest. Furthermore, since we expect our network to be scale-free, we suggest dividing degree sequence into quartiles, and we base further inference on such division.

The user with node degree much greater than the rest (approximately among top five to ten, depending of number of users) we call hub.

Hubs are users that are very communicative and enthusiastic, and can be either students or educators. If educators are hubs, than their position in the forum is said to be too enthusiastic. It is known that educators should be moderators in the network. For the purpose of this research, the above means that their degree should be in second or third quartile and that they should write not less than one and not more than two posts per day on average.

From our previous research, we identified two types of student hubs:

e. users that post content relevant to the topic, and should be identified as potential demonstrators, and
f. spammers.

Nodes with degree zero we call isolated users; those users posted a topic and got no answer, and they did not participate in any other topic.

The difference in number of posts is related only to the previous analysis; initially it is set to zero.

In order to identify behaviour of students, in some parts of the analysis we include their results at exam (student’s success).

The model proposed in this paper results in structured data source. Structured data is easy to store in data layer adjusted to semantic and adaptive learning environment. The student model ontology (Figure 1) that is structuring student data contains a class RoleInSN. This class is reserved for data storage on the role of student in the online learning community (or social network), and implicitly on socialization. Such a data source is very useful for inference necessary in learning environment adaptive characteristics development (Radosav & Junuz 2011).
There should be two types of the analysis:

- periodical activity analysis, the simplest, performed twice a month,
- success and activity analysis, performed after the mid-term exams, and

For periodical activity analysis, we suggest exploration of node degree and number of posts for each user. This analysis should provide insight into activity of both students and educators, and should provide outputs in the form of automated messages to all users.

The success and activity analysis provides insight into the success of the knowledge sharing community. We schedule it after the mid-term in order to help students improve at the final exams, if needed. The outputs are three types of messages:

- prizes for successful students, and reminders for unsuccessful ones,
- messages to educators concerning both successful and unsuccessful students, and
- messages to educators, concerning their role.

The records of all performed analysis for each user should be stored, and sent to relevant department after the end of semester:

- reports for students to their tutors, and
- reports for educators to management.

4. Model for inference

For the simplicity, we present inference in the form of algorithm.

4.1. Periodical activity analysis

4.1.1. Inference on educators’ activity

IF ( (degree in the lowest quartile) OR (the difference in number of post is less than 10) )
Send reminder to communicate more;
ELSE
  IF (educator is hub)
    Send reminder to communicate less and become moderator;
  ELSE
    Send note to keep up the good work.

4.1.2. Inference on students’ activity

IF (degree in the lowest quartile)
  IF (difference of number of posts greater than 10)
    Send reminder to keep up the good work (students active within a
    group that suits them);
  ELSE
    Send reminder to student to communicate more;
    Send reminder to educator to check the situation, and offer
    alternative ways of tutoring if needed;
  ELSE
    IF ((student is hub) OR (difference of number of posts greater than 30))
      Send reminder to educator to check content of hubs’ posts;
      IF (content is not spam)
        Send reminder to student to keep up the good work;
        Send reminder to educator to monitor the student’s activity
        (student is potential demonstrator);
      ELSE
        Ban user for seven days! (this is a spammer).

4.2. Success and activity analysis

The inference on educators’ activity is the same as in 4.1.1.

4.2.1. Inference on students’ activity

IF (student is successful at the exam)
  Send note to keep up the good work;
  IF (student is hub)
    Send note to educator to pay special attention to the student;
  ELSE
    Send reminder to educator that this student is not interested in such
    way of learning and knowledge sharing;
  ELSE
    IF (student is hub)
      Ban from the forum till the end of semester (this student is
      spammer);
    ELSE IF (student’s degree in lowest quartile or zero)
      Send reminder to educator to check on this student’s status, and
      offer alternative help.

5. Conclusions

This work presents a model for automated inference based on SNA in a large-scale online learning community, FITCS. The goal of the model is to improve performance of students at the final exams. The SNA part is concerned with the data modeling and deployment of basic graph characteristics in order to
analyze activity of online learning community users. Additionally, we also analyze success at mid-term exams, in order to improve students’ performance, if needed.

The model is designed to monitor activity of students and educators in periodical activity analysis. The outputs are in the form of reminders sent to all users according their activity. The outputs are cumulated, and at the end of semester, they grow into the report of users’ role.

The additional analysis, after the mid-term exams serves to checks if activity matches performance. It has crucial role in directing both students and educators towards the common goal: success at the final exams.

The presented model enables inference on user attributes, which are stored in the proposed student model ontology. As such, the model is a step in the development of semantic and adaptive learning environment.

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References


