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A Students' Mutual Evaluation Method for their Reports using PageRank Algorithm

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Abstract: Nowadays, mutual evaluation in education is an available method that students in the learning community use to evaluate each other. The method calculates scores of students' reports by considering who evaluates those reports. In this paper, we propose a student's mutual evaluation method using the PageRank algorithm, an appropriate evaluation method that helps teachers to easily understand whose report is the best from the students' viewpoints. In particular, we perform students' mutual evaluation based on a groupware by utilizing a "Like" function in a course practice. As a result, it was able to not only provide an overall rating from the students' sum of votes but also, by considering who voted, to promote the reliability of the students as evaluators for their mutual evaluation.

Keywords: Mutual Evaluation, PageRank Algorithm, Groupware

1. Introduction and Motivation

Currently, teachers need to evaluate several student reports after their lectures. Teachers are challenged by not only evaluating reports on multiple topics, but also by a multitude of student viewpoints. Therefore, student reports need to be evaluated from several viewpoints. A great deal of time and effort is required for a fair and multi-faceted evaluation of the reports.

In this paper, we introduce a mutual evaluation method to enable students to evaluate their reports using information technology. In this method, students perform report evaluation instead of the teachers, which produces a positive effect in the students towards education. Therefore, we develop a students' mutual evaluation method using the PageRank algorithm, which provides a graph illustrating which reports received "Like" votes and from whom. During a course, the following steps are followed: 1) Writing reports after lectures, 2) evaluating reports written by other students and voting with a "like" button using the online groupware system; and 3) Receiving votes for their own reports." Therefore, the students obtain the perspective of an evaluator; which promotes their ability of both writing and evaluating reports.

The next section describes a PageRank algorithm and the proposed students' mutual evaluation method. In Section 3, we summarize the results of the students' mutual evaluation method in a course practice. Finally, in Section 4, we conclude this paper with suggestions for future works.

2. Students' Mutual Evaluation Method using PageRank Algorithm

2.1 PageRank Algorithm

The PageRank algorithm is used by Google Search to rank websites in their search engine results. It is a method of measuring the popularity of webpages. According to website ranking, the PageRank algorithm counts the number and quality of links to a page to determine an estimate of the popularity of the website. A link structure of the Web is shown in Figure 1(1).

- Back link: A page that links to other pages is called the back link of the other pages (e.g., *A* is a back link of *D*), which indicates that the back link recommends (is related to) the other pages, and they are important for the back link.

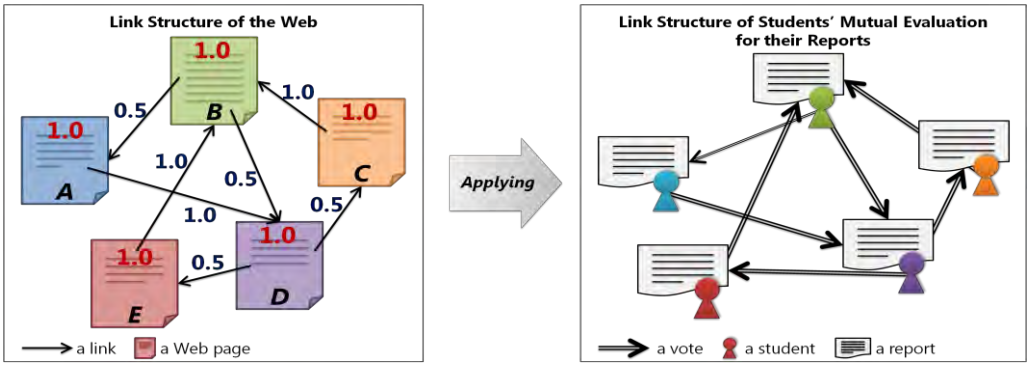


Figure 1. A link structure of the Web applied to Students' Mutual Evaluation

- Forward link: A page that is linked from other pages (back links), is a forward link of the back links (e.g., *A* is a forward link of *B*). Then, a page (forward link) has high importance if the sum of the importance of its back links is high.

We calculated the popularity of each page using PageRank as follows (see Figure 1 (1)):

$$PR(u) = (1\text{-}d) + d\ (PR(v_1)/N(v_1) + \ldots + PR(v_x)/N(v_x)) \quad (1)$$

- u: a Web page, i.e., *A*, *B*, *C*, *D*, or *E*
- $v_1,\ldots,v_x$: the set of u's back links, i.e., *D*'s back links, v_1: *A*, v_2: *B*
- $N(v_x)$: the number of forward links of page v_x, i.e., N(B)=2
- *d:* a damping factor adjusts the derived value downward. Various studies have tested different damping factors, but it is generally assumed that the damping factor is approximately set as 0.85

Initially, the importance of each page is 1.0, if there are multiple forward links of a page, the importance distributes through each link evenly, e.g., if B has two forward links, *A* and *D*, the importance of each link to *A* and *D* becomes 0.5. Therefore, *B* is the most important page in the link structure, since *PR*(*B*) has the highest value.

2.2 Students' Mutual Evaluation for their Reports

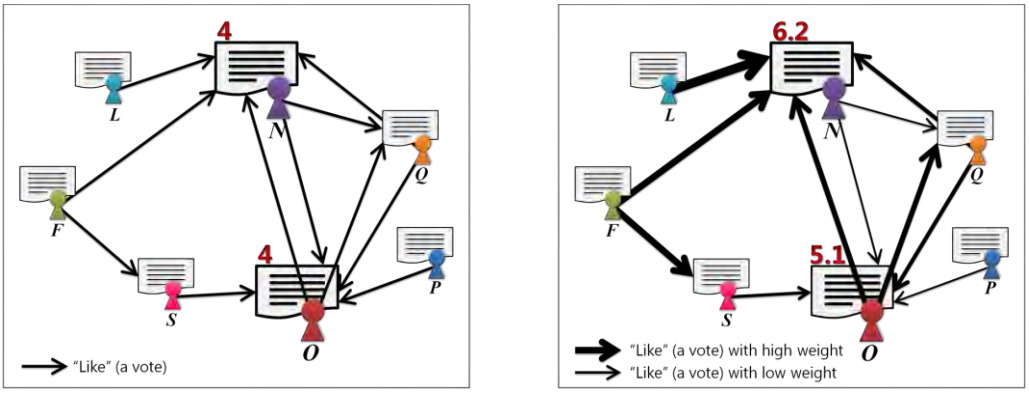
As depicted in Figure 1, (1) and (2) have the same link structure, and therefore, a back link can be considered as a vote from one student for another student's report. Therefore, in this paper, we are challenged to attempt a students' mutual evaluation of their reports using the PageRank algorithm. In our previous work, we built a system that provides a ranking of Web pages based on the PageRank algorithm by evaluating users who browse the Web pages. In this study, in order to evaluate the students' reports based on their mutual evaluation; we focused on the students who vote on reports.

We conduct students' reports by using a online groupware application; the student can post their reports at anytime and from anywhere in a given period, i.e., after a lecture and before the next lecture. Students can vote on the others' reports by pressing a "Like" button, when they think the report is good. It can reduce the students' burden of evaluating others' reports without specific points.

Using the mutual evaluation method based on PageRank, 1) a report of a student who votes for other students' reports produces a better report himself and 2) a report with many votes raises the reliability of its author's opinion when he casts his own votes. Thus, teachers can easily understand whose report is the best from the students' viewpoints, and we believe that this method can lead to an appropriate evaluation method in education in the future.

3. Results of Students' Mutual Evaluation

In this section, we present our findings from the results of the students' mutual evaluation in a course practice. This is a course of Applied Informatics, which consists of 10 lectures on different topics, and 23 students. Using the "Like" function as a vote through a online groupware, 1) we calculated the score of each report based on the sum of the number of "Like" from students; 2) we calculated the score of each report using the number of "Like" by employing a PageRank algorithm, and normalized the score between 0–10.0.



(1) A students' mutual evaluation by a sum of "Like" (2) A students' mutual evaluation by PageRank

Figure 2. A link structure of the Web applied to Students' Mutual Evaluation

As a result, we determined that the difference of the score of the same report between 1) and 2). As depicted in Figure 2, a report of a student *N* gained four "Likes" from students *F*, *L*, *O*, *Q*, and a report of a student *O* gained four "Like" from students *N*, *P*, *Q*, *S*. The sum of the number of "Like" for the report of *N* and the report of *O* are identical, i.e., 4 (see Figure 2 (1)). However, the score of the report of *N* was 6.2 and the score of the report of *O* was 5.1; they were different due to different weight based on the PageRank, which considers the quality of the evaluators (a thick arrow denotes a high weight) (see Figure 2 (2)). In general, we know that teachers have a higher level of understanding, and their evaluation of student reports is reliable. Therefore, we considered that mutual evaluation becomes more meaningful when using PageRank, since the most reliable votes came from the highest quality students.

4. Conclusions

In this paper, we proposed a group of students' mutual evaluation method for their reports using the PageRank algorithm. In a course practice, students performed a mutual evaluation for their reports by voting for good reports using a "Like" function through an online groupware application. Therefore, it is not only a sum of votes for evaluating the students' reports, but also considering who votes on the reports. It enabled the teachers and the students to understand the criteria for a good report in the education area, and it can lead to a new method of review by mutual evaluation.

In the future, we need to measure inter-rater reliability of our proposed students' mutual evaluation based on the PageRank algorithm by analyzing the correlations between teachers' evaluation and the students' mutual evaluation.

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